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PREFACE

As it is known, all living things need "space" in order to survive and they change and shape "space" with their vital activities. Human beings are also a part of the space where they lived within all stages of their existence. However, the intense urbanization process experienced especially in the 1950s and the new production-consumption model and life styles specific to this period, caused the disruption of harmony of people-space relation and the emergence of many environmental problems that we face today. Especially, Particular consequences such as the climate change, biodiversity and habitat loss have also influenced social life substantially, and the ecological and social fragilities have become more visible. Familiar to the history of humanity, but external to our daily routines, the epidemic period that we started experiencing very recently is actually a phase that we can practice very frequently in the near future, especially in the context of climate change, and thus it stands as a phase that we need to learn to live with. All these experiences highlight the necessity of reconsidering and evaluating the planning and design actions at different scales.

Our symposium, which hold with the main theme of "The Future of Planning and Design, Planning and Design of the Future", aims to develop suggestions for the future of society and settlements with a holistic approach by bringing together urban planning, architecture, landscape architecture, product design, geography, ecology, sociologist and other design disciplines who can take part in drawing the future. The purpose of this symposium is to examine the change and transformation caused by the interventions of humanity on the earth throughout history in all kinds of settlement scales and forms, and to have expert discussions on the proposals and examinations of possible habitats that can be a guide for future generations.

I am very pleased to share this publication of the papers presented at the symposium, where many similar subjects such as environment, urbanization, human and society, climate, ecology, sustainability and legal regulations were discussed. I hope it will contribute to both science and practice.

Prof. Dr. Bedriye TUNÇSİPER
Rector of Izmir Democracy University
Head of Symposium Organizing Committee

TABLE OF CONTENT

Title of Paper **Page**

ASOIU Away From the City Center 1

Public Transport Shaping the Urban Spaces in Baku 12

Urban Development Beyond the Economic Profit: Using SDGs to Create Values in Cities. The Case of Waterfront Industrial Areas of Baku (Azerbaijan) 23

Issues in Urban Planning of Residential Building: In Case of Baku Districts 27

Taking Design Decisions Regarding Creating the Zoning Plan After Analysis and Evaluation Process in Landscape Planning: A Landscape Planning Studio Work, The Example of Selçuk District of İzmir Province 40

Coastal Ecosystem Services of Erdek Bay: Assessment of Natural Dynamics and Identity 55

Evaluation of Perspectives on Ecosystem Services Provided From Urban Afforestation 66

Architecture of Transport in Socialist Albania. Railway Stations as Iconic Public Buildings for the Image of The Socialist City 73

Historical and Spatial Transformations of the Exhibition Spaces: From Modernist Whitewashed Walls to Black Screens 84

A Review of Art Museums' Publicness in the Architectural History 94

Housing Approaches After The Global Crisis: The Pandemic and The House of The Future 105

Spatial Configuration Analysis of Five Metropolitan Cities: Berlin, Mexico City, Singapore, Toronto and Vienna 120

Evaluating Visual Diversity and Complexity in Residential Areas with Different Land Values via Information Entropy: A New Methodology to Objectively Measure Environmental Aesthetics 129

Urban Security Planning: Models for Building Threat-Free Environments with Spatial Design Tools 141

The Analyzing of the Construction Systems of the Field Hospital Applications around the World 150

In Search of Lost Paradise 170

Pay Forward with Infographics 197

An Optimisation Study of Spatial Ad-Hoc Encounters with Quad-Tree Algorithms in the Context of Gldani Microrayons 208

Investigation of Urban Scale Projects Developed Using Parametric Methods 219

User-centered Design in Furniture Layout: Reviewing the Potential of Mobile Augmented Reality Technologies 229

Re-Formation of Waste Plastics through Digital Manufacturing: An architectural point of view 238

An Evaluation on Low Cost and Energy Efficient Housing Design in Tropical Climates 257

Transformation of Hospital Areas in the world after Covid-19 Pandemy 273

Who is Living Next Door? The Perception and Attitude Towards Each other: Turkish Citizens and Syrian Refugees in Konak, İzmir 298

Landscape Fragmentation Caused by Urban Transportation Network; Sample of İzmir Bayraklı - Adnan Menderes Airport Route 310

City Square Design: The Case of Çanakkale Republic Square 317

Public Parks as Health Infrastructures: Branch Brook Park 331

Planning Principles in Making New Cities in the 21th Century 352

'Yedikule Bostans': A Serious Game For Cultural Heritage 370

Extraterrestrial Urbanism: Vision, Progress, and Future Implications for City Planning and Architecture 379

Gamification As a Motivation For Park Usage 391

Future Planning Approach: Low Carbon Cities and Urban Tree Management 402

ASOIU Away From the City Center

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ABSTRACT

Azerbaijan State Oil and Industry University is one of the largest, oldest and most significant universities in our country. Placed right in the city center, these gorgeous old buildings of ASOIU are drowned among the big shopping centers, city noise, crowds of thousands of people on their way to huge business centers and offices. Apparently, the growth of population and development of technology led to the inevitable need for the expansion, which implies more students, more faculties, more laboratories and less space. Besides the auditoriums and administration, many premises of various functions are needed for laboratory practice and extracurricular activities.

Considering all the requirements and judging from the international experience, the best proposal in this case is relocation of ASOUI to a place, far from the city center. There, it could successfully perform all the functions as a wholesome complex that has conditions for not only education but also recreation, co-working, research, dwelling and sport. Khojasan region is the best from the point of accessibility and surroundings. This site represents the perfect environment that is violated in ASOIU's current location. The main issue of current site is solved before faced again – there is enough space for expansion if it is needed.

Keywords: university, campus, relocation, ASOUI

1. INTRODUCTION

Apparently, Baku is not a mega polis. We do not face all the issues that occur in big cities. Yet, public spaces, transport hubs and historically significant streets and squares have the same principles, according to which urban planners and architects should make sure the habitants do not suffer from big crowds, noise pollution or feel unsafe and uncomfortable.

28 May square is the center that contains all possible variations of transportation. Here we see the railway station, metro station and bus stops. Besides that, lots of people that work in big business centers around it and numerous huge trading centers that not enough functionally involve thousands of people in one common area, but also appear as celebrated meeting points by citizens.

This place had been a perfect site for a future university back in early 1900s but as we know, historically there is no way any place in this city would be so loud and so crowded in that period.

Time passed and what we have now is one of the main universities of our whole country, located in the place, no longer suitable for all the functions it serves for as a building and all the educational and social activities that must be carried out by the students and staff.

2. METHODOLOGY

2.1 Brief History of Expansion

Around the world, new universities are being established, and existing ones enlarged. The educational institutions require a special approach, which must consider the type, local climate conditions, social factor and classification of the premises by their purpose. Thus, while referring to the international experience one must take into account both the essentials, approved by construction norms worldwide and the peculiarities of one sort or another of the particular project. [1]
Already in the process of drawing the master plan, the architect must evaluate the feasible ways of future expansion within the chosen site.
At its current state ASOIU can be classified as **integrated and dispersed**, where separate buildings and facilities are found among the local community, as and where sites become available. [1] This type of design is the result of the inevitable process of expansion, which had to be brought to life in several ways.

The extension process began back in post-war period. There were fundamental changes in the life of the Institute. At that time, six of eight (Geological-Exploration, Petroleum, Technological, Mechanical, Energetic, Engineering-Economy, Transport and Architecture-Construction) faculties were directly involved in the training of personnel for the oil industry. The post-war expansion of the Institute's activities was related to the development of the industry and, first of all, the oil industry in the country. If before the war 98% of oil production fell to Baku, Grozny and Maykop, after the war, rich oil fields in the Ural-Volga, Emba, Central Asia, Kazakhstan and Far East regions were discovered and their mines had sharply increased demand for oil specialists. In those years, the graduates of the Azerbaijan Industrial Institute played a key role in the development of these fields. [2]

Since then, throughout the history, with the change of priority field and general technology and industry development both locally and globally, this extension process still has not ceased. At the present the 7 faculties (Faculty of Geological Exploration, Faculty of Oil and Gas Production, Faculty of Chemical Technology, Faculty of Oil Mechanical Engineering, Faculty of Power Engineering, Faculty of

Information Technologies and Control, Faculty of Economics and Management and 28 departments function within the university. Since most of the faculties require special laboratories and research premises and tools, the expansion of some departments and their need to provide the students with newer tools, as well has its impact on the capacity.

As it can be witnessed from the archive photos (fig.1), originally ASOIU was a single 2-storied building, which represented the classicism style.



Fig. 1 ASOIU 1900's

First, the strategy of adding extra floors had been implemented there. After that the new building, adjacent to it, which is an example of constructivism –was erected. (fig. 2)



Fig. 2 ASOIU allegedly 1950's

2.2 Methods of Expansion

The completely new building was established on the other side of road. An underground tunnel serves as the connection between them.

Recently, after the extensions towards the inner yard, two more levels have been added to the second building. The disadvantages of this approach is quite obvious:

1. From the constructional point of view, extra load, that is carried by the same foundation can be dangerous and most likely will cause severe issues and require reconstruction to support both the foundation and the walls in future.
2. With a lack of proper amount of space, the external extension can violate the norms for the premises that were added this way (for example, insolation or ventilation norms could not be considered) (fig. 3)



Fig. 3 Extensions to the second building

3. The university no longer has a recreational zone outdoors, because it has been occupied by the extensions
4. The more levels implies the more frequent use of elevators and currently none of the buildings is provided by the sufficient number of them, thus the accessibility is violated.
5. ASOIU students are successful in extracurricular activities. Sport premises, extra auditoriums and co-working areas are vital for their development. At the present the debaters, athletes, the participants of various clubs and student organizations have to find available classrooms among the academic auditoriums or somehow manage to find a place outside the university to hold their trainings and gatherings.
6. Fragmentation over separated buildings is normally deplored. The connection via underground tunnel is meant to be an easier way to cross the street and get to the other building. Despite of that it is nothing more than another adverse consequence of an unsuccessful effort of expansion with claustrophobic vibes.

2.3 Proposal

Considering all of the above, my proposal is to arrange a campus – i.e. several buildings classified and grouped by their purposes, coordinated on one large site [1] (fig. 4). Following this strategy there will be a good chance to avoid all mistakes of previous project and prevent the new ones. Here the expansion can be planned at the stage of initial development the master plan. In my suggestion I view the molecular type of expansion, where departments and facilities are in widely separated buildings leaving ample space for enlargement. My workflow started from the general research about the capacity of each department, their special requirements for laboratories with the consideration of two shifts and research works.

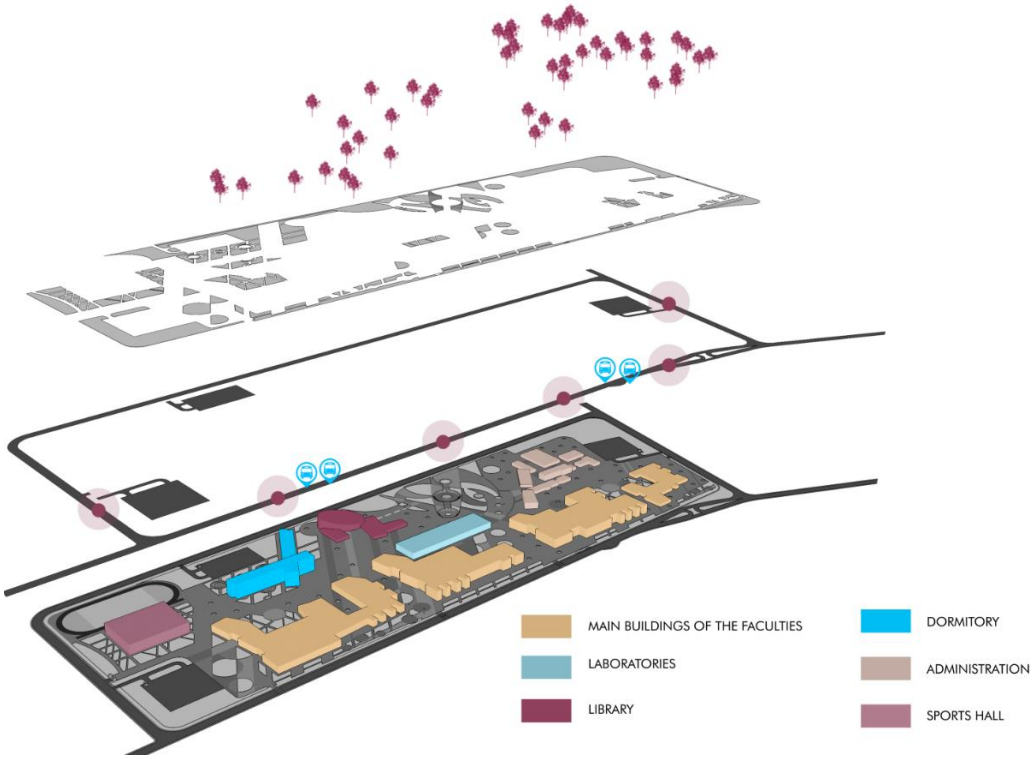


Fig. 4 Functional zoning of ASOIU New Campus Proposal

Unlike the dormitory that is available now, the on-campus accommodation would have the advantages of saving the money and time in travel and propinquity to library, etc. over weekends.

The further planning was carried out following the calculations based on the construction norms and basic typology of higher education facilities (tab. 1). Applying these rules to the project, I figured out the main concept – the faculties with the same requirements for the capacity of auditoriums were designed to be placed in the same buildings. During this arrangement, the approximate volume of expected prospective growth was taken into account. Besides the capacity these faculties also use the same laboratories, and have the same number of departments, which makes the whole task way easier while planning the functional zoning inside of the building as well.

2.4 Research Based on Information About Faculties

The preparation of specialists at ASOIU is carried out at all three levels of higher education, namely Bachelor's, Master's and Doctorate degrees (tab. 2). Obviously all 11.5K students never present inside the campus at once. Based on this the classification of seminar rooms depending on their capacity and purpose, the arrangement of recreational areas and co-working zones and vertical connections (emergency exits included) had been done.

Tab. 1 The calculations based on the construction norms and basic typology of higher education facilities

AREA	PURPOSE	SPECIAL CLASSIFIC.	AREA
Administration	For central administration, including Senate House, conf. room, committee rooms		450 m2
	For maintenance depot, including central stores and workshops, but excluding furniture stores		
Amenity	Restaurants and cafeterias	Dining areas	0.2 m2 /student
	KITCHEN	3 main meals with breakfast	0.45 m2 /meal/sitting
		1 meal per day	0.4 m2 /meal
		cooked snacks	0.3 m2 /snack
		coffee and sandwiches	0.1 m2 /snack
Communal soc. areas	Students		0.7 m2 /student
	Academic, senior administrative and research staff		0.19 m2 /student
	Non-academic staff		0.16
Sports facilities	Indoor sports		
	Outdoor sports		
	Grass pitches, playing fields		
Health services	NHS provision		0,045 m/st
	Sickbay		2 beds/1000 students
Residential accomodation	DORMITORY	study bedrooms	8.4–13 m2 /place
		ablutions	1.21 m2 /place
		storage	0.54 m2 /place
		amenities	1.0 m2 /place
		utilities	0.5 m2 /place
		communal space	0.65 m2 /place
		balance area for circulation	0,25
		additional area for self-catering dining and kitchens	1.2–1.7 m2 /place

Tab. 2 Capacity of faculties, list of all departments and laboratories

	FACULTY NAME	DEPARTMENTS	LABS	TECHERS	STUDENTS			st quant	AUDITORIUM CAPACITY		
					BACH	MAST	DOC	1/2 shift	35	75	150
1	GEOLOGICAL EXPLORATION	GEOLOGY AND DEVELOPMENT OF MINERAL DEPOSITS OIL AND GAS GEOLOGY GEOPHYSICS FOREIGN LANGUAGES	3	106	1004	-	-	500	4	5	1
2	OIL AND GAS PRODUCTION	OIL AND GAS ENGEREERING OIL AND GAS TRANSPORTATION AND STORAGE IDUSTRIAL SAFETY AND LABOR PROTECTION AZERBAIJANI LANGUAGE	1	114	1600	-	-	800	6	8	1
3	CHEMICAL TECHNOLOGY	TECHNOLOGY AND CHEMICAL INORGANIC SUBSTANCES TECHNOLOGY OF ORGANIC SUBSTANCES AND HIGH-MOLECULAR COMPOUNDS PETROCHEMICAL TECHNOLOGY AND INDUSTRIAL ECOLOGY SOCIAL SCIENCES	12	126	1020	-	-	510	4	5	1
4	OIL AND MECHANICAL ENGEREERING	OIL AND GAS EQUIPMENT MECHANICS ENGENEER AND COMPUTER GRAPHICS MECHANICAL ENGENEERING AND MATERIALS SCIENCE	4	98	1250	78	32	680	5	7	1
5	POWER ENGENEERING	ELECTRICAL POWER ENGENEERING ENERGY PRODUCTION TECHNOLOGIES ELECTROMECHANICS	15	80	875	130	-	500	4	5	1

		PHYSICS									
6	IT AND MANAGEMENT	GENERAL AND APPLIED MATHEMATICS . . .	6	130	3020	321	-	1670	15	12	1
7	ECONOMY AND MANAGEMENT	INDUSTRIAL ECONOMICS AND MANAGEMENT ECONOMICS AND MANAGEMENT OF ENERGY AND PETROCHEMICAL INDUSTRIES FOREIGN LANGUAGES		81	810	-	-	410	3	4	1
sum			41	735	9579	529	32				

2.5 Choice of Site

So what site would be perfect for such a campus? Where a big university could be provided with a friendly environment and space for future expansion? What region is far from city center and would not cause the accessibility problems for those who use public transport?

Khojasan district already appears as an example of such site. Judging by the experience of Moscow State University Baku Branch, a wonderful complex of the faculty building, dormitory and sport zone, coexist with this marvelous scenery of hills and lake, fresh air and healingly calm atmosphere, which would only encourage the students to study and not distract them and create threats like on the current location (fig.5).



Fig. 5 Khojasan, site photo fixation

2.6 References

Referring to the international experience I want to point out Chinese University of Hong Kong, Shenzhen Campus (fig.6), Aalto University (fig.7), Bergen University (fig.8) and Politecnico Milano (fig.9).

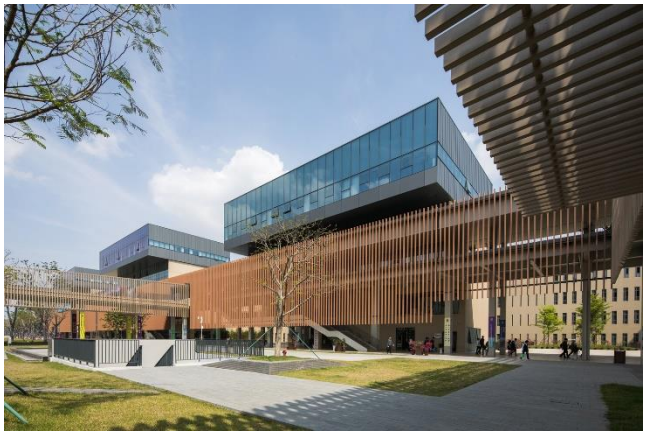


Fig. 5 Chinese University of Hong Kong, Shenzhen Campus



Fig. 6 Aalto University, Finland



Fig. 7 Bergen University College, Norway



Fig. 8 Politecnico Milano, Italy

2.7 Advantages During Pandemic

Finally yet importantly, architecture has always been about creating environment for various purposes while taking under consideration all aspects and special requirements of social life. In the complicated period of global pandemic, we faced a new challenge - to reinvent the way people have to co-exist in the process of performing their everyday tasks. We no longer should take the current situation as temporary measures but learn to live in the new reality and try to implement this new experience in future projects.

In the period of global pandemic, when all the public facilities learn to deal with new rules of interaction, architects are mobilizing their efforts, to help educational institutions around the world reconsider their design in order to guarantee sustainability, emotional wellness, and physical health. We must reconsider the value of outdoor recreation zones. Positive student wellness and mental health impacts resulting from easy access to light and air, in addition to social distancing considerations. [3]

When mental health is more vulnerable than ever, the interiors and conditions for interaction must support the willing to study and its balance with relaxation (fig.9).



Fig. 9 Small yard and wide hallways that would help reduce pressure in high traffic places (elevators and shared amenities) and diversify the general interior view

The buildings of faculties have maximum 3 levels, which would reduce the use of elevators and as well the crowding.

The new design methods would better support all the modern features of pandemic era - HVAC systems, natural ventilation, UV lamps, air filters (fig.10).

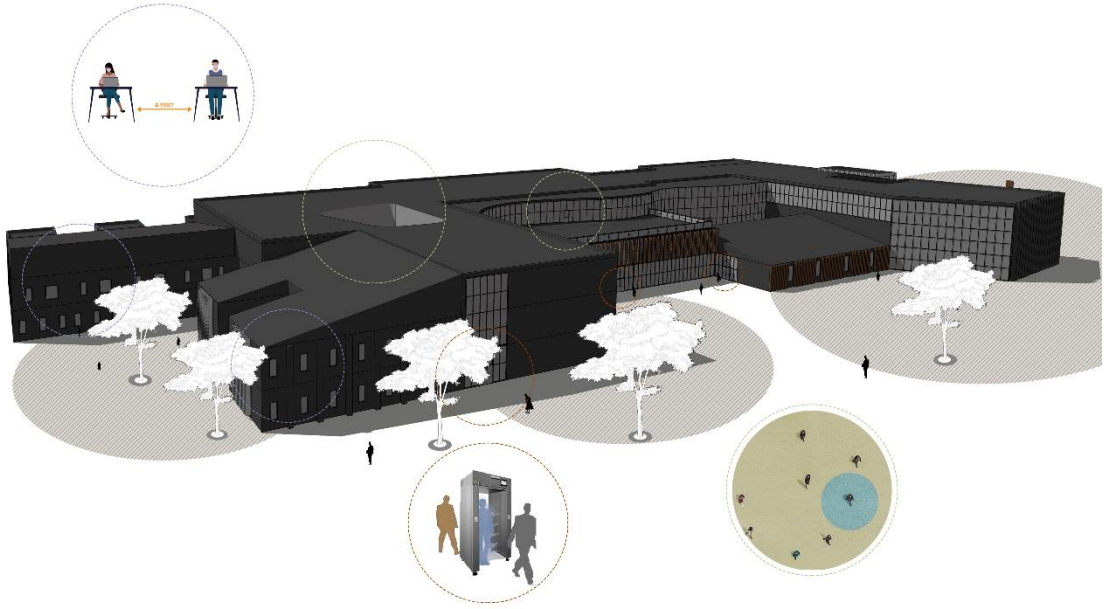


Fig. 10 Social distancing, anti-COVID disinfection portals and recreational zones

3. CONCLUSION

Architecture is about solving problems, since we have new problems we need new approaches of architects. The development demands changes and we need to be creative to figure out new ways to support this development. My research covered the history, analysis of issues of current location, analysis of advantages and disadvantages of expansion methods and proposals for the convenient arrangement, which would include all facilities.

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Public Transport Shaping the Urban Spaces in Baku

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ABSTRACT

A significant role in the continuous process of shaping and definition of the public spaces, are playing streets, railways, stations and transit stops. As an active part of an urban environment, public spaces must be inclusive i.e. provide all groups of citizens with necessary conditions to participate in society and not face issues with accessibility. The area of 28 May square is one of the most important and complex transport hubs of the Baku, due to the metro, railway and a bus station located there. The presence of different types of transportation and the historical structures side by side makes this square one of its kind. The research focuses on analysing the human behaviour and traffic flow in the square and aims to reorganize the public space in this area and provide solution for the organization of public transport. The main problem of this area is the strong presence of private, parked or circulating cars that prevent from generating a functional and useful space for the physical and visual well-being of society. Considering also a diverse group of people using this square the situation becomes more complicated.

Keywords: public space, transport hub, underground bus hub, 28 May square.

1. INTRODUCTION

Growth of cities results in their social and physical division. Cities get divided into areas with different functions, i.e. residential areas, recreational areas, service areas, industrial areas. For example, nowadays, the location of human needs is in different functional areas. Which in turn are located in different parts of the city. Therefore, it is common that people work in one area, spend leisure time in another and live in a third area. Such functional zoning of the city increases the dependence of inhabitants on the transport system.

Transit hubs are an important and complex part of urban spaces. The development of transit hubs in each city requires carefully thought-out planning. Nowadays more and more people preferring to use public transport. Moreover, transport hubs are often places where the traveller gets the first impression of the city where coming. For this reason, they must fulfil a whole set of functional and operational requirements above all. The importance of this is not always noticed, which causes the extensive issues in their planning.

One of the examples of such complication is in Baku city – 28 May square. The area of 28 May square is one of such transportation hubs which carry thousands of passengers each day. This area is an intersection point of different modes of public transport: metro station, railway station and a bus station which consists of 4 bus stops. Along with public transport, there are also flow of diverse user groups here, which is caused by buildings of different functionality surrounding the square. All this factors are causing huge crowds in this area, which is one of the main problems of this square.



Figure 1. Location of 28 May square

This square was the largest transport hub in the South Caucasus, because of Tiflis an Sabunchi railway stations located there. At present these structures are not functioning as railway stations, but they are having a historical value in the 28 May square which complicates the formation of new solutions. The presence of historical buildings on this area plays a major role on the aesthetic dimension of structures and spaces which can be built there.

This paper aims to provide a theoretical and technical basis for the development of transport hub in 28 May square, which includes analysis of transport networks and human behaviour on the territory. The structure of this paper is organized as follows. Section 1 presents the overview on the public transport and its benefits to the city. Section 2 presents the analyses of road network in the 28 May square. Section 3 presents the idea of underground bus hub, followed by the example in the Section 4. Section 5 presents the importance of planning taking into the consideration the human behaviour.

1.2 Overview to the history of railway stations

Before this square was able to serve as a transport hub for the railway station, metro and buses. However, nowadays it is not possible due to the rapid growth of population in the city. Additionally, new ascended structures are also increasing the flow of people to this area.

The station was commissioned in 1880 with the construction of the Baku-Sabunchi-Surahani railway, and was intended to serve passengers. The first station building (Tiflis) was built at the time of the opening of the Baku-Tiflis railway, the second (Sabunchi) - to the construction of the Baku-Sabunchi-Surahani electrified railway.

Until 1977, the Baku-Passenger station had two station complexes: the old Tiflis station, built in 1883 during the construction of the Baku-Tiflis railway, and the Sabunchi station, built in 1926 and designed to serve the Baku- Sabunchinskaya electric power. In 1976, in connection with the reconstruction of the Baku-Passenger station, the Sabunchi station building ceased its activity in servicing suburban transportation, and a new modern building of the Baku station was built in its place.

The Tiflis station was designed by architect H.K. Vasiliev in 1882, but at the initial stage the project in the Moorish style was completed by Professor Bruni, artist Drittenpreis and others, being the fruit of the collective work of architects and artists. It was commissioned in 1883.

The station building was designed on two levels: two-story from the side of the city and one-story - from the platform. On the ground floor, ticket offices, luggage space, office space are grouped around the lobby; on the second - mail, telegraph, waiting rooms, etc. The walls, richly saturated with ornaments resembling an oriental rug, ended with a cornice, which switched to a relatively restrained ceiling.

In 1926, to serve passengers on the electrified Baku-Sabunchi Railway, the second station complex, the Sabunchi Station, was designed and built. The architecture of the building was also done in oriental style.

In 1967, the building of the newly built entrance to the metro station "May 28" adjoined the building of the Sabunchi station, and until 1992, it was named as "April 28". In the 80s - 90s of the 20th century, large-scale work was carried out on the construction and modernization of a node from two metro interchange stations, including 4 exits and an extensive network of underpasses.

In 1977, the station underwent a major renovation, in which a new modern station building was built, closely adjacent to the building of the old Tiflis station.

The style and facade of the station building are different from the buildings traditional for Baku. So, the exterior of the station is inherent in the ancient oriental style. The building, built in that period in an oriental style, was considered the personification of luxury and majesty. Many elements of the Shirvanshahs Palace were also used on the facade of this building. Due to many years of operation and the lack of proper maintenance, the building lost its appearance, therefore, in early 2015, the work on major reconstruction was launched here.

The facade of the main building of the station was reconstructed while maintaining its architectural style; major repairs were carried out inside. Ticket offices were also thoroughly renovated in a modern style, passenger platforms, escalators were replaced with new ones. Lifts for goods, passengers and disabled people are installed. During the overhaul, administrative premises, trade and public catering facilities that meet modern standards were created here, mother and child rooms, a waiting room, and left-luggage rooms were provided for the use of passengers.



Figure 2. Sabunchi and Tiflis stations

2. METHODOLOGY

2.1 Public transport

Increased rate of population growth in cities is creating problems with transportation. Demand for public transport increases, as well as a number of private cars. The car-oriented development of cities is affecting the life quality of pedestrians. In order to make the cities more attractive for residents, they shouldn't have any accessibility issues throughout the city. For this reason, public transport should be properly planned. The successful public transport should meet the following requirements: accessible, affordable, fast, frequent, reliable, safe, convenient and serve demanded routes.

Benefits of developed public transport networks:

- Health benefits
- Reduces road congestion
- Increases mobility
- Less air pollution
- Less greenhouse gas emissions
- Economic benefits

Public transport is no longer an economical mean of transport. The salons of the metro, tram and bus are becoming more and more convenient, and the transport infrastructure is becoming more reliable and digital. Thanks to the development of information technologies, it becomes easier to determine the time of arrival of a particular transport and not to experience difficulties. With the help of information boards at stops and information which can be obtained via the Internet in real time passengers do not need to guess when their bus will arrive. Also, tickets can be bought not only at the

stops or salons, but also it is possible to receive it on mobile devices. Since public transport is a tool for economic development and job creation, investments in it should not be viewed as expenses, but as investments in the development of the city.

Finally, public transport helps to improve the ecological situation in the city and is simply good for health, because it makes passengers walk at least a little. Moreover, in the cities with developed public transport, CO2 emissions are reduced.

Public transport stops are commonly considered just as functional elements of the transport system. Their design is based on technical parameters and standardization. Nevertheless, public transport stops can play an important role in the urban environment. Indeed, they can concur to generate and enhance public spaces. However, the idea of transport infrastructures as urban places in all respects is chiefly referred to major railway, metro or intermodal stations. Ordinary public transport stops are as widely spread throughout the city as neglected by urban designers and by the scientific debate. Public transport stops can undoubtedly concur to shape the urban public space but this potential has been overlooked. [1]

As regards public transport, the 28 May square is the main central hub for the Baku city. Metro and trains arrive in the area in a very simple way but the bus stops arrangement along the whole square generates a lot of confusion especially for those unfamiliar with the area. This creates a lot of mess between pedestrians and cars that are passing through the square. There are 4 bus stops located on the square, quantity and numbers of the arriving buses stated below on the Table 1. Also, Figure 3 shows the diagram of concentration of buses each hour.

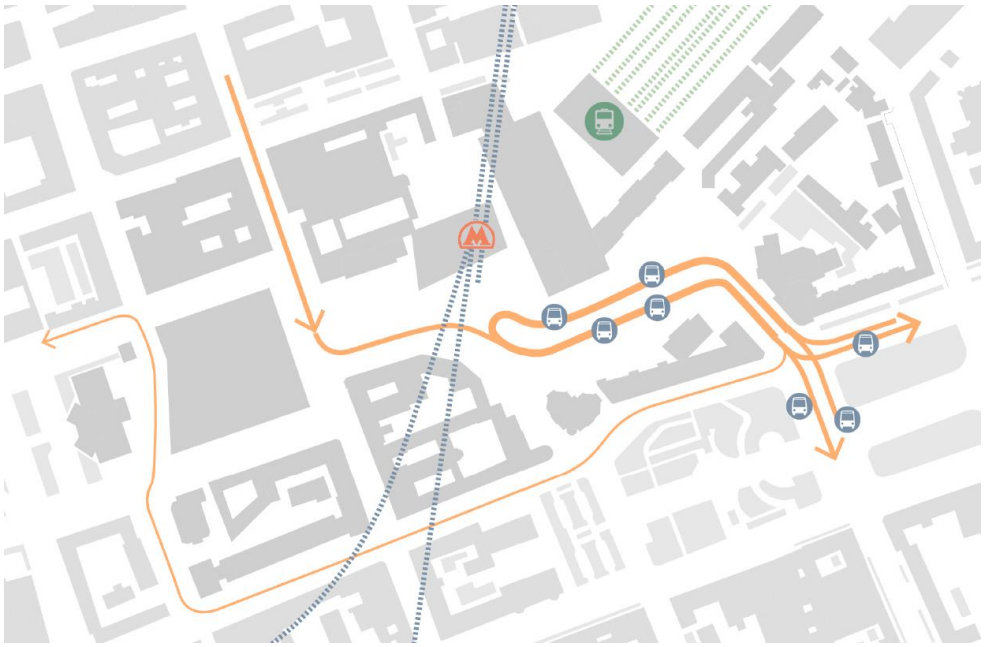


Figure 3. Public transport network

Table 1. Numbers of buses in each bus stop

1st Bus stop:	1; 30; 32; 125
2nd Bus stop:	21; 46; 175
3rd Bus stop:	14; 88A; 125
4th Bus stop:	1; 4; 5; 88
Additional:	Airport Express

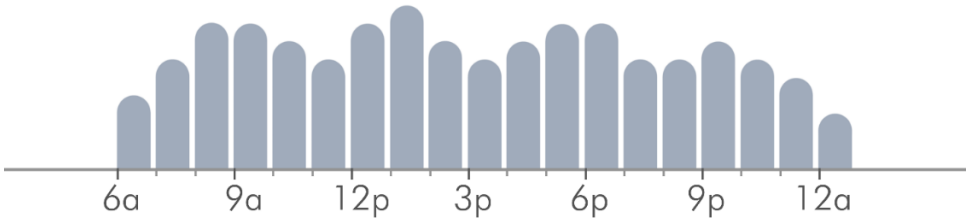


Figure 4. Number of buses by hour (min 3 – max 15)

2.2 Analysis of transport networks

Nowadays we often face the fact that there are no appropriate facilities for the movement of people in the cities, as the public spaces often are disrupted with huge flow of cars, what complicates the everyday activity of inhabitants. Usually the pedestrian mobility is being ignored and more and more the priority in accessibility is given to the road traffic, which is also an important element in formation of urban spaces. For my opinion, in the planning of road traffic and pedestrian movement priorities should be ranked equal, in order to avoid the complications which can appear as a result of neglection of this equality. The increasing dependence of cars are making the urban spaces unattractive and sometimes even not safe.

Urban design thinking on automobile dependence is focusing on making centers work. Viable centers cannot be car dependent. The domination of car parks and traffic defeats walkability and precludes the higher-order functions that centers need. "Viable" thus is taken to mean a center that is not dominated by cars, but is sustainable in long-term economic, social, and environmental amenities. [2]

The area surrounding the 28 MAY has highly frequented streets with wide sections and most of them are one-way. This factor partly causes confusion and this leads heavy cars congestion at peak times. Some connections are also completely useless for road conditions, thereby effectively increasing

problems. The best solution in this case is to correct automotive flows and completely prevent private cars from entering the square. The road that passes through the square easily can be replaced by the road located on the street below, as the road connections allow it.



Figure 5. Auto circulation

2.3 Underground bus hub

Nowadays, we are experiencing population growth, especially in urban centers. This fact leads us to think more about underground transportation structures in order to decrease the issues of traffic congestion, densely built urban areas and air and noise pollution.

During development of a transport hub, it is necessary to take into consideration the joint planning and construction of ground and underground structures, in order to increase the efficiency of the transport interchange; maximize land use opportunities; and organize the development of a local underground space. [3] Underground bus hub from the point of convenience will be a great solution for passengers, as in cold, rain and heat they will not wait outside. In the case of 28 May square, underground bus hub can be one of the advantageous solutions. This solution will allow to free up the area of the square, which as a result makes it possible to avoid huge people concentrations and prevents excess mess. Also an underground bus hub will respond to the aesthetic dimensions due to the presence of historical structures.

Benefits of using underground space for transport hub:

- Improving transport interchange efficiency.

The underground interchange hall and corridor will improve the connections among railway, subway, bus, taxi, and public parking systems which facilitates passengers to quickly arrive their destinations. Therefore, as accelerating passenger flow at transport hub, the underground interchange hall and corridor will also provide potentials for a "zero transport interchange" in transport hub.

- Maximizing land use capacity and reforming ground environment.

Accommodating many functions of transport hub into underground space will greatly increase spatial capacity; alleviate the demanding ground land use; and effectively improve land use rate. Meanwhile the ground can be used as public green space and pedestrian passageway which will eliminate disorder between pedestrians and vehicles and reform ground environment.

- Bridging the split urban areas by railway

The transport hub is usually adjacent to or even located at downtown area. Even though it was originally at the urban fringe area, it would be gradually merged into the range of downtown as expansion of the city. In the past, construction of railway splits the urban area into two parts creating inconvenience for urban development. The roads at two sides of the transport hub are not easily connected. However, now, through development of underground space in transport hub, on the basis of not affecting its functionality, will effectively enhance communications between two sides of the transport hub; remit the split of a city; and promote its coordinated development.

- Organizing regional underground space development.

The development of underground space in transport hub can be combined with the development of adjacent underground space, which will increase the comprehensive benefits of underground space development; establish the systematic underground space around transport hub; and motivate regional economic development. [3]

The Figure 6 below shows a variant of a bus hub designed by me which can be implemented in the 28 May square. This bus hub meets all criteria, which should be foreseen in 28 May square. The entrance and the exit for buses is the same. The movement of buses is controlled by the traffic lights and also there is a controller's office in the right of the entrance. The maximum number of buses in this station is 20, from which 5 of the places is reserved for future growth of the number of buses.

The waiting area for passengers is equipped with benches and info boards which gives information about buses arrival. There is also a convenience store and WC for both - passengers and drivers. There are 2 entrances to the bus station, both of them have 3 elevators, escalator and stairs.

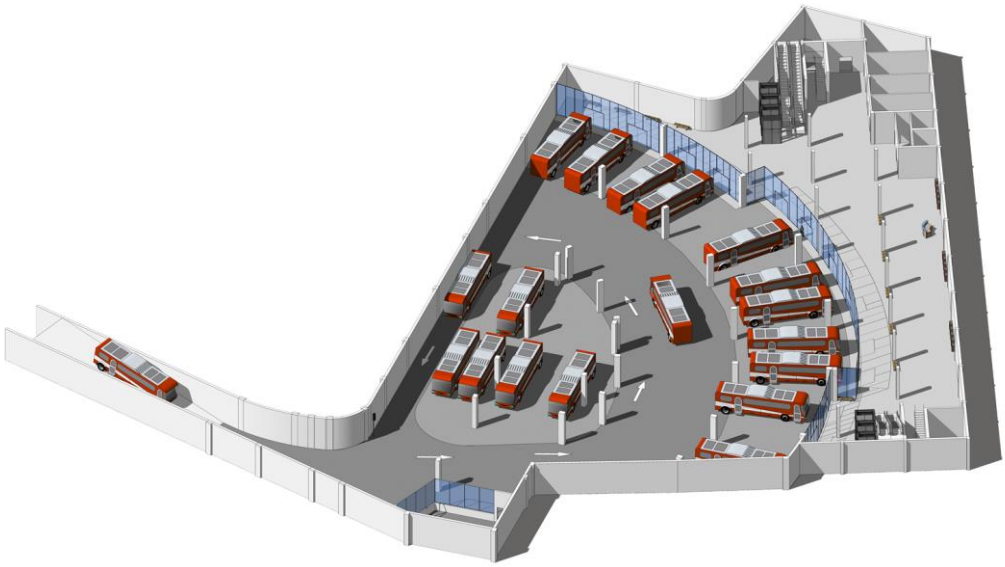


Figure 6. Proposed underground bus hub

2.4 Example of underground bus hub

One of the examples of underground bus hub is Gwanggyo station which is located in Suwon, South Korea. This station consists not only of a bus hub, but also on the lower levels here is located subway. The connection between those 2 means of transport, foster residents a comfortable and convenient travel experience, also it benefits the society and improve the functional capacity of transport hub.

The whole facility of Gwanggyo station is around 500 meters long. The entrance for the buses takes place from the center of the road, through two lanes. Inside of the underground station there is enough space for two buses to stand next to each other. The doors are automatic with sensors, so they are opening when a bus stops in front of them. The entrance for the passengers is the same as the entrance for the subway, which is very convenient and understandable for the people who are not familiar with this station.

In my opinion, in the organization of the public space at the 28 May square, we should refer to the experience of South Korea and implement the underground bus station for the bus stops that are located on the square. This example shows us an effective measure for the transportation hubs.



Figure 7. Gwanggyo underground bus station (Suwon)

2.5 Human-oriented planning

A successful public spaces are the ones which does not have any accessibility issues and serves as a social space for the everyone in the society. In order to have accessible public spaces cities should have well-connected street network, which will encourage people to walk or cycle. Having a good pedestrian accessibility will decrease the use of cars, which I fact will reduce the road traffic and pollution.

Variety of different urban functions need a good network of public spaces to keep them connected. And such connectivity is an important reason why people choose to walk, to ride a bike or to use public transport. If having a great, liveable street, but not connected to the main streams of pedestrians in the city center, it will be difficult for it to be reached walking. All the people begin their journey as pedestrians and that's why is essential to provide not only a working automobile network but even more a qualitative, convenient and safe pedestrian network that brings residents to other modes of transport. Good connectivity provides easy access to key destinations for pedestrians. Excellent connectivity actively seeks to discourage car use by making local trips easier and more pleasant by foot than by car. [4]

Due to the diverse functionality of surrounding buildings, 28 May square is an intersection of different user groups, which in fact is the main reason of crowds and mess in this area. Figure 8 below displays the functional zoning of the surrounding buildings.

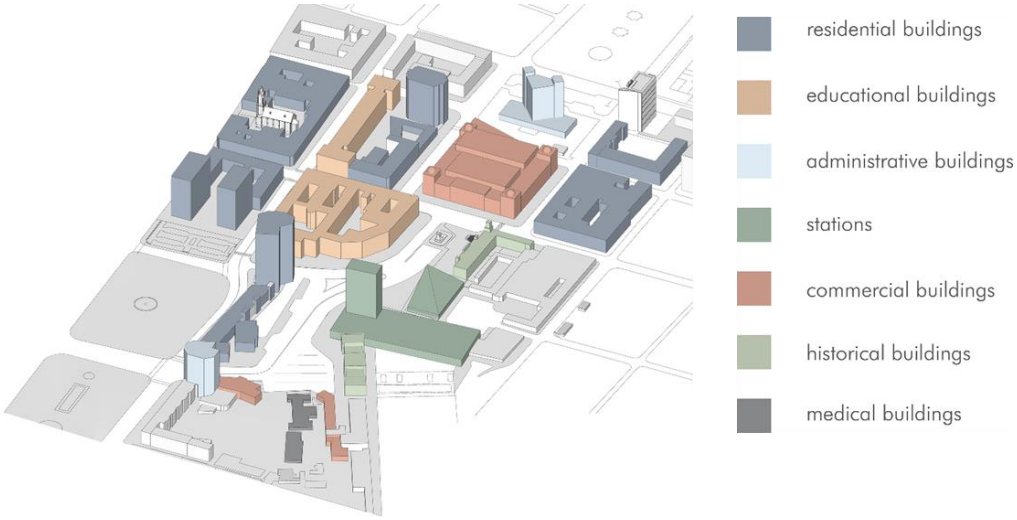


Figure 8. Functional zoning of surrounding buildings

Making this large pedestrian space would allow the city to have a new vision of the pedestrian who should take back his value despite the machines. In order to achieve holistic urban plans incorporating transport infrastructure, public spaces must be designed taking into account the behavior of people in these spaces.

In the 28 May square I tracked the movement of pedestrians and according to this I determined the concentrations of people flows (Figure 9). Based on this analysis of human behavior in the square there can be determined "attracting points", which can be given different functions, such as cafes or shops.



Figure 9. Concentration of people flows

In order to reduce the congestion of people in one area, there can be added an alternative path like a pedestrian bridge which will diversify the view that residents see every day.

This square should be a space that people do not just use as a transitional space to pass by but a space that tempts people to slow down or stop and experience the place. Thus by applying these methods several goals can be achieved: no crowds, no cars, no mess, instead we get a modern multifunctional city center, which would manage to recreate a transport hub and public space within the limits of one square.

3. CONCLUSION

This square for many years was the main transportation hub in Baku city. It started from Tiflis Station which was built in 1884 and became the main station in Baku. After that Sabunchi station was built in Baku, in 1926. Nowadays, it also keeps the transport hub name, but over time all the beauty of old times was lost, and this square became a crowded place which is occupied with cars and buses. The central position of the area known as 28 MAY is strategically ideal as a hub for public activity in the entire city. Although the city of Baku has a large extension, the presence of numerous road axes allows an easy connection between its different parts.

This research proposed effective use of underground space in the 28 May square, and coordinated development of public transport and the urban space. The development of the underground space will have positive effects, also it will be in the public interest. The transfer of the bus stops on the square to the underground structure, as well as in the experience of South Korea, will allow free the land and make some public facilities in this widely used area. Meanwhile, the model of underground bus hub which can be used in the 28 May square was presented.

Nowadays, our cities are becoming more car-oriented and the importance of pedestrians are being overlooked. In this paper the transport network of the 28 May square was analysed, and was found out that road which passes through the square can be easily replaced by the road on the other street. This will allow to a square for people not for cars. Different types of activities around one square creates the various crowds of people which complicates their movement in the square and causes large crowds in metro and buses. The concentration of people flows was tracked, according to which the crowds can be reduced.

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Urban Development Beyond the Economic Profit: Using SDGs to Create Values in Cities. The Case of Waterfront Industrial Areas of Baku (Azerbaijan)

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ABSTRACT

The city of Baku, being one of the first oil centers in the world, is pursuing urban development along its waterfront. The ongoing significant urban development along the industrial waterfront based on oil revenues and aims to create a new brand of the city which projects itself as a regional and/or global city.

The ongoing remediation projects on the coastal industrial waterfronts of Baku have their specificity to highlight. They are mostly unidimensional focusing primarily on economic valuation and beautification of the city's coastal areas. This is an obsolete and unidimensional process of urban remediation which does not respond to the multi-challenges of Baku which is facing environmental and climate change. In addition to the risks associated with coastal cities (irregularities of precipitation, cyclic changing of water level, etc.), Baku city's coastal urban infrastructure is also dealing with the particular risks related to the patterns of urban and industrial development on the Caspian Sea.

In the present context of challenges, there is a need to have a reflection beyond the economic profit by creating and remediating urban spaces with a multidimensional approach.

Keywords: Urban Development and Remediation, Waterfront Industrial Areas, SDGs, Multidimensional approach, Baku.

1. INTRODUCTION

The ongoing remediation projects on the coastal industrial waterfronts of Baku (figure 1 and 2) have their particular specificity. They are mostly unidimensional focusing primarily on economic valuation and beautification of the city's coastal areas.

The unidimensional approach can be defined today as an obsolete approach which does not respond to the multi-challenges of the city of Baku. Indeed, the city of Baku is facing environmental and climate change and the risks associated with coastal cities (irregularities of precipitation, cyclic changing of water level, etc.). Being an industrial city, the city of Baku's coastal urban infrastructure is also dealing with the particular risks related to the patterns of urban and industrial development on the Caspian Sea.

In the present context of challenges, there is a need to have a reflection beyond the economic profit, create and remediate urban spaces with a multidimensional approach.



Figure 1 and 2. The ongoing remediation on the waterfront industrial areas of Baku
Source: Tural Aliyev, 2018 ©

2. GLOBAL RECOGNITION OF SEVERITY OF RISKS IN WATERFRONT URBAN AREAS

The United Nations New Urban Agenda recognizes the severity of risks in Waterfront Urban Areas of cities (UN Habitat, 2016). Climate and environmental change and rising sea level are more important challenges for coastal urban areas of the world cities where 60% of the world's population already lives (idem). Adopted at Habitat III in Quito, Ecuador, the Agenda highlights the importance of measures, mentioning that "vulnerable as part of the impacts of climate change, sea level rise particularly affecting coastal areas" (idem).

In addition to the climate and environmental change, there are particular risks associated with the coastal urban areas at the Caspian Sea. The city of Baku, as a biggest city at the Caspian Sea, is facing seismic related tsunami risk (Kulikov E. A., Kuzin I. P. and Yakovenko O. I., 2014) and fluctuation of the sea level within the context of patterns of urban development and industrial development in the city and in the Caspian Sea. There is a general understanding that the Caspian Sea water level (attitude -27.5) could possibly rise to a maximum of -25/-26 level (if continuous humid years occur), which means it would rise up to 2.5 meters or drop off 1.5 meters within the natural variation cycle (Baku Shipyard Project, 2011). However, as it was already mentioned, it was absolutely unexpected for scientific community that the Caspian Sea basin level continued to decrease from 1940s to late 1970s and rapid 2.5 increase over two decades after 1977 (Chen J. L., Pekker T. Wilson C. R., Tapley B. D., Kostianoy A. G., Cretaux J.-F. & Safarov E. S., 2017). Indeed, the fluctuation caused much concern to all five littoral

countries (flooding has destroyed or damaged buildings and other engineering structures, roads, beaches and farm lands in the coastal zone) (Roshan G., Moghbel M., Grab S., 2012).
The presented risks show the importance of having a multidimensional approach in urban remediation of coastal zones. The multidimensionality in urban design not only focuses on economic profit, but also on social and environmental values including reinforcing the resilience of the urban spaces.

3. MULTIDIMENSIONAL APPROACH IN URBAN REMEDIATION

In the presented context, the interdisciplinary targets of Sustainable Development Goals (SDGs) can help to develop multidimensional approach. The suggested approach can embrace the targets of SDGs (primarily SDG 11 which focuses on cities) including Disaster Risk Reduction (DRR) for waterfront industrial areas of Baku and sustainability strategies for natural and industrial risks by identifying the opportunities and historical knowledge.

The multidimensional approach aims to play a role in reducing and managing the range of hazards and uncertainties. The concept of resilience, which has been defined as being an "umbrella concept", in the context of strong uncertainties in the Caspian Sea and Baku coastline, appears as a necessary condition of sustainability with its transdisciplinary and holistic when it comes to its implementation (Klein R. J. T., Nicholls R. J., Thomalla F., 2003). The resilience capacity has been defined as "[...] the ability to fall back on one's feet, to stay on course, to ensure the sustainability of an organization or society, to maintain certain permanence in a turbulent environment" (Richemond, 2003).

Based on the targets of SDGs, the presented multidimensional concept is focuses on "interdisciplinary and sensitive approach" (defined by Maurice Blanc, 2018) with mixed method of intervention – nature (defined by Cogato Lanza, 2005) and engineer based solutions (City and County of San Francisco, 2016) and having an objective of "resilience" (figure 3). These three elements should also focus on strategic perspectives which are "creation of values" and "restoring social bonds".

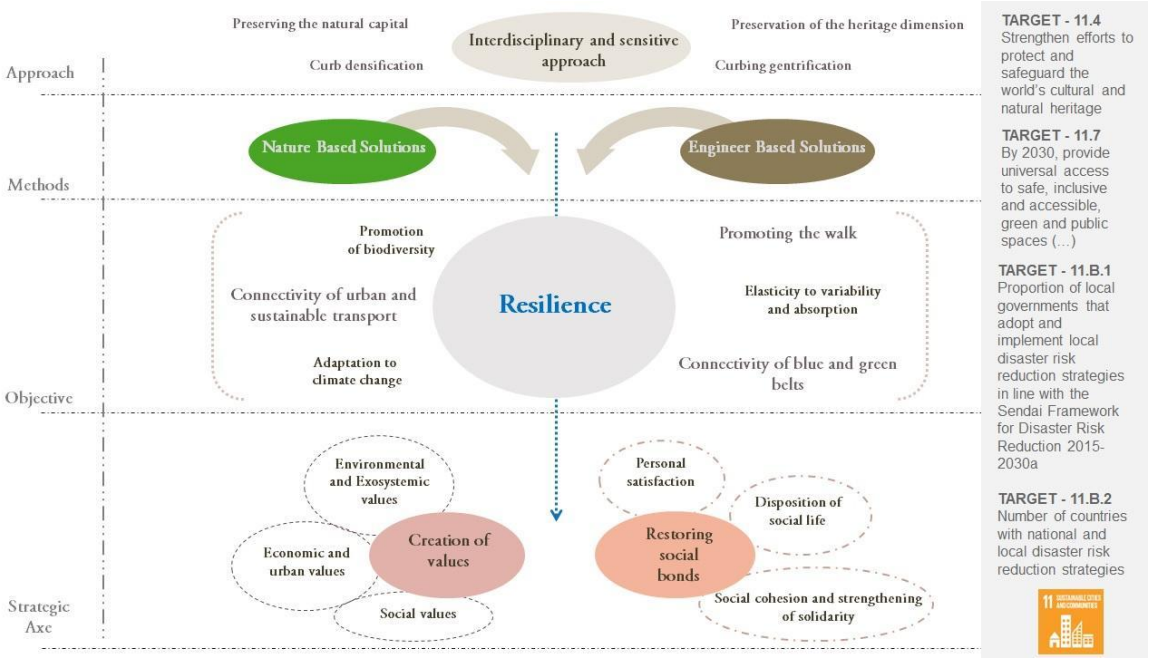


Figure 3. Multidimensional method for urban remediation of Baku city
Source: Tural Aliyev, 2020 ©

Overall aim of the concept is to react within the multidirectional approach for improving the resilience of the coastal area by reducing the risks as well as for preserving the heritage and creating new values (economic, urban, social, environmental and exosystemic). At the end, the method's objective is to make business more proper and stable in the city.

4. MATERIAL AND METHODS

The above-mentioned challenges faced by the cities highlights the importance of interdisciplinary approach in research methods and practices. The interdisciplinary approach: the relationship between urbanism and social sciences shows that the spatial planning is becoming more than more an attractive and a necessary tool for DRR and adaptation, as it presents an opportunity to regulate the long-term use of space through which exposure to natural hazards and human-induced threats can be minimized (Sutanta H., Rajabifard A., Ian D Bishop I., D., 2010). The methods to meet the presented challenges are the historical analysis, observation, and field investigation.

5. CONCLUSION

In the presented challenges, it was shown how the industrial waterfront areas are vulnerable and fragile spaces of the city. For this raison, these areas should be remediate beyond the economic values in a sustainable and resilient manner for responding to the multiple challenges, create new values (ecosystemic, environmental, social and economic) and trade-offs / co-benefits (for the population, for the stakeholders, urban planners).

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Issues in Urban Planning of Residential Building: In Case of Baku Districts

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ABSTRACT

After the industrial revolution, when the role of agriculture decreased in society, and people no longer depended on land cultivation, they started to migrate to cities chasing new opportunities. This changed the face of cities and they became not only the leading places for people to live and work but also magnets for economic, cultural and social activities. Now, cities attract not only a new generation of city dwellers, and a previously suburban generation that rediscovered the appeal of city living and urban lifestyle, but also businesses and institutional investors that are focusing exclusively on urban areas.

Despite the benefits of high urbanization, there are also problems of highly populated cities. As population growth and urbanization continue it needs to build new residential areas and it brings a number of challenges such as urban planning issues, air pollution, congestion, social issues, pressure on housing markets, transportation, etc.

Baku one of the oldest cities and the capital of Azerbaijan and it is the most industrialized city of the Caucasus which also faced industrialization starting from the end of the 19th century. During the last century, especially in USSR and in modern and postmodern period, Baku grew dramatically, and also face the same urbanization problems as other big cities in the world.

Therefore, in this article, I would like to discuss main issues in urban planning of residential buildings on the example of Baku's residential districts and give solutions which have been used to solve these problems in other big cities, which may help to change the current situation and make it a more liveable place.

Keywords: urban planning, residential buildings, city district, urban settlement, Baku city.

1. INTRODUCTION

Baku is the capital and the biggest city of Azerbaijan. And at the same time Baku is the most urbanized city in the Caucasus. The city is located on the Absheron peninsula with a territory covering over 2130 square kilometers, which is divided into 11 administrative districts that also includes 59 settlements[1].The city proper borders the Absheron region in the north with its capital city of Khirdalan situated in the outskirts of Baku. Further to the north, Baku borders the city of Sumgayit that used to be the hub of the chemical and petro-chemical industries of the Soviet Union. Since the collapse of communism and the disintegration of the Soviet Union, Baku has undergone a tremendous transformation. In this paper demographic trends for the last decade shows constant increase of population due to the high net in migration from rural areas of Azerbaijan.

Consequently, the city continues to be the leading recipient of investments and much of this is funneled into the construction industry. In addition, government investment also favors Baku where major funds are directed toward infrastructure projects, city gentrification (beautification) and renovation. Demographic pressure and the demand for new apartments has forced the city to heavily invest in construction, with new high-rise towers constantly rising across the downtown area[2].

In addition to changes in the infrastructure, the urbanization and de-industrialization of Baku has also brought some major challenges in urban planning of Baku.

This paper illustrated the historical background of Baku. History of Urban planning of Baku, especially residential areas. According to these data we will determine what kind of issues formulated during each period how they affect the environment, economy and the most important citizens' life, their health.

2. LITERATURE REVIEW

Research in this article about the general architectural background of Baku city was carried out in order to be able to redefine urban planning issues on residential districts of Baku and determine their effects on the modern urban area of the city. For this reason, firstly, look at the demographics illustration of Baku city will be taken according to populationstat.com data. Then article will show how our city formulated from the Islamic architecture period, oil boom period, USSR period which played important role of formulating city concept of Baku city and a lot of residential complexes, districts were built in that period. And the same time a look at modern and postmodern period of Baku city will be taken.

All the information were taken based on the previous researches: articles named "City profile Baku"(2013) and "Urbanization and urban public policy in Baku" (2018) of Anar Veliyev, "Urban planning of Baku: who is involved and how it works " by Farid Guliyev (2018), and article by Ganna Adrianova "Architecture of Soviet housing and main Soviet urban planning concepts" (2015).

2.1 Review of demographics and industrialisation of Baku

Baku is a capital and the largest industrial city of Azerbaijan. As a capital Baku also is one of most urbanized city in Caucasus region. According to the data of populationstat.com [3] about 2,350 thousand people in Baku urban area and about 1,117 thousand in the city itself at 2020.(Figure 1)
According to the projection in 2030 the Baku urban area population will reach 2,659 thousand.
Development of Baku as an industrial city started in the early 1900s. The main industry of the city was oil and gas extraction and shipbuilding. The basis for this was the location of the city on the coast of

Caspian sea which is one of the few places in the world rich in hydrocarbon resources. The main development of the city as an industrial fell on Soviet times, where it became the major industrial city in the Region. As a result, we can see that the population of the Baku after the industrial revolution was increased very obviously. It brought housing needs itself in city. A lot of districts were created for providing each family with house in Baku under the Soviet urban planning regulations.

In opposition to the post-Soviet development of the city has witnessed major and grandiose reconstruction projects, which is transforming it into one of modern cities around the globe. Now Baku develops new industrial areas while the core of financing of the activity in the city is oil and gas industry. Main industrial areas of the city in 2020 are:

- Heavy industry;
- Light industry;
- Manufacturing;
- Construction;
- Agriculture;
- Transportation [4].

Consequently, the urban landscape has been transformed in many parts of the city, while informal settlements and a deteriorating environment have become the main scourges of Baku.

2.2Architectural Background of Baku

For determining issues on urban planning first of all we need to look at the architectural historical background of the city.The architecture of Baku city can not be characterized by any particular architectural style. It contains several types of architectural styles starting from ancient buildings in the old city and its surroundings, western style buildings in the city center,and ending with examples of Soviet Union constructivism and modern skyscrapers in abstract forms. All of these architecture types give a unique style to Baku where ancient, western architecture meets modern Eastern.

All types of architecture of the city can be divided into the following periods:

- Islamic period architecture;
- Period of Tsarist Russian architecture;
- Soviet Architecture;
- Late modern and postmodern architecture.

2.2.1 Islamic period architecture

The history of islamic architecture in Azerbaijan started in D.A. 643 when the historical territories of modern country incorporated in the Islamic caliphate. Then after this territories belonged to various islamic empires, khanates and countries till the early 19th century when Azerbaijan was included into Russian empire. The main traces of islamic Architecture we can see in the Old City in Baku and in some villages of Baku urban area. Buildings were designed in a "national style," incorporating elements like those found in the medieval Shirvan Shah Palace; specifically, arches, columns, inner courtyards and fountains [5]. There are islamic ornaments and texts on the facade of buildings and unique Middle East styles which help to easily determine them.

2.2.2 Russian Imperial and Azerbaijan Democratic era

Until its oil boom of about 150 years ago, the city of Baku didn't really stretch beyond the walls of its old 12th-century fortress. The oil boom took place between 1872 and World War I, a time when Baku's privatized oil fields were producing more than half of the world's oil. The oil boom attracted a wave of fortune-seeking entrepreneurs, industry experts and blue-collar laborers, increasing the population tenfold to more 140,000 by 1903. A construction boom followed. From the late 1880s a small circle of wealthy oil barons -- local men such as Musa Naghiyev, Shamsi Asadullayev and Zeynalabdin Taghiyev, as well as foreigners like the Rothschilds and the Nobel brothers started construction mansions and public buildings. In the space of just 15 to 20 years a new urban layer appeared just outside the old Muslim fortress. Mixing everything from Gothic and baroque to neoclassical and oriental and the same time "national style", these eclectic buildings somehow found an overall harmony, giving Baku the reputation of the "Paris of the Caucasus". (Figure 1 to 4)

2.2.3 Soviet Architecture

2 year of independence of Baku as capital of Azerbaijan Democratic Republic finished after the red army occupied the city in 1920. For the next 70 years, Baku was the capital of the Soviet Azerbaijan. Moreover, from this point onwards, Baku's development during the Soviet period was no different from many other cities of the Soviet Union. The first decade of the Soviet administration in Baku between 1920 and 1930, is often called the Decade of Transition. This period saw the construction of wide new avenues, new suburbs and standardized buildings [6] . Within this period, the style of architecture called Constructivism dominated the urban structure. This type of architectural style was heavily influenced by the Bolsheviks who saw urban space in the context of utilitarian purposes [7]. Thus, most of the buildings constructed during this period were fashioned in a way to serve people, not for aesthetics. To provide each citizen of USSR with a house after the second world war Council of Ministers' accept the resolutions on "Measures to further industrialization, improving quality and reducing the cost of construction" and "The removal of excess in the design and construction". Starting in the 1950s these resolutions led to mass housing in Baku. Most of the city's sleeping areas now consist of buildings constructed starting from this period. Industrial micro-districts created in Baku by Garden city movement concept. Micro-district is a residential complex a primary structural element of the residential area construction in the Soviet Union and in some post-Soviet and former Socialist states [8]. Baku has 13 micro districts (figure 5 - figure 7) .These micro-districts are still standing long after their intended 50-year life expectancy and now they are home for a big part of the city's population. Since the mid-2000s, many districts apartment blocks have either been covered with new facades or destroyed and replaced with modern residential buildings.

2.2.3.1 Architecture of Soviet housing and main urban planning concepts

After the communist revolution in 1917 soviet housing at 1920-1930 was developed under the idea of transformation from individual housing to collective housing[9].

Collective housing meant that people should spend most of their time outside and need only minimum individual space for sleeping . Other activities such as eating, work, study, physical education, cultural life and etc.should take place in spacious common public places. Children should be grown up and educated outside of the home in special school blocks. According to soviet ideology it gives freedom to women to contribute more to the society[9].

The concept was implemented in the number of projects of "house-communa" (dom-comuna) and "dwelling combinat" (zhiloy-combinat) in constructivism style. In practice this idea was not fully accepted by citizens of the city[9]

Soviet housing between 1920- 1930 years: "Stalinkas" (Figure 8) are mostly residential bloks, built from the 1930s until 1950s in the era of USSR leader Joseph Stalin. "Stalinka '' residential buildings are divided into 2 main categories. One of them is made from white and red brick and another one which is made of cinder blocks. The "Stalinka '' which are made of brick have more beautiful facade elements, larger apartments and good insulation than other styles. Because they were constructed for the communist party elites. The small " Stalinka''s were made for soviet workers [9]

"Khrushchyovka" (Figure 8) is an example of low-cost which was made from concrete panels with three or five storied apartments which was constructed in the USSR during the early 1960 year until 1970.

"Khrushchyovka" was industrialised and prefabricated buildings which trucked to the site as needed. Elevators were too costly and time consuming to build. According to soviet health standards five stories was the maximum height of a building without an elevator. This is why almost all buildings have five stories [10].

Maximum square meters of "Khrushchyovka" apartments have a total area 30 m^2 for one room apartments, 44 m^2 for two room apartments, and 60 m^2 for three room apartments. These apartments were constructed for small families but in reality they are not comfortable for three generation of people to live together in these apartments (Figure 11)

USSR architecture between 1960- 1970 years was constructed under the influence of Khrushchev's speech " on the extensive introduction of industrial methods, improving the quality and reducing the cost of construction" (1954).

The common slogan was "We are not against beauty, but we are against superfluity". The efficient classicism of Stalinist empire was taken over by a purely functionalist rational style. The same housing conditions were promised for every USSR citizen. Within 20 years since 1954 60 million of soviet people were moved to new apartments in mass-scale factory-made buildings, identical regardless of climate specific[9]

Urban planning of USSR : Residential areas in the USSR were constructed in micro-district and city district in the level of public service concept. Micro-districts is a basic urban planning unit of the city in USSRs. Area is bounded by the roads. Total area of micro districts were accepted in 20-50 hectares scale. City districts is the urban unit of the city which encompasses 80-400 hectares. City districts contain several districts with big common public centers, schools, kindergartens, shops , park areas and other building and structures. In order to built quickly and successfully we used standart design in our construction and urban planning (Figure 12, Figure 13).

In 1960-1990 years architects got more freedom compare to previous times. Standart design was still in force but there were more variety of projects series according to climate zones and urban planning conditions . Houses usualy had from 9-16 floors with elevator.

Between 1970 and 1990 years "Leningrad", "Kiev", "Minsk" and "experimental" style buildings started to built . Houses of 1970-1990s years had bigger apartament areas compare to "khrushchyovka" houses. Houses consisted of sections that could be attached to each other in diferent positions and could have diferent height. When it comes to construction materials in Baku they were prefabruicated concrete panels for 9-16 store and limestone materials for 5 store buildings. Usually that kind of sectional houses were quite long lenth. It were developed alternative to level system consepts of public service that counted transportation as the main factor that infuence the building location. Funktional system was implemented in several experimental micro-districts in Baku. But other districts were constructed under level system of public service.

Housing and urban planning in USSR period in Baku was under influence of the sosiety changes and the political course of the USSR leaders. Apartments were built for the gowernment money with standart design for saving money. After disolotion of USSR Housing developed in Baku continues urban planning traditions of USSR but it is not scaled and well organized as in Soviet times. Urban planning regulation almost the same nowadays with USSR regulations in Baku.

2.2.4 Late modern and postmodern architecture

By achieving independence in the late 1991 Baku started to receive big oil contracts from abroad. In 1994, a new stage in the development of the country was ushered in with the signing of the "Contract of the Century" for the development of Azerbaijan's largest oil reserves in the Caspian Basin. Western companies began to establish themselves in the capital, during the phenomenon that is often referred to as Baku's Second Oil Boom. But this time, the development has been much more rapid and on a much grander scale than the First Oil Boom that took place at the end of the 19th century [6]. Enormous amounts of oil money accumulated in Baku and invested in its development. The appearance of Baku has changed dramatically. As flashes of light, samples of futuristic architecture burst into it and also turned into new symbols of the capital of Azerbaijan. Baku's new business districts today have shifted around the Baku city center, with many high-tech buildings and postmodern architecture. Aside from buildings used for business and institutions, various new residential developments are currently underway, many of which consist of high-rise buildings built by using monolit construction with a glass exterior, surrounded by American-style residential communities.

2.3 Tables and Figures

Table 1. Illustration of population of Baku [1].

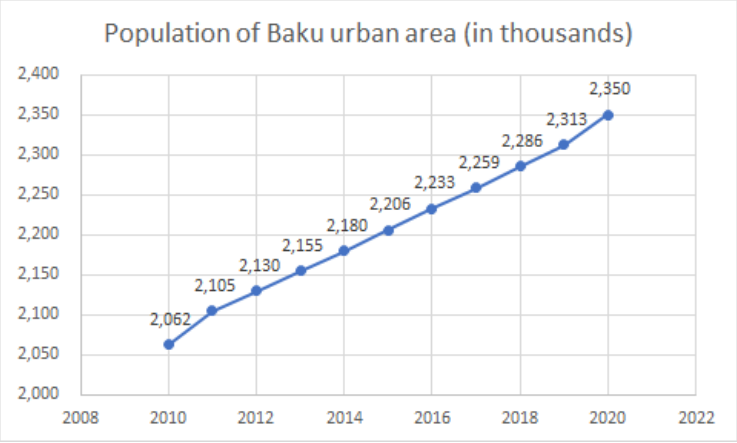




Figure 1. The house of Sadykhov brothers was built in 1910-1912 by the project of Gabriel Ter-Mikelov. The building has different compositional structures and architectural features, elements and details of local architecture. The house of residence has a rich volume of plastic.



Figure 2. The Ramazanov's house- the building belongs to 19th century and located in Icheri Sheher. The building was built by order of merchant Haji Mammadkarim Ramazanov in 1895 in the national- romantic style. The architect of building is unknown.

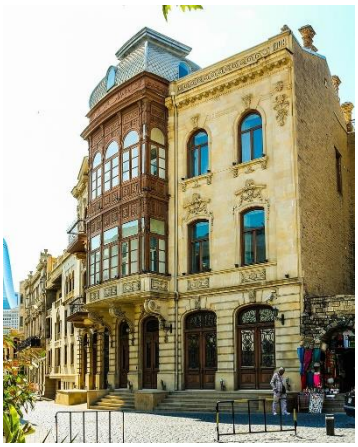


Figure 3. House of Qani Mammadov- the building was built in 1906 by the order of a successful cotton trader Gani Mammadov. Architect of building was Nicolay Bayev and the building built by combining of eastern and western style of architecture.



Figure 4. The House of Maksud Ibragimbeyov- the building was built by mayor of Baku Zivar bey Axmedbeyov for oil baron Alakbar Mashadibeyov in 1914. Now building using as Alakbar Mashadibeyov's grandson Maksud Ibragimov's house museum.

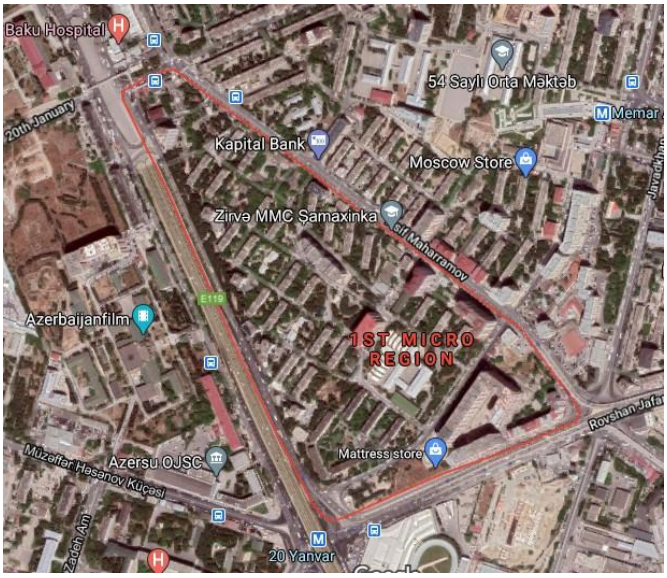


Figure 5. 1th Micro-district, located in Nasimi district. The expired large-panel residential buildings, known as "Khrushchevka", intended for temporary residence, will be demolished and the area will be reconstructed. Some works already begun in the area.

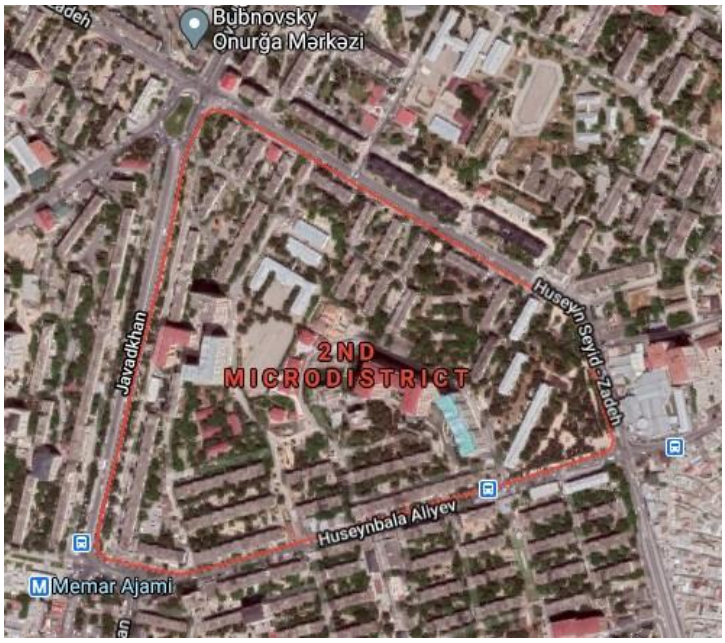


Figure 6. 2nd Micro-district, located in Nasimi district. The micro-district also will be under construction.

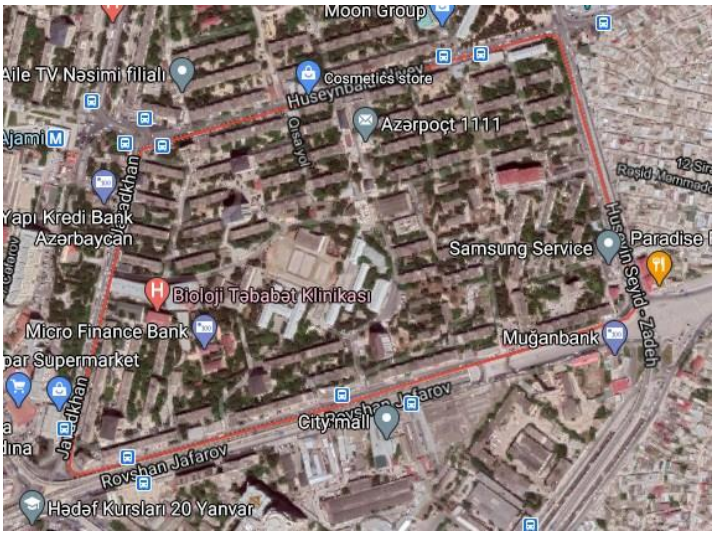


Figure 7. 3rd Micro-district also, located in Nasimi district.



Figure 8. "Stalinka" apartment which located Yasamal district.



Figure 9. Plans of typical "Stalinka" standart design house for workers.



Figure 10. Fragments of "Khruschevka" apartment.

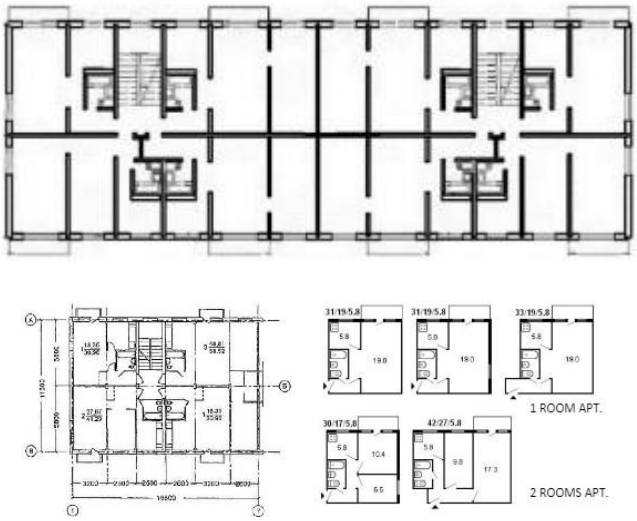


Figure 11. Plans of typical "Khruschevka" standard design house.

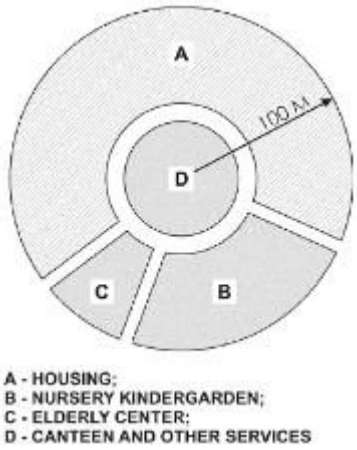


Figure 11. Housing group scheme. Level system of public service were developed in 1960 .

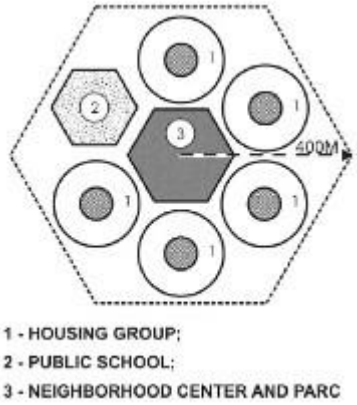


Figure 11. Micro-district scheme .

3. CONCLUSION

Baku has undergone a series of significant transformations throughout its history, all of which has its own urban problems. The rapid growth of Baku's population has significantly affected the urban sprawl in Baku city. Population forecast considered both natural growth and migration. The old Master plan of Baku envisioned that population of Baku, estimated at 1.7 million in 1985 and would grow to 2.26 million by 2006. The plan estimated that total residential housing would be 19.9 million m2 in 1986. One of main purpose of the master plan was to provide housing to every family in Baku until 2000. The collapse of the Soviet Union and then inability of the Master plan to reflect such dramatic changes led to complete chaos in the residential urban planning of city.

For example Soviet period buildings are sufferings from neglect and lack of maintenance, while nowadays because of the cost of land buildings are built in close proximity to maximize the land utilization. Therefore, current urban reconstruction has reduced the area of public space and has often gone against the basic rules of urban planning. In addition Baku as all millionaire cities face the typical problems of a budding megacity such as tract, noise and air pollution. Because of overcrowding and fast growth of the city its base infrastructure such as sewer pipes, transportation and other systems remained out dated and operated beyond their capacity. In its turn it leads for example to flooding of the streets, turning the city into a virtual lake in high rain season. Or car drivers park on sidewalks, impeding the movement of pedestrians in the downtown areas because of lack of parking zones and small width of streets in the city centre which remained from the early 1900s.

When it comes to residential districts nowadays districts which planned in Soviet times under the Soviet regulations are the house for most of people who lives in city. But as we read above that buildings were constructed in minimal requirements of living now that houses are not enough for modern living conditions. Over time, as people need a larger house for their needs, they started expanding their living space by including balconies to their flat's area. It caused chaotic view of facade of buildings. Some residential buildings covered with new facade by the government but it also has own problems like burning flimsy materials, second windows which create ventilation problems and therefore, brings discomfort to residents.
Despite buildings with minimal requirements in USSR most of residential districts had enough green areas, parks for children. Nowadays we see that green areas disappeared year by year. Long sectional houses without green pedestrian way creates depressive and boring districts. Car parking zones replaced almost all green areas of districts. Despite of Soviet urban planning regulations nowadays most of the residential complexes has not enough space for green area, park for children although

according to new urban planning regulation more than 30% of the area should be designed as green area for residents.

All residential buildings were built not more that 10 meters distance from main road without green zones between pedestrian way and traffic road. First of all it causes of ecological damage then sound pollution for residents.

The other one of problems of modern residential areas is Walkability. Now approximately all work places, administrative places, big malls, shopping districts, restaurants, cinemas are located central zone of Baku and not all the citizens able to reach that areas by walk or take bus for short distance.
In addition all buildings built by the order of government In soviet times and had same design and shapes. However now all the residential buildings built by individual customers and each building has its own style there is no harmony in city.

To solve this problems the Cabinet of Ministers take the decision in 2017 to destroy the districts which planned more than 50 years ago and create new modern residential districts. However, it remains unclear whether the current architects will correct the urban planning problems of Soviet architecture while retaining the pluses or create new problems.

The prevention and solving all these problems of urban areas is the basic concern of urban planning. It helps to plan each aspect of urban territories such as internal form, structure, function, and appearance before construction starts.
In other hand bringing new sustainable solutions to urban planning can help us to develop innovative and practical approaches toll and use and its impact on natural resources. New sustainable solutions for urban planning problems can include green buildings and housing, mixed-use developments, walkability, greenways and open spaces, alternative energy sources such as solar and wind, and transportation options. Good sustainable land use planning helps improve the welfare of people and their communities, shaping their urban areas and neighbourhood into healthier, more efficient spaces.

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Taking Design Decisions Regarding Creating the Zoning Plan After Analysis and Evaluation Process in Landscape Planning: A Landscape Planning Studio Work, The Example of Selçuk District of İzmir Province

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ABSTRACT

Cities have the characteristic of being a landscape with natural structures such as mountains and streams and cultural structures such as industry, settlement and transportation, passing through the historical process. Various studies are carried out to protect these structures, which are important sources of life and income for cities, and to transfer them to future generations. One of these studies is landscape planning. Landscape planning is a study in which urban and rural relations are established, natural structures are preserved and transferred to future generations, and cultural structures are planned to develop in a way that will cause minimal damage to the city. A healthy development plan can be created as a result of the analyzes and evaluations made during the work process in landscape planning. With this plan, the preservation, restoration, management and design decisions of natural and cultural structures in cities can be taken and implemented correctly.

In this study, the relationship between landscape planning and the zoning plan and design criteria was established in the example of Selçuk District of İzmir Province. İt was aimed to put forward the need for landscape architects to take an active role in the creation of zoning plans and the need to create zoning plans in urban design projects.

Keywords: Landscape, Landscape planning, Planning Studio, Zoning plan

1. INTRODUCTION

The city is administrative "the largest administrative unit with a high population density and managed by an administrator under a central administration." They are places that can meet the population with their features, established according to a specific development plan, and where infrastructure services are developed [1]. The deterioration in urban space and environmental areas, which increased in the following years in our country as in the world, is evaluated as a negative result of rapid urbanization. The rapid increase of urbanization in our country in recent years and the regulation of the relations of the city people with each other, with the land and with the administration have led the society to develop some institutional mechanisms [2]. However, the increasing urbanization movements, especially due to the increase in the population experienced in recent years, negatively affect the urban landscape. In this context, urbanization on the structure of landscapes; It affects such as the disconnection of their connection with each other, the fragmentation or loss habitat areas over time, the interruption of ecologically sensitive corridors and loss of continuity (Alay, 2016; Olgun et al., 2019). Especially in our country, to meet the needs of cities and to prevent the deterioration of the environment due to various reasons such as physical, social and economic, the zoning law and regulations numbered 3194 have emerged and our cities are planned and organized according to the decisions in these laws and regulations. However, the development plans, which are seen as the basic land of urban planning, cannot keep urbanization process experienced and when the current situation of the cities is examined, it is seen that there is an inadequacy in providing a healthy structure of the environment and ensuring the sustainability of this structure [2]. For this reason, it has become obligatory for city planners, ecologists and landscape architects to develop new methods for sustainable urban development against ecological problems caused by the inability to meet the necessary needs and increasing environmental problems as a result of population growth and migration in cities [3]. Thus, due to the problems caused by urbanization, many countries are working on creating ecologically sustainable cities and reshaping existing cities with ecological concerns [4]. One of these studies is urban planning with a landscape and ecological planning approach.

Landscape planning is an important factor in the process of creating a zoning plan to be prepared for the sustainability of cities. According to Ergin (2004), landscape planning aims to address the ecological and natural energy of nature, which is a physical entity, to meet the needs of cultural life in which its ideological social structure is determined and restricted. We aim to research and develop ways to benefit most efficiently in the longest time possible. It is a planning action that examines this purpose in action planning [5]. It is also planning that includes the implementation of management strategies, plans and projects for the creation of natural and cultural landscape values for the future, increasing and improving existing values by ensuring the balance of protection and use [6].

Landscape planning includes many different methods developed over time. However, as in other planning studies, throughout the landscape planning study process, the planner must choose the more appropriate ones among many different options affected by many factors [7].

In this study, the working method used in the planning studio of the Ege University landscape architecture department is examined.

2. MATERIAL VE METHOD

2.1. Geological Structure and Geographical Location of the Study Area

Küçük Menredes Basin was formed by the up and down movements at the end of the 3rd geological time. Two main shapes constitute the morphological structure in the region. These two main forms are the northern and southern hilly areas and the plains. The plain separated Aydın Mountains in the

south and Boz Mountains in the north as a result of rising and falling movements. Passing through the middle of the plain Küçük Menderes River, on the other hand, fills the plain floor and the bay with the alluvium it carries and gained their appearance. Selçuk district was established on this land consisting of alluvium near the end of Küçük Menderes Basin[16].



Figure 1. The geographical location of Selçuk District, Anonymous

Selçuk district, which is 74 km away from İzmir city centre, is surrounded by Tire and Aydın-Germencik districts in the east, Torbalı and Menderes in the north, the Aegean Sea in the west and Aydın-Kuşadası district in the south. At the same time, it is 16 meters high from the sea and has a 12 km coast to the Aegean Sea [8]

Selçuk district with a surface area of 295 km² consists of 14 districts. It has a population of 35.960 according to the general population census dated 2016[9].

2.2. Maps Associated With The Study Area

Maps related to Selçuk district constitute an important material group of this study. These maps will be used in the creation of various data with the method studied in the Aegean University Landscape Planning Studio, which is taken as an example in this study.

This maps group is as follows;

- Great Soil Group Map (Figure 2)
- Slope Map (Figure 3)
- Hydrology Map (Figure 4)
- Forest Map (Figure 5)
- Settlement Map (Figure 6)
- Transport Map (Figure7)
- Agriculture Map (Figure 8)

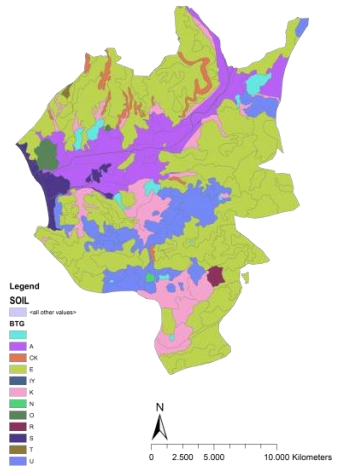


Figure 2. Great Soil Group Map[8].

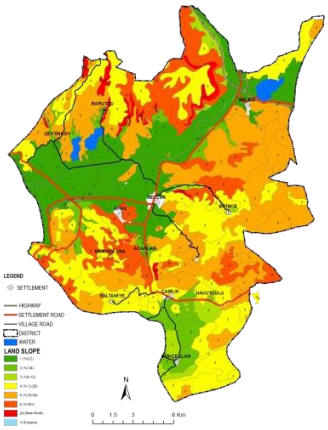


Figure 3. Slope Map[8].

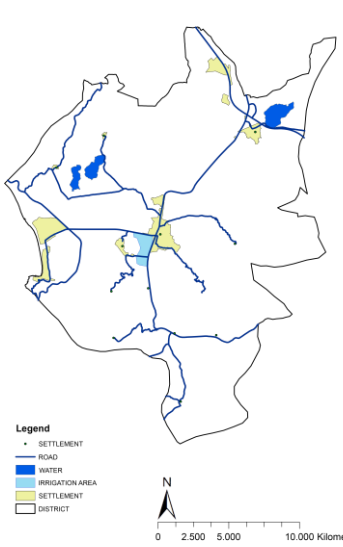


Figure 4. Hydrology Map[8].

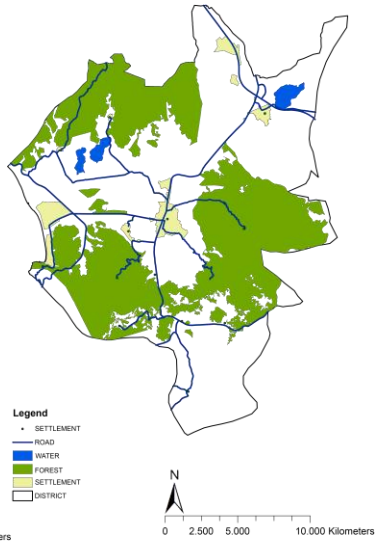


Figure 5. Forest Areas Map[8].

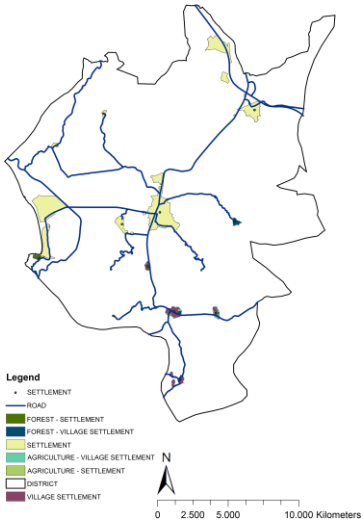


Figure 6. Settlement Map[8].



Figure 7. Transport Map[8].

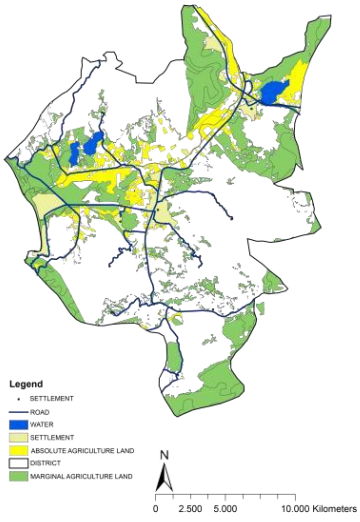


Figure 8. Agricultural Areas Map[8].

Literature search has been done on the maps. In line with these scans, important data and explanations about maps are as follows.

Great Soil Group Map: As can be seen in Figure 2, it is a map containing data on the soil structure, types and densities of the district. In this map, most of the district lands consist of 25.5% red-brown Mediterranean soil group and 10.14% alluvial soil group. In addition, it is seen that arable land structure is dominant due to the high amount of alluvial soils [10].

Slope Map: The slope mapping, as seen in Figure 3, provides information about the elevation values of the district. When the national soil map is examined, it is seen that a very steep land structure with a slice of 28.7% is dominant in Selçuk district. This rate is followed by a steep land structure with a rate of 25.5% [8].

As a result of these data, it is possible to say that mountain and hill formation are intensely seen in Selçuk district.

Hydrology Map: Hydrology map is maps showing the presence of water elements in the district. As can be seen in Figure 4, there are three wetlands in the delta formed by the Küçük Menderes Basin in the district. These wetlands are Gebekirse, Çakal and Belevi lakes [11].

Forest Areas Map: As in Figure 5, data on forest vegetation can be seen in this map. In addition, during the ancient city period of Selçuk district, the city comprised 65.35% of the forest areas. Today, it is known that this rate has decreased to 33% [12].

Settlement Map: In this type of map, urban and rural residential areas of the district are seen. The settlement map of the Selçuk district is as in Figure 6.

6.40% of the land in Selçuk district consists of residential areas. The city center is the largest part of these areas [12]. We can say that the urban settlement in Selçuk district is less than İzmir city center and districts such as Bayraklı and Bornova, where urban settlements are concentrated. Thus, we can say that the natural landscapes in the district are at a dense level.

Transport Map: The transport map is a map showing transport networks such as highways within the city. The transportation map for the study area is shown in Figure 7. Transportation to the city of Selçuk is provided by the highway reserved for Kuşadası via the İzmir-Aydın Highway. In addition, it is possible to provide transportation to İzmir-Aydın-Denizli provinces by rail as well as road transportation. This railway axis passing through the center of Selçuk district allows transportation between the south and southeastern regions of the Aegean Region [13].

Agricultural Area Map: In this type of map, we see the lands in which the district's agricultural activities are located. As seen in Figure 8, agriculture in the district is divided into two groups. These are marginal farmland and absolute farmland.

In addition, according to 2014 data, agricultural lands constitue 22.80% of the district land [12].

2.2. Selçuk District Current Development Plan

The first development plan of the city is the 1974 Selçuk Development Plan. In this plan, a limited development in the south direction of the city is envisaged and the northeastern parts of the city have been decided to be green areas. At the same time, a development zone was opened, especially in the

southern part of the city. The first plan that forms the main form of the city was made in 1986. This plan, which is the Selçuk Additional and Revision Development Plan, starting 1/1000, was supported by the Improvement Development Plan made in 1992[17]. Along with these plans, many different development plans have been created. One of these plans is seen in figure 9.

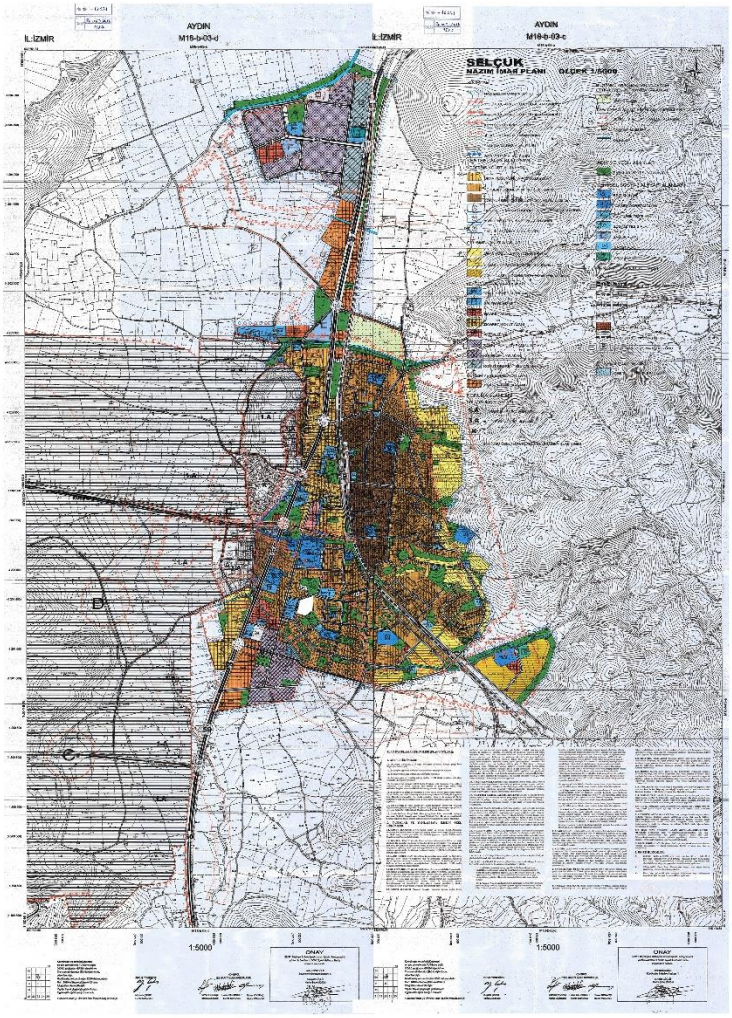


Figure 9. 1/5000 Scale İzmir Selçuk Master Zoning Plan, 2016

İzmir Selçuk Master Zoning Plan made in 2016 is the first master development plan made after 1986. In this plan, as in the plans made in previous years, the urban development decision was taken in the east direction of the development of the city, as in the south [17].

2.3. Method

The method of the study was created by taking the landscape planning studio of Ege University as an example.

In this method, a working scheme is first created and processes are processed considering this scheme. The scheme of the method is shown in figure 10.

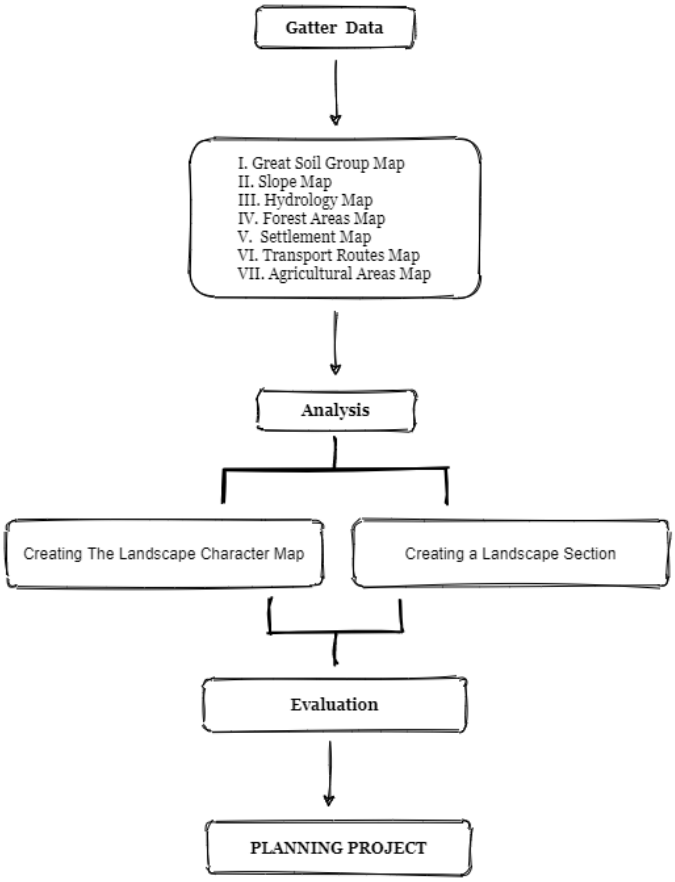


Figure 10. Method Working Scheme (Orijinal, 2020).

The method starts with the data collection process. In this process, maps of soil groups, slope, hydrology, forest, settlement, transportation and agricultural areas are collected to produce another date we need. At the same time, the literature related to the field of study is scanned. After the data collection process, the analysis process starts.

In the analysis process, firstly, the relationship map of Selçuk district is created with the data obtained from the literature review. In the second stage, the landscape character map, which is seen as the most important data of the method, is created. In the third stage, which is the next step after the landscape character map, the landscape section is created. In the fourth stage, landscape changes in the study area according to certain years are examined. At this stage, the required data are aerial photographs obtained using Google Maps and Google Earth applications. In the fifth and last stage, the existing master development plan of the city is examined and the relationship between the landscape character is determined. In line with the established relationships, future-oriented landscape management, protection and design decisions are made in the city. These decisions are processed in the applied development plan of the district Selçuk to form the basis for any future development plan, project or planning work in the district.

3. RESULTS

3.1. Selçuk District Relationship Map

It can be said that Selçuk district has a versatile structure when examined in regional and international dimensions. The reason for this is that there are cities identical to Selçuk district on both regional and global scale. Especially the Virgin Mary Church, which is located within the borders of Selçuk district, St. It has a religious connection with the St. Jean Church. Therefore, it is possible to say that Selçuk district has a strong place in the spread of Christianity.

In the Bergama district of İzmir, there is the Red Courtyard, which is one of the important symbols of Christianity [14]. Kızıl Avlu shows that there is a religious relationship between Selçuk district and Bergama district, although there is no close relationship.



Figure 11. Selçuk District-European Countries Relations Map (Orijinal, 2020).

Selçuk district is an important urban settlement as given in both national and regional examples. For this reason, Selçuk district has cultural importance. In addition to these important cultural features, the prominence of natural features will provide an important advantage for the city of Selçuk. For this reason, the relations between the landscape structure of the city of Selçuk and its cultural structure can be supported by landscape planning.

3.2. Landscape Character Map

In the previous stage, it was emphasized that the relations between natural and cultural characteristics can be supported by landscape planning. For this reason, the need to create a landscape character map of Selçuk district has emerged. Thus, using programs such as Adobe Photoshop and Autocad, a landscape map was created by combining maps of a wide ground group, slope, forest, hydrology,

settlement, transportation and agricultural areas. The obtained landscape character map of the Selçuk district is shown in figure 12.

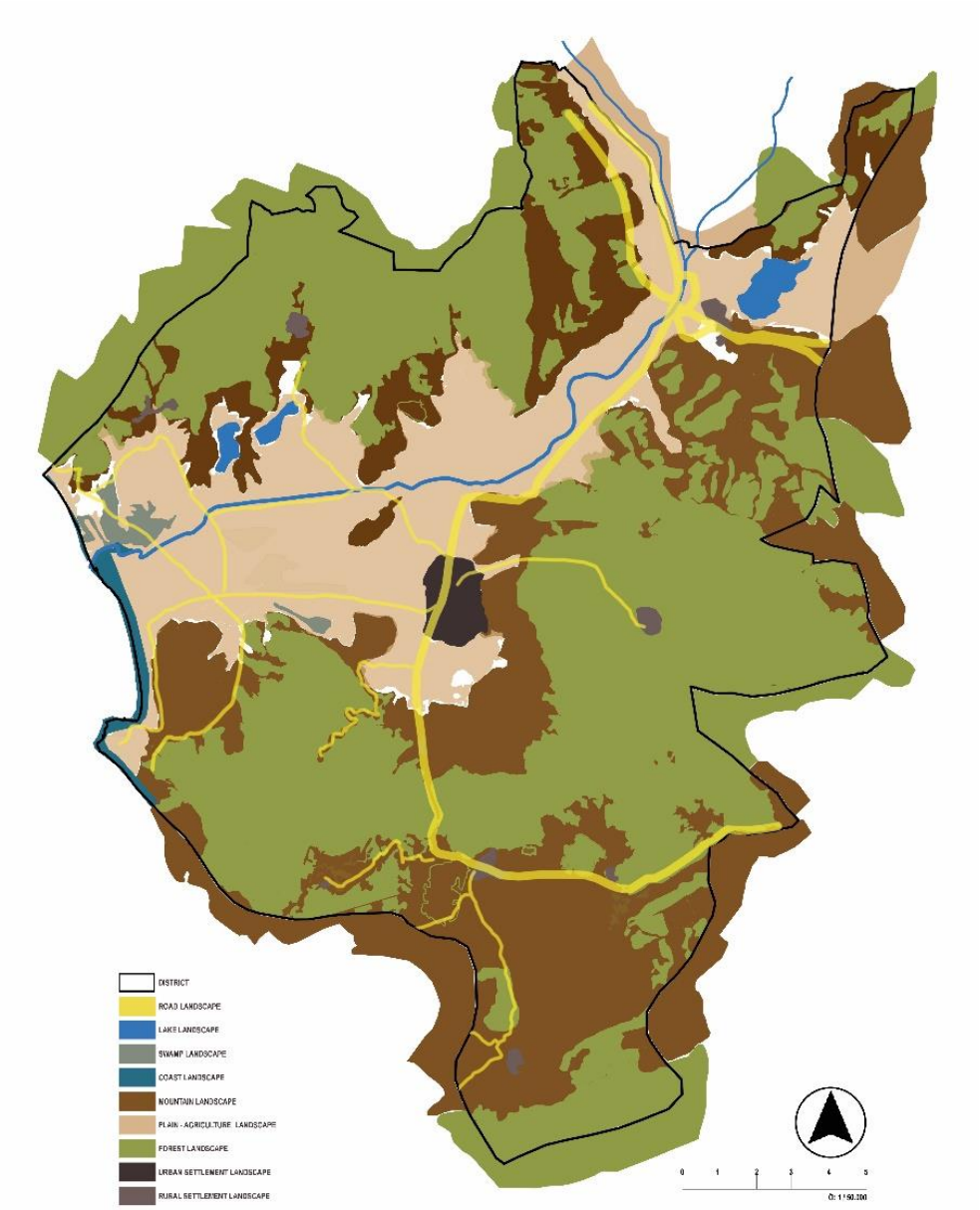


Figure 12. Landscape Character Map (Orijinal, 2020).

The first element that draws attention to the landscape map is that the landscapes do not have a definite boundary and the landscapes continue outside the district boundaries. Landscapes such as agriculture, forest, mountain, and settlement that make up the main landscape of the city are not independent of each other. As in mountainous and forest areas, landscapes with different characters are seen integrated.

Also, Little Meander, which continues its existence outside the boundaries of the district, forms an element of the water landscape by reaching out to Pamucak Coast. This river, which is an ecological corridor, creates an agricultural landscape around it due to the alluvial soils it carries.

Considering the cultural landscape and natural landscape elements that make up the main landscape mosaic, it is seen that natural landscape elements are more common in the city. However, it is thought that the existence of the agricultural landscape, which is particularly influenced by cultural factors, will create a danger for natural elements. Because the presence of water landscapes in agricultural areas can create effects such as drought and pollution in lakes the Little Meander River.

3.3. Landscape Section

Landscape section is done to reveal the accuracy of the readings after the stage of reading the landscape character map. To create the section, the final section view is taken using Google Earth and Google Maps applications and edited in Adobe Photoshop. In Figure 13, the section taken between east-west directions of the landscape character map of Selçuk district is shown.

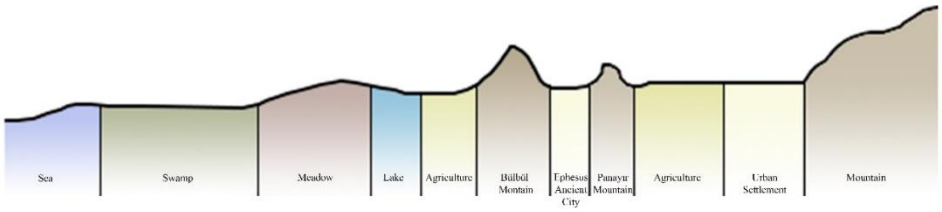


Figure 13. Landscape Section (Orijinal, 2020).

In Selçuk district, which has a wide variety of landscape structure, there is more than one different ecosystem. These ecosystems, which interact with each other and are not completely separated from each other, form the landscape structure and also provide the development of the landscape.

Aquatic ecosystems constitute an important part of the landscape of Selçuk district. However, when reading is made from the west to the east of the city, it is seen that ecosystems such as meadows, lakes and swamps decrease. Besides, the location of the ancient city of Ephesus can be read better with the section. Unlike Ephesus city, which completed its formation between Bülbül Mountain and Panayır Mountain, Selçuk district was formed on a more open area. The reason for this difference can be seen as the formation of transportation networks on the plain landscape.

3.4. Landscape Change

Landscapes change both as a result of increased human activities and under the influence of natural processes. The reasons for these changes may be human factors such as agricultural activities, urbanization and industrialization, as well as natural factors such as alluvial soils carried by rivers and streams, sediments, uplift and descent movements. Different methods are used depending on the purposes such as revealing the reasons for these changes and determining the size of the change. One of the methods is to examine the aerial photographs of a certain period of years.

Landscape changes can be viewed as seasonally or periodically. In this study, the changes due to February are examined in ten-year periods. Images of the changes are given in figure 14.

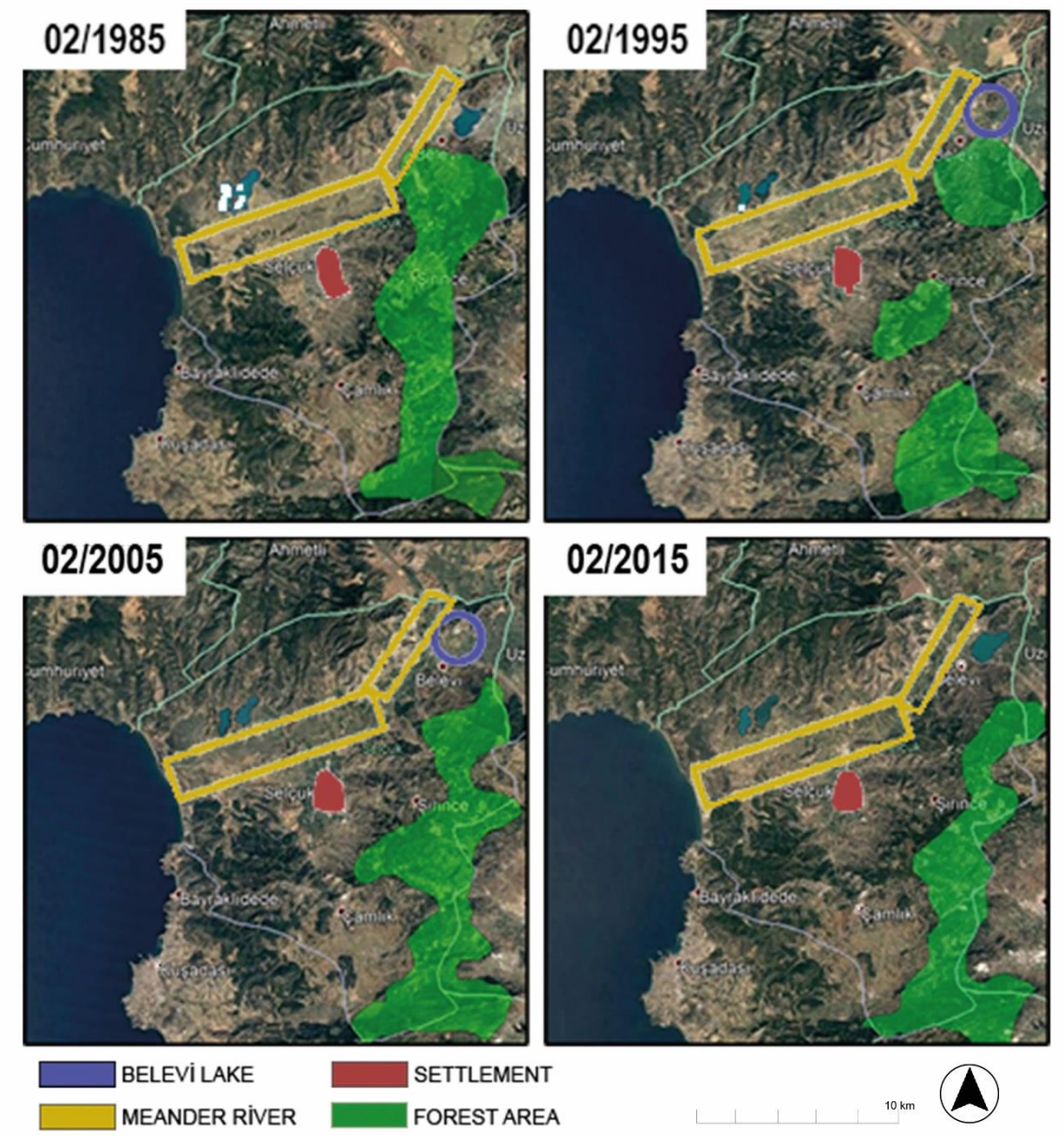


Figure 14. Landscape Change (Orijinal, 2020).

It is seen that the district centre is constantly growing. The growth of the district will cause population growth together. The increase in the population will cause environmental and urbanization problems. In one of these problems, it can be said that the consumption of natural resources will increase due to the prediction of increasing agricultural activities. Some of the natural resources are Little Meander River, Belevi, Gebekirse and Çakal lakes, which are important resources of Selçuk district. When we look at the basis of water-human and landscape relationship, water is the source of life. For this reason, any loss in lake landscapes will cause both natural and cultural life to be interrupted.

When the aerial photographs are examined, it is seen that the Belevi Lake located in the Belevi District has dried up for a period. The reason for the same seasonal change can be seen as the unconscious irrigation of agricultural lands. Also, it is observed that there is a decrease in Gebekirse and Çakal Lakes. The loss of the ecosystem unique to Gebekirse Lake, where salt and fresh water meet, will cause a decrease in biodiversity in the marsh and meadow ecosystems it interacts with.

In addition to settlements and lakes, landscape changes have been experienced in forest areas. These changes, especially close to mountainous areas, are thought to be caused by forest fires. Because it can be ignored that there will be an agricultural-active reason because the arable lands are on the plains. However, this change in forest areas is still thought to affect natural and cultural life. Because forest areas are an important part of the landscape that make up the wildlife of Selçuk district.

3.5. Zoning Plan

T.C. Zoning plan according to Article 5 of the Zoning Law No. 3194, *"ın accordance with regional or environmental plans, if any cadastral status processed on current maps drawn and land plots; general usage patterns, main types of regions, future population densities of the regions, building density, development directions, dimensions and principles of residential areas, transport systems and to demonstrate issues such solving problems and implementation of development plans, prepared, explained in a detailed report and with its report is the whole plan."[15].*

Based on landscape architecture, the development plan can be defined as "the plan in which the healthiest development of a city is supported, the relations between natural and cultural elements are established, the social differences between urban settlements are solved, the city ecosystem is supported, regions such as streams and natural green areas are protected and the necessary criteria are created."

A zoning plan to be created with this approach is only possible with studies in which the landscape architecture professional discipline is at the forefront and carried out with a landscape planning approach. In this study, the development plan of the Selçuk district created with the landscape planning approach is as shown in Figure 15. Development plan, it has been arranged according to the İzmir Selçuk Master Plan of 1/500 scale dated 2016.

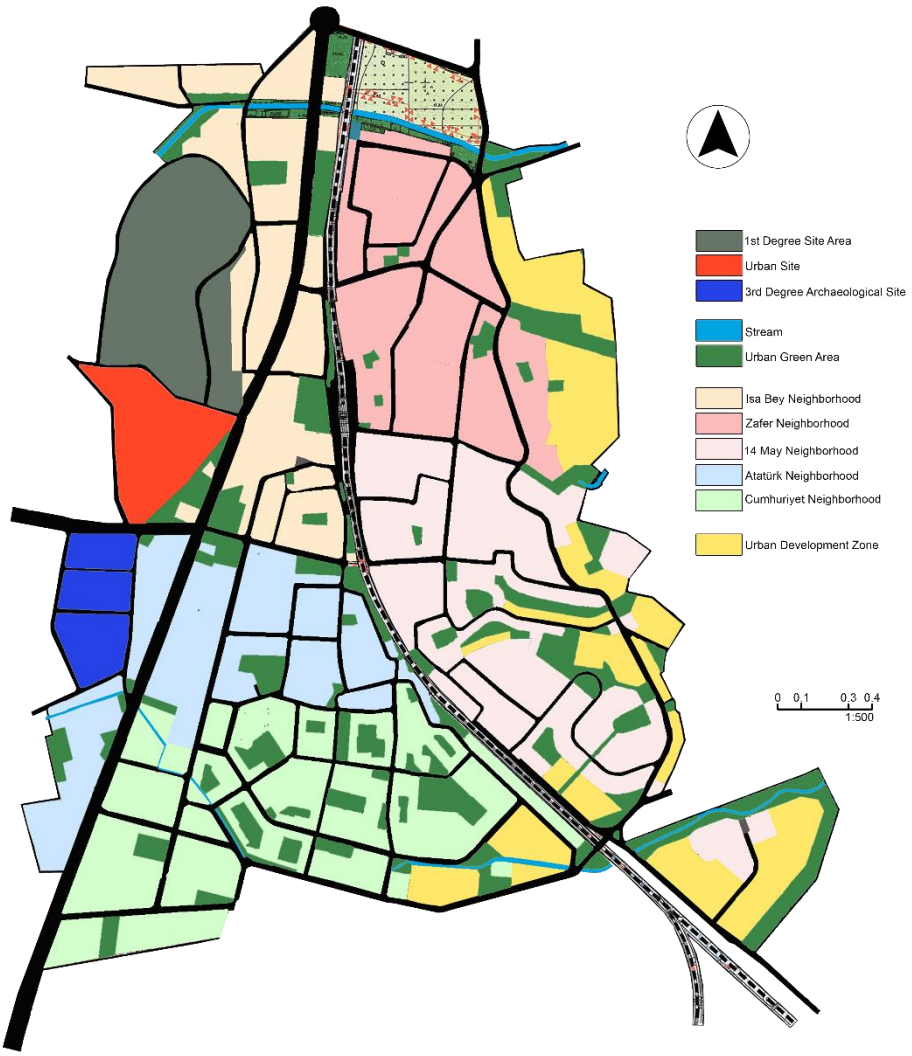


Figure 15. Selçuk District Zoning Plan, (Orijinal, 2020).

In the development plan of Selçuk district, it was seen that the railway divided the city into two and as a result of the field trip, both social and urban differences were observed between these two parts. The region with the highest urban open and green areas is Cumhuriyet Mahallesi. The low number of urban open and green areas in Zafer Quarter is the most important indicator of social differences between regions.

The areas considered as urban development zones in the zoning plan are the areas where mountain landscape and forest landscape are together. Increasing urbanization in these areas will destroy natural areas. Also, there are streams in the city. It is seen that the flood boundaries of these rivers, which are an important factor structure of the urban ecosystem, are not protected and there are urban settlements in their close vicinity.

Antony Kallinger Street, which has high cultural value, is located in the region, which continues to exist as an urban site. The importance of the street should be revealed by carrying out protection-oriented

studies in this region. At this stage, relations should be established between the historical aqueducts opposite Selçuk Izban Station, Ayasuluk Castle and Isa Bey Mosque.

Protected areas and urban settlements maintain their existence as a tangent to each other. In this relationship, the existence of slums in the close vicinity of the protected areas is in question. With the importance of the development of urban and archaeological sites with cultural value, the importance of the development of slums comes out.

4. CONCLUSION

In the development plan dated 1974, it was suggested that urban green areas were given importance. However, since 1974 is a long period between today, it is seen that the necessary importance is not given to urban green areas in the current development plan. In addition to the low number of urban green areas, a disproportionate spread is observed among the neighborhoods. This disproportionate spread is thought to cause sociocultural and socio-psychological differences between neighborhoods. Therefore, it is necessary to restructure the zoning plan and plan the urban open and green areas consciously in the development plan to be created.

The development areas in the eastern and southern parts of the city are located on mountain and forest landscapes. For this reason, smaller scale development plans should be created especially for these development regions. In this way, it will be possible to prevent environmental problems such as forest destruction in these regions.

Planning should be made with a landscape ecology approach in streams that are in urban settlements and are an important part of the urban ecosystem. In the planning to be made, an integrated approach should be put forward between streams and green areas, taking into account the urban open and green areas. Thus, it is possible to create a healthy urban model in which the green system is at the forefront and the urban ecosystem is strengthened

.

An urban design project should be created on Antony Kallinger Street, which is located in an urban protected area with high cultural and touristic value. In this project, an approach that will eliminate social and cultural injustices, especially between neighborhoods, should be adopted. For this reason, a physical integrity should be established between important cultural heritage such as Antony Kallinger Street and urban open and green spaces.

As a result of these inferences, creating a healthy and integrated city plan is only possible with landscape planning. Landscape architecture discipline comes to the fore in Selçuk district, which has the working area of many professional disciplines. Landscape architects will fulfill their duties and responsibilities in this regard.

Landscape architects can use many different methods in the landscape planning process in these tasks. One of these methods is the method used in Ege University andscape planning studio, which we examined in our study.

In this method;

- • It is possible to reveal the importance of the study area with a relationship map.
- • Landscape map and section support It is possible to say that Selçuk district consists of many different landscapes and ecosystems.
- •As with other planning techniques, we see the importance of landscape planning in cities with this technique.

- However, it has been observed that there are difficulties in creating the zoning plan and in processing landscape elements into the plan.
- However, the adequacy and accuracy of this method as a landscape planning method is open to discussion.

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Coastal Ecosystem Services of Erdek Bay: Assessment of Natural Dynamics and Identity

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ABSTRACT

The seas provide socio-economic benefits to humanity by providing the most critical ecosystem services of our planet and growth in the fields of development, transportation, energy supply, health, tourism, especially food security. However, the increasing pressures on the seas and oceans, caused by human and climate change, put these important values and services at risk. Especially coastal areas have become attractive for economic and social and competing activities such as intensive urbanization, industry, transportation, tourism in the last century.

Coastal zones are very dynamic areas due to their special location at the interface between land and sea. Coastal regions take the pressures and effects accumulated in the river basin and also cause a certain pressure on the sea side. The common indicator within the scope of the coastal / coastal ecosystem and landscape assessment is the monitoring of "The effects of man-made structures on a shoreline along the shoreline" which is stated under the Ecological objectives (UNEP (DEPI) / MED IG 20/8) assessed within the scope of the "Mediterranean Action Plan (MAP) - Integrated Monitoring and Evaluation Program (IMAP)" according to the "Marine Environment and Coastal Zone of the Mediterranean Convention. The objective of Coastal / Coastal Ecosystem and Landscape Assessment (EH-08) is indicated as preservation of the natural dynamics of the coastal areas that is defined as the protection of coastal / coastal ecosystems and landscape.

Within the scope of this study, the Erdek Bay / Peninsula, where the change has been observed due to terrestrial pressures in the Marmara Sea, which is of international importance in terms of maritime transport, is selected as the pilot area.

The steps determined in the Pilot Area within the scope of the Coastal / Coastal Ecosystem and Landscape Assessment and ecological targets (UNEP (DEPI) / MED IG 20/8) which are briefly as follows:

• Determining (i) artificial structures, man-made structures that cause physical deterioration / degradation (ii), evaluating the physical changes produced by these areas and the pressures on the ecosystem,

• Mapping these areas, monitoring the change in our Pilot Areas with Remote Sensing Methods

• Determining the Monitoring Method and strategy

Keywords: Ecosystem Services, Remote Sensing, Planning

1. INTRODUCTION

In researches on marine ecosystems, it has been observed that the most important threat is anthropogenic activities. It has negatively affected 85% of the coastline. At the same time, climate-related effects such as sea level rise, increased storm frequency, rising temperature and high carbon dioxide (CO_2) levels, overuse of resources or coastal development are direct results of human intervention. The loss of deltas of some wetlands in the world has been caused by human impact.

When the land changes on the coasts are observed, these areas are transformed into landscape areas with less biological diversity. To maintain ecosystem functioning and services, it depends on the long- and short-term sensitivity of the vulnerability of existing species and habitat.

Coastal wetlands are provided vital ecosystem services such as water quality and climate regulation. They are valuable accumulation sites for sediment, pollutants, carbon and nutrients. They provide protection from coastal erosion and storm surges, that are also nurseries and breeding grounds for birds, fish, shellfish, crustaceans and mammals. Moreover, they are renewable resources such as timber, fuel and fiber.

Turkey is a country surrounded by seas on three sides of the peninsula. It has a coastline of 3381 km from the Black Sea in the north, 909 km in the Marmara Sea, where the study area is located, 1620 km from the Aegean Sea in the west and 3755 km from the Mediterranean Sea in the south [1].

The Sea of Marmara is called the "Biological Corridor". It is one of the migration routes of fish species *(Sadra sadra, Pomatamus saltatrix, Engraulis encrasicolus*) with high economic value. Marine mammal species under protection form large groups around Kapıdağ which into our study area. [2]. Out of 146 fish species, only 3 species of economic importance remain due to the pollution in the Sea of Marmara [3].

Although Marmara Sea is important in term of biodiversity, in the region, especially in the North Marmara, continuous to increase extreme population density. Land changes arising from urban development and transportation activities on the northern coasts of Marmara put great pressure on land which have a rich biodiversity. Another important pollutant is the ship traffic with heavy passages through Çanakkale and the Bosphorus. Oil wastes left by ships and chemical wastes spilled into the sea after ship accidents cause mass death of living creatures.

The study area, Erdek Bay, is situated in north western Turkey, south of the Sea of Marmara(Figure 1). Erdek Bay which is located within the Bandırma-Kapıdağ drainage area, is an important water catchment area of the Marmara Sea. Two of the three main rivers reaching the Marmara Sea (Gönen River and Biga River) are within the study area. Pollution caused by forestry, animal husbandry, agricultural, domestic and industrial activities reaches the Sea of Marmara through the basins ofthese rivers [2].

Vegetation in the Kapidağ peninsula consists of three types: forest, maquis and fergana. Forest vegetation; *Pinus brutia Ten., Fagus orientalis Lipsky, Castanea sativa Miller, Quercus petraea Mattuschka, Quercus infectoria Olivier, Quercus frainetto Ten.* types are included.

In the scrub vegetation; *Erica arborea L, Arbutus unedo L., Quercus cocciferae L., Phillyrea latifolia L., Styrax officinalis L., Crataegus monogyna Jacq.*, types spread. *Cistus creticus L., Cistus salviifolius L., Lavandula stoeachas L. Sarcopoterium spinosum (L.) Spach* that spread in fergana vegetation. The

region is also rich in endemic plant species. [4]. The local people benefit from the diversity of plants on the peninsula for food, paint, fuel and ornamental purposes [5].



Figure 1. The location of the work area.

The settlement in Erdek (formerly Artake), sited in the west of the Kapıdağı Peninsula, formerly known as Arktonnesos [6], dates back to 5400 BC. According to the historian Herodotus, the economic situation of the region consists of grape, wine, olive and olive oil. According to the 1891 Ottoman census, Greeks constituted 89% of the males, while the Turks constituted 9% of the population. Immigrants from Thessaloniki, Kavala, Crete and Bosnia were settled in the places evacuated by the Greeks with the 1924 exchange [7].

2. ECOSYSTEM SERVICES

Ecosystems purify air and water, generate oxygen, and balance our climate. Plants help to form the appropriate atmosphere; organisms decompose and dissolve organic waste and cause the formation of soils by some species. People use and trade plants, which are pollinated by thousands of animals and insects, animal and microorganism species for purposes such as food, shelter, medical culture and aesthetics. For this reason, the fundamentals of ecosystem services should be known in order not to disturb the functioning balance of ecosystems [8]. Ecosystem services are classified into different groups from different angles.

1. Sourcing Services
    a. Food production
    b. Raw material production
    c. Water production
    d. Genetic resources
2. Regulatory Services
    a. Gas regulation,
    b. Regulation of waste water,

c. Regulation of water,

d. Erosion control and sedimentation reduction,

e. Climate regulation,

f. Pollination

g. Biological control

h. Habitat provision

3. Supporting Services

a. Food cycle
b. Soil formation

4. Cultural Services

a. Recreation
b. Cultural values [9]

Ecosystem services have the relationship between ecosystems and people's quality of life. It is defined as social benefits derived from ecological processes [10]. There are direct and indirect factors that can change ecosystem services. Direct factors are climate change, pollution and eutrophication, land use changes, and the spread of invasive species. Indirect factors are demographic change, economy, socio-politics, scientific and technological developments, and cultural structure [11].

2.1. COASTAL ECOSYSTEM SERVICES

Coastal areas that are essential for ecosystem services are being destroyed. According to researches, %90 of the world's population will live in cities, especially in coastal areas. Urbanization, energy consumption, transportation, industry, agriculture, water consumption and tourism are pressed to coastal area (waste generation, gas emissions into atmosphere, alteration of hydrological and sediment flux, pressures on groundwater recharge and supply, habitat loss, pressures on fish stock). Consequently, environmental factors are affected such as degraded air and water quality, degraded potable water and decrease in coastal vegetation land subsidence. On the other hand, changes in coastal areas cause coastal erosion, decline in biodiversity, alteration in ecosystem functions, adversely affect human health, and weaken the socio-economic structure (Table 1).

Table 1. Coastal and Marine Ecosystem Products and Services Typology [12]

	Coastal Strip	**Open Sea**
Supply Services	Fish and fish farms Alternative energy Natural products Genetic and pharmaceutical resources Ports / venue for transport	Fish and fish farms Alternative energy Minerals Natural products Genetic and pharmaceutical resources Ports / venue for transport
Regulation Services	Weather protection Carbon sequestration Natural disaster prevention Food regulation Treatment	Weather protection Carbon sequestration Food regulation Treatment
Cultural Services	Tourism / recreation Spiritual values Education Aesthetic	Tourism / recreation Spiritual values Education Aesthetic

3. METHODOLOGY

Methodology of the research consists of 4 sections (Figure 1). Conceptual Framework involves of the previously mentioned ecosystem services and legal framework. Second step is on determination of land uses. There are two kind of datasets that were utilized in the study. One of the aims of this section is to discover the potential of using Sentinel data for land cover/use mapping in our study area.

a) Conceptual framework

b) Determination of Land use change

c) Analyses

d) Results

SENTINEL-2 launched as part of the European Commission's Copernicus program on June 23 2015 which has 13 spectral bands: four bands at 10 m, six bands at 20 m and three bands at 60 m spatial resolution, 290 km swath width and high revisit frequency and sustains a widespread land study. The spectral bands of SENTINEL-2 will provide data for land cover/change classification, atmospheric correction and cloud/snow separation. The images can be downloaded freely from ESA website. This platform has cloud-free image archive [13]. In this study for generating composite image, band 2,3,4 and 8 were selected. These bands have a 10x10 m spatial resolutions. The downloaded images were taken on 12/08/2015 and 17/04/2020 (Figure 2).

Figure 1. Flowchart of the study

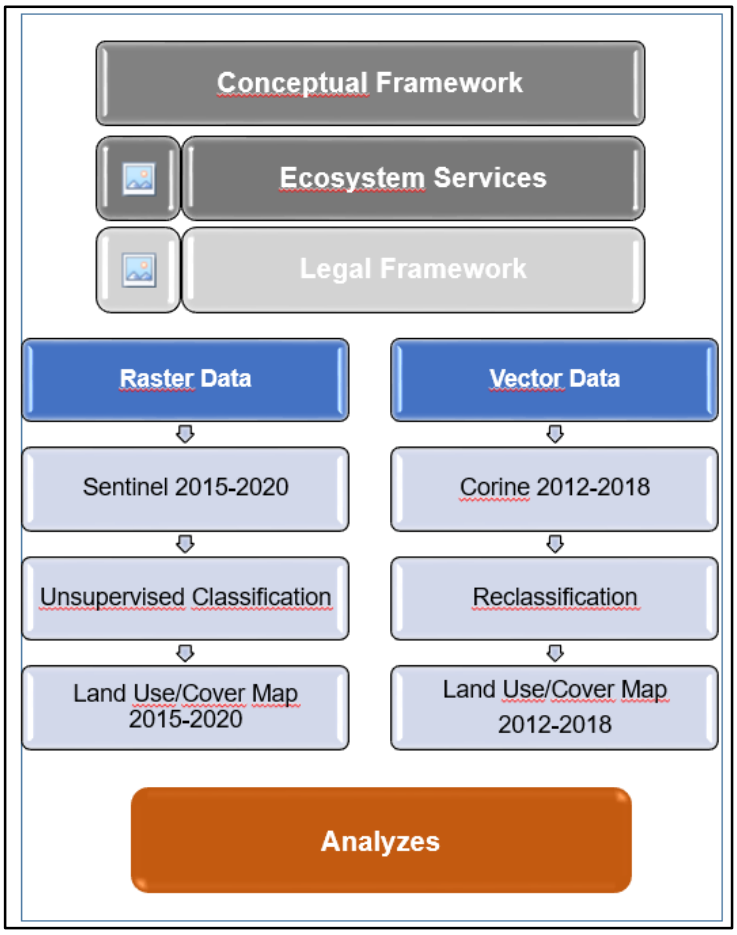




Figure 1. Sentinel Images, 12/08/2015 and 17/04/2020

Sentinel 2 images were classified into 5 classes by unsupervised classification and the Iterative Self-Organizing Data Analysis Technique (ISODATA) algorithm. Unsupervised classification is an effective method to obtain land-cover information and needs only a minimal initial input from the analyst.

Unsupervised classification is a process to cluster the spectral properties of pixels. The process outcomes in a classification map consisting of m spectral classes. The analyst then assigns the spectral classes into thematic classes (e.g., urban, agriculture). ISODATA is an iterative classification algorithm, which is a modification of the k-means clustering algorithm. The analyst can specify the maximum number of clusters in ISODATA [14] [15]. The classes in the study are artificial surfaces, agricultural areas, forest areas, inland waters and sea. The accuracy assessment generated from the unsupervised classification technique showed an overall classification accuracy was %84 for 2012 and %74 for 2020 (Figure 3).

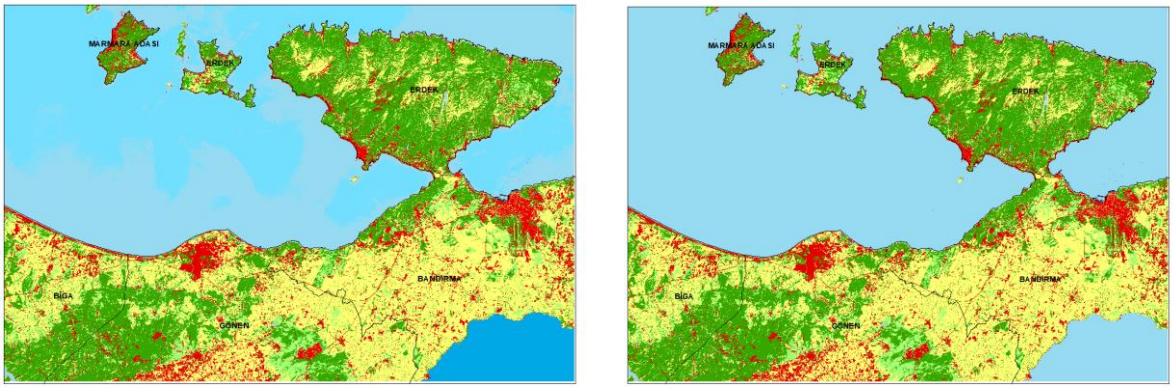


Figure 3. Unsupervised classification 2015, 2020

The vector data set which was used in the study are Coordination of Information on the Environment (CORINE) data sets. 2012 and 2018 vector datasets were utilized and reclassified (Figure 4). CORINE is a European programme started in 1985 by the European Commission, targeted at gathering information involving the environment on certain priority themes for the European Union (air, water, soil, land cover, coastal erosion, etc.). Updates have been produced in 2000, 2006, 2012, and 2018. It comprises an inventory of land cover in 44 classes and has a wide variety of applications like agriculture, transport, spatial planning etc… [16]. In this study the main classes were considered; artificial surfaces, forest lands, inland waters, marshes and sea.

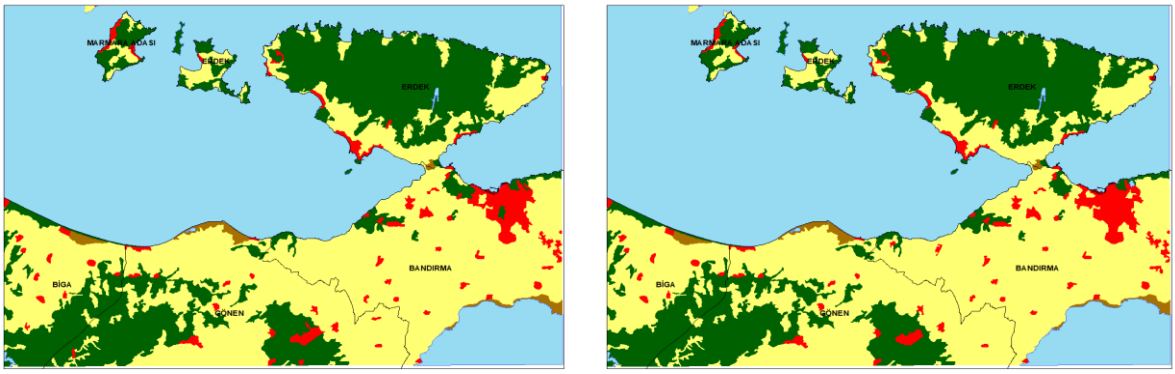


Figure 4. CORINE reclassified images 2012, 2018

The final part is analysing the results of classifications of raster data sets and vector datasets. The changes between 2015-2020 classification results of Sentinel and 2012-2018 CORINE that is also reference datasets were analysed.

4.RESULTS

The study area has nearly no change between 2012-2018 in CORINE datasets. The artificial areas are even decreased in these years as 27,28 ha. Agricultural lands are increased about 178 ha and forest areas are declined as 167,15 ha (Table 2).

Table 2. CORINE Land Use 2012-2018

	2012 Area (ha)	%	2018 Area (ha)	%	Change
Artificial Surfaces	6081.18	0.05	6053.9	0.05	27.28
Agriculture	72533.08	0.6	72711.51	0.6	-178.43
Forest and Natural areas	43026.52	0.3	42859.37	0.3	167.15
Marshes	1440.406	0.01	1440.405	0.01	0.001
Water Bodies	8631.096	0.07	8657.59	0.07	-26.494
Total	131712.3	1	131722.8	1	

The study area is not consisting of whole district boundaries. The study area is taking the Erdek Bay with surrounding regions. Taking just with boundaries of Erdek district in Ministry of Forest and Agriculture website is also showing interesting results between 2012-2018. There has been no change. Moreover, contrary to the possibility between 1990-2018 the 147,43 ha artificial surfaces are reduced and conversed into agricultural areas (Table 3).

Table 3. CORINE Land Use 1990, 2018

CORINE	1990 Area (ha)	2018 Area (ha)	Change
Artificial Surfaces	169.34	21.91	-147.43
Agriculture	899.22	1054.17	154.95
Forest and Natural areas	910.9	903.37	7.53
Water Bodies	97.15	97.15	0

The change in unsupervised classification and CORINE data is depends on accuracy of classifications. In our study despite the accuracy values, the 2015 classification results are closer to the CORINE 2012 results. The main problem was the land use interference in classification especially agricultural areas and urban areas (Table 4).

Table 4. Comparing CORINE and Unsupervised Classification Results.

	CORINE 2018 %	Classification 2020%	CORINE 2012 %	Classification 2015 %
Artificial Surfaces	0.046	0.126	0.046	0.060
Agriculture	0.552	0.355	0.550	0.592
Forest and Natural areas	0.325	0.344	0.327	0.275
Marshes	0.011	0.109	0.011	
Water Bodies	0.066	0.0656	0.066	0.071

5.CONCLUSION

The Integrated Monitoring and Assessment Programme of the Mediterranean Sea and Coast and Related Assessment Criteria (IMAP) describes the strategy, themes, and products that the Barcelona Convention Contracting Parties are aiming to deliver, through collaborative efforts inside the UNEP/MAP Barcelona Convention, over the second cycle of the implementation of the Ecosystem Approach Process [17].

The common vison of IMAP is "A healthy Mediterranean with marine and coastal ecosystems that are productive and biologically diverse for the benefit of present and future generations"

Monitoring and assessment of coastal ecosystems and landscapes and hydrography [17]: one particularity of the IMAP is the inclusion of an Ecological Objective focusing on the terrestrial part of the coastal zone. This reflects that the Barcelona Convention also covers coastal areas in its work, in line with the ICZM Protocol. The UN Environment/MAP emphasizes the integrated nature of the coastal zone, particularly through consideration of marine and terrestrial parts as its constituent elements required by the Integrated Coastal Zone Management (ICZM) Protocol.

The common indicator assessment fact sheets are linked to specific Ecological Objectives (EOs) – EO8 focus "Coast": "The natural dynamics of coastal areas are maintained and coastal ecosystems and landscapes are preserved", these are:

16. Length of coastline subject to physical disturbance due to the influence of man-made structures (EO8) to also feed the assessment of EO1 on habitat extent

25. Candidate Indicator: Land use change (EO8)

The aim of monitoring the EO8 common indicator 16 "Length of coastline subject to physical disturbance due to the influence of manmade structures" is twofold: to quantify the rate and the spatial distribution of the Mediterranean coastline artificialization; and to provide a better understanding of the impact of those structures to the shoreline dynamics [18]. The monitoring of this Indicator entails an inventory of:

(i) the length and location of manmade coastline

(ii) land claim, the surface area reclaimed onward (ha)

(iii) the Impervious surface in the coastal fringe (100m from the coastline).

EO8 indicator's monitoring was no systematic monitoring in Mediterranean regarding coastal artificialization by now. The only country that has implemented the monitoring of the EO8 common indicator on a national level.

There are 2 plans including Erdek Bay on a national level, these plans are critical especially in terms of determining the current situation and determining the future pressures-impacts in terms of "shoreline length exposed to physical degradation / degradation by the impact of man-made structures" and "Land use change", which are the critical indicators of EH (08) for the assessment of the coastal ecosystem and landscape change. These are: ""Balıkesir - Çanakkale Planning Area 1 / 100.000 scaled Regional Plan" and "Integrated Coastal Area Plan of Balıkesir - Çanakkale Provinces 1 / 50.000 scaled - BKAP". With the Legislative Decree about the Governances and Duties of Ministry of Environment and Urbanization with date 4 July 2011 and number 644, it is stated that management and planning work of the integrated coastal areas are among the duties of Ministry of Environment and Urbanization. The definition of "Integrated Coastal Areas Plan (BKAP)" is made and these plans are defined as plans that do not take place in spatial planning enchantment, are prepared with the strategical approach special to the coastal and interaction area, and direct construction plan (the Official Gazette with the date 14.06.2014 and number 29030 [19]).

Erdek Bay has been an ancient civilization land to human populations for about 8000 years. Although its rich biodiversity has declined in recent years, the natural coastline has preserved its length. Erdek Bay was a popular holiday destination for local tourists between 1950-1960. It started to lose its popularity after the 1990s, with holiday destinations shifting to the Aegean and the Mediterranean, and the ban on swimming in the North Marmara due to pollution. Therefore, there has been a decrease in urbanization. Nature has renewed and protected itself as a result of the decrease of human pressure, the absence of industry, and its preservation of its agricultural-based socio-economic structure.

Erdek Bay has preserved its agricultural identity from the Hellenistic period to the present. Even though the vineyards have deteriorated, olive and olive oil are still the most important source of income. And also, the greatest threat to the coastal ecosystem is agricultural areas because they are noy sufficiently to protect coastal erosion. The shoreline is needed to vegetation layer which will protect the coast from coastal erosion, storm and extreme weather conditions.

Erdek Bay has a high level of oxygen [20], which important for fishing, in the sea. Therefore, fishing in the region is efficiently and has an important economic value. This important ecosystem services that with pollution will be lost value.

Open source remote sensing resources offer great potential for environmental studies. In this study, open source satellite image archives were used. The past and present situation in coastal ecosystems has been evaluated using GIS and remote sensing technologies. Contrary to the general results, there was no land use change, moreover, artificial surface areas decreased. The study area is one of the unique areas in Marmara Region surrounded by urbanization and industrialization.

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Evaluation of Perspectives on Ecosystem Services Provided From Urban Afforestation

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ABSTRACT

In this study, it is aimed to evaluate the perspectives towards ecosystem services provided by urban afforestation with the help of Q methodology. The study was carried out with 50 participants from different gender and age groups, 25 from environmentally related and 25 from other professions. Participants expressed their views on the issue by prioritizing among 40 statements representing ecosystem services. According to the results of the analysis, the participants gathered on the same factor regardless of the profession, age group and gender difference, that is, they shared their views on the ecosystem services provided by urban afforestation. When the expressions that were most agreed upon were examined, it was seen that the characteristics of urban trees that improve environmental conditions were primarily emphasized. Based on the data and evaluations obtained with this study, it is suggested that Q methodology should be used as an effective decision support system tool in studies on ecosystem services.

Keywords: Urban afforestation, ecosystem services, Q methodology.

1. INTRODUCTION

The concept of ecosystem services, which refers to the processes associated with ecosystems that benefit humanity, is defined as products directly consumed or utilized for human well-being [1, 2]. On the other hand, it is emphasized that there is a strong relationship between ecosystems and human welfare, and it is argued that ecosystem services should be defined in some way in order to understand the contribution of nature and human interaction to human welfare [3].

Q methodology is an approach used to examine the different perspectives that arise in line with the opinions put forward by individuals or groups on a topic and prioritization on this topic [4, 5]. Q methodology, which is a qualitative approach in terms of revealing the subjective opinions of people and a quantitative approach in terms of expressing these opinions with measurable dimensions [6], has started to find a widespread use area due to the convenience it provides in expressing the value and importance people attach to the researched subjects.

In this study, it is aimed to determine the perspectives towards ecosystem services provided by afforestation in urban areas with the help of Q methodology. Thus, it is aimed to carry out an exemplary study for urban applications and decision makers by demonstrating the importance people attach to the urban afforestation.

2. MATERIAL AND METHOD

The method of this study, in which the perspectives towards ecosystem services provided from urban afforestation were determined with the help of Q methodology, consisted of four stages: a) preparation of statements, b) design of chart, c) identification of participants and d) analysis. In a Q methodology study, participants express their views on the subject by using statements. In this study, firstly, ecosystem services provided from urban afforestation were collected under four headings as provisioning, regulatory, supporting and cultural, and then turned into statements [7, 8, 9, 10] (Figure 1). In order for the statements in the Q methodology study to reflect the opinions on the subject in a broad perspective, a negative version of each statement should be prepared [11]. Because, as it is normal for a statement to be accepted by some people, it is necessary to consider that there may be people who can accept the opposite. In this study, the opposite of each statement obtained from the ecosystem services was also prepared, thus reaching a total of 40 statements. Curt [12] and Stainton Rogers [13] stated that statements between 40-80 in a Q methodology study is considered satisfactory.

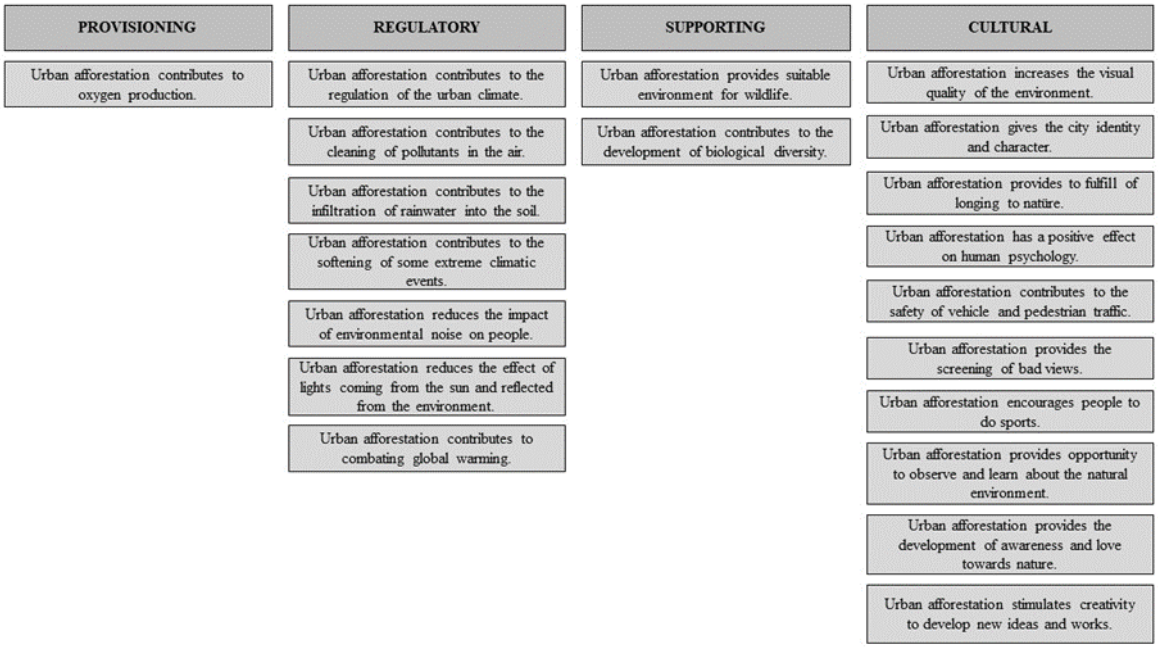


Figure 1. Ecosystem services considered in this study.

In the Q methodology study, the participants express their personal views on the subject by placing the statements on a chart with negative and positive ends in the range of "Disagree - Neutral - Agree" [14]. The chart that is seen in Figure 2 and has a decreasing cell structure towards the edges, which is also used in this study, encourages participants to prioritize among statements. After the statements written in the mixed boxes were made suitable for placement on the chart, an information note stating that participation was voluntary was sent to the participants by e-mail. The Q methodology study does not require a large number of participants, it is aimed to reveal some main points of view by a particular group of participants. Stainton Rogers [13] stated that 40-60 participants can effectively express their views on a subject. In this study, a total of 50 people, 25 of whom were Landscape Architect, Forest Engineer, Agricultural Engineer, Environmental Engineer, and academicians, and 25 from other professional groups, were applied in order to identify possible differences in their perspectives on the subject. Of the 21 women and 19 men, 40 of the participants were in the 20-40 age group, and 10 were in the 41-60 age group.

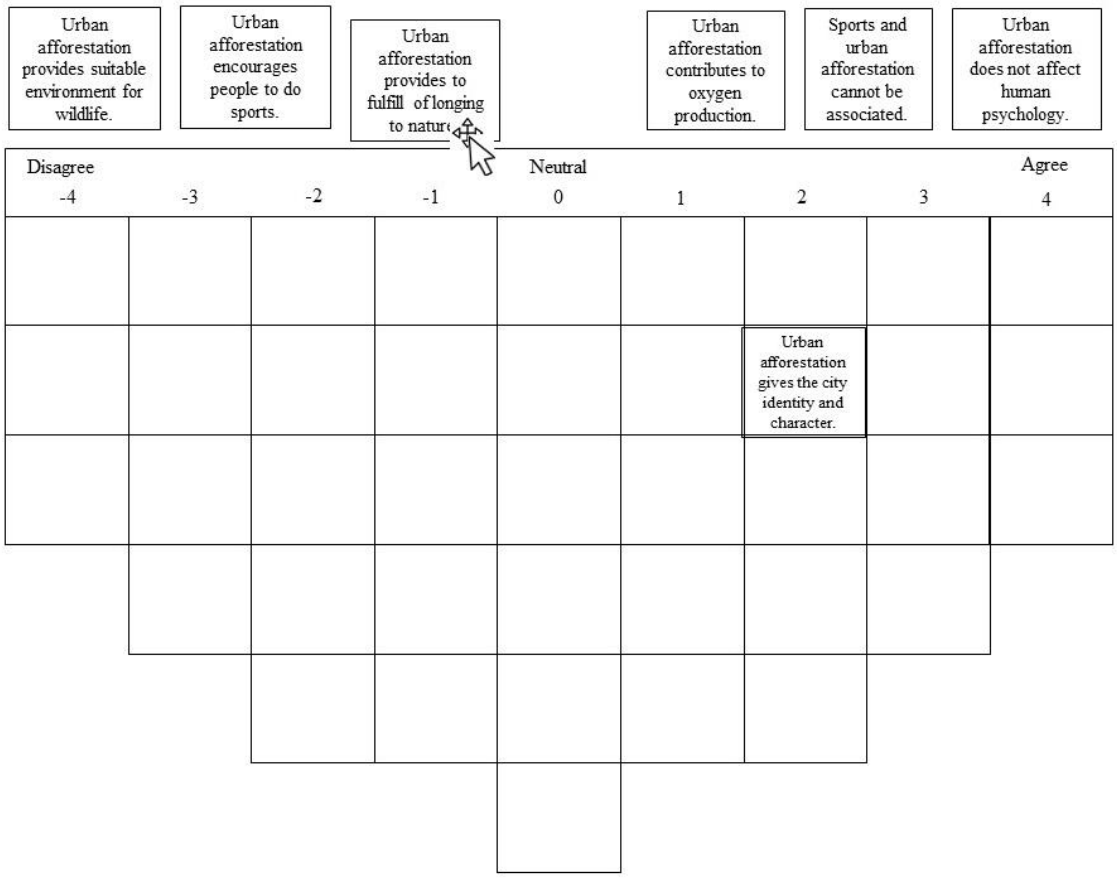


Figure 2. Chart used in the study and some examples of statements.

After the statements are placed, all charts that express the opinions of the participants on the subject are analyzed with the help of the PQ Method 2.35 program. The program reveals the point of view and prioritization between statements based on the positions of the statements on the charts.

In order to examine which statements the participants attach importance to, the Z values taken by the statements as a result of the analysis are examined. As the positions of the statements on the chart approach towards the "Agree" side in the "4" part, the Z value rises to 1 and above, when the "-4" part towards the "Disagree" side, the Z value decreases to -1 and below, when the statements are placed towards the "Neutral" side, the Z value approaches 0 (zero).

3. FINDINGS

As a result of the analysis of the charts prepared by 50 participants, one factor, namely one perspective, has emerged regarding the ecosystem services provided from urban afforestation. This situation showed that all participants came together with the same point of view on the subject, regardless of occupation, gender and age group differences.

When analyzed in terms of the distribution of positive and negative statements, it is understood that the factor has a positive approach towards ecosystem services provided from urban afforestation. In other words, positive statements were placed by the participants in the direction of "4" towards "I

agree". This situation shows that the participants agree positively about the benefits of urban afforestation, whether they belong to the relevant occupational groups or not.

Z values are examined in order to understand which statements, namely which ecosystem services, the respondents attribute high values to. When Table 1 is examined, it is seen that the contribution of urban afforestation to combat global warming is given the highest importance by the participants. Following this, the contribution of urban afforestation to oxygen production ranked second, and the role of afforestation in reducing air pollutants ranked third. These three statements show that the contribution of urban afforestation to the improvement of the environment has the highest priority among all ecosystem services.

When the first 10 statements with the highest Z value of 1 and above were examined, it was seen that 5 statements were regulatory, 4 statements were cultural and 1 statement was among the provisioning ecosystem services. This situation is important in terms of showing that the healing properties of afforestation in the urban environment are more important. The positive effects of afforestation on human psychology, improving the visual quality of the environment, giving the city identity and character, and increasing awareness towards nature are among the cultural ecosystem services that received the highest votes.

Participants were neutral to the contribution of urban afforestation to fulfill of longing to nature, regulating traffic, observing nature and reducing noise. The participants did not approve the statements stating that afforestation has no effect in reducing sunlight and combating global warming.

Table 1. The statements according to Z values

Statement (Ecosystem Services)	**Z value**	**No**
Urban afforestation contributes to combat global warming.	1.482	1
Urban afforestation contributes to oxygen production.	1.411	2
Urban afforestation contributes to the cleaning of pollutants in the air.	1.382	3
Urban afforestation has a positive effect on human psychology.	1.255	4
Urban afforestation reduces the effect of lights coming from the sun and reflected from the environment.	1.235	5
Urban afforestation increases the visual quality of the environment.	1.226	6
Urban afforestation gives the city identity and character.	1.162	7
Urban afforestation provides the development of awareness and love towards nature.	1.128	8
Urban afforestation contributes to the regulation of the urban climate.	1.094	9
Urban afforestation contributes to the infiltration of rainwater into the soil.	1.068	10
Urban afforestation provides the screening of bad views.	0.861	11
Urban afforestation contributes to the softening of some extreme climatic events.	0.751	12
Urban afforestation contributes to the development of biological diversity.	0.727	13
Urban afforestation provides suitable environment for wildlife.	0.701	14
Urban afforestation encourages people to do sports.	0.614	15
Urban afforestation stimulates creativity to develop new ideas and works in the field of science, art and literature.	0.592	16
Urban afforestation reduces the impact of environmental noise on people.	0.467	17
Urban afforestation provides opportunity to observe and learn about the natural environment.	0.411	18
Urban afforestation contributes to the safety of vehicle and pedestrian traffic.	0.397	19
Urban afforestation provides to fulfill of longing to nature.	0.314	20
Even though there is afforestation, the effect of environmental noise is high.	0.037	21
Traffic safety can also be achieved without urban afforestation.	-0.160	22

The natural environment can also be observed without urban afforestation.	-0.431	23
Biodiversity can aslso be developed without urban afforestation.	-0.657	24
Sports and urban afforestations cannot be associated.	-0.751	25
Wildlife members can also find the opportunity to live without urban afforestation.	-0.759	26
The longing for nature can also be fulfilled without urban afforestation.	-0.773	27
The environment can look good even without urban afforestation.	-0.817	28
Urban afforestation do not play a role in the development of creativity.	-0.862	29
Urban identity and character is not shaped by urban afforestation.	-0.921	30
Urban afforestations do not play a role in the development of awareness towards nature.	-1.055	31
Urban afforestation does not affect human psychology.	-1.104	32
Urban afforestation does not change the amount of oxygen.	-1.125	33
Urban afforestation is ineffective in screening unwanted images.	-1.127	34
Afforestation does not play an important role in the regulation of urban climate.	-1.154	35
Urban afforestation does not play role in infiltration of rainwater into the soil.	-1.166	36
Urban afforestation is ineffective in purifying the atmosphere from pollutants.	-1.302	37
Urban afforestation is ineffective in reducing the impact of extreme climatic events.	-1.305	38
Global warming is a process not related to urban afforestation.	-1.381	39
The effect of sun light does not decrease due to afforestation.	-1.462	40

4. CONCLUSION

In this study, it is aimed to evaluate the perspectives towards ecosystem services provided by urban afforestation with the help of Q methodology. The study was carried out with 50 participants from different gender and age groups, 25 from environmental issues and 25 from other occupational groups. Participants expressed their views on the issue by prioritizing among 40 statements representing ecosystem services.

According to the results of the analysis, the participants gathered on the same factor regardless of the profession, age group and gender difference, that is, they shared their views on the ecosystem services provided by urban afforestation. When the expressions that were most agreed upon were examined, it was seen that the characteristics of urban trees that improve environmental conditions were primarily emphasized. The contribution of urban afforestations to combating global warming ranked first, and their contribution to oxygen production ranked second. The role of afforestation in clearing air pollutants is ranked third. Among the statements on which the participants agreed the most, the regulatory ones took the first place, followed by cultural and provisioning statements, respectively.

Examining the perspectives on ecosystem services indicates how that ecosystem should be managed by guiding decision-makers in line with the expectations of the society. Q methodology is an effective tool in determining and conveying perspectives and perceptions on any subject to decision makers. For example, in this study, gathering all participants around the same view regarding the ecosystem services provided from urban afforestation sheds light on the aspects in which urban afforestation should be developed.

Based on the data and evaluations obtained with this study, it is suggested that Q methodology should be considered as an effective decision support system tool. The work to be carried out with the Q methodology is not limited to determining the perspectives on ecosystem services, but should be used effectively in issues such as environmental problems, urban and rural landscape planning, nature conservation, among other suggestions that can be developed within the scope of this study.

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Architecture of Transport in Socialist Albania. Railway Stations as Iconic Public Buildings for the Image of The Socialist City

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ABSTRACT

Due to the specific historic and political developments of the 20th century, Albania presents a distinct context within the Balkans and the Eastern Europe. The specific political shifts and conditions of the country are mirrored in its territorial and built reality.

The paper tends to envisage the development path of a country that, in almost five decades, goes from a rural reality to a rapid and centralized growth in terms of economy and urbanisation. This is due to the installation of the communist regime in the country, right after the Second World War.

The role of the railway system in the process of urbanisation of the country was of a great importance. New cities were born, and many other existing settlements were radically transformed under the guidance of the communist paradigms. From typical post-Ottoman structures or vernacular Mediterranean ones, they evolved into urban centres where propaganda prevailed and continuously modelled the "radiant" new communist society and the "new individual".

The main focus of the research tends to bring into light the relationship between train stations as a public building typology and the image of the socialist city.

The research brings out many case studies, including valuable historic information concerning the political propaganda, its role in the design process, and significant hints about the role of architects and planners in these dynamics.

On the other hand, a theoretic analysis in terms of aesthetics and language is carried out, in order to decode the image of the socialist city. The study offers an optic that provides to architects and researchers means for understanding a socialist cityscape, and more specifically the Albanian socialist one.

It is important to mention that the study contributes in the completion of the mosaic of the history of architecture and planning in the Eastern Bloc. Due to many unresolved questions, researchers are used to refer to it as a unified panorama, by neglecting the local particularities of countries.

On the other hand, many sustainable answers concerning the future of the railway system in Albania and in the region are related to the communist past.

Keywords: Socialist city, Railway System, Albania, Train Stations, Iconic Building.

1. INTRODUCTION – A century in between east and west

The 20th century represents an unusual path in the development history of Albania. As many other countries of the Balkans, the crucial geographic position has led to many invasive presences of powerful empires, countries or military alliances. The past century determines for Albania a continuous shift between East and West as a direct consequence of these presences. Until 1912, Albania remains under the Ottoman Empire, constituting the last Balkan country gaining its independence. Almost five centuries of Ottoman occupation have been mirrored in a multi-dimensional presence of Ottoman culture (lifestyle), religion, administration and spatial organisation of the territory. It is important to underline that Albania was a periphery of the Empire, fact that influenced its territorial development. Small-scale cities were envisaged during this period, but they never gained the magnificence of other important economic and administrative centres of the Empire.

The post Ottoman condition found Albania an underdeveloped rural country, with almost a non-existing transport and urban infrastructure. On the other hand, this part of the European territory remains almost unaffected by the Industrial Revolution. Economy was mainly based in agricultural production [1].

An important shift towards the Western Culture will occur during the monarchic system in Albania (1928 to 1939), where many territorial and social reforms are undertaken; numerous architects, mostly from Italy designed master-plans for the main cities, by tracing the first shift, from the typical local variations of Ottoman centres to large-scale designed cities. Tirana, as the capital of Albania represents an interesting case in this regard [2].

After the Second World War, Albania falls under the communist regime. Another time, a new shift toward the Eastern World, now to the Eastern/Socialist Bloc. Typical layers of socialist and modern features will be added to the existing urban centres, by radically transforming them. In 1990, after the fall of communism, Albania is again orienting development toward the Western Culture, with a rapid growth of the free market economy and with a diverse presence of global and international planning and architectural companies [3].

This continuous shift between different cultures and presences has left noticeable traces in the built features of the Albanian cities. It is important to mention that the most distinguishable layers in today's cityscape belong to the socialist period. That's why understanding and dealing with urban and architectural development of the époque brings out important answers for the future dilemmas.

2. FIRST TRACES OF THE RAILWAY SYSTEM IN ALBANIA

As it is mentioned in the introduction, until 1900 the Albanian territory was mainly dominated by the rural nature. The territory was dominated by small-scale administrative units, operating as autonomous economic entities. The infrastructural system was as well primordial; by being a non-primary economic centre, Albania didn't attract much investments from what the Ottoman Empire did in the Balkans. Referring to Erhan Türbedar, the Ottoman Empire invested in railway lines in Belgrade, Rumania in a total amount of 2512 km in the beginning of the 20th century [4].

The first presence of the railway system in Albania dates in 1914, during the presence of the Austrian-Hungarian occupation. The lines were designed for military purposes, and they were all narrow gauge lines [5]. The network initially was developed in the northern part of the country and gradually crossed its central part, by ending up in the southern port cities. Unfortunately, during their retirement from the territory, the invasive forces destroyed most of the engineering artworks, by leaving very few traces of them.

3. THE COMMUNIST REGIME

The communist government will aim the industrialisation of the country and a rapid growth of cities. This period represents an époque full of contrasts; full of unresolved questions, and yet the Albanian society appear to lack the necessary emotional distance for affronting facts objectively. The history of urban planning and architecture during socialism unravels important facts for understanding and decoding the image of Albanian cities.

Differently from other Eastern Bloc countries Albania experienced one of the harshest form of isolation, both in cultural and political level. How was this fact reflected in architecture and creative processes in general?

In this research, such question is tackled through a direct analysis to the architectural project.
Many interesting outcomes involve the relation between the train station typology and the socialist city; as an attempt to explain the architectural language



Figure 1. Railway system and propaganda (Source: Gazeta Tema, July 2018)

3.1 The railway system as an important element of the socialist economic system

The railway system plays an important role in the development of socialism in Albania. One of the main concerns was to integrate the entire territory in a system, in order to assure an efficient control over it. An important challenge for the socialist government was building a centralized system of governance and economy. The goal would have been impossible to achieve without an efficient transport network.

On the other hand, the sectorial economic development is tightly related to the development of the transport, especially to the railway one. In the research a map representing the gradual growth of the railway network in Albania is presented. (Fig. 2)

Logically the network slowly covers the western lowlands, and supports the development of industry and agriculture. Then the network extends to the north and south east of the country, aiming to connect to regional and international railway networks. The industry oriented development and the centralized economic model are directly depending on the railway system.

The development of this economic sector was associated with the naissance of new urban centres, dedicated to the Proletariat that populated the new industrial sites [6].

The role of the railway network was also important for the construction industry. The socialist period marked the urban growth of existing cities, as well as their transformation. From typical small-scale post-Ottoman structures, the urban settlements were radically transformed into larger urban systems, equipped with new residential areas, but also with new public spaces and economic/industrial zones.



Figure 2. Territorial map of railway network in Albania (graphic elaboration by Ana. Pekmezi)

For Albania, the growth of railway system was the synonym of urbanisation, development and raise of control over the territory.

3.2 The iconography of the socialist city

In this paragraph the role of the image of the city in the socialist environment is discussed by focussing in the specifics of the Albanian context.

Propaganda and urban development have obvious parallels in communist contexts;
The city is approached as a tool by the regime:
Public buildings and public spaces are considered as successful mechanisms for transmitting coded and direct messages to the citizens; in contrary to what happens in western contexts, where the interaction of multiple actors shapes the city, in socialist cities the scenography of public buildings and of public places shapes the citizen [7]. The spatial scale of public squares is enormous, usually dominated by statues of leaders and heroes, and physically modelled by the façades of the public buildings; Palaces of Culture, Palaces of Sports, or Regime's headquarters.
What is the role of the train station building in all this scenography?

In a socialist cityscape, the train station is not a natural symbol of the free-market economy, of free movement, free interaction and exchange; but a synonym of propaganda.
The image of the train station building is used for transmitting the idea of a continuously growing centralized economy and of a powerful communist state.

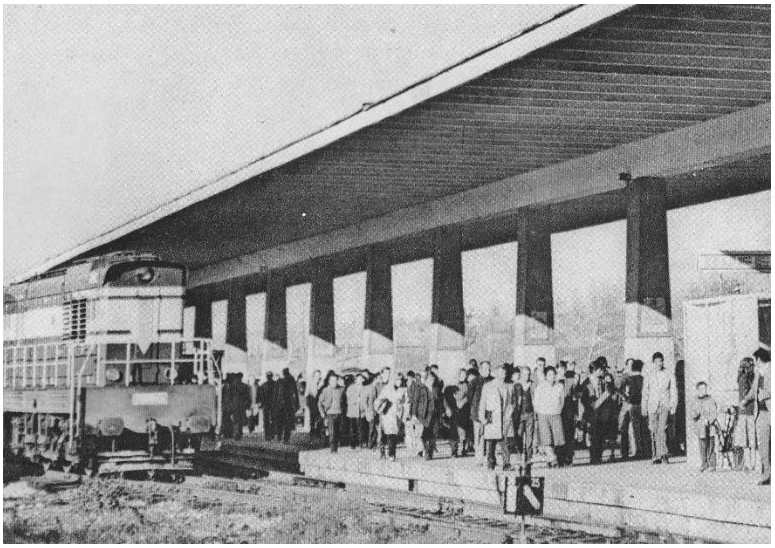


Figure 3. Image of the train station in Tirana. Source: Tirana, 8 Nëntori, 1990

For this reason, the government pays a specific attention to the public building typologies. In terms of investments and design efforts, these buildings appear to represent the most illustrative cases of architectural and design practices during the communist regime. Thus, focusing on the design features and their characteristics is considered methodologically an efficient tool for exploring the relations between propaganda and creative processes.

3.3 The role of the architect

The aim of this research is to achieve a better understanding of the ties existing between ideological propaganda and creative processes during the communist regime. There has been always a distinct relation between political power and architecture; a certain dichotomy, established from the desire to control and the need of freedom that creative processes require.

What was the role of the architect? Are we in front of an intellectual profile with a strong vocation towards theoretic discourses, and social awareness, or we face a different figure; someone educated and instructed to carefully interpret cannons of socialist ideology into architecture?
Were there cases when individuality took place in this very complicated controversy?
In most cases, design processes were controlled ideologically by the governmental institutes; before implementation architects had the obligation of "justifying" the full commitment of the ideological guidance, and foremost arguing the absence of decadent traces of "modernism" or "extravagance". Humbleness and rationality of the proposal, at the same time, the devise of being "national in form and socialist in content" were somehow obligatory concepts to be implemented within an architectural proposal [8].

In this perspective, in most cases architects are transformed in "ideological engineers" where, satisfying propaganda was principal, and then the pure professional debate concerning programme, function, space and language would come in a second and less important perspective [3].

However, although in such extreme conditions of control and isolation, very interesting cases show spontaneous expressions of creativity and intelligent architectural responses, deliberated from propagandistic charge.

3.4 Iconic buildings of socialism in Albania

In order to illustrate the complex relation between the communist propaganda and creative processes in architectural practices, we have examined 20 train stations built in Albania during 1945-1990.
The evolution of the relation between communist ideology and architecture in Albania passes through three main stages [8]:

- 1948-1958 – The presence of Socialist Classicism, as a strong influence of the Soviet Union (Stalinist Art)
- 1959-1974 – Rationalist Architecture – a "liberal" era
- 1975-1990 – The "Nationalist Architecture" - Full Isolation of the country, an atypical auto-referential development of architecture.

The following design cases, illustrate the most representative cases of each era, focusing on how ideology found its expressions in architectural languages and styles.
The first case belongs to the train station building in Durrës, designed in 1951. During this period, Albania was tightly related to the Soviet Union, politically and culturally.
In this period, architecture is influenced by the Stalinist époque, with strong references in classical elements. This gesture is of a pure ideological nature: for centuries this language of architecture was associated to reach class and bourgeois; now the proletariat dictatorship brings it to the mass, to the working class. Many factories, train stations, administrative buildings are decorated with eclectic classic orders, columns, arcs, decorative elements by presenting a certain rupture between form and function, and by creating at the same time confusion about the building age. The following drawings illustrates the main architectural expressions of the era. (Fig. 4)



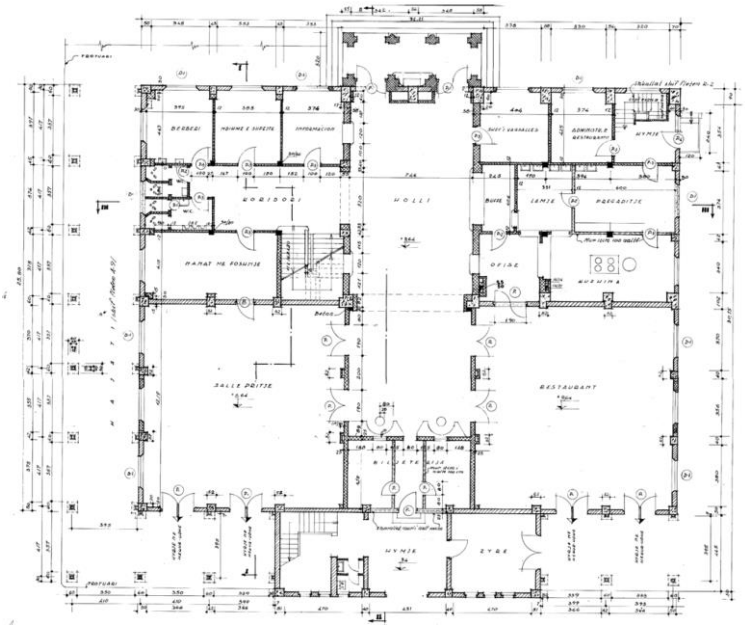


Figure 4. a) Main façades, b) plan of Durrës train station - 1951. Source: Central Technical Construction Archive (AQTN)

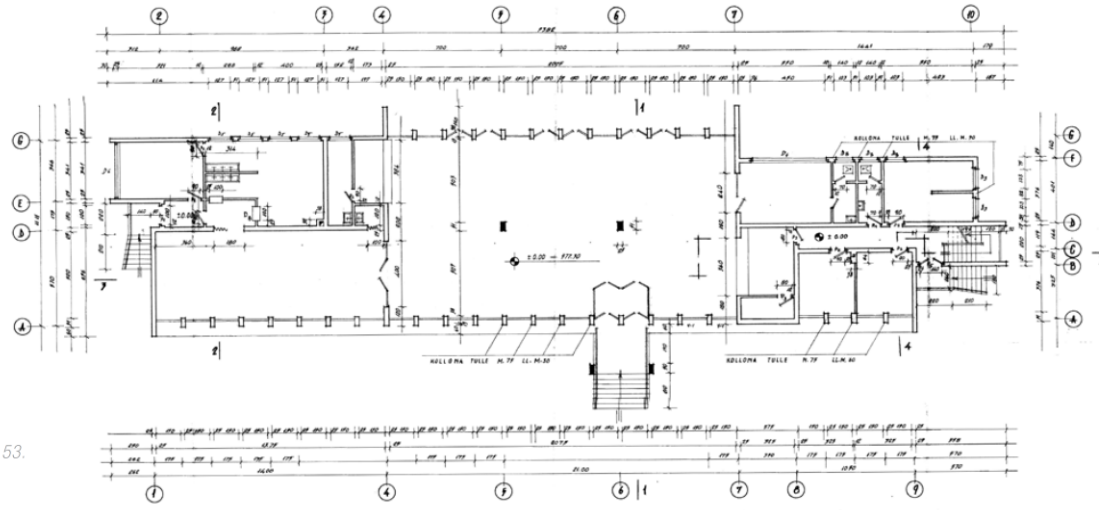


Figure 5. Ground Floor plan of train station building in Përrenjas - 1972. Source: Central Technical Construction Archive (AQTN)

The second phase, presents another chapter in the developments concerning architectural thought and creative processes in Albania. Another time, the relation between political propaganda and architecture plays a decisive role. During 1959-1974, a liberal era is perceived, as a consequence of Khrushchev's reforms regarding the industrialisation of the building industry. Although the breakdown between Albania and Soviet Union in 1961 impacted the socio-politic environment, architecture continued to develop following the principles of industrialisation, economisation and rationalisation.
Few architects have contacts with literature coming from other Eastern Bloc countries; characterised by a language recalling aesthetically to modernism [9]. However, the reference remains on the visual and aesthetical level, due to the poor understanding, and still due to the continuous observation of

the regime. Referring to Alfred Uçi [10] modernism is considered a "dangerous enemy we have faced and we will continuously combat".

Referring to Kolevica there is a lack of deep understanding of the profession, where architect's work is dominated by dilettantism and practicism [9].

The following design illustrates the theoretic confusion existing in the professional realm, by offering an architectural language quite resembling to a modernist one, but by unravelling a superficial approach at the same time.

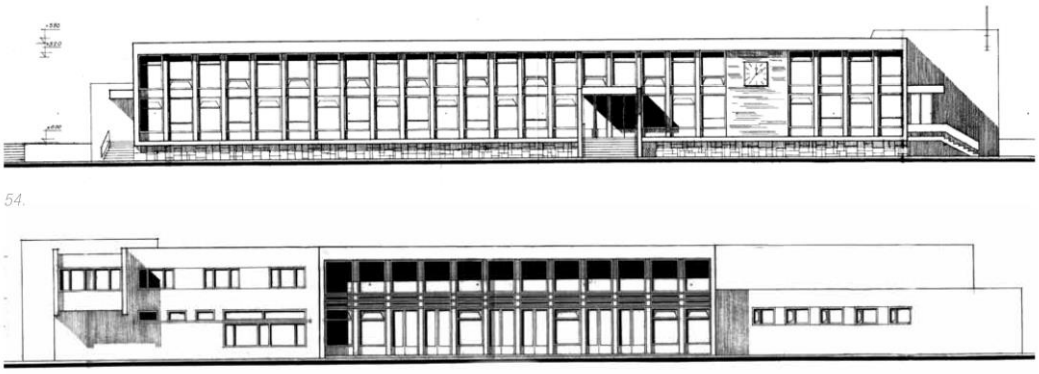


Figure 6. Main façades of train station building in Përrenjas - 1972. Source: Central Technical Construction Archive (AQTN)

The building belongs to the train station planned in a small industrial city. Despite the ideological and economic (technological) constraints, the project demonstrates an interesting compositional intuition. The aesthetics is mostly imposed by the structural dimension, where the rhythmic sequence of columns represents the most important compositional element of the façades. Still, there is a lack of coherence of what the functional layout shows and how this is expressed in the exteriority of the building. The famous devise of "form following function" appear to not be present in the design methodology.

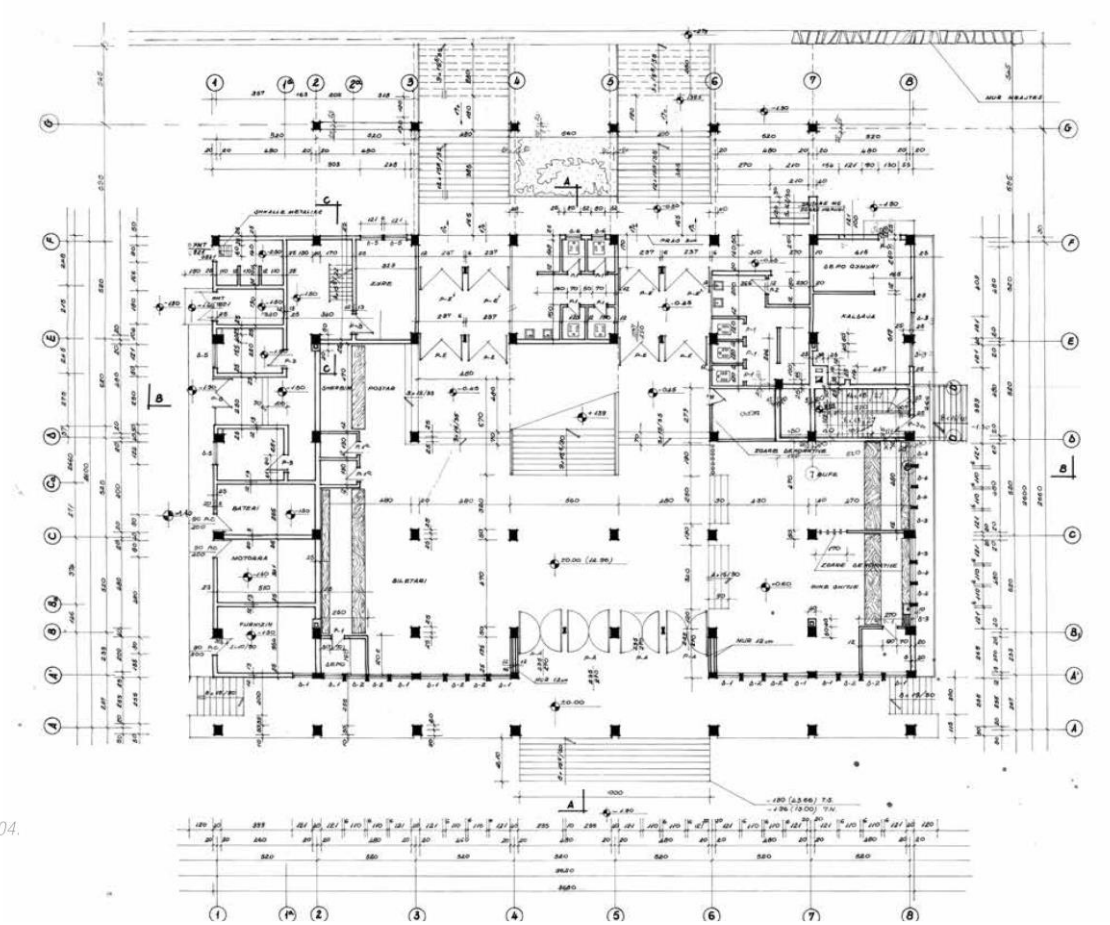


Figure 7. Ground floor plan of train station building in Shkodër - 1980. Source: Central Technical Construction Archive (AQTN)

A similar situation, illustrating the unconscious way of designing buildings, by only reproducing visually pleasant, or sculptural-tectonic images, is shown in the next project – the train station in Shkodra.
As it is perceived, the façade is composed as a sequence of repetitive elements, transmitting the idea that the same is happening in the morphological layer of the internal space. By observing the plan, again there is no intelligible connection between form and function. Façade appear to be a scenography, detached from the building's morphology performing as a separate entity.

The third development phase constitutes one of the most expressive or revealing phases in terms of dialogue between ideology and architecture. The last decade of the regime was characterized by a full isolation of the country, an intensification of propaganda and aggressiveness towards any form of expression, deviating from the communist ideology. The devise of "socialist content and national form" appear to be more than ever present in the architectural design processes.



Figure 8. Main façade of train station building in Shkodër - 1980. Source: Central Technical Construction Archive (AQTN)

One of the most revealing cases of how ideology can distort creative processes is the following project, a design for Vukpalaj train station. The architect "chooses" to fit the function to a pre-designed form, recalling the two-head eagle of the Albanian flag. This due to the constant pressure related to ideological aspects, where architecture should be inspired by national symbols and tradition.
Here we are in front of an architectural finality where the discourse that concerns form, function, space typology and structure seems to be neglected; form appears to be ambivalent, as the only element able to host ideology, able to transform the architectural entity in a pure instrument of transmitting propagandistic messages.

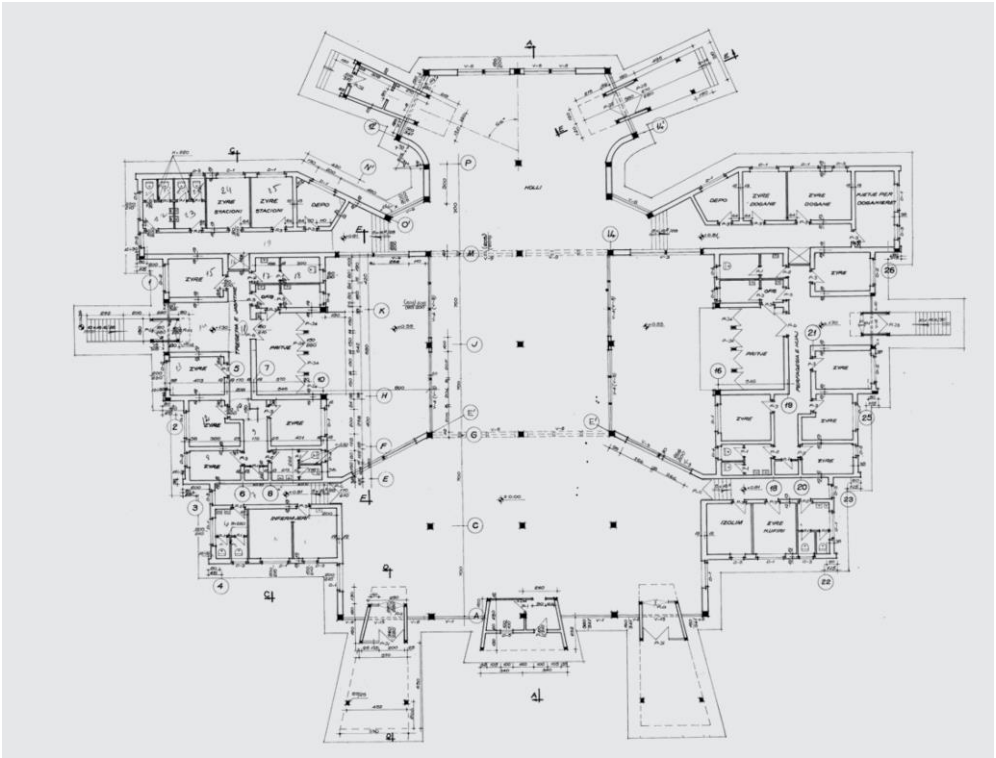


Figure 9. Plan of train station building in Vukpalaj, Albania - 1982. Source: Central Technical Construction Archive (AQTN)

4. CONCLUSION

The research constitutes one of the first attempts to deal with developments of architecture and planning during socialism in Albania. Dealing with such themes opens interesting perspectives in reading and analysing the role of architects and architecture itself in totalitarian regimes. The research offers a contribution in building the history of architecture in Albania, during 1945-1990. Still the academic environment lacks studies in the field. On the other hand, the research can further be developed by comparing development paths with other countries of the Eastern Bloc, by contributing in the completion of the mosaic of all the countries, and all of their specifics. The architecture crafted during communist regimes still remains a variation over the theme of: architecture and political power.

5. ACKNOWLEDGEMENTS

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Historical and Spatial Transformations of the Exhibition Spaces: From Modernist Whitewashed Walls to Black Screens

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ABSTRACT

This paper stems from a question, which is "Why the exhibition spaces are whitewashed?". Triggered by this question, this paper aims to initiate a discussion on the historical and spatial transformations of exhibition spaces by presenting a review on exhibition design throughout the architectural history of art museums.

With this aim, this paper traces how and why the exhibition spaces' white walls had emerged and where they have reached today.

The journey of this paper starts from the cabinet of curiosities, which are accepted as ancestors of museums. Then, it arrives to the first exhibition spaces in the 18 century. By following their transformation to the first public art museums in the 19th century, this paper reaches the modern white cubes in the 20th century. Finally, it ends with today's exhibition spaces and the changes in their spatial experience under the restrictive climate of the Covid 19 pandemic.

Keywords: History of exhibition design, white cubes, changes in spatial experience

1. INTRODUCTION

What are the common features of all art museums you have visited so far? I assume that 'having white-washed walls' may be a common answer to this question. This whiteness, which reveals itself with the dispersion of the light from the ceiling of the exhibition space, is probably a very common image in a visitor's memory.

As a result of an inspiration of this vision, this paper will trace a route of transformations to answer how the white walls in the exhibition spaces were emerged and where they have reached today. It will present different encounters at the different stops of this route by focusing on the historical and spatial transformations and how these changes in exhibition design affect the formation of different types of spatial experiences throughout the architectural history of art museums. It starts from the cabinet of curiosities, and arrives to the first exhibition spaces in the 18 century, and by following their transformation in the 19th century it reaches the white cubes in the 20th century. Finally, it discusses today's exhibition spaces under restrictive the climate of the pandemic.

2. THE FIRST DISPLAYING PRACTICES IN THE ARCHITECTURAL HISTORY

The collecting practice, which was started in the Ancient Greek with votive offerings to the Greek temples' altars as a result of religious rituals, was inherited by Roman generals for creating their private collections from the war booties in the Roman Empire [1, 2, 3]. Those collecting practices were revealed the first exhibition spaces in the architectural history.

2.1 The Cabinets of Curiosities

These spaces were the cabinets of curiosities. They were the private spaces from the collectors among the noblemen. During the Renaissance, the cabinet of curiosities had developed the collecting practices. They had turned the practice of collecting into a mysterious activity [4].

The cabinet of curiosities, which were closer to today's science museums, were accepted as the ancestors of the private art museums [5, 6, 7]. Since, they were only accessible by a very restricted group of people from the collector's network, and they were not open to the public. These cabinets were the rooms storing a range of uncanny objects such as corals, statutes, gems, fossils, animal skeletons or stuffed animals [2, 8, 9]. Depending on the idea that the whole miracles of the world could be stored in a one private room, the collections were exhibited in the multi-layered showcases, drawers and shelves [9] (Figure 1).



Figure 1. Dell' Historia Naturale, Ferrante Imperato, 1599,
the earliest known depiction of the cabinets of curiosities [10].

Figure 1 presents the earliest depiction of the interior space of a cabinet of curiosity. As it presents, in the cabinet of curiosities both the natural objects and art objects were jumbled together in every part of a room including ceiling and walls without having any didactic intent. In this regard, curator James Putnam mentions that the cabinet of curiosities had a very arbitrary and diverse display arrangement, which was shaped by the imagination of collectors [9]. In these arrangements, where many different objects are displayed side by side together, the main actor was the rarity of these objects. Since, a unique collection means not only the world it portrays but also the personality it reflects is also unique [9]. As it is shown in Figure 1, the viewer was suddenly confronted with a multitude of rare and interesting objects in every part of the room. This kind of exhibiting demanded from the audience to be captivated by this rarity [11]. Yet, this demand was not bounded on space, because the fascination was based on the rarity and variety of objects.

The space of the cabinet was intimate and enclosed. As it can be seen from the engraving, surprising experience was depending on the mystery and variety of the objects. Thus, collecting various and surprising remarkable objects was the main purpose of the owners. These collecting practices also created new kinds of social practices and relations. Possessing a collection became a mark of status and qualities of collection expressed social distinction into the existing social hierarchies [8]. The passion for collecting the images of the world in the cabinet of curiosities was limitless due to the geographical discoveries foster the mystery of the world [2]. Those collected items were organized in terms of the resemblances of things.

In here, it is important to mention Michel Foucault's ideas on the archaeology of knowledge. As Foucault pointed out, there are three episteme–Renaissance, classical, and modern–in the formation of the history of knowledge [12]. In the episteme of Renaissance, knowledge was formed by the exploration of the resemblances between things. Under the influence of Renaissance episteme, curiosity cabinets were also organized in terms of the resemblances of things. Alongside non-systematic resemblance based, enclosed, and intimate collecting spaces of the curiosity cabinets, there were also different contexts for collecting.

For instance, princes, merchants, and scholars established collections that would demonstrate their knowledge of the history and also their wealth. [13]. Rather than storing their collections in the intimate cabinets, they needed large spaces for displaying them. Hence, the collections moved into the galleries from cabinets of curiosities. However, the curiosity cabinet and the gallery were two different kinds of architectural entities. Although it is hard to find out any common architectural form of the curiosity cabinet, the gallery's emergence as an architectural space can be diversified by its expensiveness and openness to light and air.

The Medici palace, which had the collections of Medici family, was the first and early example of a gallery space that was transformed from a curiosity cabinet to an art gallery. The private spaces of the Medici Palace had been designed for creating an imposing impression for the guests of the dynasty, which can be assumed as spectators [13]. The articulation of the spaces and the artefacts in the palace arranged based on two categories [14]. The first category was related with the spatial experience by means of material things that have been specially made for a particular space, such as a wall-hanging, a wall-painting, a tile, a chair. The second one was related with the content of the collection, such as having gems, coins and statues and their related contexts. The collections were displayed in the specific spaces, such as; sculptures were exhibited in garden and courtyard, and paintings were exhibited in loggia and throughout the palace [15,16]. As well as being a residence, the Medici Palace was a site for significant social and political representations of the Medici family. Moreover, it is a very important benchmark for the museum history, because it created the emergence of the first early example of an art museum of Europe in the 15th century [14]. The experiences such as creating a display culture, first took place in the Medici Palace [2, 14].

2.2 Galleries in the 18th Century

Exhibition spaces in the 17th and the 18th centuries emerged as a result of some rare collections made accessible to a larger group of people in the society. For example, following the conversion of the Uffizi Gallery at the end of the 16th century with the intention of exhibiting the Medici family's collection, European noble families began to make their collections accessible to people [16,17]. Thus, the first exhibition spaces, which were previously shared with very few people from the collectors' network, became accessible to various people from different social backgrounds and began to gain public functions. After the Uffizi Gallery, the number of exhibition spaces opened by noble families in Europe not only had increased, but also new displaying techniques had emerged [18].

In these spaces, the displaying was take place in large and flamboyant halls with pictures categorized chronologically on their walls, and the hanging way of the pictures was intended to match with the interior design [19]. Unlike the exhibition design that we are used to see today, the paintings were arranged in frames side by side along the entire wall from the ceiling to the floor in such a way that there was almost no empty space on the wall. This exhibition design was a standard that applied in the exhibition spaces throughout the 17th and 18th centuries [15, 19]. This form of display demanded from the audience to admire the collector's power, which was also expressed by means of the richness of the interior design as well as the paintings. Thus, the interior spaces were very different and colourful when they were compared what we are used to see today. Gold ornaments, burgundy, green-dark blue, silver-grey painted, fabric or paper covered walls were common decoration elements that was possible to come across in any exhibition space between the 17th and 18th centuries [19]. The paintings of David Teniers the Younger and Johann Zoffany can be exemplified as an important demonstration for such a gallery design in that era (Figure 2 and 3).



Figure 2. Johann Zoffany, Tribuna degli Uffizi, 1772–1777. [20]



Figure 3. David Teniers the Younger, The Picture Gallery of Arcduke Leopold William, 1650 [21]

According to art critic Brian O'Doherty, no matter how the design of the interiors was free, the frame of the canvas in the display was an authority in 17th and 18th century exhibition spaces [22]. While the visitor's gaze was strolling around a central focus within the closed area of the canvas, the boundaries of this gaze were structured by the frame. In the 19th century, with the advent of non-center-oriented landscape painting, the visitor's gaze began to notice the background of the painting. Thus, in order to be displayed some pictures in the exhibition layout required a wide distance from other pictures in the exhibition. According to O'Doherty, this need of space between paintings, which represents the beginning of everything, transformed into a new displaying strategy in the 20th century that pursued completely different demands from the visitors [22].

3. THE MODERN EXHIBITION SPACE: WHITE CUBE

At the turn of the century, important transformations had taken place in terms of the experience of the exhibition space. At the beginning of the 20th century, the relation of the artwork and beholder in exhibition spaces, and also the role of architecture in this relation were specified. Until the 20th century, the architecture of the art museums followed certain architectural styles, and it had not been in tune with the changes in art [11]. However, with emergence of the abstract art at the beginning of the 20th century, how to exhibit this new art form was questioned.

This new exhibition design, which emerged in the 20th century, not only presented artworks to visitors in an enclosed volume that was bordered by white walls, but also produced an aesthetic experience that transformed the viewer. O'Doherty calls this new exhibition design that offers a transformative experience as "white cube", and marks the main stage of this experience as the modern art museum [22]. He describes the actors of this scene as white walls without openings, a ceiling as a source of lighting, and monochrome floors [22]. The 'white cube' that is described by O'Doherty reminds a prescriptive and authoritative atmosphere, which transforms everything inside the space according to three rule.

Firstly, the viewer who enters this authoritarian atmosphere should be white, a member of middle-class and if possible "only male" in Carol Duncan's words, and also he should be dignified enough to not focus on any other sense than sight [23]. Since, the 'white cube' offers a highly prescriptive aesthetic experience that cares only for the sense of sight and it reduces the viewer into a mobile eye. In this regard, this prescriptive aesthetic experience, which isolates the sense of sight from a holistic perception of space, demands viewer's full attention. The exhibition space detaches the viewer, who is equated with a visual receiver, from his context and offers him spaces in which daylight, the sounds of life, and images do not enter.

Secondly, the 'white cube' convinces the viewer that he is looking at very important artefacts regardless of what is presented, and demands a spiritual respect for these artefacts. Since, as Marcel Duchamp underlined it with a urinal he installed in a gallery space, the qualification of an object as the artwork is highly related to the placement in the 'white cube'. Thus, the 'white cube' reveals transformative relations between the white walls and the audience as well as between the white walls and the art object. Artefacts, which are placed in the whitewashed exhibition spaces, are transformed into the artworks that would be recorded in the art history.

Thirdly, the whitewashed exhibition space, is an indispensable condition that not only destroys but also reconstructs the context during the meeting of the artwork with the audience. It destroys the context, in order not to steal a role from the artworks that are displayed and becomes almost invisible and free from any visual stimulus. However, it also reproduces the context. Since, as if an underlining of Gestalt's of figure-ground principle the white walls become an integral part of the works. Therefore, it becomes very difficult to perceive the artwork without the 'white cube' (Figure 4).



Figure 4. Christopher Neugebauer, Museum of Modern Art, NYC, 2013. [24]

3.1 Displaying Strategies Against White Cubes

Until the 20th century, the displaying strategies offered more colourful experiences to the viewers than the 'white cube's authoritative atmosphere. In this regard, the experience of the modern exhibition spaces was seen insufficient by avant-garde artists. At the beginning of the 20th century, a group of artists, architects, art historians, and theorists criticized spatial features of modernist exhibition spaces. Critiques were about the context of the modern art museums, which were addressing the modern exhibition spaces' spatial limits in terms of displaying art. Critics were criticizing the vision based, fixative atmosphere of these spaces.

For instance, according to constructivist artist El Lissitzky, modern art needs a different displaying strategy from existing strategies. He denotes that, a modern exhibition space should not put the viewer into a passive position, rather it should enable the viewer as an active participator [19, 25, 26]. Thus, El Lissitzky sought for an exhibition space, which enabled interaction between visitors and art objects, that was going beyond the single-line displaying experience of modern art museums. In 1928, he designed an exhibition space, which was the *Kabinet Der Abstrakten* [19] (Figure 5). In the *Kabinet Der Abstrakten*, the viewer was compelled to physically interact with the artworks within the display. The walls were covered with steel slats, which were painted white on one side and black on the other. These painted slats changed the tonality of the background while visitors were walking through the exhibition space. As visitors were moving around, the background was changing from white to grey and to black. There were also sliding frames for moving the artworks. Thus, the exhibition experience was bounded on the actions of the visitors.

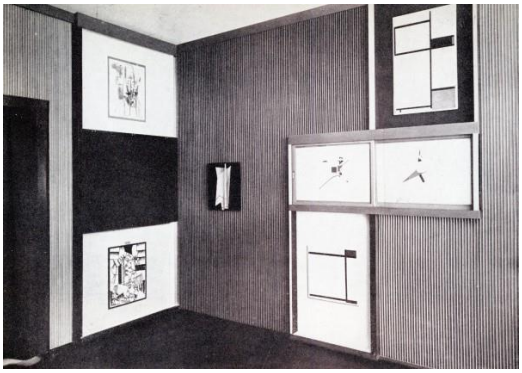


Figure 5. Kabinet Der Abstrakten by El Lissitzky, 1928. [27]

The aim of this exhibition, in which the viewers physically interacts with the displayed objects, is dealing with the sight sense together with the touch sense, and also transforming the passive role of the viewer into a collective one [26]. Thus, the experience of the viewer was no longer limited to the hanging ways of paintings' frames. The space and the viewers became a part of the exhibition experience. However, these collective displaying experiments, which are interacting with the space, did not become widespread. The 'white cube', which is based on individuality rather than collectivity and therefore clears the space from any distracting components, become widespread. After MoMA moved to its building in Manhattan, which was designed by Philip L. Goodwin and Edward Durell Stone in 1939 and distinguished from other museums of its time, the prescriptive and transformative experience of the 'white cube' became widespread. Thus, the 'white cube' has become a standard tool for managing the art reception in modern art museums throughout the 20th century [19].

It is interesting that the 'white cube', which focuses only on sight sense and offers a highly passive exhibition experience, dominated the 20th-century displaying practices by surpassing among the displaying formats that were providing more vivid experiences to the viewers. Although MoMA had a central role in the domination of the 'white cube', according to art historian Walter Grasskamp, the emergence of the modernist exhibition space was occurred as a result of a sequential events[28]. The first event happened at the end of the 19th century, which was the linear hanging of the pictures at the eye-level with a sufficient distance between them [28]. The second event was the usage of the white background in the exhibition spaces. [28]. The pure white walls in an exhibition space were firstly used in the Vienna Secession Building [19, 28]. Bauhaus was also using white walls in open-plan exhibition spaces [19, 29]. In this regard, Klonk states that Bauhaus accepted exhibition space as an adaptable machine, a total environment within a white sphere enhanced by reducing the ornaments [29]. By means of various experiments in the exhibition setting, they aimed to reach a more dynamic environment. After the emigration of Bauhaus artists to New York during the beginning of the Second World War, the displaying practices of Bauhaus and the white walls were conveyed to the MoMA and echoed to the world [30].

There have been artists and also art museums who have made experiences against the authoritative exhibition practices of the 'white cube'. Artists, who were criticizing the limits of the 'white cube' in the 1960s, tried to expand the boundaries of the exhibition space. For example, William Sandberg, who was the curator and director of the Amsterdam Stadelgic Museum in 1962, organized an experimental exhibition called Dylaby [31]. This exhibition, which can be described as the follower of El Lissitzky's *Kabinet Der Abstrakten*, tried to transform the 'white cube' by presenting an experience that is very different from the 'white cube'. In here, the viewer was free from a passive role, and placed in the position of a vital actor, who changed the reception of the artworks. Moreover, the artworks were also out of their frames. The viewers, who physically interacted with the artworks, and the artworks that were free from their frames transformed the authoritative 'white cube' into a playful space.

The New York Guggenheim Museum, which was designed by Frank Lloyd Wright and opened in 1959, was also regarded as an anti-white cube museum. In this museum, the exhibition space was transformed into a spiral route. Moreover, the importance of the single-row hanging was disappeared in terms of the viewer. Since, during the exhibition experience, the viewer could see both the pictures on different floors as well as the other viewers. On the other hand, since Guggenheim Museum's circular form created a touristic focal point in the Manhattan city, it was also the first museum to initiate the debate 'whether or not to supersede the artworks inside the museum in the display' [32]. Another anti-'white cube' museum was the Pompidou Centre in Paris, which was designed by Renzo Piano and Richard Rogers and opened in 1977. Pompidou Centre also rejected the logic of the modernist 'white cube', it pursued an emancipated viewer experience with its diversified functions and the flexibility of its open-plan spaces [33]. In the exhibition space of the Pompidou Centre, the viewer was free from a prescribed route. However, despite these oppositions, the 'white cube' has been a displaying strategy that is constantly being returned.

Thus, the authority of the 'white cube' began to dominate the art museums that were against it. For example, in 1986, architect Gae Aulenti and curator Italo Rota divided the flexible exhibition spaces of the Pompidou Centre in Paris into 'white cubes' due to the "request of some collectors" and they dictated a prescribed route to the visitor [34].

4. CONCLUSION

O'Doherty states that a result of the increasing criticism and experimental displaying strategies, the exhibition space has ceased to be a uniform space in postmodern era [22]. However, the issue that exhibition space ceases to be a uniform space or not is still open to debate.

It is obvious that art museums' architecture has diversified by following the path that was opened the Pompidou Centre in the 1970s and also after the construction of the Guggenheim Bilbao. In fact, 'stararchitects' surprise us almost every day with a spectacular art museum they have designed. However, when we enter to these art museums, we encounter a whitewashed exhibition space, which is illuminated by a source of lighting from the ceiling. We witness that the design of the exhibition spaces, contrary to the variety of museum architecture, cannot go much further than the 'white cube'. In these spaces, after we contemplate to the pictures in these 'white cubes' we move to the 'black cubes', where we contemplate at video art. However, we actually repeat the same experience in every exhibition space. Moreover, we also come across the authority of the white cube even at the outside the museum, such as in the new wing of the Stadeljik Museum, which is designed by Benthem Crouwel with reference to the 'white cube'.

In the exhibition space, which was the only space where we met with artworks once upon a time, the limits of our gaze was defined by the frame of the canvas. After the canvas became free from its frame, the whitewashed walls in the exhibition space began to take over the authority of the frame. We were free from the authority of the frame, but this time we were trapped in the prescriptive atmosphere of the 'white cube', which demanded to forget all our senses except the sense of sight.

Today, with the Covid19 pandemic, we are now experiencing a completely different experience in our relationship with the artworks. We take a virtual tour of the gallery spaces fitted into the screens. The 'white cube' seems to have transformed into a more restrictive blackness of the digital exhibition spaces' experience. Today, the authority of this experience is the black screens of our computers and phones. As the number of pixels on the horizontal and vertical axis of these screens increases, we feel that our experience has also increased. Although, we can easily access to these spaces with a few clicks after pressing the button of the device, we do not have a holistic spatial experience in these digital exhibition spaces.

Holding an exhibition setting in our palm by means of the screen of our phone, gives us a strange feeling of freedom. With this feeling, which shares both freedom and captivity, the authority of the frame again shows itself by means of those screens that we gaze upon. It reminds that, before the white cube, the frame draws the boundaries of the gaze that wanders through the closed space of the canvas. However, this time our screen take place the role of the frame and it draws the boundaries of our gaze.

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A Review of Art Museums' Publicness in the Architectural History

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ABSTRACT

This paper is about art museums' publicness, which is a hot topic not only on museums' agenda, but also on the agenda of the cities that follow culture-oriented development since the 1990s. Art museums that this paper is concentrated on, are one of those alternative forms of public spaces that have seen particularly with the rise of neoliberalism in the 1980s and have intensified during the 1990s. As being an alternative form of public spaces, these museums are publicly accessible but privately managed or owned spaces, which provide some other activities in addition to exhibition, such as buying various merchandise, socializing in cafes or restaurants, watching movies, or even attending concerts and fashion shows in these museums.

This study seeks how art museums' publicness in the context of architectural history has been changed since the opening of the Louvre to the public in 1793, and where this change has reached throughout the years. In order to answer this large question, what are these changes, how these changes have evolved, what are the nature, scope, explicit and implicit motivations of them are presented. Although the history of the art museums does not follow a linear process, this paper precedes in chronological order in parallel with their transformations throughout architectural history.

Keywords: museum publicness in the architectural history, public art museums, history of art museums.

1. INTRODUCTION

In the 21st century art museums are mixed-use facilities, which have major roles on cultural tourism, urban marketing and global branding along with their commercial components such as cafes, shops, bookstores, theatres, cinemas [1]. With all their facilities they are important players of global image wars. They define a common global culture and bring globalization by opening new branches in different cities, which are designed by famous architects [1, 2, 3]. These new branches have major roles on cultural tourism, urban marketing and global branding along with their various commercial components. [4, 5, 6].

Moreover, as being an alternative form of public spaces, art museums in the 21st century are publicly accessible but privately managed or owned spaces, which provide some other activities in addition to exhibition. With these additional activities, the art museums of the 21st century are dedicated to the exhibition of both the cultural artefacts and the experiences. For instance, one can buy various merchandise from the shops of these museums, or can use their cafes or restaurants, watch movies, or even attend a concert in these museums. In this regard, they are one of those alternative public spaces, in which public can gather and socialize. (Figure 1.)



Figure 1. Public gathered for the jazz concert,
by Museum of Modern Art (MUMOK), Vienna, 2015

This paper states that the art museums in the 21st century are not only contributing to the formation of a global culture, but also they are creating new types of publicness based on various kinds of interactions. Motivated by this statement, this paper aims to present art museums' diversified types of publicness, their changed social roles and their spatial experiences, between the 18th century and the 21st century. It questions how art museums' publicness in the context of architectural history has been changed since the opening of the Louvre to the public in 1793, and where this change has reached throughout the years.

In order to answer this question, this paper firstly presents the emergence of art museum as an idealized context of art, and it gives the origins of publicness in the first art museums. Then it presents the diversified conceptions of art museums' publicness by starting from the opening the Louvre to the public in 1793. After presenting the discussions on the main role of the 18th century public art museum, it focuses on the emergence of public art museum as an architectural building type in the beginning of the 19th century and its declaration as the context of art for the public in the 19th century. It continues with the rise of the modern art museum in the beginning of the 20th century, in which a new conception of public for art museums were emerged. Lastly, it discusses the role of art museums in the society of the 21st century, the contemporary meanings of art museums' publicness and gives the conclusions.

2. THE EMERGENCE OF THE IDEALIZED CONTEXT OF ART: THE ART MUSEUM

The museum word stems from the Greek word *mouseion* [7, 8, 9]. In the words of Lewis it means "the temple of the muses" [7]. In the Hellenistic period, *mouseions,* which were dedicated to muses of arts and sciences, had been functioning like the schools in which philosophy and scientific researches took place [8, 9]. In *mouseions,* the collecting of art had been developed by storing votive offerings and war booties. The development through the first idea of the museum as an institution was emerged with the Museum of Alexandria in 280 BCE [10, 11]. The roles of the museums in the constitution of the knowledge and the history, formation of a global culture and in the competition of the cities were inherited from the Museum of Alexandria, which is referred as the ancestor of the museum institution. Moreover, this heritage brought the collecting practice [8, 12, 13]. It is accepted that the first artifacts were collected as a result of religious rituals. The first collections are the votive offerings to the altars of Greek temples [7, 9]. The closer to the collections of today's public museums was the *Pinakotheke* (picture gallery) of Propylaea in 5th century BCE on the Acropolis Athens. The paintings were displayed in *Pinakotheke* for honouring the gods.

Eventually, the collecting habit spread to the rich and in the time of the Roman Empire, generals constituted their own private collections from the war booties [9]. For the first time in the history, General Marcus Agrippa (63BC-12BC) declared that statues and pictures of religious figures should be exhibited to public instead of being stored in villas. In the words of Gordon, "this was the first explicit declaration of value of an art collection as a cultural heritage and of the right of the public to share in its enjoyment" [14]. By exhibiting their collections to public, Roman generals were demonstrating their success and power as well.

Those collecting practices were resulted in the first spaces of exhibiting in the history of art museum architecture. The first emergence of exhibiting spaces as an architectural entity was with the churches of the medieval Europe [13]. In the meantime, art in the churches was primarily devotional rather than celebrating war booties or votive offerings. Artistic production also took place in churches with a divine understanding such as depicting religious scenes and icons to the masses. In Europe between 5th and 15th centuries, art collections were mainly under the privilege of the church, where in public only could see them [14]. Beyond those first spaces of exhibiting, there were the cabinets of curiosities in which collecting practices had been developed (Figure 2.).



Figure 2. Dell' Historia Naturale, Ferrante Imperato, 1599,
the earliest known depiction of the cabinets of curiosities [15].

They were the spaces, which had turned the practice of collecting into a mysterious activity, by storing a range of uncanny objects such as corals, statutes, gems, fossils, animal skeletons or stuffed animals [12]. The cabinets of curiosities, which were the private spaces of the collectors from the noblemen, are referred in literature as the ancestors of the private museums [9, 12, 14]. In those spaces, there

were not an understanding to present the collection to the public. The origins of this understanding were appeared in the 15th century.

2.1 The Origins of Publicness in the First Art Museums

Medici Palace was the first and early exhibition space for an understanding through the origins of publicness. It was built in the mid-1440s by the architect Michelozzo di Bartolomeo as a new residence for Cosimo de' Medici and his family [16]. As well as being a new residence, it was a site of significant social and political representation for the Medici family, and also it created the emergence of the first early example of an art museum of Europe in the 15th century [11].

The experiences such as creating a display culture, which created the museum institution, first took place in the Medici Palace [9, 11, 16, 17]. For instance, the Medici Palace was the first space, which was designed and decorated with guests in mind [16]. Medici Palace was ensuring an exhibition experience to its guests with its particular spaces, yet it was a private domestic space (Figure 3.).

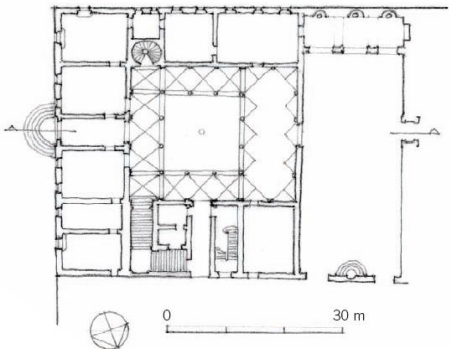


Figure 3. Plan of the Medici Palace. [18]

However, with the emergence of the Uffizi Gallery, the first exhibition space, which was open for larger groups, was appeared on the stage of the architectural history in the 16th century. It was designed by Giorgio Vasari in 1560 for Cosimo I de' Medici to include offices for hosting bureaucratic meetings of various bureaucrats [19]. It was redesigned and transformed in 1581 by the architect Bernardo Buontalenti in order to function as an exhibition space, and it became the first space in which new ways of exhibiting art such as a historical narrative, was experimented [20]. For displaying the collection of the Medici dynasty within a space in a historical narrative, the plan of the Uffizi Gallery was arranged within a long narrow courtyard surrounded by two-three storied wings (Figure 4.).

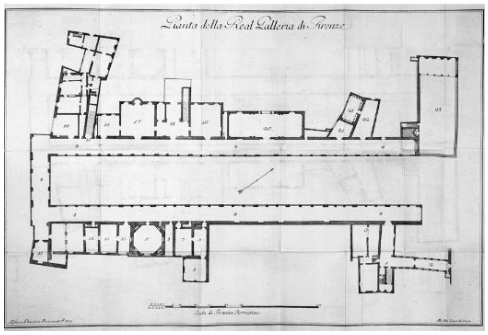


Figure 4. Plan of the Uffizi Gallery, Giovanni Canocchi, 1779. [21]

The Uffizi Gallery paved an important way for the invitation of the public to the art museum [9, 19, 22, 23]. It was placed strategically by connecting the Piazza della Signoria with the Ponte Vecchio Bridge over the Arno River for creating street like plaza (Figure 5.).

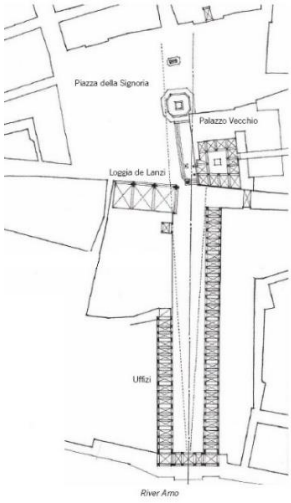


Figure 5. Site View of the Uffizi Gallery. [18]

Thus, the Uffizi Gallery had become more visible within the public life by means of this strategic placement (Figure 6.). Not only with the strategic placement of the building, but also the transfer of the collection of the Medici dynasty to a relatively public context like Uffizi Gallery the dynasty become publicly legitimated [23].



Figure 6. Uffizi Gallery seen from the River Arno, Paolo Fumagalli, 1820. [21]

After the Uffizi Gallery, exhibition spaces were spread around Europe between the late 17th and 18th centuries with the purpose of collecting and exhibiting artefacts, and numbers of collections were made accessible to the public [10, 17, 20]. However, the conception of the public in here was not indicating a general public. These exhibition spaces were open to the public, yet "to anyone with clean shoes" [17]. They were only relevant for a privileged community of the elites [23]. Although these private collections allowed limited public access, the public had first invoked in the museum context by means of them.

3. DIVERSIFIED CONCEPTIONS OF ART MUSEUMS' PUBLICNESS

It is important to indicate that, researchers that are focusing on the emergence of publicness of art museums, which was dated back to the 18th century, refer 'public' as a small group of visitors that constitutes a small part of the general [10, 23, 24, 25, 26]. According to them, it was not an inclusive public and their members were; the artists that took education in the museum, aristocrats, or middle-

class white men. Moreover, these individuals of this small community was also not equal [26]. The artists and the aristocrats not only had unlimited access to the museum, but also they were using separate entrances. Although there is an agreement on the restrictions of public art museums in terms of openness and inclusiveness, the users are referred as 'public'.

However, in the public space literature, the 'public' notion involves individuals who have equal rights in the public space and do not belong to a certain community [27]. Moreover, it is accepted as the rightful members of society [28]. Considering the differentiation of the two literatures, the public notion in this paper aligns with the notion of public within the public space literature. By depending on public space literature, from now on this paper will refer 'public' to the all members of society that have equal rights for reaching public spaces.

3.1 Opening Art Museum to Public in the 18th Century

The issue of art museums' publicness dated back to the opening of Louvre palace to public in 1793 during the French Revolution. In France, during the Revolution, the royal art collection was declared as the property of the nation and in 1793 the Grand Gallery of the Louvre palace was converted into a public art museum [22, 29, 30]. The publicness of the 18th century public art museum was functioning for a larger structure, which was the nation state, in order to realize its ideology [9, 11, 23]. The main aim of opening the Louvre to the public was for being "a sanctuary for art that would augment the glory of (French) nation" [22].

In here, it is important to indicate that, nation in the 18th century was representing a group of subject counter to monarchy, and it was not "brought into line with the state" [31]. The notion of public in the 18th century public art museum was representing a small part of the population, which only include "the aristocracy and the educated bourgeoisie" [22]. In this regard, the main role of 18th century public museum was showing the power of imperial collection to the public in a way to represent nationalization.

3.2 Conception of Public and Art Museums' Role in the 19th Century

As being different from the conception of public in the public art museum of the 18th century that addressed the aristocracy and the educated bourgeoisie, the conception of public in the public art museum of the 19th century addressed the 'citizen' [22].

By referring Hannah Arendt's conception of public and private realm dichotomy in "The Human Condition", it is important to indicate that, the public art museums in the 19th century were in accord with the public and the private dichotomy in the same era [30, 32]. In the 19th century, the private was considered as opposed to the public realm, which was the realm of politically constituted individuals with shared values. In accord with this dichotomy, public art museums were focused on the individuals of the public realm, and with an emphasis on state's power and its triumphs they define them as citizens with shared values [30]. Although it addressed the citizen, it is hard to define the conception of the 19th century art museums' public in as an inclusive one that regarding equal rights. Since, only males who have properties were regarded as full citizens [33].

In this regard, the 19th century art museums' social role was to function as a site of education to enlighten citizens, which were witnessing cultural, scientific and technological changes of the 19th century, within a homogenous public sphere [11, 14, 23, 25, 31, 33, 34, 35]. The 19th century art museums were instructing and educating masses with pedagogical aims and didactic intents, which were made visible through strategic arrangements of objects. According to Simon Sheikh, they were working as Habermas's "bourgeois public sphere", and had been an institution for; "aesthetic debate

and judgment, on what was beautiful and true, valuable and significant in art… not only a cultural space, but also cultivating, and had as such an educational role" [35, 36]

By regarding museums' relationship with the public in the 19th century, there were a hidden agenda of the insistence for instructing public with systematically classified didactic displays. Public museums, which were born in the 18th century, had become an institution for observation of masses in the 19th century through the enlightenment of public [22, 23]. The19th century public museums were institutions for observation during modernity in favour of the nation states. By means of them, nation states formed a new strategy of governing to regulate citizens for behaving accordingly to the museum setting and encouraging them to police themselves. With this politics, public art museums in the 19th century were concerned as institutions that increase the cultural level of population and aimed to homogenize the society with the enlightenment of masses [23]. Thus, the main role of public art museums in the 19th century as being ideological institutions, was to create a homogenized public and culture as a product of Enlightenment [22].

3.3 A New Conception of Public in the 20th century

In the 20th century, art museums inherited some features of their precursors from the 19th century, such as their main function that was being an ideological institution for creating a homogenized public and culture [22]. However, with the emergence of modern art museums in the 20th century, a new conception of public occurred, which was experiencing an "undistracted visual contemplation" [30]. In this regard, it is possible to state that art museums in the 20th century not only inherited the main function of art museums in the 19th century, but also they inherited the main understanding of the 19th century public art museum's exhibition display, which was accepting the visitors as receivers of certain massages underlined through architectural space and didactic arrangement of objects. Thus, the public in the 20th century, which were previously conceived as ideal citizens, had evolved into a different conception of public by means of the modern art museums' practices.

In this regard, the Museum of Modern Art (MoMA) was the art museum in which this new conception of public, which was equal to a group of consumers, was born and became widespread [37, 38, 39, 40]. MoMA's operational strategy in the 20th century, which was established in a mercantile way, was the main reason for it [38, 39, 40]. MoMA was established by a group of wealthy trustees including the Rockefeller family, who wanted to run the museum as a business company that was working with marketing and publicity strategies to promote modern art to the American public. In the early reports of the museum, Alfred Barr, who was the first director of the MoMA, presented the strategy of the museum to the trustees with these words: "consider the Museum entirely as business. If the product is good its duplication and distribution can be endless" [37].

The building of the MoMA, which was designed by Philip L. Goodwin and Edward Durell Stone, was highly different from the other 19th century dated buildings in the neighbourhood during the 1930s [41]. After its construction, the MoMA's building pioneered the International Style around the neighbourhood with its glass and steel façade, and purified forms. The design of the building fulfilled the foundational objective of the MoMA, which was being initiative for running the museum as business-like [39]. It had a modern translucent glass facade with strip windows in order to provide visual accessibility and to invite strolling visitors in the street to the building (Figure 7). MoMA's title was displayed on the side of the building to be seen by pedestrians from the nearby street. The entrance was designed for ensuring easy access from the street level. Another novelty that was introduced to the museum architecture through MoMA, was designing an outside sculpture gallery rather than an inside courtyard [40]. According to Pedro Lorente this space was also designed for attracting more visitors to the museum. Moreover, when the visitors entered the museum, there was the curved information counter seen at first. In this counter, MoMA's products, reproductions,

publications were displayed and sold [39]. Meanwhile, there was not any shopping facility in other museums., shopping facilities entered the art museums after MoMA and standardized later [37].

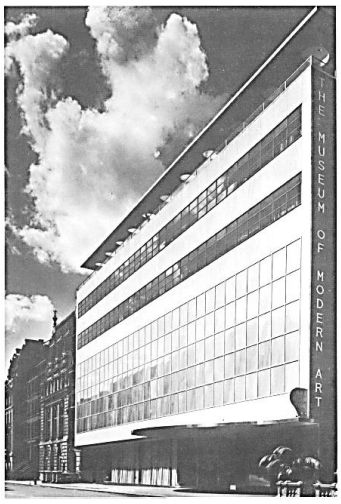


Figure 7. The Facade of the MoMA, 1939. [42]

Although a new conception of public was emerged in the 20th century with MoMA, like the museums of the 19th century, modern art museums also conceptualized public by privileging men and being not an inclusive notion [30]. For instance, not only women artists are generally excluded in MoMA, but also its collection mostly included images representing nude female bodies and gave no information about their personal identities. [30]. On the other hand, male images in the exhibition reflect certain personal identities by being more visible in the public arena [30].

Thus, MoMA was an important turning point in the architectural history in relation to art museums' publicness. With a comparison of the public art museums in the 19th century, it is possible to state that it underlined the change of the dichotomy of private and public realms. In accord with this dichotomy in the 19th century, public art museums emphasize the importance of citizens' shared values in the public realm by focusing on the state's power and triumphs in their exhibitions. However, it is possible to state that MoMA put the emphasis on the individual experience in the private realm by introducing a new experience of exhibition space [30].

3.4 A New Type of Art Museums' Publicness in the 21st century

The 1990s faced important breaking points in the history of art museums. Not only an increase occurred in art museums' construction numbers, but also new type of art museums emerged [34, 40, 43, 44]. These museums were implementing strategies that they had deduced from new museological approaches, which were occurred at the end of the 1980s. Hence, these new types of museums that have emerged in the 1990s and onwards are referred to as "new museums" [5, 34].

With the emergence of new museums in the postmodern era, art museums' mode of operating had dramatically changed towards "consumption, distraction and spectacle" [45]. Whilst spaces in modern museums were mostly dedicated to exhibition spaces rather than gastronomical and commercial facilities, such as museum shops, restaurants, and cafes, with the emergence of new types of museums this relationship has changed [34]. Thus, it is possible to state that in the 1990s art museums' social role for providing social interaction for the public was considered as important as museums' educational role, which was dominant in the 19th century. Art museums in the 21st century have been not only providing social interaction for visitors, but also have been generating the periphery of major urban centres [1, 45, 46].

In this regard, art museums were transformed into important and prestigious assets for cities. The transformation of art museums into prestigious assets for cities fostered by means of the long-time economic development plans of the cities. These development plans were funded by the regional administration, by the government or by the private wealth. As being prestigious assets, they have been regenerating and providing extra income to the major urban centres. Under the influence of neoliberalism, art museums' branches in post-industrial cities, which were designed by famous architects, defined a globalization for the art world [1]. For instance, firstly the Guggenheim in 1997, then Louvre and the MoMA opened their branches during the 2000s. These new branches are all had major roles in cities, such as fostering cultural tourism, urban marketing, and global branding along with their various commercial components [1, 2, 3, 5, 14]. Moreover, these new museums in post-industrial cities have not only been exhibiting artworks, but also they have been exhibiting their spectacle-values [47].

Therefore, these new types of art museums in the 21st century are not only providing social interaction for visitors, but also they are generating the periphery. And this bring out a new type of publicness, which is highly depending on economical sustainability under the practices of neoliberalism. In this regard, art museums in contemporary society are considered as important and prestigious assets for cities. It is possible to indicate that they are revealing "a new sense of fun", as in the words of the recent news headings, in which visitors able to shop, eat and attend to live performances in the museum setting [48].

4. CONCLUSION

This paper presented art museums' publicness in the context of architectural history that has been changed since the Louvre, and it discussed where this change has reached in the 21st century. It opened the discussion on art museums' publicness by focusing on the origins of publicness. As it is presented, the 18th century art museums' public was indicating a small part of the general, and the main role of public art museums in the 18th century was showing the power of imperial collection to public.

In the 19th century, the public conception was transformed and it addressed the citizen. Furthermore, the public notion in the 19th century was also not an inclusive notion like in the 18th century, due to the conception that only males who have properties considered as citizens. In terms of the changes in art museums' social role, this paper denoted that, in the 19th century art museums' role was reconsidered to enlighten citizens by broadening their knowledge, which were witnessing cultural, scientific and technological changes of the 19th century. As being a product of the Enlightenment, public art museums in the 19th century considered public as ideal citizens, which contemplate and affirm the power of state. They were also in accord with the conception of the public realm in the 19th century, which was the realm of politically constituted individuals with shared values, as Arendt denoted [32].

This paper argued that art museums in the 20th century not only involved some inheritances of their precursors in the 19th century, but also they were enacted some important inventions and changes. For instance, art museums in the 20th century transformed the displaying logic of art museums in the 19th century into a more neutral and vision dominant one. MoMA was an important turning point in the history of art museums in terms of publicness. When the operational strategy and the new exhibition experience in MoMA were reviewed, it is possible to state that MoMA put the emphasis on the individual experience in the private realm. In relation to publicness, MoMA brought about new possibilities in the 1990s.

In the 1990s, with the emergence of new approaches in the theoretical and critical thinking of museums in theory, as well as influences of neoliberalism on art museums' economy and conception of public, art museums' publicness transformed into economical asset. Thus, this paper argued that there were not only transformations in terms of architecture in the history of art museums, but also the conception of art museums' public and the role of art museums in society in parallel with the

changes in public conceptions had changed since the Louvre. It showed that these changes followed a route from a privileged bourgeoisie to citizen in the 19th century and then evolved into involvement of as much as different parties of the society in the 20th century.

Therefore, this paper showed that art museums have always defined the public as a homogenous concept, yet with exclusionary connotations since opening the Louvre to the public. After witnessing the latest debate in ICOM about the changing roles of museums in the 21st century, it is possible to indicate that despite the continuance of the rooted ideas such as reaching public through education since the 19th century, museums in the 21st century search for new ways to communicate with diverse publics. The main challenge for museums as public spaces today, is arranging their relationships with diverse publics and reaching a democratic and inclusive art museums' publicness through their physical spaces or social media. In order to fulfil this challenge, this paper contend that it is important to reconsider art museums' publicness as being open to diverse publics and conflicts of society.

5 .REFERENCES

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Housing Approaches After The Global Crisis: The Pandemic and The House of The Future

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ABSTRACT

Throughout history, the idea of creating an ideal space for an ideal society always has been existed. As a way of creating ideal space, utopias described the spatial productions as a result of the future expectations. On the other hand, urban utopias have tried to find solutions to the social crises and it was developed on the basis of the idea of establishing a future-oriented life model. At this point, the concept of housing has been the focus of these approaches in both theory and practice.

Today, there is a new global crisis that changes the way of using space and predicts a different future by affecting daily life. Therefore, the new design approaches about housing during pandemic and the idea of house of the future became a new matter of curiosity for researchers.

In this study, the focus is on housing approaches developed as a result of today's conditions. In this context, it is aimed to find an answer to the question of whether the proposed new life models for housing in the current crisis environment can be considered as examples of contemporary utopia and to discuss the intellectual exercises presented in this period.

Keywords: housing, futurism, utopia, pandemic and architecture, house of the future, Covid-19

1. INTRODUCTION

The idea of creating an ideal economic, politic, social and physical environment for an ideal society always has been existed through history. Generally, these searches for ideal were caused by crisis that changed living conditions radically. The term of utopia has described the ideals hoped by the society and has produced as a result of future aspirations. From this view point, urban utopias have developed with a vision tried to find solutions to the social crises and tried to achieve a better life condition. When the main topic is about expectation from the future, the concept of house has been the focus of these visions both theory and practice.

Today, a new global crisis has been experienced and changes the way of using space by affecting daily life. The pandemic named Covid-19 disease have predicted a different future for the world. Professionals from different disciplines come together to struggle these global effects caused by the pandemic and to improve our living conditions [1]. At this point, the meaning of house during the pandemic and the approaches about house of the future are a new matter of curiosity for society.

In this study, which was developed based upon the idea that utopias have similar concerns and visions, even in different circumstances and periods, the focus is on housing approaches developed as a result of today's conditions. In this context, firstly, it was tried to be explained the terms of utopia and crisis environment. Then, examples of urban utopias from 19th and 20th century were discussed in order to be guide for this research. Secondly, with the help of national and international academic studies, the perspectives developed for new residential life after pandemic have been determined. Finally, it is aimed to determine suggestions and designs about the "house of the future" shaped by the pandemic crisis.

2.FUTURE VISIONS ABOUT THE SOCIETY AND THE HOUSE THROUGH HISTORY

2.1 The Concept of Utopia

Utopias have been defined in many ways, primarily as a type of expression in the field of literature, such as philosophy, social sciences, psychological sciences, literature, history, architecture, and urbanism (Yılmaz, 2007 quoted from Demirkan, 1999) [2]. Usta (2005) explains that the utopias have a past about five thousand years, starting from Sumer, Egypt, Greece, and then coming to Rome, China, India and then reach to the Middle East and Europe. In history, the idea of utopia, which basically aims at reaching the ideal living conditions, has existed as a society ideal, which equality was at the forefront, where have the ideal built environment, from the Ancient Age [3].

The term of utopia was first used in Thomas More's book "De Optima Reipublicae Statu Deque Nova Insula Utopia" written in 1516 that produced a life model with an approach similar to the future ideals of the Ancient Age [4]. When examined etymologically, the word of utopia was produced by combining the Greek words "u" (non-existent, imaginary) and "topos" (land, space). According to Emerson (1973), the word utopia was derived from two Greek words, eutopia (good place) and outopia (no place) by More[2]. While using this term, Thomas More expressed an ideal society, also pointed out that this society cannot be realized and is a product of imagination [2]. Besides, according to the dictionary meaning, utopia has been defined "impossible design or thought" [5] or "an imaginary place or state in which everything is perfect" [6]. In other words, Megahed and Ghoneim (2020) defined utopia as replacing the present with an imaginary scene of a future or the time thought to be better [7]. According to Duman Yüksel (2012), utopian thinking contains the social visions that can be achieved in the future or the pursuit of perfection that is desired but cannot be achieved [4].

The term of utopia, which has an important place in this intellectual environment, has been described the spatial productions as a result of the future aspirations and shaped by willing to reach better conditions after global crisis. In other words, each crisis has led to the discussion of the spaces surrounding social life and the development of ideal space production and became the basis of searches for liveable futures.

2.2 The Meaning of Crisis Environment

Etymologically, the word crisis comes from the Greek word "krisis" which means "to decide" [8]. According to TDK "It is a difficult period regarding community life in a country or between countries." [5]. The term also used synonymously with words such as "sudden development in the direction of deterioration", "great distress", "depression" and "depression" [8]. In short, the crisis is theoretically perceived as a dangerous and extraordinary situation [9]. The concept of "crisis", which occurs unexpectedly and is generally used to described negative developments, also brought up the need to question the past and future decisions [10]. On the other hand, the crisis also indicates an opportunity for renewal. Therefore, it can be said that these crisis environments are the beginning of a new era in every sense such as economic, social or political [8].

Crisis indicates the process of change affecting the social structure, and the crisis environment indicates a multi-faceted tension in political, technological and sociocultural terms [8]. Throughout history, crises on a country basis have turned into a global crisis, triggering each other, and one crisis led to the emergence of another.

The main factors that cause the crisis environment are summarized as natural factors, economic factors, technological factors, political and legal factors, social factors [11]. One of the most well-known examples of economic crisis, the Great Depression which started with the collapse of the New York stock market in 1929 [8], is known to be one of the steps leading to the Second World War as political and social crisis.

In addition to the economic crises affecting the commercial and social structure, pandemics also caused many destructions afterwards and affected social life during history. The Black Plague from the 14th century, Cholera from the 1800s, and the Spanish flu from the 1900s are examples of these crises. In the current period, the Covid-19 virus, which is also a global pandemic, is considered a global crisis changed everyday life [1].

2.3 Future visions as utopias after 19th century

In the history, the future vision examples of ideal societies were produced against the social order of the period, especially providing the collectivity. The production of the cities where the societies imagined in the books lived has been tried to developed by Renaissance architects with a rational, hierarchical and humanistic approach in medieval age [4]. After 19th century, Industrial Revolution caused a new era which the concept of the city and the society has changed. Thus, utopias were created in different scopes and various visions. In this period, unlike previous ages, designers accepted planning and architecture as a tool to reach ideal people and healthy cities [12].

In the 19th century, the main issue was the rapid urbanization and the unhealthiness of urban life as a result of the Industrial Revolution. As a result of crises such as rapid population growth as a result of migration, unhealthy living conditions of worker class and social inequality, also global pandemics like cholera and plague, new searches have been developed in this period. In this context, Hygeia (1876) by Benjamin Ward Richardson and Looking Backward (1888) by Edward Bellamy have been suggested

as healthy life models. Moreover, Phalanstère (1834) by Charles Fourier and Linear City (1892) by Sori Y Mata have been suggested built environment models.

Designers of 20th century have produced more ideas for the future due to the industrialization, scientific approaches and the advancement of technology. Crises such as environmental problems came from 19th century and world wars of 20th century caused all these productions, and future visions have been improved in order to solve these defined crises. In this context, numerous built environment proposals have been predicted by developing new theories in terms of the relationship between society and the city [13]. These visions have become richer in terms of quality and quantity, since there is technology helped the idea of "achieving the ideal" [12]. Thus, some of these examples have been physically offers that constructed in real life, although, some of them have been imagined about social life order and some of them have been just an idea produced unrealistic solutions.

First of all, Garden City (Howard, 1898) was a utopic city model implemented in real life. This vision proposed a new life model in the rural area against the crowding in the city centre after industrialization and the deterioration in the urban order. The model, which has advantages such as being in nature, easy access to green, low rent payment and being away from industrial pollution, has been one of the examples implemented. Secondly, Le Corbusier's Contemporary City was a design of a "modern city" contains the ideal of functional and rational modernist life imagined after effects of World War I. Modern city, which prefers rational growth instead of organic growth, has been thought to be a solution to problems such as migration from rural to urban, inability of low-income families to find suitable housing, economic crisis, and increased diseases. In this context, Contemporary City has become an urban model that includes solutions such as removing the problems by constructing high buildings, leaving the street to the citizen by creating wide boulevards around the buildings. On the other hand, another design of Le Corbusier, Villa Savoye, which reflects the 5 basic principles of modernism, was among the examples realized as an ideal residential design as a result of the Spanish flu. The model, one of the striking examples of its era as a modernist icon, emerged as the result of a global epidemic crisis. Unlike the Contemporary City, Villa Savoye has become a realized utopia.

After 1950s, the failure of the rational design approaches of modernism in urban life led designers to a new search [12]. As an example of these periods works, Clusters in the air, one of the most interesting projects of metabolism, was a new way to explore relations between the city and the nature. The model, which developed to bring the cities back to their old order as a result of the destruction caused by the World War II, more focused on human association and mobility. Thus, when faced with crises that require the rebuilding of cities, such as natural disasters and wars, the proposed technique was suggested to be a saver by being flexible [14]. As a final example, Plug-in city, is one of the unique examples shown a hypothetical fantasy city model that combines society, technology and architecture. Plug-in City, which proposed a mega-structure on an urban scale, proposed a collective life. Unlike the rational productions of modernism, this proposal was open to chance. The system created by the structure can be distorted and reconstructed in a way that allowed dynamic and different experiences against monotonous designs of modernism.

In addition to these examples, Antonio Sant'Elia - La Citta Nuova (1914), Tony Garnier - Cite Industrielle (1917), Frank Lloyd Wright - Broadacre City (1934), Walter Jonas - Intrapolis (1958), Warren Chalk & Ron Herron, City Interchange (1963), Ron Herron - Walking City (1964), Archizoom - Non-Stop City (1969), Stanley Tigerman - Instant City (1968) were future visions from 20th century.

After these examples from the history, it is possible to say that there was always search for an ideal future (Fig. 1). Besides, utopias have been a tool for adapting technological developments and new lifestyles to the concept of housing. In other words, in the historical process, residential architecture has become a laboratory where new and alternative design approaches are tested [2].

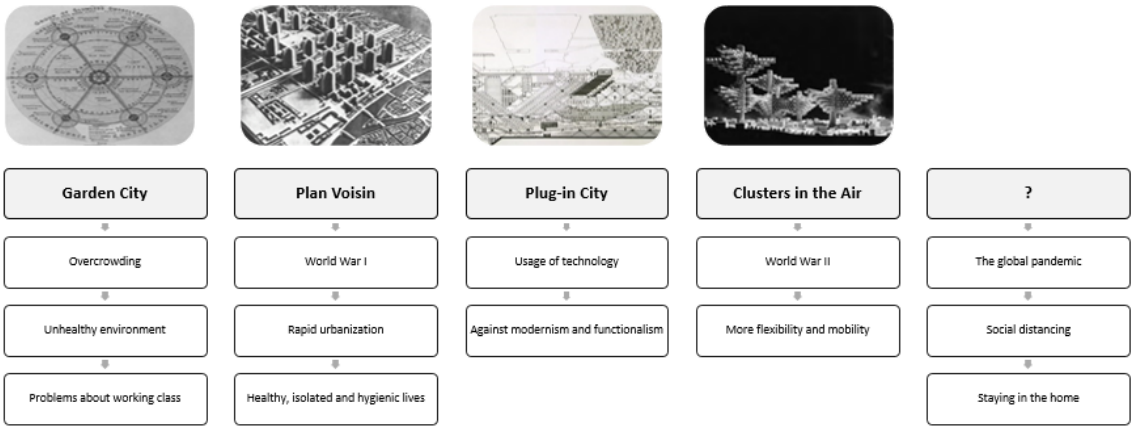


Figure 1. Utopias from history and expectation from today

3. THE COVID-19 PANDEMIC AND HOUSE OF THE FUTURE

With the Covid-19 pandemic, housing has become a shelter that showed the whole world the deep connection between health and living conditions. However, some housing examples were found to be harmful for their users due to reasons such as having unhealthy environmental conditions, not being able to maintain physical distance in overcrowded living areas, insufficient isolation or unhygienic conditions [15]. Therefore, with the aim of improving the housing conditions and developing a permanent future foresight, the focus was on new house designs based on the social isolation approach, on the other hand, renovations, modifications or functional additions were proposed to improve the quality of the existing building stock.

In this part of the study, first of all, the Covid-19 crisis was defined. Then, as a result of the literature review, the effects of the pandemic on houses and the designs of "the house of the future" were determined. Finally, the findings obtained from the intellectual exercises improved in this period were mentioned.

3.1 What is COVID-19 Pandemic?

The New Coronavirus Disease (COVID-19) is a virus that was first detected in Wuhan Province, China in late December 2019 and identified in January 2020 as a result of research. Initially, this disease, which was transmitted from animal to human, started to be transmitted from person to person as a result of mutations. It spread rapidly to other provinces of China, especially Wuhan, and other countries of the world [16]. Later, virus cases in various countries in Europe, North America and Asia began to be reported, and the World Health Organization declared a global epidemic on 11 March 2020 in response to this increase [17].

Basically, the spread of this disease, which is transmitted by respiratory tract, has been very rapid. For this reason, many countries have started to take measures against the epidemic at the beginning of 2020. The quarantine process, which started with the restriction of activities at the borders of the country, continued with the suspension of trains, planes and long-term bus services in most cities around the world. Workplaces and schools have moved from home to work. Collective events such as celebrations, ceremonies, matches were cancelled. As a result of these developments, home quarantine was declared outside of the mandatory needs [17].

3.2 Approaches about "The House of the Future" during Pandemic

During pandemics, the form has always followed the fear of infection, just as much as the function (Megahed and Ghoneim, 2020 quoted from Ellin,1999) [7]. People redesigned interiors, cities and infrastructure; our built environment is shaped by diseases in order to minimize the risk of infectious diseases [7].

In 21th century, when the World Health Organization (WHO) declared the COVID-19 as a pandemic, the lifestyle of citizens was changed all around the world. This pandemic significantly influenced our both personal and professional lives, so this situation caused a new way of thinking about urban planning and architecture theory and practice [18] [19]. To create anti-virus-related ideas, to redesign the existing spaces according to hygiene conditions, to protect social and physical health in closed spaces, in short, to consider effecting of pandemic on our physical and built environment have become the most important questions of architects and planners. In the light of these considerations, post pandemic house were one of the main topics of researches.

During this time, the fact of needing houses that provide social isolation and protect from infections has understood [7]. In other words, the pandemic reminds people that house is one of the most important places for protecting from outside world. But this situation caused a new demand from house; more living options so house became the center of physical and mental activities. Due to quarantine, people started to work, educate, learn, exercise, product from home. Therefore, it has been inevitable that the design concept of the house will change in the future.

Within the scope of the study, articles, competitions, organizations and workshops that taking post pandemic housing as a focus have been determined to find these new design concepts. First of all, articles were classified to see expectations from the post pandemic house (Tab.1). Secondly, competitions were classified about themes and winner's designs (Tab.2). Then, organizations were determined in order to see academic searches during pandemic (Tab.3). Finally, workshops were tabularized to show expectations from house of the future (Tab.4).

Table 1. Articles in relation with pandemic

Authors	Title of the paper	Suggestions
Nanda, Thanos, Valtonen, Xu and Zandieh, 2020	Forced Homeward: The Covid-19 Implications for Housing [20]	considering work-related spaces / adding **private gardens** / using energy efficient features and considering **energy consumption** / increasing **indoor air quality** / organizing more **flexible spaces** for work, leisure, exercise or class
D'Alessandro, Gola, Appolloni, Dettori, Fara, Rebecchi, Settimo and Capolongo, 2020	COVID-19 and Living space challenge. Well-being and Public Health recommendations for a healthy, safe and sustainable housing [21]	using visible and accessible **green elements** / improving **climatic conditions** / creating more **flexible and adaptable spaces** / increasing **thermal comfort** and **indoor air quality** / being careful about water consumption / providing waste management / using more smart home systems / using antibacterial and antiviral materials in building systems
Allen, Ayodeji and Deborah, 2020	The Environment and COVID-19 Transmission: A Perspective [22]	allowing air movements and **ventilation** / managing relative **humidity** / increasing **sun light**
Megahed and Ghoneim, 2020	Antivirus-built environment: Lessons learned from Covid-19 pandemic [7]	enhancing better facilities for food production in **indoor gardens, terraces or green roofs** / considering healing effects of light, air and nature/ providing better **air quality** / designing **wider corridors**, doorways and stairs / **being multifunctional, flexible and adaptable** / considering **self-sufficient** strategies like energy consumption / using **hygienic building materials** / adapting **artificial intelligence** and touchless technologies
Kashdan, 2020	Six Ways Urban Spaces May Change Because of [23]	refocusing on **green spaces** / choosing **hygienic building materials** / ramping up touchless technology / maximizes **individual space** rather than shared
Bahardursing, 2020	6 Ways COVID-19 Will Change Home Design [24]	choosing **adaptable layouts** / designing **private outdoor spaces** like roof gardens, micro backyards, porches and balconies / creating **functional** private offices / **sanitizing entryways** / using **smart kitchen design** / using **air purification** systems
MASS Design Group, 2020	Case Study: Senior Affordable Housing, The Role of Architecture in Fighting COVID-19 [25]	designing **wider hallways** and circulation areas / creating **outdoor areas** at each level to access fresh air / designing **larger balconies** for each apartment / redesigning entry halls to sanitize / providing **natural ventilation** / considering **greenhouse** solutions
Makhno, 2020	Life after coronavirus: how will the pandemic affect our homes? [26]	**leaving open-plan spaces** / separating each zones / considering **self-sufficient** power and water / adapting **smart home systems** / using **hygienic building materials** / adding **new functions** to the house like working zones / creating open **green spaces for farming**
Hipwood, 2020	Coronavirus: an architect on how the pandemic could change our homes Forever [27]	**leaving open-plan scheme** / using high-performance windows, insulation materials for **indoor air quality** / allowing **natural light** / being **self-sufficient** / producing energy by using solar panels or other renewables

Ratnam, 2020	Post-Covid design: Envisioning the home in the new normal [28]	creating "digital detox zones" and **broken plan scheme** / considering **sound-proofing** / designing **small dwelling units** with modular structure/ dynamic **breathable facades** / using **flexible** storage systems / being **self-sufficient** with solar panels, double glaze windows etc. / creating **sanitation zones**, buffer zones and workspaces, also storages / using **antibacterial materials**
Andrew, 2020	5 Design Trends for the Post-Pandemic World [29]	**leaving open concept plans** / designing working spaces / **flexible solutions** / adding **storage units** to the house / creating more **outdoor living spaces**
Lijuaco, 2020	Architect Carlo Calma Re-Shapes Home Design For Our Post-Pandemic New Normal [30]	designing **balconies** and terraces as healing spaces / supporting **gardening**
Türkoğlu, Türkan, Bıyuk, Özhan ve Tekeli, 2020	Acil Korona Mekanları: Konut içi etkiler üzerine; Araştırmalar ve Fikirler Kılavuzu [31]	creating **private zones** for working / designing special **lighting elements** and providing **sound isolation** / creating exercise spaces / supporting **gardening** in the house / creating **sanitation zones**
Turan, 2020	Pandemide Kentsel Sistem: Yaşama, Çalışma ve Sosyalleşme Mekânlarında Yeni Standartlara Doğru -- Yaşam Mekanlarımız Nasıl Değişecek? [32]	rethinking about **entrance halls** and cleaning / adding **balconies** each space of the house / considering **cross ventilation** and redesigning the facades / creating working spaces / **increasing floor height** of the apartment

Table 2. Competitions in relation with pandemic

Date	Name of the competition	Theme	Suggestions
May-Sep 2020	HUB competition for post-pandemic housing for young people	the impact of the pandemic and recession on access to employment and **social mobility** for young people / enhance young people's life-chances / to design **new forms of housing** that could make **a tangible difference to life-chances**, particularly for younger people starting out in their careers	**working from home** / the need for **quality outdoor space** / the importance of **maintaining community and networking** / **shared outdoor space** / **communal courtyard** / delightful **flexible spaces**
12nd Jun 2020	RETHINK: 2025 – Design for life after Covid-19	to consider life in 2025 and how the pandemic will have **modified the way humans interact with space** *Mainly areas:* healthcare spaces, remote learning, **high-density living**, public transport, high streets vs **online shopping**, international travel, and the **use of technology** to monitor and control populations	**bringing nature into the space** with **gardens** / **individual homes** / **terraces** / to create **a new space** between private home and public social space / **hydroponic growing space** for fruit and vegetables / **rooftop exercise classes** / **prefabricated extensions** for building facade / **front gardens** / window for **interaction with nature** / **a virtual window** with HD screen, allowing a full perspective so communication
17th May 2020 - 30th Aug 2020	Pandemic-Dwelling - Home in times of Pandemic	Create **a Pandemic Dwelling a Model** for the world to live in. *Mainly problems:* for a pandemic dwelling (a house) - the lack of a **multifunctional space** and **free movement** / the need of **the sight of greenery** * Most of us don't have the luxury of **a study room or a work space** as we have never thought of it before, while some don't have **a recreational space** for the family and **a Balcony**.	conformity to a standard dwelling design dictate / **minimum covered spaces** / **flexible programme** / **the isolation of indivisual spaces** / to provide of **privacy and security** / to think through the basic functionality and navigation of spaces of the structure, thoughtful conceptualization behind design and aesthetics and expressive, study, kitchen W.C & bath, think of **some space out of the BOX** (This will be one of the criteria of the Winning Entries)
17th Jul 2020 - 30th Nov 2020	2021 International Residential Architecture Conceptual Design Competition	Should we re-define the "**household**" in a way where we, under all circumstances, ensure a sense of community? How can we safely integrate **outdoor space** for everyone in the future of housing?	change of borders of private and public / a new **affordable housing typology**, where residents can live sustainably, and can feel both protected and connected

Table 3. Organisations in relation with pandemic

Date	Name of organizations	Theme	Suggestions
30th Sep 2020	What Is to Be Asked?: Architecture and Urbanism Beyond COVID19 - Open Call for Collaborative Research & Proposal	What is happening now and how is it being recorded? What are the specific preventions responding to various disasters? How will communities be redefined? How will public space be reorganized?	remote work (working from home) / change of social spaces / transformed office buildings (How can the size of the office building, be transformed and expressed in the corona era?) / compartmentalization of shared areas / flexibility of open space **/ private (personal) spaces** / to extensively study residential spaces and their effects on the body, mind, and soul of humans (in the quarantine process) / how can an empthy street that lost its soul transform to street into multifunction space which fulfill the society emotion during pandemic? / What is the architecture for the future wellbeing?
27th Nov 2020	Call for Papers: The Future of Architecture and Urbanism in the Post-COVID Age	to imagine a post-COVID urban landscape / to explore the present and future implications of the COVID-19 global pandemic the design or re-design of buildings and public spaces / the quarantine or redirection of goods and people / the adoption of new social roles / the imposition of new urban design policies and practices	*Response and Experience:* social practices and experiences in public and domestic spaces *Design and Interventions:* short and long term impacts of social distancing and tele-working on urban development and architectural design *Health Equity and Social Justice:* the pandemic's effect on vulnerable populations, communities of color, migrants, refugees, and the elderly *Education and Pedagogy:* the pandemic's effect on the educational experience for students *Environment and Sustainability:* impacts of climate change and global warming on the susceptibility of urban and rural communities to infectious illness
Venice Biennale 2021	Open Air: New Ways We Can Live Together in Nature	"We need a new spatial contact."	new spaces in which we can live together / a turn towards existing plans, multi-family housing and **mobile units** / between a move towards urban flight and global housing crises, the growth of **more low-rise, dense developments** / turning away from single family homes in rural areas and suburbs / new models of shared living in nature

Table 4. Workshops in relation with pandemic

Date	Name of the workshop	Theme	Suggestions
26th May 2020 - 6th Jun 2020	Temas Atölyeleri	Workshop 1 - Witnesses to the moment and place	Using backyards / designing larger spaces for protecting from physical contact / being multifunctional / providing public relations in private zones
		Workshop 2 - The states of opening out from the *eyvan* to the balcony	Regarding the balcony most / creating semi-open spaces like «sofa»
		Workshop 3 – Buffer zones	Considering balcony as semi-public spaces / digitazing society / creating buffer zones
		Workshop 4 – Make my dream	Creating alternative spaces
		Workshop 5 - Urban components: Contact or no contact	Saving daily life activities / providing relationships in the house
		Workshop 6 – Social, not physical	Designing according to physical distance / being adaptable
1th - 6th Aug 2020 15th Nov 2020	Evin Halleri	* Is the house a shelter, a home, is it ours, is it the way we want, is it where we want, can we stay always, are we guests, are we going to go soon, are we safe and private enough?	Creating buffer zones / creating private zones for every user in the house / considering different user profiles

3.3 Findings

Scientific and intellectual studies utilized within the scope of the study were classified and tabulated as **articles, competitions, organizations** and **workshops** and evaluated separately. Then, what specific issues were emphasized or how suggestions were made in studies that generally focused on post-pandemic housing spaces were evaluated.

When the articles were examined, it was seen that, in general, our expectations from home were emphasized **to protect our physical and mental health**. Issues such as *energy consumption, increasing the quality of indoor air, using green more, creating private spaces* and *enriching functions* in the home were mentioned.

When the current architecture competitions related to the pandemic and housing are examined, it is seen that the themes of the competition and the suggestions of the participants awarded are also focused on similar issues, but the emphasis is mostly on the **spatial organization of housing for social life and mental health**. Approaches such as *social mobility and working from home, multifunctional and recreational spaces* became prominent.

Housing in workshops about the prospects for the future, the benefits were read on the basis of examples from Turkey. The intellectual exercises in the workshops were examined as themes and suggestions, as in competitions. Unlike the competitions, it has been highlighted to the issue of *buffer zones (semi-public)* in the housing space for **socialization (publicity) and isolation (privacy).**

Finally, the organizations are one of the most effective methods for defining the problem and developing solutions, as they create interactive and scientific discussion environments. In many organizations held during the pandemic, people evaluated the present and researched the future. When examined in the organizations related to the future of the housing, it was observed that similar issues were focused and also the same solutions were produced for **shelter after the pandemic**. Its main themes are related to the necessity of the housing space to *be flexible, compatible and multifunctional*.

Many inferences can be made on the future of housing after the pandemic from the common emphasis and suggestions made in all these scientific and intellectual studies. According to the findings obtained from the study, when the approaches that are the most decisive in finding solutions to the housing problem of the future were brought together, the main themes of **social life in housing** (Fig.2a)**, space organization in housing** (Fig.2b) and **building technologies for housing** (Fig. 3) were determined in the most general terms. Then, suggestions, inferences and approaches related to these main themes were grouped among themselves and the following table was obtained (Tab.5).

Table 5. Suggestion approaches for the housing of the future after the pandemic

Social life in housing	Space organisation in housing	Building technologies for housing
• Being flexible and adaptable • Adding new hobby spaces for farming, gardening, exercise • Maintaining community and networking for social mobility • Providing social isolation and privacy • Thinking every user such as migrants, refugees, and the elderly	• Creating indoor gardens, larger balconies, terraces, courtyards • Directing people to make prefabricated extensions • Adding buffer zones for sanitizing • Planning wider corridors, hallways and stairs • Using daylight in design • Leaving open-plan spaces • Being multifunctional by adding working spaces or mobile units	• Being self sufficient with the help of energy efficient building design rules • Considering building thermal comfort of each units • Enhancing indoor air quality with natural ventilation and air purification • Choosing smart home systems • Using antibacterial building materials

a.

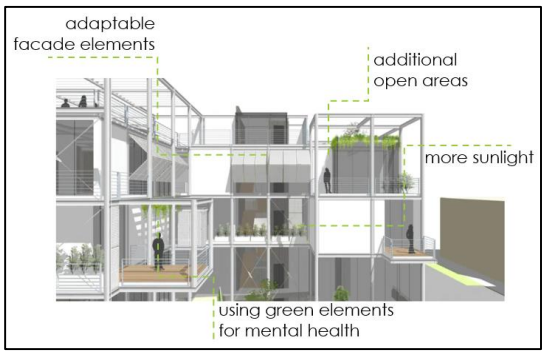


b.



Figure 2. a. Social life suggestions for post-pandemic housing [33], b. Spatial use suggestions for post-pandemic housing [34]

a.



b.

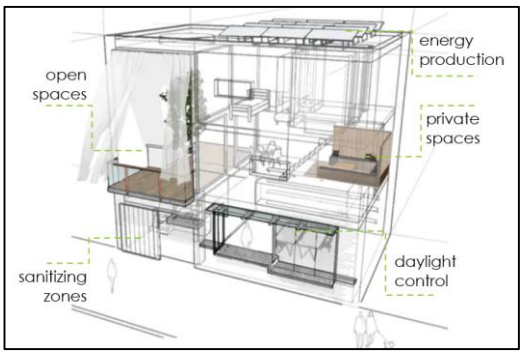


Figure 3. a. Building technologies for post-pandemic housing [35], b. Building technologies and spatial use suggestions for post-pandemic housing [36]

4. CONCLUSION AND DISCUSSION

It is easily read from examples of past utopias that every crisis environment has encourages architects and urban planners to propose a new life model in built environment. In other words, these studies aiming at the ideal life is an indication that designs born in a crisis environment can be revolutionary. It is possible to give examples of these designs, such as the utopias realized like Garden City or the unrealized future visions such as Plug-in City and Clusters in the Air. In addition to that, Le Corbusier's proposed high-rise buildings against unhealthy conditions of cities, as well as housing models such as Villa Savoye and Unite d'Habitation are remarkable examples as solutions for modern period crises. Especially considering that Villa Savoye was designed for a clean, healthy and hygienic house after the Spanish Flu, it is striking that this housing model, which emerged from a global crisis, guided the design world as an icon of modernism.

As Goniewicz et al. (2020) said [37], crisis environments like the current pandemic are new chances for architects, planners and built environment professionals to think on past events and learn what can be improved for future responses [7]. This global crisis became a lesson for architects and urban planners in order to shape future built environment. Pandemics have forced architecture and city planning to cope with it, despite of being catastrophic [19][38]. Therefore, Covid-19 might have similar effects on architecture and can caused a new way of living [7]. In line with this idea, in the study, national and international articles, architectural competitions, workshops and organizations were examined and the effects of the pandemic on the future houses were tried to be read and the suggestions developed were compiled.

As a result of the study, the suggestions classified into three main categories as social life in the house, spatial organization of the house and building technologies of house were determined to explain features of the future houses shaped by the pandemic. However, it has been concluded that the proposals for housing life remain only spatial and functional additions. Besides, it is seen that the concepts discussed in the current literature have begun to be repeated at some point, so the solutions to this crisis are insufficient to be different, innovative and creative. At this point, it is early to judge how responses to effects of COVID-19 on house design theories [7]. Considering that the current period continues with different experiences, it is predicted that the approaches to the housing design will improve and these exercises, which are still in the intellectual stage, will develop.

To sum up, the benefits of this experience to the design should be considered and developed more intensively and should be treated as long-term transformations. In this context, the pandemic has shown the need to redesign the house and built environment in order to struggle future pandemics or global crisis.

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Spatial Configuration Analysis of Five Metropolitan Cities: Berlin, Mexico City, Singapore, Toronto and Vienna

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ABSTRACT

Cities are variable structures with different dynamics that must be studied in rational ways. Graph Theory and Fractal Theory are two substantial theories which are used in this study assist quantitative evaluations on the cities. Within the scope of this study, firstly, the complexities of morphological features of five metropolitans (Berlin, Mexico City, Singapore, Toronto, and Vienna) are analysed by using Graph Theory-based indices. Calculations based on pedestrian movements, land use functions, the characteristics of transportation connections, landforms, distance from the center that affects the city complexity are made. Secondly, the spatial growth of these five metropolitans is evaluated in 1990, 2000 and, 2013 in the context of Fractal Theory. The results are explained in the same language. Thus, cities that speak the same language are turned into meaningfully comparable thanks to their quantitative analysis' results. Although only numerical evaluations will not lead to absolute true results in terms of multi-dimensional urban development, these two outstanding theories in urban morphology draw a strong framework to evaluate spatial development. While evaluating the development of cities with a holistic perspective, it is required to examine historical facts together with social, economic, and demographic changes as much as evaluating the spatial changes and interpreting the complexity.

Keywords: Graph Theory, Fractal Theory, Urban Morphology, Urban Complexities, Quantitative Analyses.

1. INTRODUCTION

Cities are dynamic structures that develop, change, and grow with internal and external factors. It is important to analyse urban space with recently developed methods. In this context, urban morphology examines the differences in urban forms, and urban structures by applying quantitative and qualitative methods. In addition, "Graph Theory" (by Kansky and Danscoine, 1989) and "Fractal Theory" (by Hausdorff-Besicovitch) draw an effective quantitative theoretical framework to analyse physical urban components such as streets, open areas, buildings by pointing out different levels of complexities in cities.

Based on these notions, the study aims to discuss urban structuring and urban growth through different world cities by using two important recent theoretical approaches; one is the graph theory indices which is a strong tool to understand urban structures, and the other one is the fractal dimension analysis which is a new approach in the measurement of urban macroforms. The exploration of the concepts is based on the application in randomly selected five metropolitan cities from different continents; Berlin, Mexico City, Singapore, Toronto, and Vienna. As a beginning, it is briefly reviewed that what graph theory and fractal theory are and how they are compatible with urban areas. Second, graph theory indices are calculated for the urban cores of these five metropolitans for a quantitative evaluation. In this part, the changes in the built-up area of these five metropolitan cities in 1990, 2000, 2013 are observed by calculating fractal dimension values. These observations and urban development histories of the cities are discussed in the light of fractal analysis. This paper is finalized with a discussion on the results of the analysis.

2. LITERATURE REVIEW

In this part of the study, graph theory and fractal theory are briefly explained.

Graph theory is a quantitative method to analyse urban pattern of cities. Kansky and Danscoine (1989) are the pioneers of using graph theory to examine urban transportation networks. Çubukçu (2015), Kut et al. (2016) and studied on the relationship between urban pattern, urban history, and urban culture [7], [15]. Also, Kahraman et al. (2016) discussed the relationship between urban pattern and liveability scores of ten most liveable cities that reported by Economist Intelligence Unit in 2015 [13]. Çubukçu and Çubukçu (2017) analysed and compare two neighbourhoods' urban pattern (one represents illegal and the other represents legal neighbourhood) by using graph theory indices [6].

According to Minor and Urban (2008), Graph Theory has two constituents as nodes and edges [16]. Nodes are particular/substantive elements and edges are the connection links among nodes in a network. In the scope of this study, twelve Graph Theory-based network indices are calculated on 2 kilometers radius areas in urban cores of selected cities: (1) beta index, (2) eta index, (3) network density, (4) node density, (5) sinuosity, (6) order of a node, (7) cyclomatic number, (8) diameter, (9) alpha index, (10) gamma index, (11) pi index, (12) theta index.

(1) Kansky and Danscoine (1989) and Çubukçu (2015) state that **beta index (β)** equals to the ratio of edges (e) to nodes (v):

$\beta = e / v$.

Higher values of the beta index indicate the presence of a high number of alternative routes, which results in a more complicated network structure [7], [14].

(2) Kansky and Danscoine (1989) and Çubukçu (2015) state that **eta index (η)** equals to the average edge length [7], [14]. It is a ratio of total edge length (M) to the total number of edges (e):

$\eta = M / e$.

(3) Hammond and McCullagh (1978) and Çubukçu (2015) define **network density (£)** as the ratio of the total length of edges (M) to the total area (A):

£ = *M / A,*

where the study areas are equal, networks with the higher number of edges have higher network density (edge density) [7], [12].

(4) Hammond and McCullagh (1978), and Çubukçu (2015) express that **node density (N)** equals to the ratio of the total number of nodes (v) to the total area (A):

N = *v / A,*

same as the network density, networks with a higher number of nodes also have higher value of node density where the study areas are equal [7], [12].

(5) Hammond and McCullagh (1978) and Çubukçu (2015) state that **edge sinuosity(S)** is the measurement of the straightness of a line [7], [12]. It is a ratio of a real distance to air line (the shortest distance between two ends). If the edge is a straight line, the sinuosity value is equal to 1.

(6) **Order of a node** is the number of edges that connected at a given node.

(7) Kansky and Danscoine (1989) explains **cyclomatic number(μ)** as a measure of transportation networks' structure. Highly connected graphs have higher cyclomatic number value. It is a useful measurement of the transportation networks. Because, it is observed that highly developed countries have highly connected transportation systems contrary to the less developed countries that have less connected transportation networks [14]. The formula is:

μ = *e – v + p,*

where e is the number of edges, v is the number of nodes, p is the number of non-connected subgraphs [14].

(8) Kansky and Danscoine (1989) defines **diameter (δ)** is the maximum number of edges in the shortest path between two nodes. It is a measurement of the topological length between nodes. The formula is:

δ (G) = $_{x}max_{y}$ *d(x,y)* ,

where G is a graph and d is the topological length. Higher connectivity results in lower diameter value in two study areas with equal size [14].

(9) Kansky and Danscoine (1989) expresses **alpha index (α)** as the adjusted form of cyclomatic number. The formula is:

α = *μ / ((v(v-1)/2) - (v-1))* ,

where *μ* is cyclomatic number, e is the number of edges, v is the number of nodes [14].

(10) Kansky and Danscoine (1989) states that **gamma index (γ)** is a ratio between observed number of edges to nodes of a given network. The formula is:

γ = *e / (v (v-1)/2)* ,

where e is the number of edges, v is the number of nodes [14].

(11) Kansky and Danscoine (1989) defines **pi index (Π)** as a measure of relations between a network as a whole and particular edges of a network. It is written as:

Π = C / d ,

where C is the total length of a network and d is the total length of the network's diameter. Higher value of pi index means higher degree of development of transportation network (more connected and complicated) [14].

(12) Kansky and Danscoine (1989) states that **theta index (Θ)** is a ratio of the network (total length, total traffic flow, total volume) to nodes. The formula is:

$\Theta = T / v$,

where T is the total length / volume / flow and v is the observed number of nodes [14].

While "Graph Theory" is associated with the urban pattern, "Fractal Theory" is related to work on the complexity level of organization of urban space. Fractals are defined as spatial objects with repetition and similarity in urban design literature. The geometric properties of the fractal object are independent of scale. Fractal dimension is a statistical magnitude that measures how a pattern fills the space (space-filling efficiency). Fractal dimension is defined by Hausdorff and Besicovitch, hence it is named after their names: Hausdorff-Besicovitch dimension [1], [9]. Numerous scholar has been studying the urban structure and the relationship between fractals and built-up areas in cities [2], [3], [4], [8], [9], [10].

Although there are several methods to determine the fractal dimension, the box-counting method is the most used in urban studies. In the box-counting method, cells with varying sizes cover the black-and-white digital image of the study area. The black cells are counted for each grid size and black cells show the built-up areas and white cells represent unstructured areas. The fractal dimension is the ratio of log(n(s)) to log(1/s):

$\log(n(s)) = log(U) + Dlog(1/s) + \varepsilon s$

where, D is fractal dimension, log(U) is constant, U is built area, s is box size and εs is the error term [9], [10], [17].

The fractal dimension value ranges between 1 and 2. The high fractal dimension value means that the ratio of idle areas in the city to the urban stain is low. It can be said that cities that grow with fringes indicate a low fractal value. That is to say, a higher fractal dimension value means a higher space-filling efficiency [2], [3], [10], [11].

3. DATA COLLECTION AND PROCESSING

For this study, five random metropolitan cities (Berlin, Mexico City, Singapore, Toronto and Vienna) around the world are chosen (Figure 1).



Figure 1. Location of the selected metropolitan cities
Source: Created by the authors

In this part, firstly, graph theory indices are calculated for the urban cores in Berlin, Mexico City, Singapore, Toronto, and Vienna. Then, fractal dimension values are calculated to understand the changes in the built-up areas in 1990, 2000, 2013.

3.1 Graph Theory Indices

To calculate graph theory indices, study areas were determined by drawing circles with a radius of two kilometers (Figure 2). The centers of the circles are the centers of the urban cores; it can be a historical center or business center.

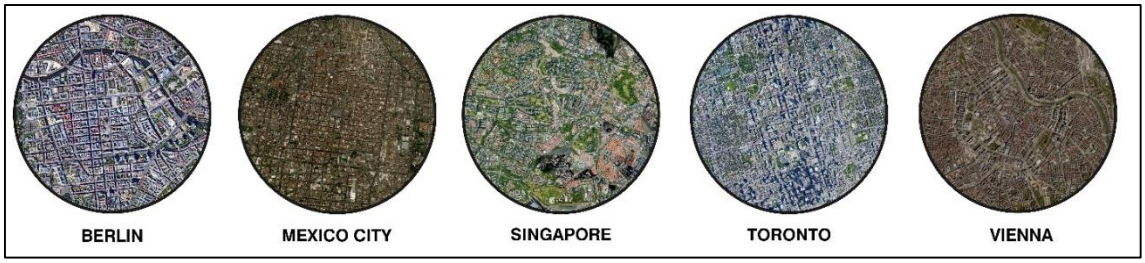


Figure 2. Selected urban cores within 2km radius at the selected metropolitan cities
Source: Created by the authors

Pedestrian paths should be used for the calculation of Graph Theory based indices. These paths are acquired from OpenStreetMaps by using QGIS 3.10.5. The data is processed in ArcGIS and represented by nodes and edges. As Buhl et al. suggested in and as implemented in previous studies courtyards of the buildings and private paths in the courtyards are excluded from the calculation [5], [13], [15]. Streets that have more than 17 meters-width are represented with double lines in drawings. After editing the data, the network data sets are created with "New Network Dataset" tool in ArcGIS. Figure 3 shows the edges and nodes of the study areas. The last step of this phase is to calculate 12 Graph-Theory network connectivity indices for each urban core.

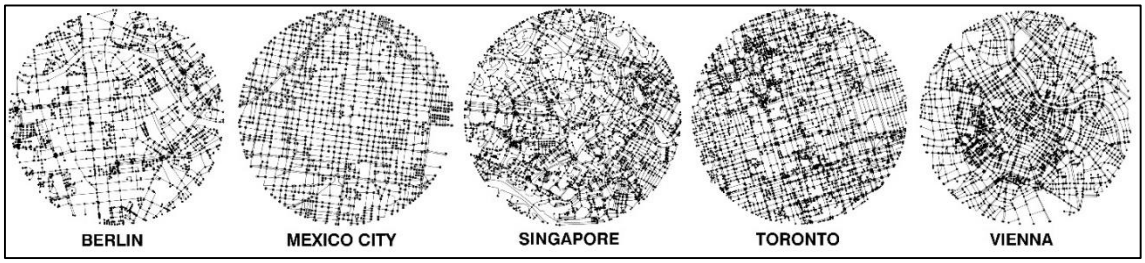


Figure 3. Edge and nodes of the study areas
Source: Created by the authors

Table 1. Study area, number of nodes, number of edges, total length of edges of the selected cities
Source: Calculated and created by the authors

City	Study Area (m^2)	Number of Nodes	Number of Edges	Total Length of Edges (m)
Berlin	≈12,530,000 m^2	2323	3216	≈231,098 m
Mexico City	≈12,565,000 m^2	1436	2244	≈222,029 m
Singapore	≈12,566,000 m^2	4161	5689	≈313,762 m
Toronto	≈12,566,000 m^2	5808	6949	≈307,361 m
Vienna	≈12,533,000 m^2	3213	5903	≈506,545 m

Table 1 presents the descriptive statistics for the nodes and edges of the study areas. As it is seen from the table, Vienna has the highest length of edges, followed by Singapore, Toronto, Berlin, and Mexico City. The highest number of nodes is in Toronto which is followed by Singapore, Vienna, Berlin, and Mexico City. The number of edges in descending order is as follows; Toronto, Vienna, Singapore, Berlin, and Mexico City.

Table 2. Descriptive statistics for the Graph Theory-based network indices (2019)
Source: Calculated and created by the authors

Index/ Cities	Berlin	Mexico City	Singapore	Toronto	Vienna
Beta index	1.384	1.562	1.367	1.196	1.837
Eta index	66.261	98.943	55.152	44.230	157.654
Network density	0.01767	0.01767	0.02500	0.02446	0.04042
Node density	0.000190	0.000114	0.000300	0.000462	0.000256
Sinuosity	0.975	0.990	0.952	0.983	0.987
Order of a node	2.764	3.000	2.724	2.420	3.319
Cyclomatic number	894	809	1529	1142	2691
Diameter	3374.310	5593.390	5718.912	5318.682	4787.085
Alpha index	0.000332	0.000786	0.000177	0.000067	0.000521
Gamma index	0.001192	0.521618	0.000657	0.398900	0.001144
Pi index	63.153	39.694	54.864	57.780	105.814
Theta index	91.734	154.616	75.405	52.920	157.654

Table 2 summarizes the values of network indices of Graph Theory. A higher beta is a result of a more complex urban layout. According to Table 2, Vienna has the highest beta index value. After Vienna, Mexico City, Berlin, Singapore, and Toronto comes respectively. This may be the result of the study area overlaps with the historical center of Vienna. On the other hand, a higher eta index means a pedestrian flow with higher speed and uninterrupted pedestrian paths. Although a higher possibility of interruption on longer streets may cause a decrease in the availability of alternative routes, Vienna provides qualified pedestrian flow. Higher network density represents denser pedestrian paths. So, it is clearly seen from Table 2, Vienna has the highest network density value as the edge length is quite high compared to others and it is followed by Singapore, Toronto and Berlin, and Mexico City. Nodes are the representations of pedestrian decision points. This means Toronto has the highest density in terms of the pedestrian decision points as it has a gridiron urban layout compared to the organic and/or mixed form of Singapore, Vienna, Berlin, and Mexico City (Table 2). Sinuosity value shows the straightness of the streets; higher sinuosity value is more straight streets. That is to say, although the sinuosity values are close to each other, Mexico City has the straightest streets compared to the other cities (Table 2). Since Berlin, Vienna, and Singapore have an organic urban pattern, it may be appropriate to compare Mexico City with Toronto's grid pattern. The reason why Mexico has a higher value than Toronto is the existence of urban parks and pedestrian paths in Toronto. A higher order of a node offers more alternative routes for a pedestrian on a node (decision point). Vienna has the highest order of a node value and it is followed by Mexico City, Berlin, Singapore, and Toronto. This situation gives an idea of Vienna has a pedestrian-oriented network development at the historical core.

Cyclomatic number points out the complexity of the network. The more complex a network is the higher value of the cyclomatic number value. It is used for the evaluation of transportation networks. As it is seen from Table 2, Vienna has the highest cyclomatic number value, and Singapore, Toronto, Berlin, and Mexico City follow Vienna. It can be said that Vienna has a more developed transportation network compared to the others. Diameter index measures the length of the shortest path between the most distanced nodes. A higher diameter value means less linked network. Among these study

areas, Singapore has the highest diameter value and Berlin has the lowest diameter value. This means Singapore has a less linked network and Berlin has a more linked network than the others. A higher alpha value gives a more connected network. , Mexico City has the most connected network comparing to the other cities depends on the alpha value. Gamma index also measures connectivity but it is considerably different than the alpha value. Gamma value regards the relationship between observed links and possible links in the network. Table 2 presents Mexico City has the highest gamma value. Pi value expresses the relationship between the total length of the graph and its diameter. A higher pi value shows a more developed network. Accordingly, Vienna has the highest pi value (Table 2). Berlin, Toronto, Singapore, and Mexico City follow Vienna respectively. Theta index measures the load of a network; higher theta means a higher load. According to the theta index, Vienna has a higher load of the network thanks to its total edge length. It is followed by Mexico, Berlin, Singapore, and Toronto (Table 2).

3.2 Fractal Dimension Analysis

For this part of the study, spatial changes of the selected cities are observed with fractal dimension analysis, which is a new approach in the measurement of urban macroforms reshaped as the spatial reflection of urban growth. Fractal analysis is applied using digital images. The main tool is a software called "Fractalyse", which has been developed especially to measure the fractality of cities. Fractal dimension values were calculated with the box-counting method on the built-up area visuals of the years 1990, 2000, and 2013 of each city. Increasing fractal dimension value means the city experiences compact growth. On the contrary, decreasing fractal dimension value represents the city is growing fringed. Table 3 presents the built-up area images and fractal dimension values in 1990, 2000, and 2013 of Berlin, Mexico City, Singapore, Toronto, and Vienna.

Berlin has been expanding markedly by sprawling in the 2000s, and the 2010s compared to the 1990s. While the structured urban area is growing, the fractal dimension value decreases. In other words, Berlin has been losing its space-filling efficiency over years (Table 3).
Mexico City has grown to rural areas with fringing between 1990 and 2013. Fractal dimension value decreases with a small amount. Mexico City has lost its space-filling efficiency from 1990 to 2013 (Table 3).

Singapore has increasing dimension values (Table 3). It is because, although the fragmented urban structure expands to the north of the city thanks to the stronger transportation network, urban sprawl is prevented by filling the space in the south of the city.
Toronto has slightly increasing fractal dimension values as 1.855 (1990), 1.860(2000), and 1.861(2013). Namely, Toronto achieves compact growth throughout the years and space-filling efficiency has increased (Table 3). The urban area has extended to the city borders after 1990, as the city has experienced a population increase with migration and natural population growth, and also increasing urban density from the after-war period (since the 1940s).
Vienna has a decreasing fractal dimension value between 1990 to 2000; then it has an increasing dimension value from 2000 to 2013. It can also be said that Vienna has growth with fringes between 1990 and 2000, but the city experienced growth in built-up areas with space-filling from 2000 to 2013 (Table 3).

Table 3. Fractal dimension values of the selected cities
Source: Calculated and created by the authors

Years/ Cities	Berlin	Mexico City	Singapore	Toronto	Vienna
1990					
	dim= 1.807	dim= 1.753	dim= 1.599	dim= 1.855	dim= 1.747
2000					
	dim= 1.781	dim= 1.734	dim= 1.695	dim= 1.860	dim= 1.733
2013					
	dim= 1.761	dim= 1.730	dim= 1.703	dim= 1.861	dim= 1.748

When the fractal dimension values are examined, it is seen that the dimension values of Singapore and Toronto cities have increased. On the other hand, the fractal dimension values of Mexico City and Berlin have decreased. Vienna has different trends in each period; the fractal dimension value decreased from 1990 to 2000, then it increased from 2000 to 2013.

From another perspective, in 1990, Toronto has the highest fractal dimension value and it is followed by Berlin, Mexico City, Vienna, and Singapore respectively. In 2000, the ranking remains the same as in 1990. In 2013, Toronto has the highest fractal dimension value and it is followed by Berlin, Vienna, Mexico City, and Singapore (Table 3). In this case, Toronto has a higher degree of space-filling efficiency comparing to the other cities in each period.

According to studies held in the 1990s, for cities that show homogeneous and compact urban growth such as American or Australian cities, fractal dimension values calculated as near to 2. Fractal dimension value varies for European cities in between 1 and 2 but close to 1. Because most of the European cities dispersedly grow from the city center through the peripheries [2], [3], [11]. It is obvious that selected metropolitan cities show some exceptional cases for inferences based on previous studies. The reason why Singapore has a different fractal dimension value from the general statement in the 1990s may be the built-up area and the unbuilt area are highly intertwined at small scales. Berlin and Vienna have a fractal dimension value between 1 and 2; still, these cities do not have a value closer to 1. Mexico shows a similar spatial growth trend to Berlin and Vienna (Table3). Considering that, this generalization is based on the studies conducted in and before the 1990s, it is highly anticipated that metropolitan cities of the 2010s may have tendencies different from the usual rule.

4. CONCLUSION

In this study, five world metropolitan cities (Berlin, Mexico City, Singapore, Toronto, Vienna) are evaluated in terms of spatial development by using recent theories that draw a quantitative framework. Firstly, graph theory indices and fractal theory are briefly introduced. As a second step,

each index of graph theory is calculated for the two kilometers radius area at urban cores of these cities. Then, fractal dimension analysis was performed for selected metropolitan cities. In this case, each city's spatial urban development compared with each other and their spatial growth evaluated in years in itself.

As a result, it is important to emphasize that since both of these theories only help quantitatively make urban spatial analysis, they might be incapable in terms of the social and economic dimensions for the most effective planning studies. Nevertheless, they create quite a strong framework to analyse and evaluate the existing urban structure.

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Evaluating Visual Diversity and Complexity in Residential Areas with Different Land Values via Information Entropy: A New Methodology to Objectively Measure Environmental Aesthetics

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ABSTRACT

Visual diversity and complexity are significant components in environmental design as they influence aesthetic evaluations. Promoting visual diversity, avoiding monotony, avoiding chaos is necessary to create aesthetically satisfying, preferable physical environments. However, the guideline to achieve high visual diversity and moderate complexity is unclear and subjective. "Information entropy" is proposed as an objective measure of complexity and diversity. This study aims to propose a new methodology to measure entropy scores in two types of urban scenery. One represents low market value residential settlement and the other represents high market land value residential settlement. After calculating the entropy values for given images, the extent to which these entropy scores correlate with people's perception is also analyzed. Forty-seven participants evaluated the perceived complexity and diversity in general and 166 participants evaluated the diversity and complexity considering the variation in images for 6 variables; 1) building form, 2) building height, 3) facade material, 4) building color, 5) building typology, and 6) landuse. Results show correlation for some variables but not for others. The limitations of this methodology are discussed as well as the applied value in urban design.

Keywords: visual diversity, complexity, environmental aesthetics

1. LITERATURE REVIEW

Aesthetic quality in urban areas influences people's behavior and their preference to stay or leave [11]. Although environmental preference is argued to be subjective and random according to general knowledge, scientific studies provide empirical evidence that shows the otherwise [11]. Environmental preference is predictable as some type of buildings and open areas are more preferable than others to some populations sharing similar socio-economic characteristics and lifestyles. Moreover, these studies prove that preferences related to aesthetic evaluations of physical environment are empirically measurable [6], [7], [8], [9], [10], [11], [12], [13].

Visual diversity and complexity are significant components in environmental design that influence aesthetic evaluations. A voluminous number of studies investigate how people evaluate environmental aesthetics in general and visual diversity and complexity in particular. Those studies focus on environmental aesthetic evaluations in indoors, outdoors, recreational settings, public areas, urban and rural areas [11]. General knowledge and scientific studies show promoting visual diversity, avoiding monotony, avoiding chaos is necessary to create aesthetically satisfying, preferable physical environments. However, the guidelines to achieve high visual diversity and moderate complexity is unclear and subjective. In this context, Stamps argued that objective measures should be developed to guide designers to create better environments and suggested "information entropy" as an objective measure of visual diversity [16].

Entropy provides a quantitative valuation for subjective aesthetic considerations by visual scripts. It is originally a measure of physical disorder, but it is also used as a measure of disorder in information by Shannon and Weaver in 1949 [14], [15], [16]. The basic equation for information entropy is shown below, in which "H" is the entropy, "p" is the probability of occurrence of a level of a factor, "i" is the case; "n" is the total number of cases (Figure 1). When all items in the setting are identical, the settings show no differentiation then the entropy value on a given factor is zero. For homogenous settings, the entropy value is calculated as the lowest. As heterogeneity increases the entropy value increases as well [15].

$$H_{factor} = -\sum_{i=1}^{nlevels} p_i \log_2 p_i$$

Figure 1. The basic formula of entropy
(Source: Shannon and Weaver, 1949, pg. 14)

Although entropy is considered as an objective measure, it can be measured in various ways depending on how you define the factor. Many studies propose alternative ways to measure entropy on building facades, streetscapes and urban skylines [1], [2], [3], [4], [15], [17], [18]. In each study, the factor of interest on which the entropy value depends differs. The factor can be defined as the shape of the building or the size of the window etc. This variation shows that there is still room for better calculation of entropy measures in different types of physical environments. This study aims to propose a new methodology to measure entropy scores in residential urban scenery.

The focus is on residential settings because aesthetically pleasing residential settings may help to improve residents' quality of life. Studies also showed that environmental aesthetics may have an economical value; people can pay more for the same house or the apartment if its exterior looks better and/or located in a better environment [5], [9]. Yet, how indicators of environmental aesthetics (visual diversity and complexity) differ in different types of residential areas have rarely been studied [9]. On the other hand, the cities are composed of different morphological characteristics and involve different types of residential environments for people from different social and economic backgrounds. Previous studies showed a relation between urban morphology and social poverty [19], [20]. However,

the relation between the indicators of environmental qualities (complexity and diversity) and land values has not been studied yet. Given that this study aims to compare the complexity and diversity in low and high market land value residential settings.

2. METHOD

This study is conducted in three phases; 1) site selection, 2) entropy calculation and 3) surveys for perceived complexity and diversity.

2.1 Site Selection

Two residential areas in Ataşehir, İstanbul are selected as case study areas to reflect the physical differences between low and high market land value residential settings in Turkey in general. The market land values of the selected case areas are derived from "Kent95" project, which was supported by Bernard van Leer Foundation and conducted by the Center for Economic and Social Studies Foundation (TESEV) in collaboration with Kadir Has University in Istanbul Studies Turkey. Thanks to that project, the spatial distribution of socio-economic differentiation within the provinces of Istanbul has been mapped and published online since 2019. The location of Ataşehir district in Istanbul and variation in land values are shown in Figure 2 as well as the two case areas selected in this study. For the first case area, the land value is above 2993 TL/m2 and for the second case area, the land values range between 138-372 TL/m2. In other words, Case 1 represents "high" and Case 2 represents "low" landuse value residential area.

Aerial images of those selected areas were achieved from a website (https://panorama.istanbul/) which provides panoramic views for various areas in the city of Istanbul (Figure 3 and Figure 4). These images are taken from Çamlıca TV Tower and accessible online with the permission of the GIS Directorate of İstanbul Metropolitan Municipality.

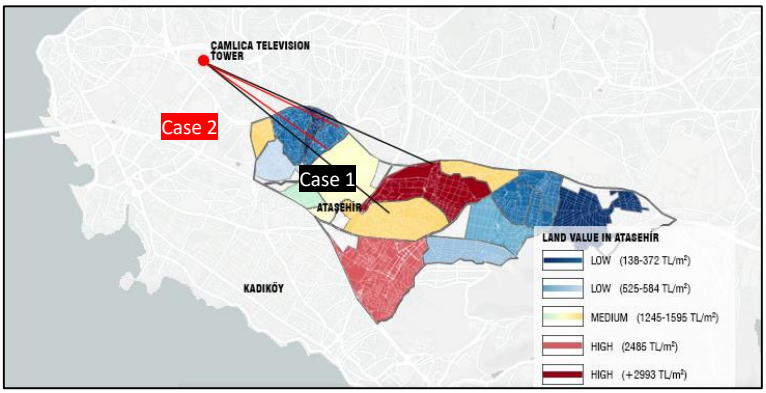


Figure 2. Land values in Ataşehir, İstanbul, TR
Source: Redesigned by the authors based on the digital map of Kent95 project
webpage: http://harita.kent95.org/istanbul/ilce/atasehir (the last access day; 01.06.2020)

2.2 Entropy Calculation

Entropy values are calculated for 6 variables; 1) building form, 2) building height, 3) facade material, 4) building colour, 5) building type, 6) landuse variation.

In order to calculate the entropy for the first 5 variables the buildings that can be clearly noticed were marked in each case (Figure 5 and Figure 6). 119 buildings in the first case area and 186 buildings in the second one were marked as noticeable. As the areas of building facades vary; entropy values are evaluated in two ways; one is based on the "frequency" of buildings and the other is based on the

"area". For the sixth variable (landuse variation) each image is divided into 2280 pixels by using "create fishnet tool" of ArcMap 10.5 (Figure 7 and Figure 8). The size of the grid is determined as half of the smallest noticeable item in the image.



Figure 3. Case 1 representing high market land value residential area
(Source: Taken from https://panorama.istanbul/)



Figure 4. Case 2 representing low market land value residential area
(Source: Taken from https://panorama.istanbul/)



Figure 5. Identified buildings in Case 1

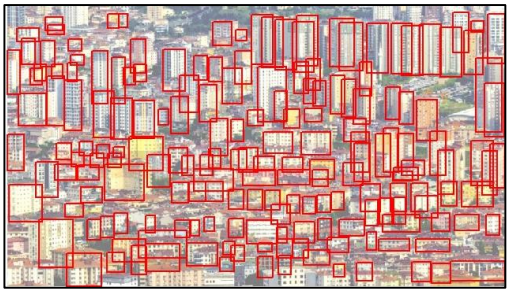


Figure 6. Identified buildings in Case 2



Figure 7. Grid on Case 1

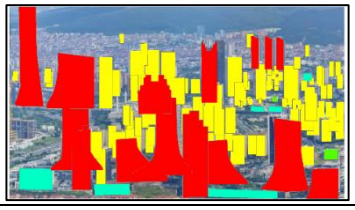
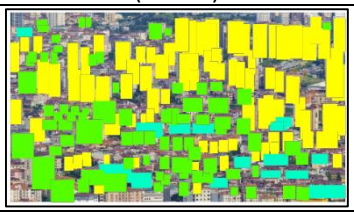
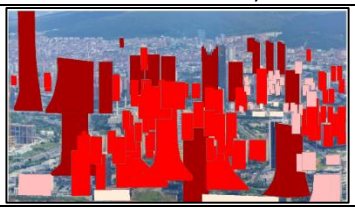
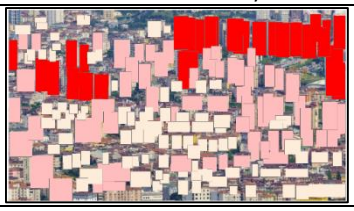
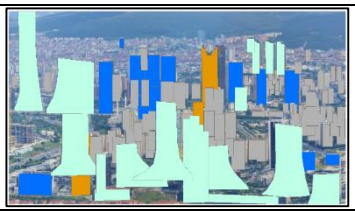
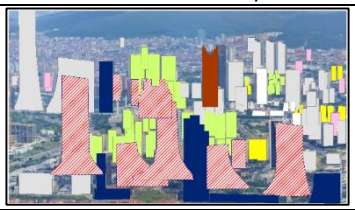
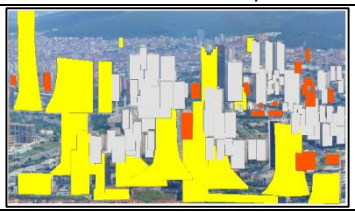
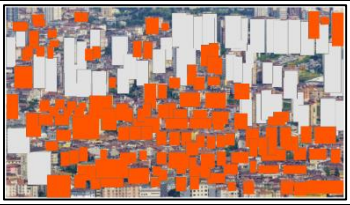


Figure 8. Grid on Case 2

For the first 5 variables (building form, building height, facade material, building colour, building type), each building in each image is coded as one of the prespecified types as explained below. This coding is based on the first author's perception. It is important to emphasize that although entropy is an objective measure; the coding necessary to measure entropy is subjective. After completing the coding for each variable; two types of entropy were measures 1) frequency entropy, 2) area entropy. For frequency entropy, the total frequencies were counted to calculate the entropy value (See Table 3, Table 4 for more details). For area entropy, the total areas of these coded elements were calculated (See Table 5, Table 6 for more details).

Among the 5 variables; for 3 of them 4 classes, for one of them 3 classes and for the remaining 11 classes were specified. For building form (high rise, wide, square and amorph), building height (skyscraper, high-rise, middle-rise and low-rise), and building facade material (glass, concrete, glass+ steel and glass+ concrete) 4 classes were specified. For building colour, 11 types classes were specified as yellow, green, pink, blue, grey, brown, orange, red, dark blue, white and colourful (colourful represents the buildings when two colours are equally dominant on the facade. For the building type 3 classes were specified; unidentified, luxury, single building. Table 1 shows how each building is coded for each variable in each case area.

Table 1. The coding of each building for each variable and entropy values

Variables/ Legend	High Market Land Value Area (Case 1)	Low Market Land Value Area (Case 2)
BUILDING FORM Amorph Square Wide High rise		
	(Entropy value for frequency = 0.94297; for area = 1.25951)	(Entropy value for frequency = 1.33374; for area = 1.24625)
BUILDING HEIGHT Low rise Middle rise High rise Skyscraper		
	(Entropy value for frequency = 1.61626; for area = 1.48172)	(Entropy value for frequency = .,45043; for area = 1.55972)
BUILDING FACADE MATERIAL Glass Concrete Glass + steel Glass + concrete		
	(Entropy value for frequency = 1.22250; for area = 1.68157)	(Entropy value for frequency = 0.000; for area = 0.000)
BUILDING COLOR Yellow, Dark blue Green, Orange Pink, Red Blue, White Grey, Colorful Brown		
	(Entropy value for frequency = 2.38319; for area = 2.33522)	(Entropy value for frequency = 3.09494; for area = 3.04447)
BUILDING TYPE Unidentified Luxury Single		
	(Entropy value for frequency = 1.27348; for area = 1.21867)	(Entropy value for frequency = 0.86210; for area = 0.99830)

For landuse variation each cell in each image is coded as one of the 4 types; green areas, structured areas, mixed areas which include both structure and greenery, and other (roads, etc.). Table 2 shows how each pixel is coded. This coding is based on the first author's perception. In other words, although entropy is an objective measure; the coding necessary to measure entropy is subjective. After completing the coding for each variable, the total frequencies were counted to calculate the entropy value. As the grids are the same size; frequency and area calculations would not vary. Given that, only one entropy value was calculated to measure landuse variation. Table 3 to Table 6 shows the detailed calculations of entropy values.

Table 2. The coding for landuse variation and entropy values

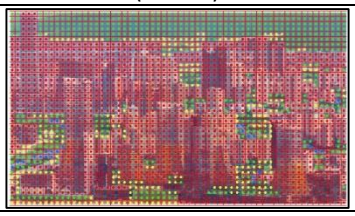
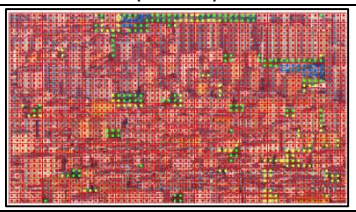
Variables/ Legend	High Market Land Value Area (Case 1)	Low Market Land Value Area (Case 2)
LANDUSE VARIATION Green areas Structured areas Mixed areas Other (roads etc.)		
	(Entropy value = 1.28072)	(Entropy value = 0.66617)

Table 3. "Frequency entropy" calculation for Case 1
(Source: Calculated and created by the authors)

Stimuli	Variables (Factors)	Level of factor (x)	Stimuli(n)	Occurences P(x)	Px*log2(P(x))	H=-∑Px*log2(P(x))
high-market value land-area	building form	rectangle(high-rise)	96	0.80672	-0.24997	
		rectangle(wide)	6	0.05042	-0.21730	
		square	2	0.01681	-0.09907	
		amorph	15	0.12605	-0.37663	
		TOTAL	119		-0.94297	**0.94297**
	building height	skyscraper	18	0.15126	-0.41217	
		high-rise	64	0.53782	-0.48125	
		middle-rise	31	0.26050	-0.50554	
		low-rise	6	0.05042	-0.21730	
		TOTAL	119		-1.61626	**1.61626**
	facade material	glass	17	0.14286	-0.40105	
		concrete	86	0.72269	-0.33862	
		glass+steel	3	0.02521	-0.13386	
		glass+concrete	13	0.10924	-0.34897	
		TOTAL	119		-1.22250	**1.22250**
	building colour	yellow	11	0.09244	-0.31756	
		green	38	0.31933	-0.52590	
		pink	6	0.05042	-0.21730	
		blue	0	0	-	
		grey	41	0.34454	-0.52965	
		brown	1	0.00840	-0.05794	
		dark blue	6	0.05042	-0.21730	
		orange	0	0	-	
		red	0	0	-	
		white	6	0.05042	-0.21730	
		colorful	10	0.08403	-0.30024	
		TOTAL	119		-2.38319	**2.38319**
	building type	unidentified	78	0.65546	-0.39945	
		luxury	20	0.16807	-0.43242	
		single building- high rise	21	0.17647	-0.44162	
		TOTAL	119		-1.27348	**1.27348**
	land use variation	green	495	0.21711	-0.47840	
		mixed	237	0.10395	-0.33950	
		structured (building)	1522	0.66754	-0.38922	
		road etc	26	0.01140	-0.07360	
		TOTAL	2280		-1.28072	**1.28072**

Table 4. "Frequency entropy" calculation for Case 2
(Source: Calculated and created by the authors)

Stimuli	Variables (Factors)	Level of factor (x)	Stimuli(n)	Occurences P(x)	Px*log2(P(x))	H=-∑Px*log2(P(x))
low-market value land-area	building form	rectangle(high-rise)	98	0.52688	-0.48708	
		rectangle(wide)	17	0.09140	-0.31548	
		square	71	0.38172	-0.53037	
		amorph	0	0	-	
		TOTAL	186		-1.33292	**1.33292**
	building height	skyscraper	0	0	-	
		high-rise	29	0.15591	-0.41803	
		middle-rise	65	0.34946	-0.53006	
		low-rise	92	0.49462	-0.50234	
		TOTAL	186		-1.45043	**1.45043**
	facade material	glass	0	0	-	
		concrete	186	1	0	
		glass+steel	0	0	-	
		glass+concrete	0	0	-	
		TOTAL	186		0	**0**
	building colour	yellow	18	0.09677	-0.32605	
		green	22	0.11828	-0.36427	
		pink	6	0.03226	-0.15981	
		blue	4	0.02151	-0.11912	
		grey	16	0.08602	-0.30444	
		brown	12	0.06452	-0.25511	
		dark blue	4	0.02151	-0.11912	
		orange	17	0.09140	-0.31548	
		red	7	0.03763	-0.17808	
		white	41	0.22043	-0.48089	
		colorful	39	0.20968	-0.47256	
		TOTAL	186		-3.09494	**3.09494**
	building type	unidentified	53	0.28495	-0.51611	
		luxury	0	0	-	
		single building- high rise	133	0.71505	-0.34600	
		TOTAL	186		-0.86210	**0.86210**
	land use variation	green	120	0.05263	-0.22358	
		mixed	110	0.04825	-0.21100	
		structured (building)	2022	0.88684	-0.15365	
		road etc	28	0.01228	-0.07795	
		TOTAL	2280		-0.66617	**0.66617**

Table 5. "Area entropy" calculation for Case 1
(Source: Calculated and created by the authors)

Stimuli	Variables (Factors)	Level of factor (x) - area(m2)	Stimuli(n)	Occurences P(x)	Px*log2(P(x))	H=-∑Px*log2(P(x))
high-market value land-area	building form	rectangle(high-rise)	152514.7	0.43035	-0.52349	
		rectangle(wide)	17201.8	0.04854	-0.21186	
		square	1432.6	0.00404	-0.03214	
		amorph	183249.7	0.51707	-0.49203	
		TOTAL	354398.7		-1.25951	**1.25951**
	building height	skyscraper	164881.2	0.44202	-0.52062	
		high-rise	167010.9	0.44773	-0.51905	
		middle-rise	30395.1	0.08148	-0.29475	
		low-rise	10732.6	0.02877	-0.14729	
		TOTAL	373019.8		-1.48172	**1.48172**
	facade material	glass	171770.5	0.48468	-0.50644	
		concrete	106547.6	0.30064	-0.52128	
		glass+steel	19744.1	0.05571	-0.23209	
		glass+concrete	56336.5	0.15896	-0.42177	
		TOTAL	354398.7		-1.68157	**1.68157**
	building colour	yellow	8809.9	0.02486	-0.13250	
		green	67246.5	0.18975	-0.45499	
		pink	5632.5	0.01589	-0.09497	
		blue	0	0	-	
		grey	106840.5	0.30147	-0.52152	
		brown	7960.0	0.02246	-0.12300	
		dark blue	44564.1	0.12575	-0.37616	
		orange	0	0	-	
		red	0	0	-	
		white	6922.5	0.01953	-0.11091	
		colorful	106422.6	0.30029	-0.52118	
		TOTAL	354398.7		-2.33522	**2.33522**
	building type	unidentified	138435.9	0.39062	-0.52974	
		luxury	197832.2	0.55822	-0.46952	
		single building- high rise	18130.7	0.05116	-0.21941	
		TOTAL	354398.7		-1.21867	**1.21867**

Table 6. "Area entropy" calculation for Case 2
(Source: Calculated and created by the authors)

Stimuli	Variables (Factors)	Level of factor (x) - area(m2)	Stimuli(n)	Occurences P(x)	Px*log2(P(x))	-Px*log2(P(x))
low-market value land-area	building form	rectangle(high-rise)	245648.129	0.63396	-0.41685	
		rectangle(wide)	35879.9216	0.09260	-0.31788	
		square	105953.647	0.27344	-0.51153	
		amorph	0	0	-	
		TOTAL	387481.697		-1.24625	**1.24625**
	building height	skyscraper	0	0	-	
		high-rise	115866.231	0.29848	-0.52064	
		middle-rise	163948.211	0.42234	-0.52519	
		low-rise	108372.901	0.27918	-0.51389	
		TOTAL	388187.342		-1.55972	**1.55972**
	facade material	glass	0	0	-	
		concrete	388187.342	1	0	
		glass+steel	0	0	-	
		glass+concrete	0	0	-	
		TOTAL	388187.342		0	**0**
	building colour	yellow	34564.8	0.08904	-0.31070	
		green	92145.2	0.23737	-0.49249	
		pink	13687.0	0.03526	-0.17015	
		blue	8054.4	0.02075	-0.11600	
		grey	48463.2	0.12484	-0.37476	
		brown	16976.8	0.04373	-0.19746	
		dark blue	5965.4	0.01537	-0.09257	
		orange	34500.9	0.08888	-0.31036	
		red	9881.8	0.02546	-0.13481	
		white	61189.6	0.15763	-0.42014	
		colorful	62758.3	0.16167	-0.42501	
		TOTAL	388187.342		-3.04447	**3.04447**
	building type	unidentified	184679.732	0.47575	-0.50987	
		luxury	0	0	-	
		single building- high rise	203507.611	0.52425	-0.48843	
		TOTAL	388187.342		-0.99830	**0.99830**

2.3 Surveys for Perceived Complexity and Diversity

Two surveys were prepared; extended and reduced surveys. Both surveys involved questions on gender, age, and education. In addition to questions related to demographic and social characteristics; an extended survey includes 24 questions and the reduced survey includes 4 questions. In the extended survey, participants evaluated two concepts (the perceived diversity and complexity) in each image (Case 1 and Case 2) for each variable (building form, building height, facade material, building colour, building type, and landuse) (2 concepts X 2 images X 6 variables = 24 questions). In the reduced survey, participants evaluated diversity and complexity in each image (2 concepts X 2 images = 4 questions). 47 participants volunteered to fill the extended survey and 166 participants volunteered to fill the reduced survey. For the extended survey (47 participants); the majority of participants were female (76.6%); between the ages of 20-34 (80.9%), either graduated from a university (42.6%) or graduate students (34%) and expertise associated with non-design disciplines (59.6%). For the reduced survey (166 participants); the majority of participants were female (74.7%); between the ages of 20-34 (47.6%) or between ages of 35-49 (39.8%), either graduated from a university (42.2%), a high school (30.1%) or undergraduate student (15.7%) and expertise associated with non-design disciplines (82.5%).

Participants were recruited via the snowball technique using social media. They were briefly informed about the content of the survey and they were explicitly told there is no right or wrong answer to urge them to give their honest opinions.

3. RESULTS

Results will be discussed in three phases; 1) entropy values (objective measure of complexity and diversity), 2) survey results (subjective measure of complexity and diversity) and 3) the relation between objective and subjective measures of complexity and diversity.

Recall, the entropy values for building form, building height, facade material, building colour, building type were calculated in two ways for both images (Table 1); 1) frequency and 2) area entropy. Table 3 to Table 6 show the entropy calculations for both Case 1 and Case 2, and create an opportunity to compare entropy values for each variable.

For "frequency entropy"; results showed that high land valued area (Case 1) has higher entropy values for 3 of the 5 variables (building height, facade material, and building type compared to low land valued area (Case Area 2). For the remaining two variables (building form and building colour) low land valued area achieved higher entropy scores. The difference between Case 1 and Case 2 is quite low for building form, building height and building type. On the other hand, this difference is quite high for facade material and building color (Table 7).

For "area entropy"; results showed that high land valued area (Case 1) has higher entropy values for 3 of the 5 variables (building form, facade material, and building type) compared to low land valued area (Case Area 2). For the remaining two variables (building height and building colour) low land valued area achieved higher entropy scores (Table 7).

For both (frequency and area entropy), the difference between Case 1 and Case 2 is quite low (negligible) for building form, building height and building type (Table 7). On the other hand, this difference is quite high for facade material and building color. Given that, we can claim that entropy calculations based on frequency and area are parallel.

In addition, the entropy value for landuse variation is compared between Case 1 and Case 2. As Table 2 and Table 7 show high land valued area (Case 1) has higher entropy values compared to low land value area (Case Area 2).

Table 7. The comparison of entropy values in Case 1 and Case 2

	Entropy Values (Objective Measure)				Survey Results (Subjective Measure)	
	Frequency Entropy *		Area Entropy		Perceived Diversity*	Perceived Complexity*
	Comparison	Difference	Comparison	Difference		
Building Form	Case 2 > Case 1	-0.39077	Case 1 > Case 2	0.01326	Case 1 > Case 2	Case 1 > Case 2
Building Height	Case 1 > Case 2	0.16583	Case 2 > Case 1	-0.07800	Case 1 > Case 2	Case 1 = Case 2
Facade Material	Case 1 > Case 2	1.22250	Case 1 > Case 2	1.68157	Case 1 > Case 2	Case 1 > Case 2
Building Colour	Case 2 > Case 1	-0.71175	Case 2 > Case 1	-0.70925	Case 1 = Case 2	Case 1 = Case 2
Building Type	Case 1 > Case 2	0.41138	Case 1 > Case 2	0.22037	Case 1 > Case 2	Case 1 > Case 2
Landuse Variation	Case 1 > Case 2	0.61455	-	-	Case 1 > Case 2	Case 1 = Case 2
Total Entropy	Case 1 > Case 2	1.31200	Case 2 > Case 1	1.12800	Case 1 = Case 2	Case 1 = Case 2
*Case 1: High Land Value Area / Case 2: Low Land Value Area						

Next, survey results were analysed. Recall surveys were completed in two phases; 1) extended sample (for the reduced survey: 4 questions and 166 people) evaluated the images in general without any information about the variables that may affect their evaluation, 2) reduced sample (for the extended survey: 24 questions and 47 people) were explicitly told to evaluate the images by focusing on specific variables such as building form, building height, etc. For the extended sample, the mean values for complexity and diversity are calculated for each image and the presence of a statistical difference between these mean values is analysed via t-test (Table 8). Results showed that when the variables considered intuitively and the image is evaluated generally the mean complexity and diversity values were similar for both images. Both images were evaluated as slightly below average (2.62 and 2.67) on diversity. In other words, extended sample participants evaluated both images as consisting of many different items in the space which makes it a little diverse, beautiful, enjoyable, and liveable place ($p>0.05$). Similarly, both images were evaluated as slightly above average (3.82 and 3.89) for complexity, indicating that there are many different items in the space which makes it slightly complex and ugly, less enjoyable, and less liveable place ($p>0.05$).

Table 8. The mean values for each case area and t-test results for diversity and complexity (extended sample)

DIVERSITY (t=0.39; df=330; p=0.70)		COMPLEXITY (t=0.45; df=330; p=0.65)	
Case 1	Case 2	Case 1	Case 2
2.67 (1.31)*	2.62 (1.25)*	3.89 (1.29)*	3.82 (1.37)*

* Mean (Standard Deviation)

For the reduced sample, the mean values for complexity and diversity are calculated separately for each variable in each image. Then, the presence of a statistical difference between these mean values is analysed via t-tests (Table 9). Results showed a statistically significant difference between two case areas for diversity scores for all factors except building colour. For building form, building height, facade material, landuse variation, and building type; Case Area 1 is evaluated as more diverse than Case Area 2. For complexity, the mean values for two case areas differ significantly for 3 of the 6 variables. For building form, facade material, and building type Case Area 1 is evaluated as more complex than Case Area 2.

Table 9. The mean values for each case area and t-test results for diversity and complexity for all variables (reduced sample)

	DIVERSITY*		COMPLEXITY*	
	Case 1	Case 2	Case 1	Case 2
Building form	2.98 (1.21)	2.45 (1.16)	4.09 (1.12)	3.53 (1.44)
	t=2.18, df=92, p=0.03		t=2.08, df=92, p=0.04	
Building height	3.62 (1.21)	3.11 (1.18)	3.79 (1.27)	3.4 (1.28)
	t=2.07, df=92, p=0.04		t=1.46, df=92, p=0.15	
Facade material	3.3 (1.32)	2.43 (1.14)	3.62 (1.21)	2.83 (1.34)
	t=3.44, df=92, p=0.00		t=2.99, df=92, p=0.00	
Building colour	3.34 (1.13)	3.6 (1.04)	3.47 (1.08)	3.7 (1.1)
	t=-1.1, df=92, p=0.26		t=-1.0, df=92, p=0.30	
Building type	3.32 (1.24)	2.81 (1.19)	3.68 (1.2)	3.09 (1.32)
	t=2.04, df=92, p=0.04		t=2.29, df=92, p=0.02	
Landuse variation	2.23 (1.25)	1.72 (1.08)	2.89 (1.58)	2.6 (1.58)
	t=2.12, df=92, p=0.04		t=0.91, df=92, p=0.36	

Finally, when the relation between objective and subjective measures of complexity and diversity is compared (Table 7) results showed partial support for the argument that "entropy calculations can be used instead of subjective evaluations of diversity and complexity". For facade material, the results gained from entropy calculations show the highest difference and entropy scores were parallel to the results gained from participants' subjective evaluations. For other variables and general evaluations,

the results did not show such strong support, rather the results are vague and inconsistent. Such inconsistencies may stem from methodological shortcomings which will be discussed in the next section.

4. CONCLUSION

This study aims to explore the extent to which entropy calculations can replace subjective evaluations of complexity and diversity which are generally achieved via surveys. An original methodology is proposed to measure entropy on urban skylines representing two types of residential areas, which are typical in Turkey. Results provide partial evidence for the use of entropy instead of surveys to evaluate complexity and diversity in urban areas. Evaluations for facade material were similar to the results gained from entropy calculations. However, entropy scores were not parallel to evaluations of other variables. The following methodological shortcoming may have produced these inconsistencies for those factors. First, the thresholds used to assign each building to one of the levels of each variable may be incorrect. For example, for building form wide and square building types may be more differentiable when the building is large and less differentiable when the building is small yet they are counted as two different classes. Second, one scene may involve many levels of a variable (e.g. various building forms) which makes that scene perceived as complex or diverse for bare eyes. Yet, despite this variation, if one type is dominant than the others then the entropy value is calculated as low. In other words, when one type dominates; entropy calculations based on frequency may fail to reflect people's perceptions of diversity and complexity. Third, entropy calculations ignore the spatial distribution of items in a scene. Yet, as Gestalt principles suggest our eyes perceive the different items in a scene based on similarity, continuation, closure, proximity. Given that, more work is on call to improve the calculations for entropy.

Despite all these limitations, this study has applied value as one needs to design not just based on intuition but with the knowledge that can be tested and reproduced. Design guidelines that highlight the importance of achievement of high visual diversity and moderate complexity in an environment are subjective and vague. Such subjective referrals may be misinterpreted by designers. Given that, creating better environments based on such subjective design guidelines is completely aleatory. Objective measures that explain design guidelines more specifically is necessary. Entropy can be one of these objective measures. This study proposes a methodology which can be improved by future studies. When such objective measures are developed, they can be used to evaluate the success of alternative designs and to direct decision-makers to choose better alternatives.

5. ACKNOWLEDGEMENTS

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Urban Security Planning: Models for Building Threat-Free Environments with Spatial Design Tools

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ABSTRACT

From the early ages to the present day, cities and living environments demanded the need for common and uninterrupted safety. The city not as a collective form of built environment, but also as a base for safety and technological defence systems varied from border security to protection of urban cores and crowded places like squares and public buildings. These modes of varying systems of peace keeping and threat-free zoning builds up with digital and physical defence systems ubiquitously encompassing our lives. Furthermore, basic expectations of livelihood for cities and countries encompass; population dynamics in the periods of migration and outmigration, urban dwelling through deliberate action and cooperation for daily basic activities, ideological / religious / cultural communities, tensions between middle age relic feudal modes and modern societies. Such motivations and/or conflicts create the expectation of people not be harmed by any kind of threat.

In this context, this paper will give findings from three sets of inquiry for building the foundations of a "Urban Security Planning Model". In the first part of this paper; risks posed by war, asymmetrical war and terrorism in a context of safety / security expectation and motivation and security in space and safety strategies for terrorism resistant cities and safety and risk management theories will be discussed. In the second part; discussions on the use of space and urban geography on different sides and terrorist group attacks in regional or civil war will be given. In the third part, urban and rural cases for PKK terrorist attacks in the last 35 years, ASALA Terrorist attacks between 1975-1985 and a prominent international case of Afghanistan-Kabul case which is underpinned as a case of urban life under the threat of war, occupation and terrorist groups will be evaluated. In the concluding chapter, uses of space and geography for the synthesis on reducing the risks of security service provisions, discussions of risk management in the contexts of security, war, terror and defence activities, and model representations of spatial design tools and prospects for urban planning and design discipline will be speculated.

Keywords: urban security, war, asymmetrical war, terrorism, spatial design.

1. INTRODUCTION

From the early ages to the present day, cities and living environments demanded the need for common and uninterrupted safety. The city not as a collective form of built environment, but also as a base for safety and technological defence systems varied from border security to protection of urban cores and crowded places like squares and public buildings. These modes of varying systems of peace keeping and threat-free zoning builds up with digital and physical defence systems ubiquitously encompassing our lives. Furthermore, basic expectations of livelihood for cities and countries encompass; population dynamics in the periods of migration and outmigration, urban dwelling through deliberate action and cooperation for daily basic activities, ideological / religious / cultural communities, tensions between middle age relic feudal modes and modern societies. Such motivations and/or conflicts create the expectation of people not be harmed by any kind of threat.

In this context, this paper will give findings from three sets of inquiry for building the foundations of a "Urban Security Planning Model". In the first part of this paper; risks posed by war, asymmetrical war and terrorism in a context of safety / security expectation and motivation and security in space and safety strategies for terrorism resistant cities and safety and risk management theories will be discussed. In the second part; discussions on the use of space and urban geography on different sides and terrorist group attacks in regional or civil war will be given. In the third part, urban and rural cases for PKK terrorist attacks in the last 35 years, ASALA Terrorist attacks between 1975-1985 and a prominent international case of Afghanistan-Kabul case which is underpinned as a case of urban life under the threat of war, occupation and terrorist groups will be evaluated. In the concluding chapter, uses of space and geography for the synthesis on reducing the risks of security service provisions, discussions of risk management in the contexts of security, war, terror and defence activities, and model representations of spatial design tools and prospects for urban planning and design discipline will be speculated.

2. CONCEPTUAL FRAMEWORK

The basic expectations of livelihood between cities and countries are;
a. increasing population accumulation in the periods of migration and prosperity,
b. Survival and survival through action and labour cooperation of daily and seasonal requirements,
c. religious and non-religious communities, relatives and blood-related tribes, under the domination or independent clan and other feudal clusters in the personal and / or relative groups has maintained the sense of security.
Such motivations create the expectation that they will not be harmed for the vital safety of individuals and societies. From the early ages to the present day, the need for security and the administrative arbitration took the form of "sur /wall", which was established before natural or artificial thresholds from primitive ages to middle ages. The city borders then evolved into a country border defined by patrolling and customs. In today's technological defence age besides digital country defence systems; "earth and air surveillance" in abundant everywhere.

The New Military Urbanism: The crossover between the military and the civilian applications of advanced technology - between the surveillance and control of everyday life in Western cities and the prosecution of aggressive colonial and resource wars-is at the heart of a much broader set of trends that characterize the new military urbanism. Of course, the effects observed in the urban Western setting differ wildly from those seen in the war-zone. But, crucially, whatever the environment, these hi-tech acts of violence are predicated on a set of shared ideas. (Graham, 2011)

Ring of Steel – London-UK: The security cordon around the City of London, named as Ring of Steel, was established for preventing terrorism. It was designed during the IRA 'troubles' era. Belfast was the

first to get a ring of steel and roads entering London were narrowed in order to force the drivers to slow down and with the help of this they could be recorded by CCTV cameras. These roads had a concrete median with a steel box where law enforcement personnel could stand and monitor the traffic. City planners call these precautions 'fortress urbanism'. In this kind of urbanism some roads can be closed to traffic entirely. Despite the term 'ring of steel', the roadblocks and chicanes are actually created with concrete blocks, sometimes plastic coated, that are plugged together.

Initially the ring of steel evolved to plastic cones and on duty policemen which the locals described as the 'ring of plastic' (URL 1). The steel barriers and guarding areas were then replaced by more permanent structures like concrete barriers, checkpoints and thousands of video cameras. After the 9/11 attacks, and the increased terrorist threats to the United Kingdom, security was an important issue again. In December 2003, the Ring of Steel was widened to include more zones in London. With the help of a system called ANPR traffic entering London was also monitored and recorded at many places by an automatic number-plate recognition system. This duty was 24/7. The data is stored for five years for analysis and evidence.

Fortress Urbanism: In fortress Urbanism the city is hardwired and scattered with security cameras, police check points and patrol stations with mid and high level protection walls. A culture of security surrounds us and slowly limits cultural windows of the city life. We can observe a space-time contraction between middle ages and nowadays. The city is parcelled between zones of protection and spaces in between. The area between the forts may turn into a space of no law, terrorized by bandits and gangs. We should be wondering if perhaps could someday serve as a predictive future history for cities like London and New York. (URL 2) That coming urban secrecy and fortressed paranoia is, in fact, already marked in advance for future readers in a poem by Seamus Heaney: "'O land of password, handgrip, wink and nod, / Of open minds as open as a trap, / Where tongues lie coiled, as under flames lie wicks, / Where half of us, as in a wooden horse / Were cabin'd and confined like wily Greeks, / Besieged within the siege, whispering morse…..This morning from a dewy motorway / I saw the new camp for the internees / A bomb had left a crater of fresh clay / In the roadside, and over in the trees"

Feral Cities: In a 2003 paper for the Naval War College Review, author Richard J. Norton defined the term feral cities. "Imagine a great metropolis covering hundreds of square miles," Norton begins, as if narrating the start of a film pitch. Once a vital component in a national economy, this sprawling urban environment is now a vast collection of blighted buildings, an immense petri dish of both ancient and new diseases, a territory where the rule of law has long been replaced by near anarchy in which the only security available is that which is attained through brute power. (URL 3)

Imagine a great metropolis covering hundreds of square miles, once a vital component in a national economy, this sprawling urban environment is now a vast collection of blighted buildings, an immense petri dish of both ancient and new diseases, a territory where the rule of law has long been replaced by near anarchy in which the only security available is that which is attained through brute power. With the city's infrastructure having collapsed long ago—or perhaps having never been built in the first place—there are no works of public sanitation, no sewers, no licensed doctors, no reliable food supply, no electricity. The feral city is a kind of return to medievalism, we might say, back to the future of a dark age for anyone but criminals, gangs, and urban warlords. It is a space of illiterate power—strength unresponsive to rationality or political debate. From the perspective of a war planner or soldier, the feral city is also spatially impenetrable, a maze resistant to aerial mapping.

Indeed, its "buildings, other structures, and subterranean spaces, would offer nearly perfect protection from overhead sensors, whether satellites or unmanned aerial vehicles. Urban terrain confronts military commanders with a synergism of difficulties rarely found in other environments," many of

which are technological. For instance, the effects of radio communications and global positioning systems can be radically limited by dense concentrations of architecture, turning what might otherwise be an exotic experience of pedestrian urbanism into a claustrophobic labyrinth inhabited by unseen enemy combatants.

The cities of the future, rather than being made out of glass and steel as envisioned by earlier generations of urbanists, are instead largely constructed out of crude brick, straw, recycled plastic, cement blocks, and scrap wood. Instead of cities of light soaring toward heaven, much of the twenty-first-century urban world squats in squalor, surrounded by pollution, excrement, and decay (Davis, 2007).

The extension of military ideas of tracking, identification and targeting into the quotidian spaces and circulations of everyday life, including dramatic attempts to translate long-standing military dreams of high-tech omniscience and rationality into the governance of urban civil society. This is just part of a "deepening crossover between urbanism and militarism. Cities themselves are portrayed "as intrinsically threatening or problematic places," Graham writes, and thus feared as sites of economic poverty, moral failure, sexual transgression, rampant criminality, and worse. All cities, we are meant to believe, already exist in a state of marginal ferality (Macek, 2006).

In some of the book's most interesting sections, Graham tracks the growth of urban surveillance and the global "homeland security market." He points out that major urban events—like G8 conferences, the Olympics, and the World Cup, among many others—offer politically unique opportunities for the installation of advanced tracking, surveillance, and facial-recognition technologies.

Deployed in the name of temporary security, however, these technologies are often left in place when the event is over: a kind of permanent crisis, in all but name, takes over the city, with remnant, military-grade surveillance technologies gazing down upon the streets (and embedded in the city's telecommunications infrastructure). A moment of exception becomes the norm. Graham outlines a number of dystopian scenarios here, including one in which "swarms of tiny, armed drones, equipped with advanced sensors and communicating with each other, will thus be deployed to loiter permanently above the streets, deserts, and highways" of cities around the world, moving us toward a future where "militarized techniques of tracking and targeting must permanently colonize the city landscape and the spaces of everyday life." (Graham, 2011).

3. CASES DEPICTING DEFENDING CITY FRAMEWORKS

In this section, we will give brief and concise information and evaluation of three vital cases for Turkey's defending city agenda. PKK-KADEK, ASALA and Taliban as an extreme case demolishing spatial and political system of Kabul and Afghanistan

3.1 PKK – KADEK Terror Networks

Below is given a brief and periodical actions of the terrorist group, with a section summarizing their spatial tactics.

- ➔ November 1978: declaration of expanding terrorist actions by incorporating city and regional wide attacks / May 1978 many ringleaders arrested by security forces / Head ring leader flees to Syria / 30th of June Hilvan Kurt-Başı village bombed attack and many other citywide attacks / Although 12th of September 1980 military coup silenced many attacks, attack capabilities of the terrorist alliance still in effect /
- ➔ 1980-1984: Lebanon Bekaa Valley – 300 terrorists been trained by term president Assad / Northern Iraq camps /

- ➔ 1984-1993: guerrilla tactics used for terror attacks in south-east region of Turkey / accelerated attacks between 1992-1993 and peaks in 1994 /
- ➔ 1993-1998: moving away from separatist agenda and moving towards autonomous regional territory argument / besides pseudo arguments, attacks on civilians accelerates (Başbağlar Massacre - Suicide Attacks) /
- ➔ 1998-2002: PKK-KADEK ring leader caught by diplomatic force use in Kenya-Nairobi /
- ➔ 2002-2009: dissolution of excessive terrorist attacks / so-called political agenda / pushing terror groups outside Turkish Territory / Introducing out of boundary operation agenda by Turkish Republic
- ➔ 2009-2020: 2015 so called dissolution-resolution process / Ditch Resistance 2016 / Kahramanmaraş and Osmaniye Fires in 2020 by allied sub-groups

Table 1. Martyr lives claimed by PKK-KADEK and retaliations

YEARS	TERMINATED PKK TERRORISTS	**CIVILIAN MARTYRS**	**MILITARY OFFICER MARTYRS**	**SECURITY PERSONNEL MARTYRS (POLICE)**	**VILLAGE GUARDS MARTYRS**	**TOTAL MARTYRS**
1984	11	20	24	0	0	44
1985	100	82	67	0	0	149
1986	64	74	40	3	0	117
1987	107	237	49	3	10	299
1988	103	81	36	6	7	130
1989	165	136	111	8	34	289
1990	350	178	92	11	56	337
1991	356	170	213	20	41	444
1992	1055	761	444	144	167	1516
1993	1699	1218	487	28	156	1889
1994	4114	1082	794	43	256	2175

Geographical and spatial methods and tactics used in terrorist attacks are;

- ➔ Attack focusing on mountainous regions and crowded urban cores
- ➔ Using caves, coves and slits for hiding from land and air operations
- ➔ Logistics and supply maintenance from Syrian and Greek governments, as well as US and Russia
- ➔ Turkish armed and security forces and officials as the main target / gunned and bombed attacks in Turkey and Northern Iraq
- ➔ Claiming many lives –especially teachers and public officials – in mass massacres and suicide attacks in city centres.
- ➔ Bombed attacks in tourism centres such as Kuşadası and Antalya
- ➔ The terrorists carried out its actions in city centres and used civilians as shields
- ➔ Demonstration-protest-riot, kidnapping, assassination, sabotage, chemical warfare; bomb attacks to post offices, train stations, power lines and police stations; armed attacks to military facilities, police and village guards)

3.2 ASALA Terror Networks

Below is given a brief and periodical actions of the terrorist group, with a section summarizing their spatial tactics.

- ➔ ASALA (Armenian Secret Army for the Liberation of Armenia), period between 1975 – 1994 (non-active after 1984)
- ➔ Terrorist Attack Regions: Middle East, Europe, Turkey and Armenia
- ➔ Ideologies: mixed set of hatred for Turkish Identity, Extreme Armenian Nationalism
- ➔ Listed as Terrorist Group in USA, Canada, UK and Turkey
- ➔ 70 bombed and 39 gunned assaults in 38 cities in 21 countries (including Turkey)
- ➔ Enlisted as Foreign Terrorist Organisations and US Terrorist Exclusion List in USA; Proscribed Group-UK; Specified Groups (Australia, Canada, EU and Russia)

Geographical and spatial methods and tactics used in terrorist attacks are;

- ➔ Attacks: mostly Turkish Officials as targets, + Trans World Airlines (Madrid) Air Canada (Los Angeles), total 110 incidents
- ➔ Turkish Martyrs: 42 diplomats and 4 foreign citizens,
- ➔ Wounded: 15 Republic of Turkey Citizens and 66 foreign citizens
- ➔ First bombed attach in Turkey: 7th of August 1982, Ankara Esenboğa Airport (9 Martyrs, 72 wounded)
- ➔ According to US Records: since 1968, 84 incidents, 299 wounded and 46 lives claimed.
- ➔ Close ties and terrorist collaboration with PKK-KONGRA-GEL+IRA+Italian Red Brigades
- ➔ All attacks to civilian targets (Target Typology): Diplomatic Targets %41, Airports and Aviation Facilities %34, Offices+Shops %14 and others (civilians+press+religios targets+transportaion facilites) %11
- ➔ Dis-mantling of the group: After 1983 Paris Orly airport attack + dispersed and demolished by security forces

3.3 KABUL-AFGHANISTAN CASE-Taliban

During its rule, Taliban controlled almost 90% of Afghanistan territories. It was deprived in November 2001 as a result of the operation launched on the grounds that it was protecting Osama bin Laden, which the US held responsible for the attacks after the September 11, 2001 attacks. In 2004, the Taliban reorganized and resisted the US and its Allies. In 2009, the rebellion strengthened and returned to guerrilla warfare.

As of 2013, this "guerrilla warfare" turned into a mixed form of attack on hand-made explosives (HME), light weapons and HME-Light Weapons, mostly on city centres and main sub-routes.
As the Afghan Security Forces increase their strength and training, such attacks are diminishing
The United States military has been engaged in Afghanistan since shortly after the 9/11 attacks in 2001 but however, in 2018, it is still not completely eliminated and continues terrorist activities in Afghanistan. It continues to exist in the Pashtun region in the north of Pakistan and is causing losses to alliance forces through terrorist acts. In its struggle with the alliance forces, the Taliban make propaganda to the public that 'foreign forces and the government that supports it are the greatest threat to their existence'. It can be said that this propaganda was partly successful

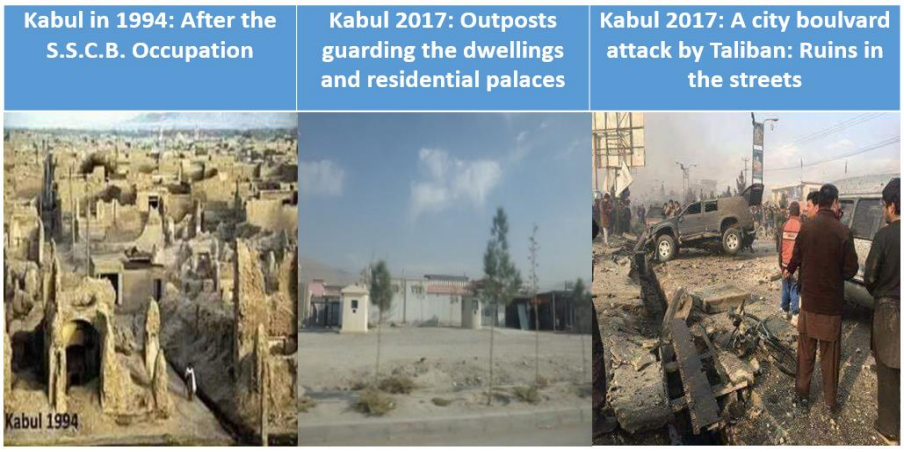


Figure 1. Kabul City between 1994 and 2017

Negative effects of distorted settlement on security perception due to very high rental rates in Kabul City:

In Kabul, people live in ruined houses and suffer from "burnout syndrome" due to insufficient infrastructure; like longing power cuts, lack of sewage systems. As a result of electrical cut downs due to lack of infrastructure, fire broke out many times in the city and this situation caused great economic losses. The perception that "nothing will improve" and that "irregularity will last a lifetime" causes the concept of safe city not to be established as in "broken windows theory" (URL 5). As in the example of the Republic of Turkey; providing housing for low-income groups (such as 1+1 in size to meet basic family needs and privacy) is necessary. Infrastructure and low budget trade areas and streets should be built and economic losses and mass demolitions should be prevented.

Lack of greenery, breathing city, socialization and recreation areas:

Near Kabul, there is only one green area called Pakman. Both historical photographs and interviews with the elderly, reveal that Kabul had a green nature. Human being is a whole with nature and as s/he uses the green spaces, the inhabitants of that city feel alive. A positive psychological state will reduce the tendency to commit crime in society. This will contribute to the construction of a safe city. Among the social activities of the people of Kabul are gathering and going to the picnic. Meat is relatively accessible because livestock is dense. Spreading these green spaces into the city in small dimensions will enable the people who do not have cars to produce positive psychological feelings intertwined with greenery and will not constitute a collective target since the people are not gathered in only one area. Sports areas such as free style cycling or skateboarding should be created for a small number of people. The main reason for this is that security in Kabul has not been fully achieved yet. The areas where many people will gather and watch and play sports may lead to security weakness.

Colourless city, no livelihood:

The buildings in Kabul city centre are generally surrounded by concrete walls and barbed wires, depicting a colourless life. Political messages are sometimes hung or written on these walls. Since these walls cannot be demolished easily as they are private property, at least they can be coloured to create positive emotions for the citizens. By establishing teams by the municipality, the walls can be painted in lively colours as in many world cities. The squatter housing slums in the hilly terrain opposite the Police Headquarters were initially painted in this way but were left unfinished due to the budget constraints. During a meeting with a police officer, he was interviewed to comment on the psychological effects of the activity on him and he replied; "I felt alive. I was happy to look at this view every day."

Production is almost non-existent:
Economic production in Kabul is very low. The factories are bombed and demolished. Infrastructures for employment deployment need to be planned and constructed. As long as NATO Base is seen as a source of trade and employment, there is low chance of improvement of overall city.
In the centre of Kabul City, there is a region called Green Zone. This zone, which is guarded like a fortress, encompasses ministries, embassies and military bases. Also the Green Zone cannot be visited by an ordinary Afghan without being checked several times. Moving facilities such as embassies and military bases out of the city may contribute to the "normalization" of the city. Afghanistan is Afghans, and the city of Kabul belongs to her inhabitants.

Table 2: Summary Framework: Security Management Problems in Kabul

Taliban Attacks in Kabul: Kabul Security Helix	Unplanned and unregulated urban setting	Warlords and local merchants building fortress gated campuses as sanctuaries
No Green Infrastructure	No eligible production sector	Colourless city life

4. DEFENDING CITY – RESILIENT CITY

Due to the increasing terrorist measures and widespread low-intensity war environments all over the world, "how to make cities safer" is an important debate. In this sense, the concepts of "resilient city" or "defending city" are used. With these concepts, it is expressed that they fulfil important defence and protection functions that protect people living in cities from internal and external threats. Because the new threats that arise bring into the agenda holistic measures that should be taken not only by law enforcement agencies but also by city administrations. Especially in cities, it is important to make efforts to increase security by reorganizing public spaces.

In this respect, there are five different implementation strategies brought by the "preventive city" approaches applied in making cities safe against terrorism in the world. These are;
Covered Space: Concealing the public spaces and gathering areas in the city visually so that terrorist attacks cannot be targeted directly.
Slippery Space: The design of public spaces in the city to be accessed indirectly.
Stretched/Textured Space: Placing preventive elements against explosions and terrorist attacks in public spaces in the city, establishing checkpoints.
Barbed Space: Reconsidering urban furniture in a way to make terror behavior difficult in public spaces in the city.
Tense Space: Continuous monitoring of public spaces in the city with effective surveillance tools (Şahin, 2016).

The situation of the cities should definitely be addressed at the crisis tables created for security at the top level of the state. City administrations should be made aware of this issue, cooperate with universities and non-governmental organizations and form an action plan on designing secure cities. Intensive use and excessively dense public transport transfer stations in the city centre should be distributed and turned into a more extensive network. City centres should be closed to excessive transit traffic, and the number and scope of pedestrian zones should be expanded by carrying out widespread pedestrianization. Urban design practices should be implemented in city centres to reduce the possible post-effects of terrorist incidents. Corridors should be established to facilitate the access of emergency teams to urban public spaces before and after terrorist attacks and to ensure the evacuation of citizens without any problems.

5. CONCLUSION

In this paper, we deliberately did use any image referring or relating to terrorist attacks. Because threat networks and groups purposefully aim to surpass peaceful images within the minds of civilians and pave a way to force their agenda by triggering and sustaining fear, restlessness and discomfort among the public. So any image documenting or portraying about the damage they had given, or any civilian losing her/his life would be a way of projected propaganda. The more you want to ensure your safety, the more you might be away from the public realm and become a victim of totalitarian waves of discontent. Shortly freedom and legal rights of citizenship cannot be compromised for overall public safety. Cities in history were protected by high walls and ironman shielded guards. But now – in modern times - cities are and must be protected by the rule of law based on human and citizenship rights. In this context, this paper is a sample of a series of other papers discussing also the regional and territorial contexts of terror risk management in frames such as, security, war, terror and defence activities in other countries.

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The Analyzing of the Construction Systems of the Field Hospital Applications around the World

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ABSTRACT

There have been many epidemic diseases throughout the history of humanity. One of the epidemic diseases is Covid-19 epidemic that affects recent past and near future significantly. This unpredictable situation affects the society in terms of socio-cultural, economical, health as well as in the fields of architecture and engineering. While the epidemic cannot be prevented, places where infected people can be treated in isolation from the society are needed. Field hospitals that produced with different construction systems have built in many countries as a solution for this problem. In this research, it is aimed to examine the construction systems of the field hospitals within the period of the Covid-19 epidemic. The construction systems of field hospitals that built world's various countries and Turkey were analyzed. Based on this analysis, there have been made inferences that why countries may have preferred this construction systems. In this framework, the use of qualitative research methods has been emphasized. Documents and literature were examined. So, the differences in the own resources and technological infrastructure of the countries explain the diversity of the construction systems that used. The field hospital established in Wuhan, China, is formed by placing the containers on top of each other and side by side. In İstanbul, Turkey, it is produced from mild and structural steel. In Central Park, America, and Cremona, Italy, hospital is built with a pneumatic system. In Sao Paulo, Brazil, and in Mulhouse, France, and in Gothenburg, Sweden, hospital is constructed with mild steel and membranes. In Rafah, Gaza, hospital is built with masonry system with brick material. In Russia, is constructed with structural steel. By emphasizing the positive and negative aspects of construction systems, field hospital applications were examined and inferences were made as a result of the analysis.

Keywords: Field Hospitals, Covid-19, Construction System Applications, Pandemic Disease

1. INTRODUCTION

In history, many diseases have been existed since the existence of mankind. However, some diseases have been affected the world not only regionally but also globally. So it has been turned into a pandemic situation such as Spanish flu, SARS, Covid-19 etc. Because these diseases has been transmitted by respiratory, it could not be prevented and spread rapidly. One of the steps to be taken to prevent the spread in the community is to isolate and treat the infected person as soon as possible. At this point, the role of architects and engineers has been important as well as health-care workers.

To construct appropriate hospitals for treatment has been a good solution to prevent the pandemic. One of the design approaches for these hospitals is converting existing places for treatment [1]. Therefore, various countries constructed field hospitals with different construction systems. These hospitals can be either temporary or contemporary. In this research, twelve field hospitals from various countries that built in both SARS and Covid-19 period were examined. The construction systems of these hospitals were analysed. A table was designed based on these data. The construction system that was chosen by countries was examined and various inferences obtained.

1.1 Defining the Problem

Many diseases have been occurred throughout human history. These unavoidable diseases have turned into a pandemic and have affected the whole world. In this case, the best measure to be taken is to reduce the risk of contamination and prevent spread. Within this framework, many field hospitals have been built. Because quick construction process is needed, the construction system type is also important.

1.2 Purpose of the Study

The aim of this research is to examine the construction systems of the field hospitals were built. In this context, field hospitals were built in various countries of the world were analysed. Based on the data, evaluations were made and conclusions were obtained.

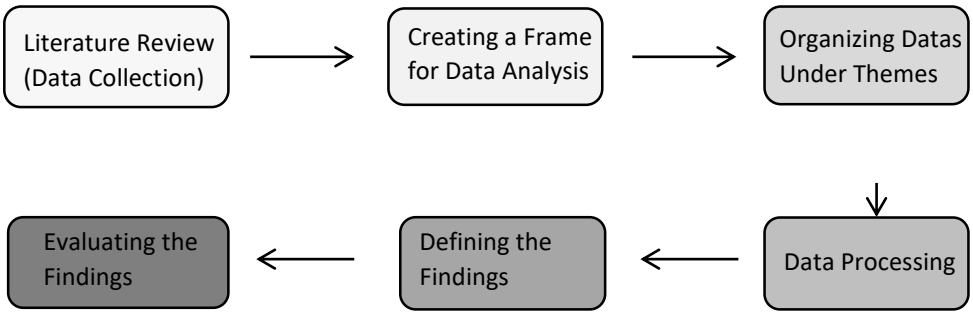
1.3 Scope of the Study

Since the pandemic disease is a worldwide epidemic, pandemic hospitals are built in different countries to solve these health problems. In this context, the construction systems of field hospitals that built world's various countries and Turkey were examined. But in this frame, field hospitals evaluated in two basic parts. One of them is converted temporary hospitals. The other one is new built field hospitals.

1.4 Methodology of the Study

In this research, qualitative method has been used. Literature review has been done.

Table 1. Methodology of the Study [2].



2. DEFINITIONS and LITERATURE REVIEW

For this research some definitions are important to understand the concept of field hospital that constructed in pandemic period. Also literature review is significant. For title of this research, what type of researches were made and what is difference between past researches and this research subject is important. This analysis made this subject unique.

2.1 Definitions

There are two types of definitions. These two definitions explain the differences between them and field hospital that was constructed in pandemic period.

2.1.1 Field Hospital

This is a mobile, self-contained, self-sufficient health care facility that capable of rapid deployment and expansion or contraction to meet immediate emergency requirements for a specified period of time [World Health Organization] [Figure 1]. This facility is built during war and it is easy to set up and detachable in short period of time. But in pandemic, the most important part is isolation and hospitals can be either temporary or contemporary.

2.1.2 Emergency Care

Emergency care covers a spectrum of activities, including pre-hospital care and transport; initial evaluation, diagnosis and resuscitation and in hospital care [World Health Organization] [Figure 2]. This facility includes long process and focuses on various periods. But for pandemic, time is short and the main issue is isolation.



Figure 1. No 13 Field Hospital near Vendeuil Caply, France, World War I [3].

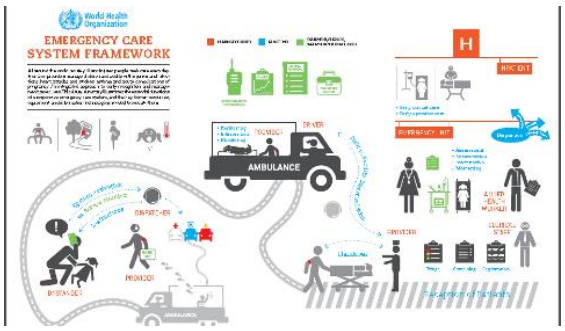


Figure 2. Emergency Care System [4].

2.2 Literature Review

There weren't many researches in the literature related with this topic. Recently, there were a few studies but both their context and emphasized points were different from this topic. So lack of the information about field hospitals construction systems have been made research subject unique.

In the Covid-19 period hospital capacity for patients has been questioned and needs changed. There were decisions to be taken. There is a study about this issue but they just focused on the hospital capacity for patients in the scope of Covid-19 period [5].

Emergency department design has some principles. For the design process there was a study that emphasized it. The main issue on this study was flexibility of the layout of the plan. It included the relationship between spaces and how to organize spaces or rooms [6]. But for Covid-19 pandemic period, hospitals were design with standards to prevent virus transmission.

In Covid-19 period, one of the first built field hospitals was Leishenshan Hospital. To construct a hospital in a short period of time and also with certain standards, there was some process that should be followed. With help of simulation and BIM technology, it was possible to build field hospital for Covid-19 patients [7]. But in this study, one hospital in Wuhan district was analysed. This analysis was focused on regional not global.

In Wuhan district when the first Covid-19 cases were occurred, government took the decision to convert spaces that appropriate for treatment to field hospitals. From this perspective, not only new built field hospitals but also converted hospitals were used for treatment. Because these places temporary, they were used in a period. If there was severe symptomatic patient, he wasn't hospitalized in converted places. He was transferred to new built field hospitals such as Leishenshan Hospital [8]. This article also was focused on regional district not global.

When Covid-19 was turned to pandemic situation, various countries were realized that precautions are needed. Because it was an unpredictable situation, there was lack of measures. In Bahrain, in short period of time like 7 days, military set up 130 beds intensive care unit [9]. This article was focused on Bahrain as regionally and also gave information about construction period.

Studies in the literature that related with this research title focused on regional information. In this research topic, there are different field hospitals from various countries. The construction systems of field hospitals were analysed. These criteria make this research topic unique.

3. FINDINGS

To explain the field hospital's construction system concept, hospitals that used in pandemic period have been analysed in world's various countries and Turkey. Based on evaluations, hospitals analysed in two main categories as;

- Converted Temporary Hospitals
- New Built Field Hospitals

3.1 Converted Temporary Hospitals

Large and wide span passing, temporary hospitals built by converting public venues, such as exhibition centres, stadiums into health care facilities to isolate patients with mild to moderate symptoms of an infectious disease from their families and communities while providing medical care, disease monitoring, food, shelter, and social activities [8].

Not only China but also other countries converted places to temporary hospitals for Covid-19 patients such as UK, USA, Spain, Italy, Germany, South Africa, Iran, Russia, Serbia etc.

ExCel London is an exhibition and international convention centre that has 100.000 square meter enclosed area. In Covid-19 period, because of increasing number of the patient government took the decision to convert ExCel London to temporary hospital [Figure 3]. So ExCel London became world's largest critical care unit [10]. Manchester Central Station was opened in 1880 as its first function. Due to preference of other transportation vehicles, usage of the train stations decreased. So this station closed in 1969 and converted to exhibition centre in 1982. In 2020, because of the Covid-19, this centre converted to temporary hospital as its third function [Figure 4] [11].



Figure 3. ExCel London Convention Center Converted Temporary Hospital, London, UK [10].



Figure 4. Central Station Converted Covid-19 Temporary Hospital, Manchester, UK [11].

Russia constructed new built field hospital for Covid-19 patients in March, 2020. As time passes, because of increasing in the number of Covid-19 cases, Russian government converted ice rink into temporary hospital in November 13, 2020 [Figure 5] [12].

Because coronavirus firstly occurred in Wuhan, China took a decision to classified patients with mild symptoms, moderate symptoms and severe symptoms. For mild and moderate symptomatic patients they have been converted places such as this stadium [Figure 6]. But for severe symptomatic patients, they have been built hospitals [8].

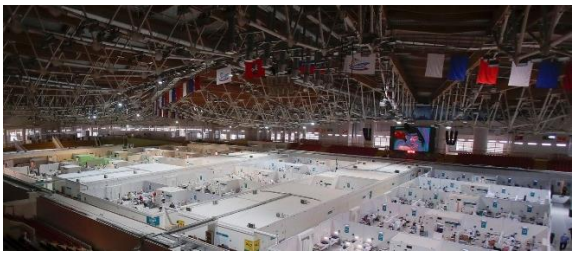


Figure 5. Ice Rink Converted Covid-19 Temporary Hospital, Moscow, Russia [12].



Figure 6. A Stadium Converted Covid-19 Temporary Hospital, Wuhan, China [8].

3.2 New Built Field Hospitals

In this research, constructed 12 field hospitals analysed chronologically based on opening days, in the scope of both Covid-19 and SARS diseases. One of the hospitals is constructed in 2003 for SARS patients and other 11 hospitals constructed in 2020 for Covid-19 patients. New built hospitals constructed based on some criteria such as isolation from society, accessibility for patients.

3.2.1 Xiaotangshan Hospital

Table 2. Information of Xiaotangshan Hospital

• Location	: Beijing, China	• Opening Day	: 30 April 2020
• Facility Usage	: Patients with severe symptoms	• Number of Storeys	: 1 storey
• Construction System	: Prefabricated Modular System	• Construction Period	: 7 days
• Construction Area (sqm)	: 25.000 sqm	• Patient Capacity	: 1000 beds
• Construction Workers	: 4000 workers	• Ventilation	: Mechanical V.

Xiaotangshan Hospital constructed in 2003 for patients in the period of SARS disease. After treatment, this place was abandoned until Covid-19 was occurred. Because of increasing of the cases, this hospital was renovated and prepared for Covid-19 patients [Figure 7]. This hospital was hospitalized patients with severe symptoms. As a construction system, prefabricated Modular system was used and it was built in 7 days [13].

Xiaotangshan Hospital was used as a model for China's new built hospitals in the Covid-19 period. Due to its construction period was short and layout of the plan was optimum based on some criteria, Chinese government decided to use it as a model for the other hospitals such as Leishenshan and Huoshenshan Hospital [13] [Table 2].



Figure 7. Xiaotangshan Hospital, 2003, Beijing, China [13].

3.2.2 Huoshenshan Hospital

Table 3. Information of Huoshenshan Hospital

• Location	: Wuhan, China	• Opening Day	: 3 February 2020
• Facility Usage	: Patients with severe symptoms	• Number of Storeys	: 1 and 2 storeys
• Construction System	: Prefabricated Modular System	• Construction Period	: 10 days
• Construction Area (sqm)	: 34.000 sqm	• Patient Capacity	: 1000 beds
• Construction Workers	: 7000 workers	• Ventilation	: Mechanical V.

Huoshenshan Hospital is China's first new built hospital in 2020, in the Covid-19 period. It was constructed between 23 January, 2020 and 2 February, 2020 [Figure 8]. Before the construction period, Xiaotangshan Hospital used as model for Huoshenshan Hospital. Because this hospital is temporary, when number of case started to decrease hospital was closed in 15 April, 2020. In Huoshenshan Hospital, prefabricated modular cell system applied [Figure 9]. A container-type prefabricated modular unit was selected for the isolation wards. The walls of this container were made of a double-sized steel glass sandwich panel, skeleton was made of galvanized cold-formed steel components that were connected by bolts [7] [Table 3].



Figure 8. Huoshenshan Hospital, 2020, Wuhan, China [14].



Figure 9. Huoshenshan Hospital Prefabricated Modular System [15].

3.2.3 Leishenshan Hospital

Table 4. Information of Leishenshan Hospital

• Location	: Wuhan, China	• Opening Day	: 8 February 2020
• Facility Usage	: Patients with severe symptoms	• Number of Storeys	: 1 and 2 storeys
• Construction System	: Prefabricated Modular System	• Construction Period	: 12 days
• Construction Area (sqm)	: 80.000 sqm	• Patient Capacity	: 1600 beds
• Construction Workers	: -	• Ventilation	: Mechanical V.

Leishenshan Hospital is China's second field hospital that was built in Covid-19 period [Figure 10]. Its construction period took 12 days with the huge 80.000 squaremeter area. In this pandemic period, rapid design and construction has been necessity. Prefabricated modular system has meet these needs [1].

Leishanshen Hospital constructed with prefabricated modular system. For prefabricated units, both container-type units and units as steel frames were used [Figure 11]. Medical technology facility of Leishenshan Hospital adopted steel structure since a container-type prefabricated unit was infeasible for this building [Table 4]. As Huoshenshan Hospital, this hospital also constructed with modeled on Xiaotangshan Hospital. Increasing with number of cases, Leishenshan Hospital was closed in 15 April 2020 [7].



Figure 10. Leishenshan Hospital, 2020, Wuhan,
China [16].



Figure 11. Leishenshan Hospital Prefabricated Modular System [17].

Site plan indicates 3 different areas as logistic, medical staff living and medical treatment areas [Figure 12]. On focused plan, contaminated zone defined where patients hospitalized. Also there are two different paths that used by medical personnel and patients separately [Figure 13] [7].



Figure 12. Leishenshan Hospital layout of the site plan [7].

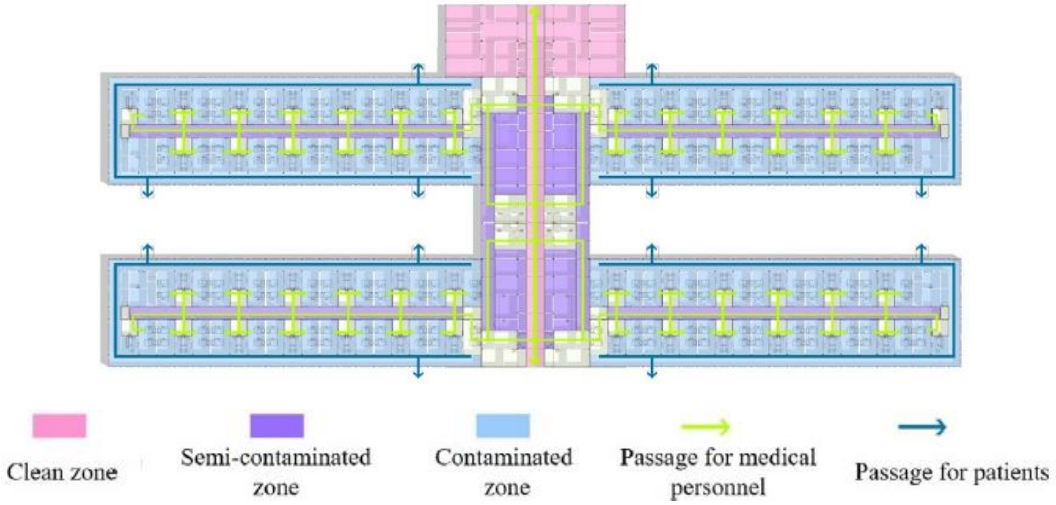


Figure 13. Leishenshan Hospital layout of the plan [7].

Before Leishenshan Hospital was constructed, it was designed with BIM modeling. With the help of simulation, mechanic ventilation system solutions were tried. There were four types of solution that air supply and air exhaust placed different positions. As seen in the simulation result, best solution that selected was A solution [Figure 14]. This simulation method was helped to solve problems before construction [7].

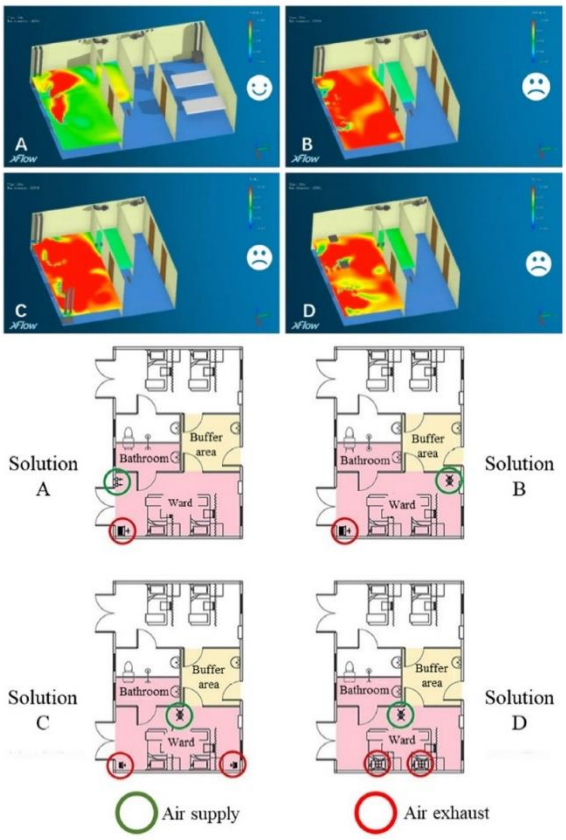


Figure 14. Leishenshan Hospital ventilation system [7].

3.2.4 Field Hospital

Table 5. Information of Italy's Field Hospital

• Location : Cremona, Italy	• Opening Day : 20 March 2020
• Facility Usage : Triage Centre	• Number of Storeys : 1 storey
• Construction System : Pneumatic System	• Construction Period : -
• Construction Area (sqm) : -	• Patient Capacity : -
• Construction Workers : -	• Ventilation : Mechanical V.

Italy's field hospital was set up in front of main hospital building as triage center for Covid-19 patients. In this place, patients were indicated and directed to the main hospital building accordingly. As construction system, pneumatic system was used. In the figure 12, red tank that was placed in right

side supplies air pressure to the system. With the help of yellow tube, air can reach to field hospital. Structural elements of the system can self-stand with supplied air pressure constantly [Figure 15] [Table 5] [18].



Figure 15. Field Hospital, 2020, Cremona, Italy [18].

3.2.5 Field Hospital

Table 6. Information of Russia's Field Hospital

• Location : Moscow, Russia	• Opening Day : 21 March 2020
• Facility Usage : Patients with severe symptoms and patients without symptoms	• Number of Storeys : 1 storey
• Construction System : Steel Construction	• Construction Period : 40 days
• Construction Area (sqm): 80.000 sqm	• Patient Capacity : 500 beds
• Construction Workers : 3200 workers	• Ventilation : Mechanical V.

Because of the characteristic of Covid-19, contaminated air should be cleaned. So Russia's field hospital was constructed far from settlement area. This hospital has been used by patients with severe symptoms and patients without symptoms. This field hospital has 80.000 square meter construction area. For construction period, it took 40 days to complete. Against the huge construction area, patient capacity is low [Table 6] [20].

Layout of the plan, Russia's field hospital resembles China's field hospitals such as Huoshenshan Hospital [Figure 16]. But as construction system, it is different from them. This field hospital built with steel construction system. Firstly, structural steel construction was built then covering materials were applied [Figure 17] [20].



Figure 16. Field Hospital, 2020, Moscow, Russia [19].

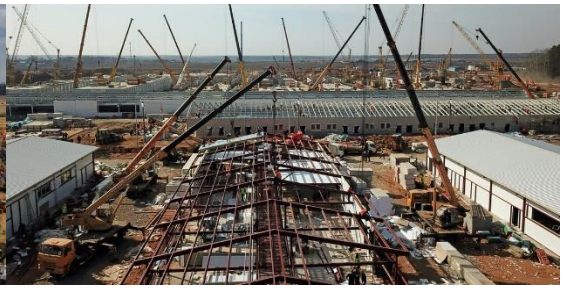


Figure 17. Field Hospital Construction Period [20].

3.2.6 Field Hospital

Table 7. Information of Sweden's Field Hospital

• Location : Gothenburg, Sweden	• Opening Day : 23 March 2020
• Facility Usage : Patients with severe symptoms	• Number of Storeys : 1 storey
• Construction System and Membran Cover : Steel Structure	• Construction Period : 3 days
• Construction Area (sqm) : -	• Patient Capacity : 20 beds
• Construction Workers : -	• Ventilation : Mechanical V.

This field hospital was constructed for severe symptomatic Covid-19 patients. It was opened in 23 March 2020. Sweden's field hospital also was set up in front of the main hospital. This field hospital built with steel structure as a frame. To cover up this structure, membrane material was used. For this system, single-storey system was appropriate to construct [Table 7] [21].

As construction period, it took only 3 days. Because it is easy to set up steel structure and membrane cover system, during wars it was used. Also it is easy to detach this system. This structure's patient capacity was 20 beds [Figure 18] [21].



Figure 18. Field Hospital, 2020, Gothenburg, Sweden [21].

3.2.7 Field Hospital

Table 8. Information of France's Field Hospital

• Location : Mulhouse, France	• Opening Day : 24 March 2020
• Facility Usage : Patients with severe symptoms	• Number of Storeys : 1 storey
• Construction System and Membran Cover : Steel Structure	• Construction Period : -
• Construction Area (sqm) : -	• Patient Capacity : 30 beds
• Construction Workers : -	• Ventilation : Mechanical V.

France's field hospital was constructed for severe symptomatic Covid-19 patients. It was constructed in Mulhouse near the heliport to transfer patients easily. For material supply, construction area was important also. It was opened on 24 March 2020 [Table 8] [22].

It resembles field hospitals that set up during wars. It is easy to set up and also detachable in short period of time. Its construction system is steel structure and membrane cover. As construction system, it was suitable for single-storey system [Figure 19] [22].



Figure 19. Field Hospital, 2020, Mulhouse, France [22].

3.2.8 Rafah Field Hospital

Table 9. Information of Gaza's Field Hospital

• Location	: Rafah, Gaza	• Opening Day	: 25 March 2020
• Facility Usage	: Patients with severe symptoms	• Number of Storeys	: 1 storey
• Construction System with Brick Material	: Masonry System	• Construction Period	: -
• Construction Area (sqm)	: -	• Patient Capacity	: 500 beds
• Construction Workers	: 200 workers	• Ventilation	: Mechanical V.

This field hospital was constructed in Gaza that isolated from society because of the characteristics of Coronavirus [Figure 20]. As a facility usage, it was built for severe symptomatic patients. In the construction area, there were 200 laborers that worked to construct. As patient capacity, 500 beds were served for patients [Table 9] [24].

It resembles It was built masonry system with brick material as construction system. From this construction system, it seems that it was constructed mostly with traditional methods and regional elements such as brick material [Figure 21] [24].



Figure 20. Field Hospital, 2020, Rafah, Gaza [23].



Figure 21. Field Hospital Construction Period [24].

3.2.9 Samaritan's Purse Field Hospital

Table 10. Information of Samaritan's Purse Field Hospital

• Location : New York, USA	• Opening Day : 1 April 2020
• Facility Usage : Patients with severe symptoms and patients without symptoms	• Number of Storeys : 1 storey
• Construction System : Pneumatic System	• Construction Period : 2 days
• Construction Area (sqm) : 500 sqm	• Patient Capacity : 68 beds
• Construction Workers : -	• Ventilation : Mechanical V.

This field hospital was set up in the Central Park in New York. It hospitalized patients with severe symptoms and patients without symptoms. It was opened on 1 April 2020. It took two days to construct this facility. As construction area, it is 500 square meter [Table 10]. Lots of care units were set up and open for use of 68 patients. It was constructed as pneumatic system that works with air supplied arches repeats themselves to self-stand. There are also air supplied tubes that support this system with perpendicular joint [Figure 22] [Figure 23] [26].



Figure 22. Samaritan's Purse Field Hospital, 2020, New York, USA [25].



Figure 23. Field Hospital Pneumatic System Interior [26].

3.2.10 Field Hospital in Pacaembu Stadium

Table 11. Information of Brazil's Field Hospital

• Location : Sao Paulo, Brazil	• Opening Day : 6 April 2020
• Facility Usage : Patients without symptoms	• Number of Storeys : 1 storey
• Construction System and Membran Cover : Steel Structure	• Construction Period : -
• Construction Area (sqm) : 6.000 sqm	• Patient Capacity : 200 beds
• Construction Workers : -	• Ventilation : Mechanical V.

This field hospital was set up in the Pacaembu Stadium, in Brazil. It was opened on 6 April 2020. As construction area, it is 6.000 square meter. In this 6.000 square meter, 200 beds were prepared for Covid-19 patients. This facility was settled on turf area. At perimeter, there are seating areas for audience that belong Pacaembu Stadium [Table 11] [27].

It was constructed as steel structure and membrane cover. This facility was accepted moderate symptomatic patients. With the help of Pacaembu Stadium's tribune, this field hospital was isolated from the city [Figure 24] [27].



Figure 24. Field Hospital in Pacaembu Stadium, 2020, Sao Paulo, Brazil [27].

3.2.11 Prof. Dr. Feriha Öz Emergency Hospital

Table 12. Information of Prof.Dr. Feriha Öz Emergency Hospital

• Location : İstanbul, Turkey	• Opening Day : 29 May 2020
• Facility Usage : Patients with severe symptoms and triage centre	• Number of Storeys : 1 storey
• Construction System : Steel Construction	• Construction Period : 45 days
• Construction Area (sqm) : 75.000 sqm	• Patient Capacity : 1008 beds
• Construction Workers : 4000 workers	• Ventilation : Mechanical V.

Prof. Dr. Feriha Öz Emergency Hospital was constructed in İstanbul, in Turkey. It was opened on 29 May 2020. As construction area, it is 75.000 square meter. Besides patient capacity is 1008 beds. It took 45 days to construct [Table 12] [28].

Layout of the Prof. Dr. Feriha Öz Emergency Hospital plan resembles Russia's field hospital and China's Xiaotangshan Hospital that was used as model for China's other field hospitals [Figure 25]. But this hospital's construction system is steel construction. It is different from China's prefabricated modular system. At the same time its' construction system is the same with Russia's field hospital. As a structural material, 230 tons mild steel and 120 tons structural steel was used [Figure 26] [28].



Figure 25. Prof. Dr. Feriha Öz Emergency Hospital, 2020, İstanbul, Turkey [28].



Figure 26. Prof. Dr. Feriha Öz Construction Process [28].

3.2.12 Prof. Dr. Murat Dilmener Emergency Hospital

Table 13. Information of Prof.Dr. Murat Dilmener Emergency Hospital

• Location	: İstanbul, Turkey	• Opening Day	: 31 May 2020
• Facility Usage	: Patients with severe symptoms and triage centre	• Number of Storeys	: 1 storey
• Construction System	: Steel Construction	• Construction Period	: 45 days
• Construction Area (sqm)	: 75.000 sqm	• Patient Capacity	: 1008 beds
• Construction Workers	: 4000 workers	• Ventilation	: Mechanical V.

Prof. Dr. Murat Dilmener Emergency Hospital was constructed in İstanbul, in Turkey. It was constructed in Atatürk Airport region. It was opened on 31 May 2020, two days after Prof. Dr. Feriha Öz Emergency Hospital. As construction area, it is 75.000 square meter. And patient capacity is 1008 beds. It also took 45 days to construct [Table 13] [29].

Construction system of Prof. Dr. Murat Dilmener Emergency Hospital is steel construction. It was constructed with the same construction system type of Prof. Dr. Feriha Öz Emergency Hospital [Figure 27] [29].



Figure 27. Prof. Dr. Murat Dilmener Emergency Hospital, 2020, İstanbul, Turkey [29].

4. DISCUSSION

With the analysing of the findings, table was composed. Field hospital applications were arranged chronologically based on the days they were opened. This table was designed based on the comparison of the information regarding these hospital applications. This information were organised under some headings such as facility usage, construction system type, area, period, workers, patient capacity, number of storeys, ventilation [Table 14].

Table 14. The Analysing of the Field Hospital Applications

Field Hospital Applications	Facility Usage (Based Patient Group)			Construction System Type	Construction Area (sqm)	Number of Storeys	Construction Period	Construction Workers	Patient Capacity	Ventilation (Mechanic)
	Triage Center	Patients without Symptoms	Patients with Severe Symptoms							
Xiaotangshan Hospital (China)			✓	Prefabricated Modular System	25.000 sqm	1 storey	7 days	4000 workers	1000 beds	✓
Huoshenshan Hospital (China)			✓	Prefabricated Modular System	34.000 sqm	2 ve 1 storeys	10 days	7000 workers	1000 beds	✓
Leishenshan Hospital (China)			✓	Prefabricated Modular System	80.000 sqm	2 ve 1 storeys	12 days	_	1600 beds	✓
Field Hospital (Italy)	✓			Pneumatic System	_	1 storey	_	_	_	✓
Field Hospital (Russia)		✓	✓	Steel Construction	80.000 sqm	1 storey	40 days	3200 workers	500 beds	✓
Field Hospital (Sweden)			✓	Steel Structure + Membran Cover	_	1 storey	3 days	_	20 beds	✓
Mulhouse Field Hospital (France)			✓	Steel Structure + Membran Cover	200 sqm	1 storey	_	8 workers	30 beds	✓
Rafah Field Hospital (Gaza)			✓	Masonry System with Brick Material	_	1 storey	_	200 workers	500 beds	✓
Samaritan's Purse Field Hospital (USA)		✓	✓	Pneumatic System	500 sqm	1 storey	2 days	_	68 beds	✓
Field Hospital in Stadium (Brazil)		✓		Steel Structure + Membran Cover	6.000 sqm	1 storey	_	_	200 beds	✓
Prof. Dr. Feriha Öz Emerg. H. (Turkey)	✓		✓	Steel Construction (mild + structural)	75.000 sqm	1 storey	45 days	4000 workers	1008 beds	✓
Prof. Dr. Murat Dilmener Emerg. H. (Turkey)	✓		✓	Steel Construction (mild + structural)	75.000 sqm	1 storey	45 days	4000 workers	1008 beds	✓

Number of the field hospitals that were constructed is twelve. Three of them were constructed in China and two of them were constructed in Turkey. Each one of them was built in USA, France, Italy, Russia, Brazil, Gaza and Sweden [Figure 28].

Three type of facility usage have been available. Three of them have been used as triage centre. Also three of them have been used by patients without symptoms. The part with the most number with 10 has been used by patients with severe symptoms [Figure 29].

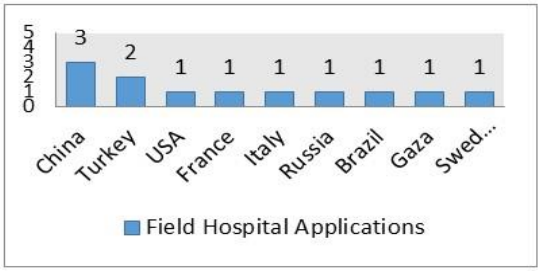


Figure 28. The Distribution of the Applications

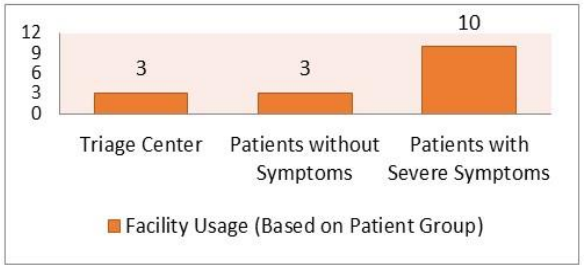


Figure 29. The Distribution of the Facility Usage

Five different construction system were used by nine various countries as field hospital. Prefabricated modular system was used only for China's field hospitals. But steel construction system was used both for Turkey's two field hospitals and Russia's field hospital. Steel structure and membrane cover, it was used by the most number of countries such as Sweden, Brazil and France. Pneumatic system was chosen by Italy and USA. Masonry system with brick material that is old traditional system was chosen only by Gaza [Figure 30].

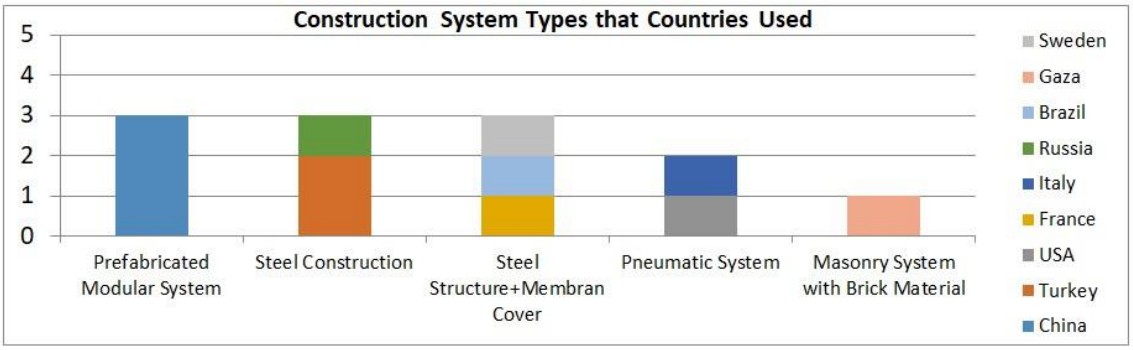


Figure 30. The Distribution of the Construction Systems by Countries

Comparison between construction period and patient capacity of field hospitals' provides many results in the analysis of the data. Prof. Dr. Feriha Öz and Prof. Dr. Murat Dilmener Emergency Hospitals and Russia's field hospital have the longest construction period. However, Xiaotangshan, Leishenshan and Huoshenshan Hospitals have the highest patient capacity. Construction period and patient capacity of the Sweden's and USA's field hospitals have the lowest numbers but it is consistent in itself [Figure 31, 32].

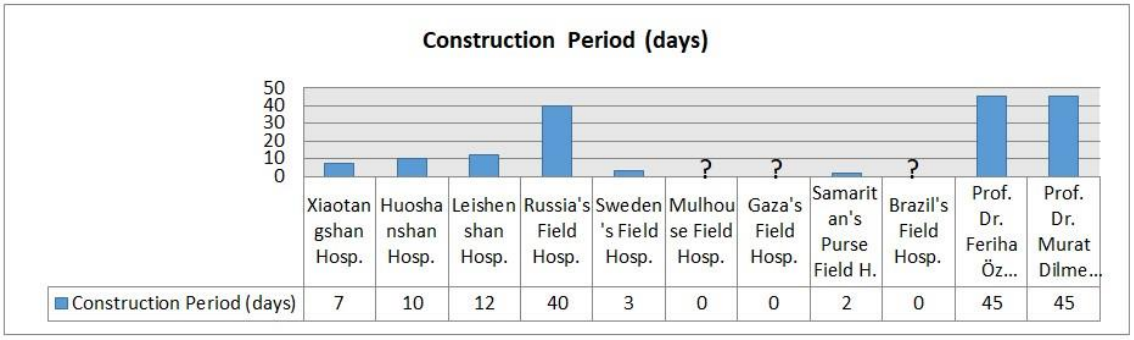


Figure 31. The Construction Periods of the Field Hospitals

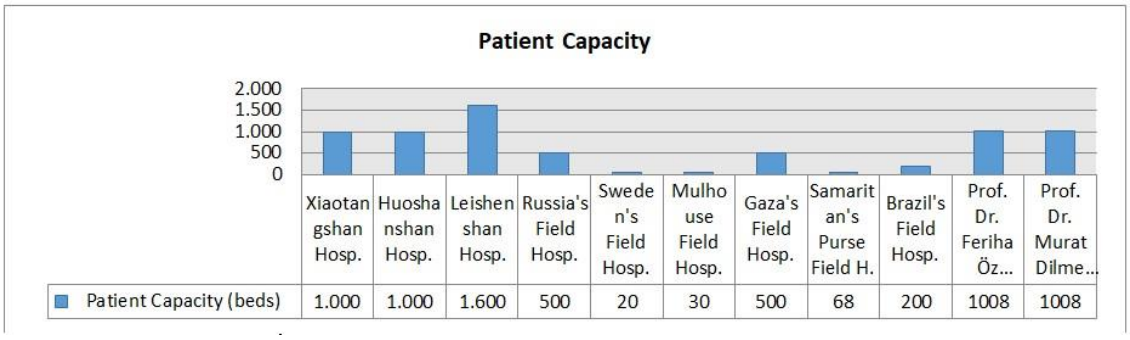


Figure 32. The Patient Capacity of the Field Hospitals

Also comparison between construction area and patient capacity of field hospitals' provides many results in the analysis of the data. Leishenshan Hospital, Russia's hospital, Prof. Dr. Feriha Öz and Prof. Dr. Murat Dilmener Emergency Hospitals have the maximum construction area. However, Leishenshan Hospital has the highest patient capacity and Prof. Dr. Feriha Öz, Prof. Dr. Murat Dilmener Emergency Hospitals and Xiaotangshan, Huoshenshan Hospitals have moderate patient capacities. On the other hand, Russia's field hospital has the highest construction area but low patient capacity. Sweden's,

France's, USA's and Brazil's field hospitals have low construction area and patient capacity but it is consistent in itself [Figure 32, 33].

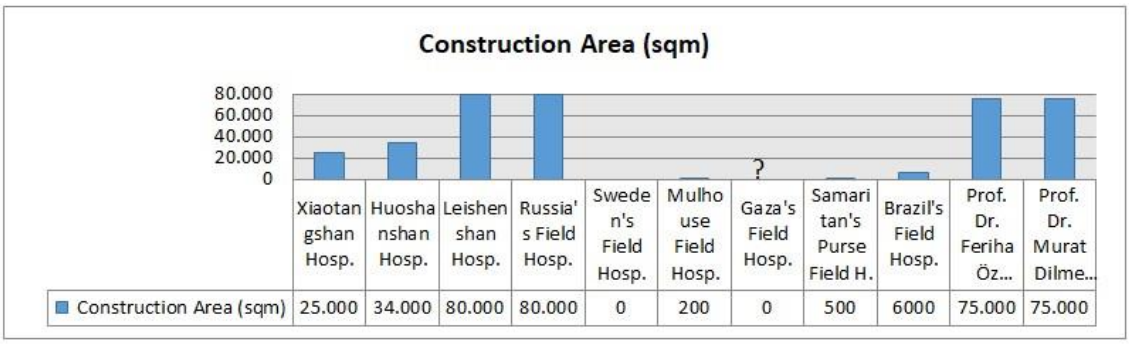


Figure 33. The Construction Area of the Field Hospitals

5. CONCLUSION

In this research, the aim was analysing the construction systems. The main part of this research was findings that were analysed in two parts as converted field hospitals and new built field hospitals. New built field hospitals were the focal point.

New built field hospitals' analysis was done chronologically based on hospital's opening days.

In this research, twelve field hospital's constructions systems and construction phases were analysed. These hospitals were constructed in mostly Covid-19 period but to understand the concept of pandemic and pandemic diseases in history, one hospital that was constructed in SARS period analysed in this research.

In this research, field hospitals from nine different countries were evaluated. Also five different construction systems were applied.

1. Prefabricated Modular System
2. Steel Construction
3. Steel Structure and Membran Cover
4. Pneumatic System
5. Masonry System with Brick Material

From the chronological analysis, the first country that was constructed field hospital was China. In the history of pandemic, it is seen that China was the original country that both SARS and Covid-19 was occurred. Because of this experience, construction period of hospitals wasn't took long period of time. The last country that was constructed field hospital was Turkey. But there were reasons for this such as construction type.

As construction system type it is clearly seen that, the fastest and efficient system was prefabricated modular system. Because all field hospitals that were built with this system, were quickly constructed and have high patient capacities. Russia's field hospital, Prof. Dr. Feriha Öz and Prof. Dr. Murat Dilmener Emergency Hospital have also high patient capacity but construction period was longest. From this perspective, construction period of steel construction type was longest in total five construction systems. For pneumatic system if air supply is available constantly, it is easy to build units for care. Hence USA's and Italy's field hospitals were built in short period of time with low patient capacity. At the same time pneumatic system facilities can be detached and set up different places.

Russia's field hospital, Prof. Dr. Feriha Öz Emergency Hospital, Prof. Dr. Murat Dilmener Emergency Hospital, Xiaotangshan Hospital, Leishenshan Hospital and Huoshenshan Hospital had the highest

construction area. From this perspective, with prefabricated modular system and steel construction system allows high square meters.

For number of storeys, places that built with prefabricated modular system allow two storeys. Prefabricated modular system forms with units. In Leishenshan and Huoshenshan Hospital, units were placed on top of each other. These units were allowed two storeys. In steel construction system, steel trusses provides wide span. As Prof. Dr. Feriha Öz Emergency Hospital, Prof. Dr. Murat Dilmener Emergency Hospital, it allows huge square meters with one storey.

Mechanic ventilation system was needed for all of these field hospitals. Because virus is transmitted by respiratory, the air inside the hospital should be circulated and cleared constantly. So, natural ventilation was not enough for this type of hospitals. One of the important criteria for mechanical ventilation is negative air pressure. Negative air pressure supplies to separate the contaminated air in patient rooms from the entire facility's air [1].

As a result, because pandemic period has been ongoing situation, there has been lack of information about the construction systems of the field hospitals. These criteria make this research subject unique. Also this research has been contributed and enriched the literature.

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In Search of Lost Paradise

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ABSTRACT

Nature, vital force, the opposite of the artificial or the nonexistent, the power to perpetuate life… This vital force, which is the source of existence for everything and which abides in everything, has been portrayed in many different ways throughout history. With the fear of the unknown which existence infused in him, humankind accepted nature, which has the power to create itself and which is both at the source and is the source of everything, as the creator almighty. Humankind has equated nature sometimes with mythology, sometimes with creation myths, sometimes with formulas, and sometimes with profit sheets. Naturally, differences in meaning regarding nature will shed light on different periods.

This study explores how nature is perceived in the collective memory, from myths to religions, from the Scientific Revolution to the Ecological Crisis we are experiencing today. In the light of the different shapes nature has taken during different eras, and which were represented through sexual identity, the meanings attributed to nature will be investigated. These investigations focus on the sexual differences in social structures and on the concept of nature constructed by human history along a background melody that belongs to the history of politics, science, and technology.

Keywords: nature, Scientific Revolution, the Ecological Crisis, myths

1. INTRODUCTION

Nature, vital force, the opposite of the artificial or the nonexistent, the power to perpetuate life… This vital force, which is the source of existence for everything and which abides in everything, has been portrayed in many different ways throughout history. With the fear of the unknown which existence infused in him, man accepted nature, which has the power to create itself and which is both at the source and is the source of everything, as the Creator almighty. Humankind has equated nature sometimes with mythology, sometimes with creation myths, sometimes with formulas and sometimes with profit sheets. Naturally, differences in meaning regarding nature will shed light on different periods.

This paper explores how nature is perceived in the collective memory, from myths to religions, from the Scientific Revolution to the Ecological Crisis we are experiencing today. In the light of the different shapes nature has taken during different eras, and which were represented through sexual identity, the meanings attributed to nature will be investigated. These investigations focus sometimes on the sexual differences in social structures and sometimes on the concept of nature constructed by human history along a background melody that belongs to the history of politics, science and technology.

2. MOTHER NATURE AND THE "NATURE" OF HUMANKIND

According to Merchant, the story of nature or the universe may actually be taken from a perspective that incorporates the story of man and woman. Sexual differences and sexual ties have an important place in this story. [1]

The natural contrasts with the artificial. It is identified with the feminine. It is a mother, a prudent lady, an empress, a woman with spiritual power, a goddess or a pure virgin nymph. The fact that, in antiquity, nature was associated with the woman is related to the characteristics of motherhood and fecundity. The female nature was central to organic cosmology.

In antiquity, nature was considered to be the founding force in the cosmic universe. From Gaia in Ancient Greece to Ceres in Rome, and from Isis in Egypt to Innana among the Sumerians, this founding and organizing force has always been seen as being a woman. However, the most important is that a woman was the primordial figure. Nothing exists prior to her; she creates the whole world through parthenogenesis.

Gaia, for example, is a cosmic being more than a deity: She is the fundamental principle at the source of every element. Through parthenogenesis, Gaia first gives birth to the Sky (Uranus), the Mountains and the Seas (Pontus). Afterwards, she mates with Uranus and gives birth to the male and female Titans, the Cyclopes and the Hecatonchires. [2]



Figure 1: Left, 5th century BC, Gaia dancing with the Fauns. Right, 5th century BC, Gaia, at the war of the Gigantes, seen surging in horror out of the Earth

Here, Gaia (Figure 1, left) has surged out of the Earth and is standing serenely as opposed to the movements of the masculine Fauns. Her power is not depicted through beauty, or voluptuous feminine curves, or tender motherly feelings. Here, Gaia stands serenely. Serenity here could be symbolizing equilibrium. In this vase painting, Gaia's fertility is depicted without rendering a single feminine body curve. Not only does she not look like a fecund woman, but her gender may only be understood by the shape of her dress. Though the grape-like fruit above Gaia's head symbolizes her fertility, her true power derives from a body that is in command of all "directions." Accompanied by the gesture of holding out her skirt, the arms, trunk and head pointing toward the East, West, North and South reinforce the feeling of an omnipresent, coolheaded, authoritative mother.

In the second picture (Figure 1, right), Gaia is seen surging out of the Earth horrified at the war of her sons the giants. Her astonishment expresses a mother's distress at such a situation. Before us is mother-nature Gaia, creator of the whole universe, in a pacific feminine attitude in comparison to masculine figures.

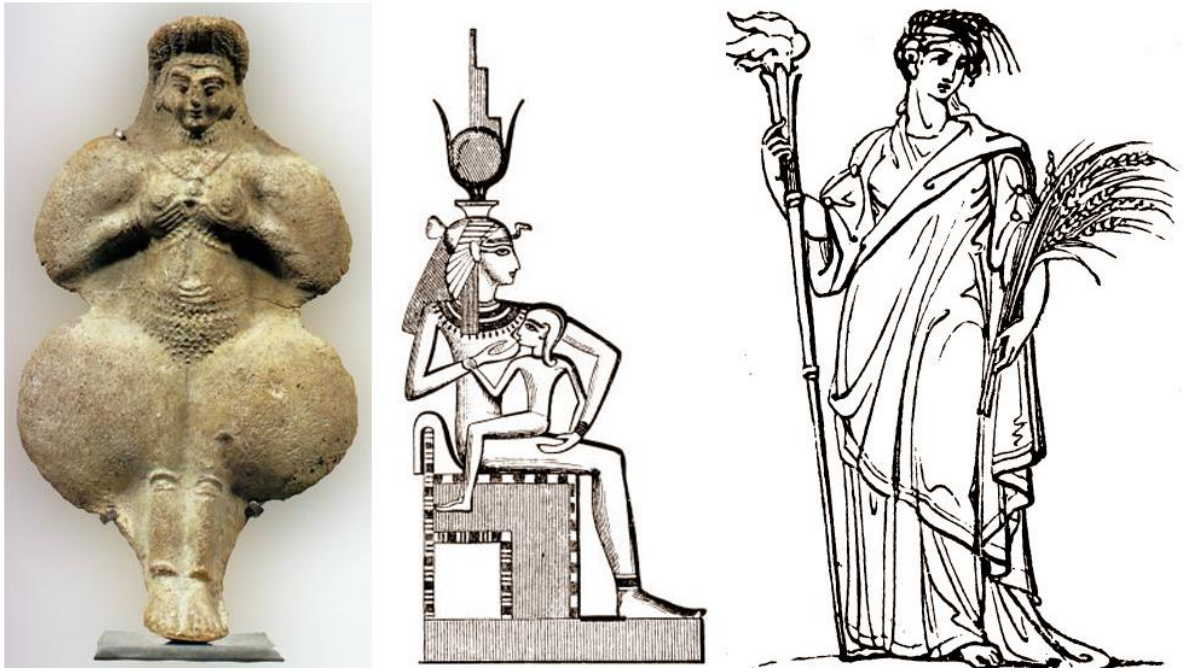


Figure 2: Left, Innana, mother goddess of the Sumerians. Center, Isis, the Egyptian deity, ruler of earth, sea and the underground, who has sway over life and death, seen here feeding her son the sun god. Right, Ceres, goddess of fertility in Rome, 18th century illustration

Feminine Mother Nature representations may be seen in all myths. These are usually primordial figures at the very beginning of the chain of existence. During their, era these goddesses are expected to protect people against natural disasters or drought. For example, Isis (Figure 2) alleviates disasters with her magical powers and is a remedy for humankind's helplessness in the face of nature. Similarly, while Ceres (Figure 2) at first was a goddess that did not previously exist in Rome, she was a mythological character who was conceived in the likeness of Demeter, the Goddess of Fertility, during a period of great drought through the reordering of readings of antiquity. Confronted with disaster, Rome once again calls on its forgotten mother. With her forgiving, enfolding, calm, regulating and creative qualities, the woman embraces her Roman children and humankind once more.



Figure 3: Left, Jean Auguste Dominique Ingres, *Jupiter and Thetis*, 1811. Right, a representation of the half-horse, half-man Centaur

While the almighty creative force was female, humankind associated with masculine representations natural disasters with which it could not cope. While Zeus (Figure 3, left), for example, was the god of such phenomena as lightening, thunder and thunderbolts, he was a masculine symbol who succeeded in seizing power by force and becoming god of gods. Here, the male is associated with feelings devoid of fear and mercy, he is not the one who gives order to nature but the one who rules by disrupting harmony.

Similarly, the Centaurs, that is, the man-horses, are wild and savage creatures with bodies that are half-human and half-animal who live in the wild and eat raw meat. [2]

Centaurs are a symbol of strength (Figure 3, right). Humankind can feel strong in the face of nature only when in synthesis with it. A half-animal half-human figure will be able to cope better with the difficult conditions imposed by nature. This approach is the reflection of a nature which has not been objectified by humankind. In such a cosmic order, humankind perceives itself as one with it, not as its master and ruling power.

While with their fear, sudden rage and unknowables, masculine characters give the feeling of the sublime, feminine characters, despite their power, which also brings them forth and encompasses them, through their enfolding motherly attitudes, give the feeling of the beautiful. According to Kant, the sense of the sublime incorporates strength, and also terror, nobility and splendor [3]. The woman is engaging, friendly and gives joy, or in other words, she is beautiful [4].

It is interesting to note that nature, with its generosity, goodness, kindness, fertility, gentleness and beauty, was at this time represented by feminine powers, whereas natural forces and disasters were represented by masculine characters. While man is the one who disrupts the order, woman (Mother Nature) is the one who, albeit over time, curbs, heals and regulates it. The curbing power is woman, with her mercy, forgiveness and patience.

3. PARADISE LOST

Alone in nature, when humankind had to confront its difficulties, it represented this trauma through diverse stories. In my view, the Expulsion from Paradise, the common story in all religions, may actually be interpreted as the moment when humankind, who is a part of the whole universe, becomes aware of its struggle with nature. Because, while in these accounts, the Garden of Eden is always portrayed as a place that limitlessly offers its resources and absolute harmony and balance to everyone, Adam and Eve, who were cast out of this beautiful garden, were to struggle throughout human history with the myriad of catastrophes presented by nature: floods, fires, drought, earthquakes… This realization of the truth, this beginning of arduous struggle was to be depicted as a departure from the perfect and eternally fruitful lands.

Henceforward, humankind would no longer be part and parcel of nature, it would be the force that exerted power upon it. Nature, upon which power was to be exerted, would be the subject of different prospects, from a piece of landscape that would become a country and a homeland to a land that would be tilled and harvested, that would be cultivated to ensure perpetuation of generations, or that would be formulized into an experimental basis in order to give meaning to the existence of the solitary humankind.

At this point, it will be appropriate to recall Cronon's question of how humankind perceives nature. Cronon asks the following questions: When we speak of nature, do we think of a nature in which humankind does not exist? Or do we think of a nature that is ruled by humankind? [5] With these questions, Cronon actually offers a subheading, mentioning that nature is not as natural as it seems. He says, when speaking of nature, we should now understand nature as something which has been intertwined with and has changed along with us, namely a nature that is constructed. He furthermore remarks that the belief that nature is balanced is not realistic and cites Michael Barbour's work about the findings of 1950s that nature is not as balanced and predictable as might have been thought.

Then, we may say that there never was a paradise in perfect harmony, that was constantly balanced, continually green and always limitlessly offering its fruits to humankind. Like nature in reality, the nature in this story, i.e. that of the Garden of Eden, was also constructed. …and the perception of the natural as the Garden of Eden was actually a melancholy quest for a harmony that never existed.



Figure 4: Jan Brueghel the Elder, *Adam and Eve in the Garden of Eden*, 1615

In this painting (Figure 4), Adam and Eve are seen as far-off silhouettes in natural systems and no different from them. In a landscape reminiscent of a tropical forest – and it would be possible to make an association between the date the painting was made and the colonialist period and even work up the interpretations of the desire for that which one lacks – we notice humankind among animal pairs. Adam and Eve are integrated with them, and we only notice them if we look very carefully. Perhaps, they are on a stroll, or perhaps, they are about to notice the apple tree. Perhaps, in a short while, clouds will gather over these fruitful lands, peaceful, fertile lands, and lightning will flash, or the animals that are in harmony will flee in terror.



Figure 5: Lucas Cranach the Elder, *The Fall of Man*, 16th century

In another painting of the same period (Figure 5), humankind is depicted in a very different manner than animal species. God entrusts the Garden of Eden to these two humans, who are very different from the other animals. At the center of the scene with one hand, God is describing the garden which he entrusts to them, while with his other hand, he shows the tree they must avoid. In my opinion, it is interesting to note that what makes them different from the other animals here is that they are beings who can communicate and who can speak and understand as they communicate. Thus, it is evident that humankind, who we can clearly feel is the master of paradise, achieves the right to own something through reason. This 16th century painting tells us of the inner voice of the human race on the very threshold of rationalism saying, "I am master because I am intelligent, therefore I can rule this garden." Nevertheless, the joy of power would last until collaboration with the devil. …and as Cronon reminds us, humankind would ally with the devil again to regain the paradise he had lost. [5]

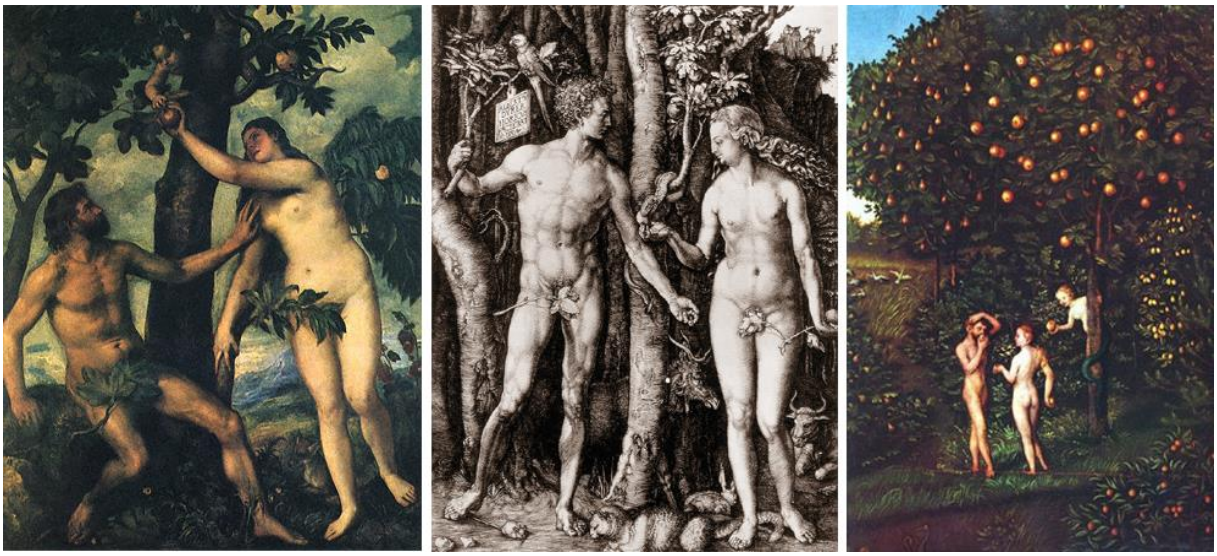


Figure 6: Left, Titian, *Adam and Eve*, 1550. Center, Albrecht Dürer, *Adam and Eve*, 1504. Right, Lucas Cranach, *The Fall of Man*, 16th century

The Garden of Eden is always depicted as a landscape in eternal verdure adorned with mighty trees (Figure 6). There is not a single building in it, and there is no need for one since from this standpoint nature is humankind's natural home.

We said before that the Garden of Eden is a constructed story like that of nature in reality. Then, did Eve, being responsible for the departure from this garden of delights, cause all women to begin life a step behind? For Eve was the one who succumbed to her will, who was the temptress, who could not fully use her head… Of course, she was not the only reason for their expulsion from paradise, but it was mostly because of her that humankind had been cast out. In the story of the Expulsion from Paradise, had the place of woman next to man, her place on earth, been depicted together with the portrayal of a nature of absolute beauty?

I would like to continue with Merchant's questions: Was there truly an intrinsic bond between woman and nature, or was this a tie between a construct of nature and of the knowledge on how to behave as women? [6]

In the male-dominated society of the period, the answer to these questions would be "yes."

According to Merchant, in early capitalist societies, woman's role and nature emerged as women harried by their entrepreneur husbands. Science, technology and the economy dominated both nature and women. During the 16th and 17th centuries, the organic cosmos and the female earth became passive and ready to be dominated. [7]



Image 7: Sebastian Münster, *God Creating Mountains*, 1578

The myth of creation, i.e., that the universe was created in a moment by one creator, developed in an opposite direction from the view that Mother Nature created the universe within her own reproductive cycle. The former belief is usually seen in religions rather than myths. In the picture above (Figure 7), instead of the portrayal of a nature that would develop from the fecundity of a woman in relation to the time component, we can observe the belief that the universe can exist if and only if it is created through male power and technical know-how. Here, god is of the masculine sex, nevertheless, with his half-human half-cloudlike body, he creates nature using craftsmanship as if working iron. Thus, nature is not that which creates but that which is created.

According to Merchant, starting in the 17th century, a mechanistic approach to nature developed based on the Western mathematical tradition, according to which nature can be divided into parts, and then, these parts can be rearranged. Mathematical formulas are criteria that incorporate rationalism and certainty. Newtonian physics and the mathematical formalism of the 20th century have confined nature within a lattice-like matrix, but it was not possible to store data for facts that could not be computed. Mechanistic approaches actually transformed nature into artificial environments. Nature lost its quality as such and turned into a concept to meet the needs of humankind.[8]



Figure 8: Left, Sebastian Münster, a cosmographer 1552. Right, Sebastian Münster, a cosmographer 1600

With the advent of the 17th-century scientific revolution, nature became objectified and could only be meaningful and would be grasped and understood if it served the human race. Henceforward, dialogue would become monologue, and in the hands of science and technology, nature would be understood insofar as it could be known and formulized. In the pictures above (Figure 8), two different cosmographers are the subjects of Münster's work.

The first cosmographer uses instruments to measure out the universe, while the second one looks at the globe in his hand as if he has unraveled the mystery of the universe. The male character in the picture on the right holds the globe by its axis, giving a powerful image. Moreover, the pleasure derived from dominating may be read on his face. Henceforth, being human means being a man, it means dominating nature, which is feminine.

However, while rationalism was dividing the universe into grids at top speed through a perspective based on pure reason, this approach would prove insufficient for humankind to give meaning to nature. In Romanticism, which was a criticism of modernity, it was of interest to note how the relationships established with nature differed from previous ones.

During this time, nature emerged either in its sublime or beautiful guise. In essence, these two concepts also incorporated sexual identities and the meanings attributed to them.

According to Kant [3], even though a snow-covered mountain peak rising above the clouds or stormy weather may raise enjoyment, it will do so with awe, while a flower garden, a valley or a portrait of Venus brings joy. Tall trees and lonely shadows are sublime. Night is sublime, day is beautiful. Shadows in the light of the stars on a summer evening or the rising of the moon give feelings of friendship in the infinite world. The sublime moves, the beautiful charms. The sublime is accompanied by many feelings, melancholy or quiet wonder. Deep loneliness is sublime, it stirs terror. The sublime must be great, the beautiful can be small. The sublime must be simple, the beautiful can be ornamented. A long duration is also sublime. The past is noble, whereas the future has something of the fearsome in it.



Figure 9: Thomas Cole, *The Falls of Kaaterskill*, 1826

In this painting (Figure 9), America had not yet been conquered by civilization, it was not weary of these civilizations, and within this landscape that is very different from the old continent, we notice the human figure right at the top of the waterfall, diminutive in the wilderness. Though at first glance the nature here reminds one of the lost paradise, it is actually a real place that also includes dead branches, but in the face of death, promises life anew. The feeling of the sublime in this landscape arises from the uncertainty of whether this small human being in this huge forest that integrates dead branches and verdure will or will not be able to build his own garden

here. For even though nature exhibits its vital force, it will make humankind, who is detached from it, feel helpless. Humankind can no longer be a part of it even if it wants to, and it will always be asking itself how it can curb it. One should also bear in mind the connection between the masculine and sublime landscape and America (Figures 9, 10).

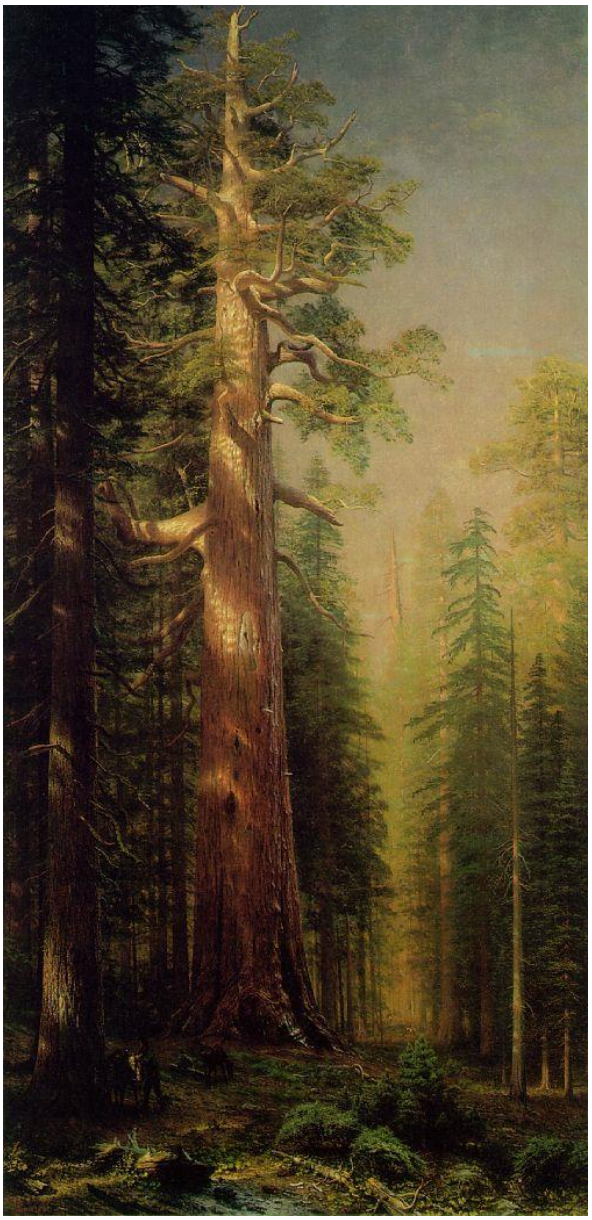


Figure 10: Albert Bierstaadt, The Great Trees, Mariposa Grove, California, 1876.



Figure 11: Sophie Gengembre Anderson (1823-1903); Left, *the Time of the Lilacs*; Right, *Take the Fair Face of Woman, and Gently Suspending, with Butterflies, Flowers, and Jewels Attending, Thus Your Fairy is Made of Most Beautiful Things*

The feeling of the sublime raised by the depictions of nature in America is reinforced by a male figure who seems dwarfed by them. The sex to represent humankind in nature was male, and though the fact that a male figure next to the grandeur of nature in these representations at first injects a feeling of helplessness compared to the size of this overwhelming nature, actually, in my opinion, humankind's ability to discover a place in the depths, to make a spectacle out of it even though it does not possess it concurs with the role of the masculine sex in social history.

Nevertheless, it is no coincidence that pictures which mostly represent spring and the awakening of nature in the pastoral landscapes of Europe (Figure 11) are shown together with the purity of a young girl.

According to Kant [4], whoever it was who coined the term "fair sex" for the female figure wanted to describe her in flattering words but had hit upon something even better than what he meant to imply. When describing man, we must not think of man as devoid of beauty. If the female character is beautiful, we perceive the male character as sublime. Thus, nature has created the charming distinction between the two sorts of human being. For example, quite unlike the previous picture, this one shows smaller trees in the distance under an overcast sky. This is a place somewhere in Old Europe. Which is also interesting to note is a sprig of lilac which the girl has casually placed in her hair with the desire to spruce herself up (Figure 11, left). How could we interpret the fact that springtime, when nature is at its most fertile, raises the feeling of beauty rather than that of the sublime? What is the relationship between beauty and the feminine character?

According to Kant, women grow up with a feeling for all that is beautiful and decorated and seek happiness in dedicating themselves to something. They are delicate and from an early age know how to dress up and adorn themselves. At this age, young men are boorish and clumsy, whereas women have many sympathetic sensations such as good-heartedness and compassion. The masculine incorporates contrast as opposed to order. [4]

Woman is beautiful, she is the one who is looked at, she learns at an early age to dedicate herself. Nature is also that which is looked at, and as the vital force, it has dedicated itself to humanity. Humankind will tame both to ensure its perpetuation.



Figure 12: Frederic Morgan, (1847- 1927); Left, *A Day on the River*; Right, *A Flood*

With the advent of modernity, nature was accepted as a system entirely distinct from humankind and became a mere landscape to be viewed. Happiness would henceforth mean promenading in this landscape (Figure 12, left). Humankind had determined its place in its relationship with nature, it did not exist in or with it. Nature was a system out there somewhere, it was studied, observed and depicted. In the picture above, we see a mother and her children cruising on the river. There are then those moments when the nature we assume is in balance tears free of its system. These are catastrophes. In the picture above (Figure 12, right), there are parallels between nature which has lost its control and the mother who is trying to save her children from disaster and survive. Both are mothers, both give birth and protect, both have to be curbed. Though it may be thought that there is a contrast between the woman's struggle and nature bursting in rage, in fact, their natures are similar.

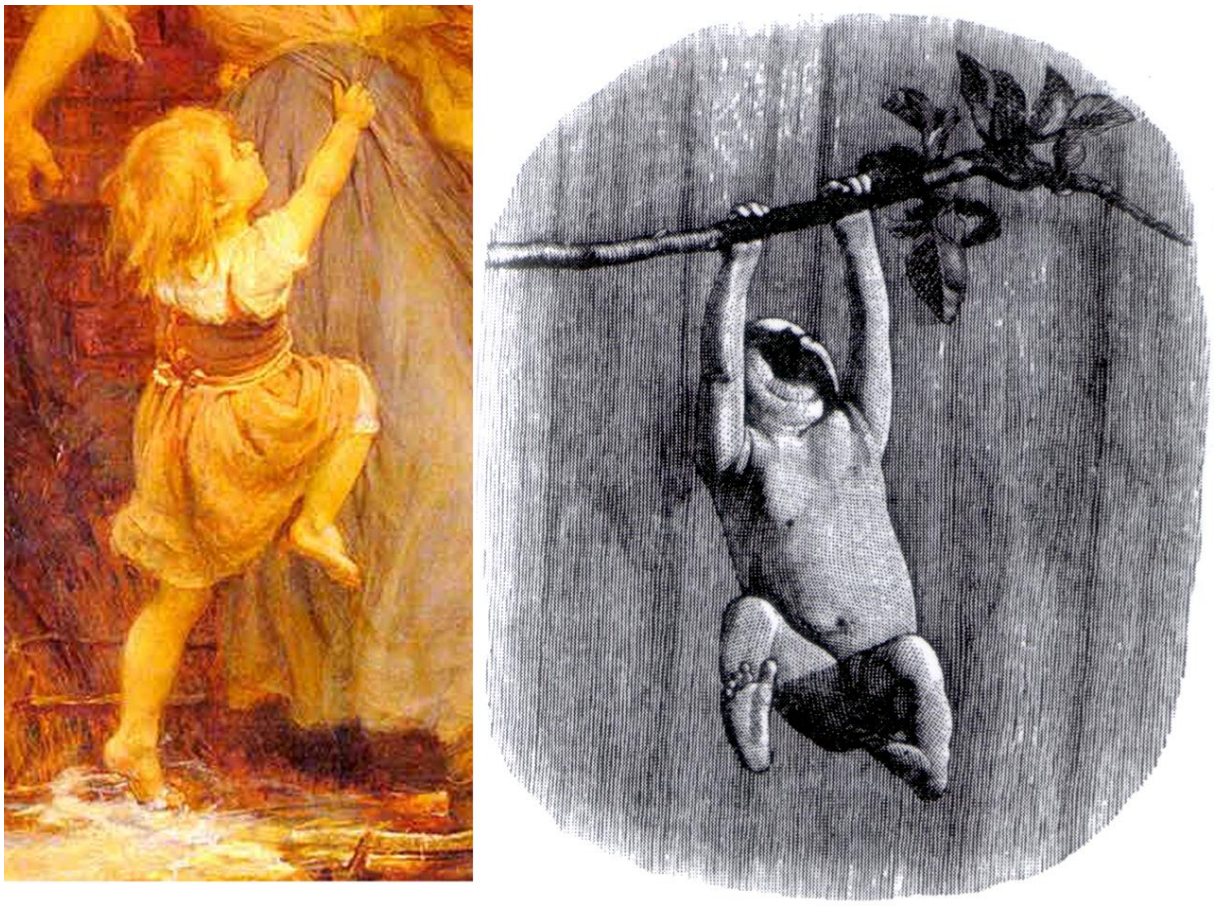


Figure 13: Left, Frederic Morgan, (1847- 1927), detail from *A Flood*. Right, Victorian illustration of a baby in nature

Humankind can withstand natural disasters. In the detail above, it is interesting to note the child figure holding on to her mother of her own accord without a move from the latter. The period was a time when humankind detached itself from nature and investigated it, a time when it could only describe nature through scientific data. However, science was to end up with the view that the natural home of humankind is nature itself. The theory of evolution and the ensuing science of genetics hold that humankind comes from a developmental and evolutionary lineage within nature. In that case, all species in nature are our relatives, from fish to birds and to apes. However, our closest relatives are apes. This view is very different from the idea of the human as created in a moment and whom religion had for centuries blessed with reason and given the power to rule. With science and the theory of evolution, the belief that humankind could exist exclusively in the social sphere was replaced by beliefs that even without social doctrines, humankind can adapt to nature even as an infant.

According to the Victorian illustration above (Figure 13, right) and according to science, the newborn has the strength to hold up his full body weight. His instinct to cling to his mother gives him the strength to survive, thus assuming his harmonious place in nature. [9]



Figure 14: Randolph Caldecott (1846-1886), illustration from a book of fairytales

Science recognized nature as the home of humankind; what was natural was not to exist within a social construct but to exist freely in nature. Although this is what science asserted, fairytales advised children that humankind's natural habitat was the city. The young of the human species must never go out unattended in nature. This was important for him to later adapt to social life. In this picture (Figure 14), depictions of wildlife are noteworthy. In a thick and wild forest that is dark and impenetrable, the children experience fear. It is obvious that the girl's hesitation and fear is greater than the boy's. Messages conveyed by fairytales tell us and build the following in the social life of the future: Do not stray from society, do not act on your own, if you are a woman and do not have a man at your side, rethink all this! For strength and courage pertain to man, and you can surrender to him!

4. IN SEARCH OF LOST PARADISE

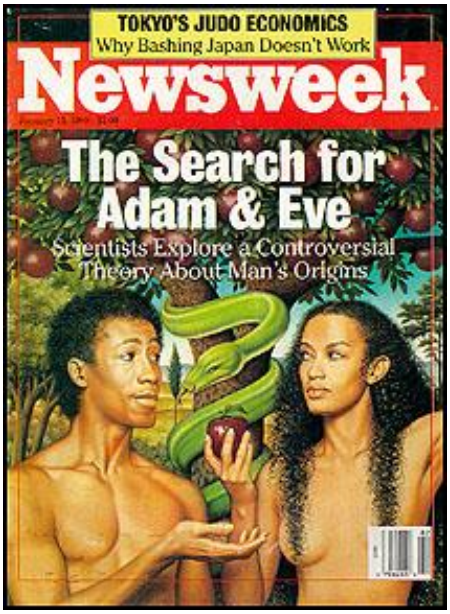


Figure 15: 1988 Newsweek cover

The image of Eve in religious myths is always a weak-willed figure. In Renaissance art, she was represented as the white-skinned, voluptuous woman of the lost paradise or the golden-haired woman who innocently surrenders herself. However, scientists' Eve was a dark-haired, black-skinned woman, and she roamed the hot savannas in search of food. The imagery of Eve, Adam and the lost Paradise was greatly altered once they were combined with the theory of evolution.

According to Charles Darwin, Africa is the homeland of our closest relatives, chimpanzees and gorillas, and humankind has evolved from there. It is stated that, when we look at the genealogical tree of evolution, we can see that this is also where our great-great-grandmother comes from. According to the generally accepted theory of evolution, it was 2,000,000 years ago that humankind started settling in Europe after having left Africa. This hypothesis is called Out of Africa or the Eve Hypothesis. [10]

According to scientists [11], Eve was not the only woman on earth, nor was she the most beautiful or maternal. Her success lay in her ability to propagate her genes. As for the Adam figure, it is difficult to trace because the Y chromosome is part of the DNA in the cell's nucleus. According to scientists, Eve may have had more than one husband, but the common ancestor for all girls is Adam. Science today believes that the lost paradise did actually exist. It was somewhere in what is Africa today (Figure 15). However, in the image, the conception of a fertile and limitlessly green paradise has been replaced by a drier and less green landscape portrayal. The re-description of Eve next to an absolute paradise that has changed shows us that a new world has been constructed. Eve is depicted as a woman who is far from the image of ideal beauty but is nevertheless extremely captivating.



Figure 16: Left, Frederic Morgan, (1847- 1927), *The Danty Chair*. Right, holiday paradise Ölüdeniz

Humankind had henceforth irreversibly altered nature. …but what did nature use to be? Here is how Cronon answers this question: While some would call ideal nature a pristine wilderness, for others, it is the pastoral countryside, and others would even celebrate the city as the natural home of humankind. Eden describes a good, beautiful and perfect landscape. Myths of Eden declare that it has been lost [5]. Eden may also be perceived as the Amazon rain forest or as the garden of a pristine world. City planners or speculators know very well how to market the idea of Eden with promotional literature such as social attraction in grassy yards, shopping malls behind safely gated entrances and golf courses.

With the advent of the holiday concept, which appeared along with working life at the turn of the 20th century, the meaning of nature for urbanites estranged from it changed once more. Even though for the sake of approaches that incorporate the rural into the city, Gardencities as examples of integrating nature with the city offered healthy settlement options for the working class both in Europe and America, what was to rehabilitate humankind would be the sea, sand and sun (Figure 16). At every opportunity, humankind would henceforth escape into nature, take refuge in it, but after a while, would return to his true home, the city. The paradise of modern man consists of a whiff of a fragment of landscape and vacation spots where we take refuge in our spare time.



Figure 17: The Rocky Mountain Arsenal

20th century modernity is full of stories of the loss to humanity and nature caused by science and technology. The traumas experienced especially during World War II reminded us that the world could not consist merely of a human-dominated society. The lost paradise was also sought-after following World War II: this by turning into wildlife refuges weapon manufacturing facilities in which all kinds of deadly gases, arms and chemicals were produced during the nuclear war, and where animals were once used in experiments. Today, behind what we identify with wildlife in our memories is a stratum of land which is actually designed by humankind (Figure 17).



Figure 18: Super Trees, Grant Associates of Bath, Singapore

Another lost paradise design may be seen in the applications of sustainable systems. For example, this garden design called Super Trees (Figure 18) is formed of structures that imitate natural photosynthesis and transpiration. According to my source, this project is a grove of "super trees" that will become part of large parks to be built in the future in the environs of the Singapore marina. These tree-shaped structures whose heights range between 100 and 180 feet will at the same time be home to orchids and fern, and just like real trees, will provide a resting place under their shade for people. Apart from the climbing plants that will grow on its latticed skin, photovoltaic and solar thermal panels will also be placed on these super trees designed so as to absorb solar energy. The structure, which will store rainwater and enable natural transpiration, will be illuminated at night and become a natural lantern. [12]

According to Merchant, the science of the last 200 years engendered a mechanistic Western world. In the market economy of capitalism, natural resources have been equated with the costs of progress and limits to growth. [7]

However, 2 movements in the 20th century have changed the static approach to nature and revealed how important it is for humankind to live within the ecological system. Merchant explains the key points as follows:

First of all, the Scientific Revolution's mechanistic view of nature gave way to a stronger and more fluid representation introduced by David Bohm. According to Bohm, motion became the key concept in perceiving the world. While the world was previously perceived as matter that could be divided into atoms and electrons, with Bohm's holomovement concept, the world was now seen as a flow of energy. According to this concept, the world both contains everything and is contained by everything. Time is energy that enfolds and unfolds and has no definite space. Thus, knowledge will spread throughout the universe and over all times. Knowledge has no definite space. The world, the universe, or existence are all a three-dimensional flows of energy. Second, Ilya Prigogine developed theories as to the emergence of order out of chaos. From its smaller to greater states, could chaos itself be a norm? These could be the keys to ecological sustainability for the 21st century. [6]

If we can think of new social lives and a sustainable environment today, a hopeful future for perpetuation of humanity and natural ecosystems could be possible. For this, priorities must be restructured. Non-hierarchical forms of organization, simpler living styles that produce less waste, recycling of wastes and "soft" technologies could be the new possibilities for these new perspectives. Furthermore, as the one who shares the same fate as nature, it is woman who will take on the role of forerunner in these ecologist movements.

5. NATURE IN THE ECOLOGICAL MOVEMENT AND THE GLOCAL MARKET



Figure 19: A National Geographic Society TV advertisement sponsored by Gulf Oil

This photograph (Figure 19) is an advertisement which the National Geographic Society ran on its TV channel in 1984 and was sponsored by the Gulf Oil Corporation. The advertisement consists of a photograph showing the spontaneous contact of two hands one of which is a monkey's paw and the other a human hand. We see a young, white hand with well-trimmed nails and another black, hairy hand of approximately the same size that symbolizes a hard life. Haraway mentions that we need to

look at the touch shown in this advertisement and the history of this touch between nature and humankind. "How do the races, species, gender and science codes work to reinvent nature in the Third World for First World audiences within post-colonial and multinational capitalism?"

According to Haraway, what is ecological in the image is the female touch. While the main point in the advertisement is perceived as gender, the latent point is the coexistence of the human race and the non-human species in nature together with the colonialist approach. This touch was so desired that it pervaded post-World War II National Geographic television, photography and texts. In this message, Gulf Oil aimed to emphasize the understanding that grew between the two species as a result of years of research conducted by Dr. Goodall, a woman of science, on chimpanzees. Here, the scientist woman lays aside her authority over nature. The chimpanzee is an active participant in this negotiation, and animals are not resources but a part of this world. There is no doubt that Gulf Oil is proud of being the sponsor of this message. [13]

The photograph, in which the chimpanzee's trusting friendly paw is placed over Dr. Goodall's divinely poised hand, addresses the feelings of support and attachment between the two species.



Figure 20: Advertisement for Isbank environmental investment funds

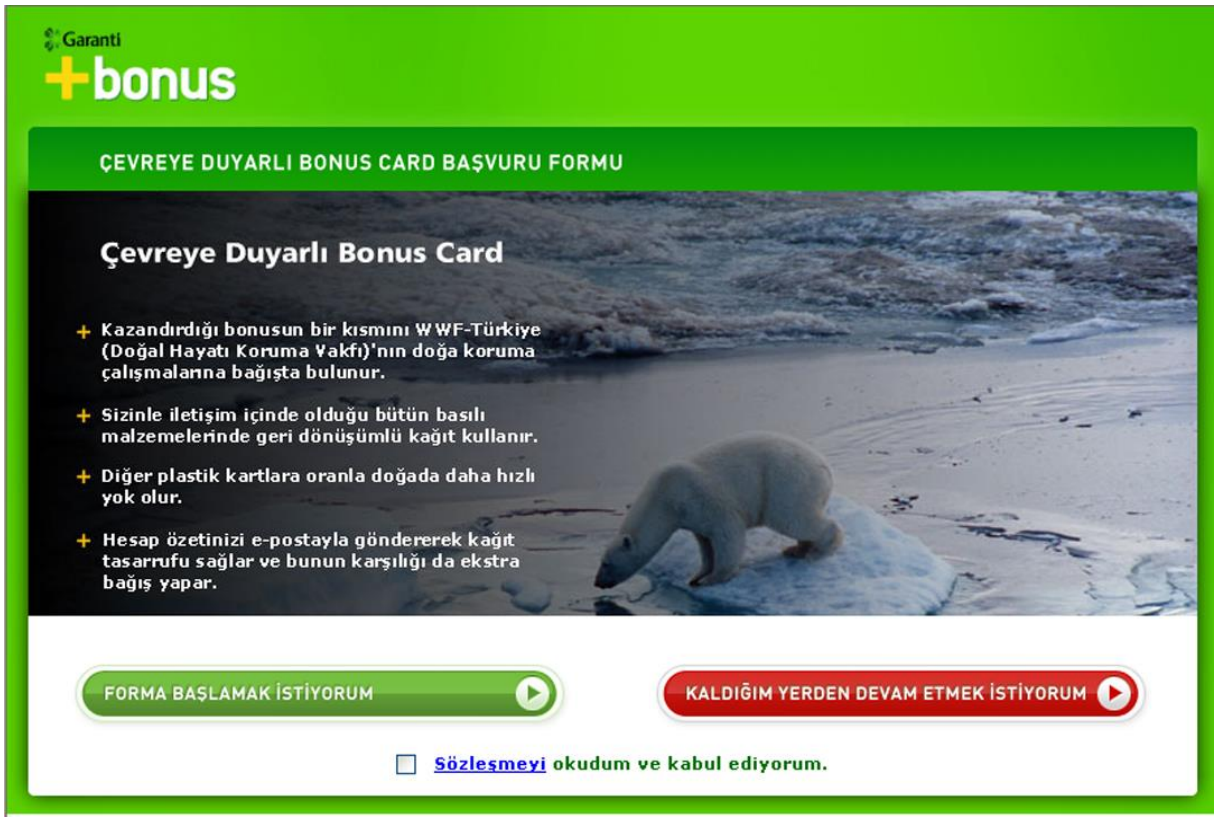


Figure 21: Advertisement for Garanti Bank's environmentally aware credit card

While the global market is appropriating everything today, it is trying to reestablish a relationship with the ecological movement and with women. Advertising strategies are drawn up via the most popular subject of recent times.

In the advertisement above (Figure 20), the migrating birds symbolize the growth in earnings on a statistical table. In the second image (Figure 21), the helpless polar bear promotes with its melancholy the sale of a credit card and preference for that card.

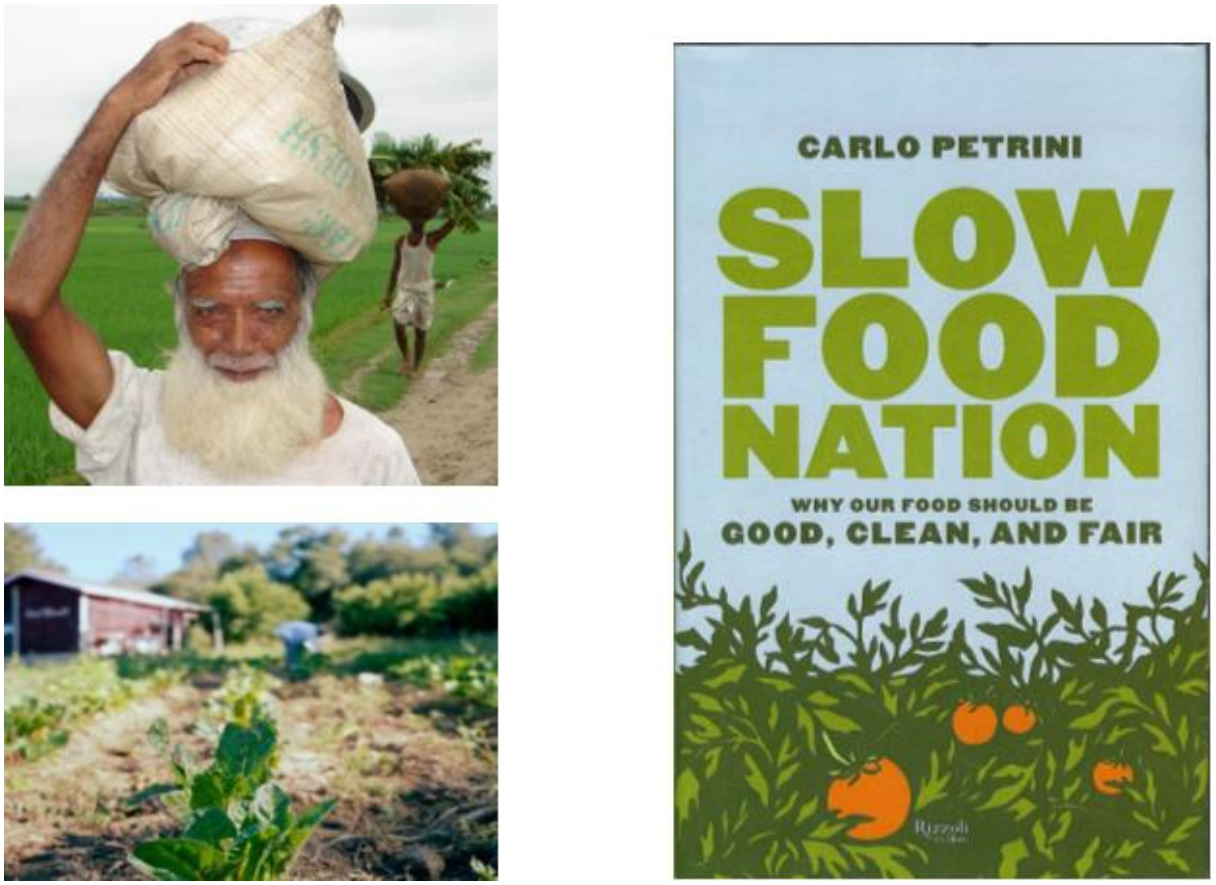


Figure 22: The Going Local movement against the Global

The Going Local movement established by local agriculturists against globalization is searching for ways to obtain safe food by natural means (Figure 22). Emerging today as a local movement and with a slogan about localization, it is supported by international corporations. Within the global market, can no movement against it avoid its vortex?



Figure 23: The Going Local Movement and advertisements for ecological agricultural products

The rake and shovel next to the fork and spoon in the Going Local movement's poster remind us that we cannot get anything from nature without toiling in it (Figure 23). As for the advertisement on the left (Figure 23), the depictions of nature are of semi-rural places which also incorporate human settlements. It is also interesting to note that the baby, symbol of the next generation, is in a father's arms instead of a mother's arms.

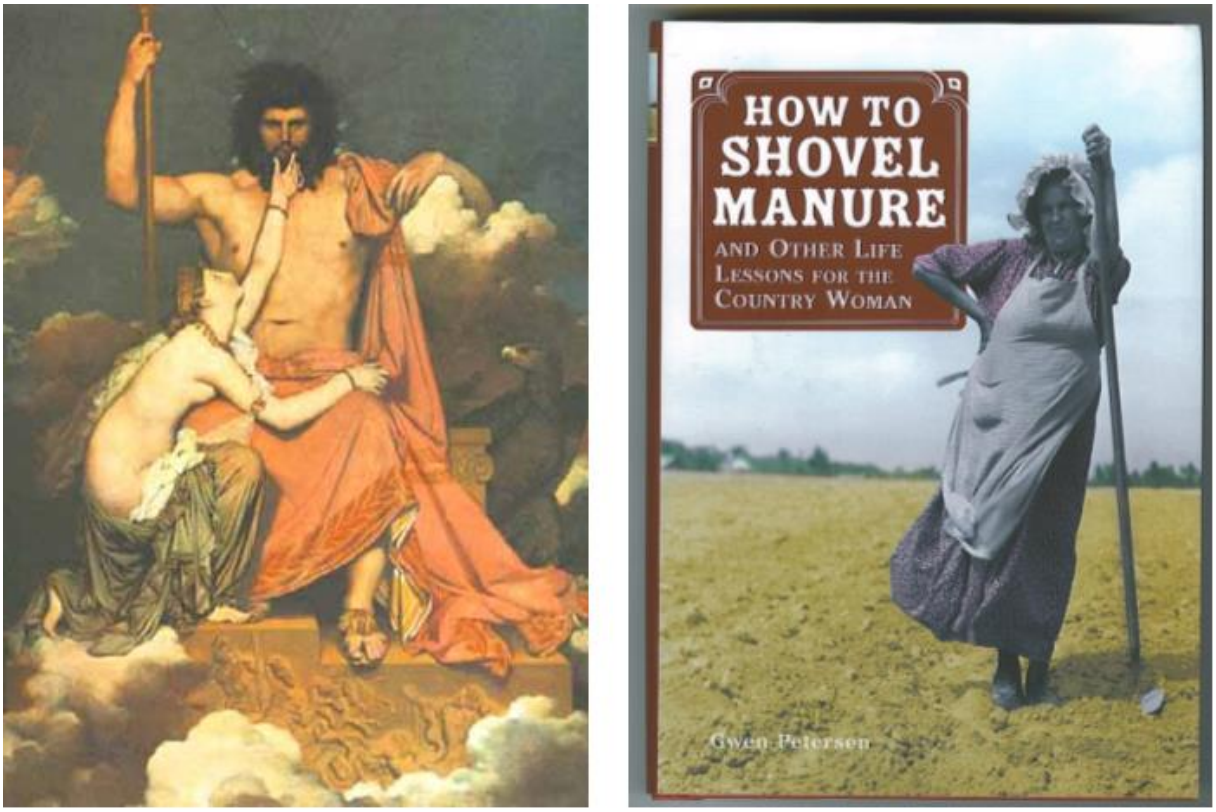


Figure 24: Left, Jean Auguste Dominique Ingres, *Jupiter and Thetis*, 1811. Right, book cover for *How to Shovel Manure*

Today, woman is at the center of all ecologist movements. This is the reflection within social history of two companions whose destinies have been constructed together. This structuring is centered on ecology, but it is now being reinterpreted through movements that involve big capital. The book above (Figure 24, right), while telling one about the farm women's trials and tribulations from the standpoint of the history of sisterhood, also includes notes on grazing cattle, irrigation and moving up to summer pasture. The woman bears similarities to mythical characters holding divine power in their hand, such as Zeus. While the agricultural implement in her hand delineates power, it reminds us of the staff of gods. She has none of the usual attributes of beauty, neither golden locks nor a curved waist. This woman, with her apron, which is described as a legacy in the book, assumes a pose that shows she is about to till the soil that will flourish like paradise. Woman is once more before us in the role of the mother goddess within the global market's new toy, the ecological movement, but again, she is of the lower class and part of cheap labor.



Figure 25: Left, Pompeo Batoni, *the Education of Achilles by Chiron*, 1746. Right, Jane Webb, male and female cyborg nudes

Heidegger spoke of how, in antiquity, there was a belonging together of nature and humankind. According to this approach, called *hypokeimenon*, nature and humankind lived in a world as equals, and humankind did not feel as if it dominated nature [14]. Power, for instance, pertained to mythological characters that were half-human half-animal.

With the advent of rationalism, nature became objectified in the hands of humankind and turned into the latter's resource. The same goes for woman. In the light of mechanism, while formulas mathematized nature, it was reduced to productivity tables according to profit scenarios.

As for holism, it was first proposed by J. C. Smuts in 1926, in his book *Holism and Evolution*, as an alternative view to mechanism. Smuts maintained that nature cannot consist of a purely mechanistic scheme, that it is made up of more than just its physical or chemical components. According to holism, the whole expresses more than a sum of its parts. Synthesis redefines these parts, and the parts redefine the whole. Holism has helped us better understand the natural cycle and become the philosophy of the science of ecology. [8]

Today, we are living in a time of new approaches toward nature brought on by the genetic revolution. Nanotechnology shows us once more the infiniteness of nature and existence, the boundaries of which it was believed could be established through formulas. As for the myths of the new human, they are adorned with half-human, half-chip cyborgs.

Cyborgs and utopias about them offer a new structuring in the economic, social and cultural domains via a genderless society. Perhaps, the equalization of women may only be possible in a world where sexual identities are rejected. In Rome, Ceres was a goddess who did not previously exist in mythology. She was created after the famine and drought and was called upon for help. Thus, the cyborg may be a new savior for woman.

To conclude with Haraway: "Cyborg imagery (…) means both building and destroying machines, identities, categories, relationships, space stories. Though both are bound in the spiral dance, I would rather be a cyborg than a goddess." [15]

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Pay Forward with Infographics

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ABSTRACT

Since industrial revolution, design has a catastrophic effect on the ecosystem of the world due to the creation of new materials of permanent garbage which pollute the air and the earth. Today sustainability, energy security, climate change are the challenging issues that concern every business, government and every designer on the earth. Factors such as the loss of the world's ecological balance, uncontrolled population growth, rapid growth of the parallel economy, natural reduction of resources, overconsumption, ecosystem degradation and biodiversity led graphic designers to reconsider not only economic but also social, ecological, and ethical consequences. Graphic design is a sophisticated discipline that creates visual content to communicate messages while serving consumption and effecting the habits of the society.

One of the rapid ways of communication is the data visualization infographics for informative purposes. Infographics uses complex data to transform into understandable visual expressions such as universally interpretable symbols, graphics. This research aims to analyze the role and impact of infographics as a visual representation of information and communication method in terms of an education resource for sustainable actions. Within the scope of this research, it was concluded that environmentally conscious infographics can be used as a very effective educational tool in schools. Canadian educational infographics on environment have been examined on climate change within the framework of literature review. This research reveals that infographics has a powerful impact on our decisions and actions on environment as a rapid visual message interpreter. It can be claimed that infographics is an effective education method which also develops student skills such as visual literacy and critical thinking.

Keywords: infographics, data literacy, green graphic design, sustainability, climate change.

1. INTRODUCTION

Our world is no longer the same place since the rise of industrialization. The urbanization, new inventions, the construction of railroads that evoked international trade started the demand on goods. The mass production and overconsumption of fossil fuels, coal, oil, gas mines over years caused depletion of the ozone layer and climate warming. Today the world is under threat of an unprecedental global warming, water scarcity and environmental pollution through industrial waste. In the 21st century catastrophes (hurricanes, tornadoes, wildfires, landslip), climate change, species extinction, deforestation have become the abnormal circumstances of our daily life which are frequently encountered.

Anderson, Hawkins, Jones (2016) claim that one of the major risks confronting mankind is climate change. As fossil fuels are burned, the concentration of CO^2 in the atmosphere increases year by year building up the natural greenhouse effect thus warming the planet. According to the ensemble-mean results of state-of-the-art Earth System Models, climate warming during the 21st century is estimated to be between 1.0-3.7 –C depending on future greenhouse gas emissions. "Greenhouse effect is the result of chemical compounds in the Earth's atmosphere acting as greenhouse gases, trapping outgoing terrestrial radiation and warming Earth's atmosphere" (Lee, Lester et all, 2007). However, the amount of some atmospheric gases like carbon dioxide, methane, nitrous oxide and chlorofluorocarbons have increased since the late 19th century as a result of human activity. Global warming indicates an increase in global average temperature and is hypothesized to be the result of an intensified greenhouse effect. The utmost problem is the burning of fossil fuels for energy which artificially enhances the natural greenhouse effect.

This is all shaped with the growth of industrial empire which dominates the economies and politics all around the world. There is no doubt concerning the tremendous growth in industrialization and uncontrolled population which shaped today's world. Mehta points out that there is a correlation between population growth and the urbanization of the planet. "*Population growth and urbanization have contributed to enormous expansion of the energy, manufacturing and transportation sectors of the economy during the twentieth century."* (Mehta, 2002, p.23). It could be said that growth of population in need of energy caused the overburning of fossil fuels and deforestation leading to green gas effect and global warming. This is the result of the overconsumption of resources which we are facing today.

The tremendous technological advances in industry created demands on consumer culture today. The ambition to make more money exposed the occurrence of commercial advertising to sell more goods. In this context; this article aims to question the effective role of graphic design as part of the problem and infographics as a part of the solution of the environmental catastrophes. According to Roberts (2006, p. 28) the arrival of graphic design as a distinct practice was in large part the result of the Industrial Revolution. By the late nineteenth century advertising had become an industry and governments also used visual communication as promotional materials for their own propaganda and public pronouncements. Especially the Second World War is a good example of usage of visual communication between governments and the governed. Graphic design is a potential tool for good or bad that can be seen in war propaganda or political promotion. By the 1960s, graphic design had become a subject of serious study in art schools and used as a manipulator of ideas into visual communication in economy, politics and social needs. Industries and economies had become more powerful with worldwide recognized logos, symbols and logotypes (Roberts, 2006, p. 29).

Graphic design as a manipulator of messages, owns an enormous power to orient society. The endless passion to sell goods in order to gain income, make profit with glamorous ads created the consumption

madness. As a result, overconsumption of goods drained and reduced the resources and polluted the oceans, seas, rivers, air and the soil. According to Bielenberg (Simmons, 2011, p.1) to maintain the current status is not an option. The tenuous relationship between humans and the natural world has become an unsustainable scenario. It may be too late or impossible to change the course quick enough. The current economic and industrial development needs to be adapted in a sustainable way with the usage of innovations in technology.

Graphic design is related with invention, innovation, human ingenuity and creative problem solving, it can pay forward to shape a better future for the planet and all living beings. Graphic design is a discipline that connects the producer with the consumer utilizing multiple types of media. It helps to convey the message of the product, event or the campaign. Graphic design has been used to sell products by advertising since industrial age. Balcı (2016) stated that graphic design is a discipline that advertises a product or service and conveys a message to the target audience by using various visual elements like typographical items, pictures, illustration according to design principles. The rise in technology in the 20th century developed the manufacturing, print and communication techniques. As a result of these improvements and especially in computer technology; the commercial and consumerism culture has emerged all over the world. After the occurrence of digital age and widespread internet network, the world has created a mass consumption of goods and services thus creating trillion tons of industrial waste from plastic bags to packaging boxes.

2. DESIGNERASAN INTERPRETER OF MESSAGES

Graphic designers as mediators of consumption culture carry a big responsibility in creating innovative solutions for a sustainable future. Simmons (2011, p.3) describe designers as "problem solvers" and they work according to their own interests and values. Dougherty (2008, p. 8) points out that there are three distinct ways of thinking about a graphic designer's role: designer as a manipulator of stuff; designer as message maker; and designer as agent of change. The messages and the brands that a graphic designer creates have a big impact on consumption. Graphic design has the power to influence people for change. Designers try to help clients change the way people think or the way they act. Robert (2006, p. 29) claims that awareness of "ethics" in the way life was conducted had become a topic for discussion with a general feeling that public bodies were less suspect than large private companies. During the last thirty years graphic design has become part of the social landscape, projecting ideas about popular culture, industry and much more. The rising technology with personal computers and internet network also accelerated the process of communication. The electronic communication through internet network connected people to each other and eliminated distance and time.

O'Gradyn (2008, p.9) points out the advances in technology and communication are driving phenomenal change. Today in the age of communication designers globally seek to find better ways to share information. Geographical, cultural and language barriers combined with conflicting messages and costumer choices created an overwhelming clarity for design. It is the information design that transfers complex data into a clear and effective presentation of information. Frank Thissen argues that information "design involves a multi and interdisciplinary approach to communication, combining skills from graphic design, technical and non technical authoring, psychology, communication theory and cultural studies". Information design is the defining, planning and shaping contents of a message and the environments it is presented in with the intention of achieving particular objectives in relation to the needs of users.[1] Information design transmits information efficiently into signs, graphs, and charts. At information design, graphic designer uses symbols, type, colors and images and makes

[1](iiid)

deliberate aesthetic and cognitive choices to create effective communications. Information design is ubiquitous. Information design is used on a roadway signature, on a map design, on a website, on a brochure, ballots, voter information guides, new product assembly and usage guides for furniture or a electronic product, signage for travel hubs such as airports, train terminals, exhibits at museums, on books and for sustainable environmental information guidelines (Baer, 2009, p.14). Infographic types vary according to the category of the content; such as statistical infographics, informative infographics, timeline infographics comparison infographics, geographic infographics, process infographics and comparison infographics. Almost every industry uses infographics to explain their complicated data to the audience as an effective visual communication method.

Society for Technical Communication's (STC) describes information design as the translating of complex, unorganized or unstructured data into valuable, meaning full information. Today's unprecedental deteriorating world by human activity is in need of clear compact information to create communication system for the sake of a better future. In this context this article aims to analyze and show the impact of information design as a rapid visual message interpreter for change for the better. So the information data needs to be effective and be rapidly understood by the viewer. Designers use numerous tactics and methods to make information meaningful. Writing, editing, graphics, symbols and illustration are used in the practice of information design. All these elements and tactics working together can help ensure the effective communication of information. Effective communication is the very essence of information design (Baer, 2009, p. 13). According to Micki Breitenstein;

> *"Traditional information delivery is very linear and includes tables of contents, indexes and such. People respond to visually engaging design, but they can get easily lost if the design isn't well organised. There are benefits to the dictatorial linear structure. People need both: the confort of someone telling them where to go next, but the arrraction of multilevel visuals"* (Baer, 2009, p. 17).

At information design the data needs to be presented in the most efficient and effective way in order to accomplish an accurate communication with the society. The argument of this article is to question infographics as an effective communication in guiding people to change for better with sustainable actions. The world is running out of time; it is getting hotter, the icebergs are melting, the oceans, sea, the soil and the air has been polluted, the resources are disappearing each day, forests are being destroyed and living species are dying and there are millions of suffering sick and homeless people all around the world. So what change can graphic design make within people's mind? Is it possible to change human behavior by environmental infographics? I think graphic design can create a consciousness through environmental infographics. Chapman and Gant (2007, p.7) claim that design is a needed, necessary and valuable process of invention and innovation, with the potential of taking us closer to a sustainable society – a society in which we design for sustainable consumption. In this sense consumption must not be longer polarized in terms of consuming or not consuming – the model of nonconsumption means designing nothing at all. Although this may seem to be contradictory, the consequence of our streamlined and automated life styles imply to determine the role of the designer. The aim of design must be to design in a way that promotes consumption models of long term sustainability.

It can be also said that today's graphic designer's role has been reshaped through ecological changes and challenges we are facing in the current world. Design needs to be sustainable. According to Manzini, design must play a role and become instead "part of the solution" by its nature in relation with human beings. Design holds a special power; a power that is at the same time both very weak and very strong (Chapman 2007, p.77).

In this context, graphic design as a tool for making a demand on consumption is the weakest part and graphic design as a tool in shaping the habits and orienting the society for a sustainable future is the strongest part. I believe graphic design has an ethical mission as a challenge in reshaping the consumer culture's demands to create a sustainable future. Information design aims to communicate the message in a clear way to understand. Prior to design, the intention of the infographic and the target audience should be envisioned. This research aims to examine the role and effects of infographics as a visual representation of information and communication method on sustainable actions. Within this scope environmental infographics have been examined only on climate change according to the subject matter and design principles.

4. STRUCTURE OF THE INFOGRAPHIC

One of the biggest problems facing today's world is the climate change and global warming. World Wide Fund for Nature: According to the claims of WWF, carbon dioxide and other heat-trapping gases are released into the atmosphere as a result of fossil fuels, cutting down trees and specific livestock types. Scientists indicate that there will be catastrophic effects if warming is more than 1.5°C. These effects can already be felt by droughts, fires, flooding and heatwaves which are caused by extreme weather as the coral reefs are destructed due to changes in ocean temperature. As climate scientists point out, global temperatures must be kept to 1.5°C in order to avoid the worst climate changes.[2] The infographic titled 'Climate risks: 1.5°C versus 2.5°C Global Warming" of WWF reveals the effects of global warming to the planet. The infographic (Figure 1) is made up of descriptive texts, headers and 2D illustrations representing the topics of arctic sea ice, sea level rise, forest, sun, human and marine life. This infographic gives information about the climate risks: 1.5°C versus 2.5°C global warming effects including the following headings 'extreme weather, water availability, arctic sea ice, sea level rise, coral bleaching, oceans, species, costs and food'.

This kind of complex information needs to be clarified for an effective communication to the audience. Environmentally conscious projects usually contain too much information to be communicated to the audience. Particular environmental design problems such as these need a creative brief and good planning as well as objective solutions. According to Nathan Shedroff, information needs to be designed in an objective way; organizing data and creating of information may have a profound impact on its meaning. The written information which is the key component of information design should be clear and concise, at a level the audience can understand (Baer 2009, 49).

For a well designed effective infographic there should be consistency and visual harmony with usage of graphics, signs, symbols, colours, illustrations with the typography. The main title, section title, headers, descriptors and body text should be set with a right typeface according to the content. At WWF's infographic on climate crisis, a majuscule condensed sans serif typeface is used for headings and a smaller punto size - minuscule sans serif typeface used for descriptive texts. In overall design the usage of texts are in harmony with the illustrations. The complex and dense information about climate crisis has been designed in a clear and effective visual structure.

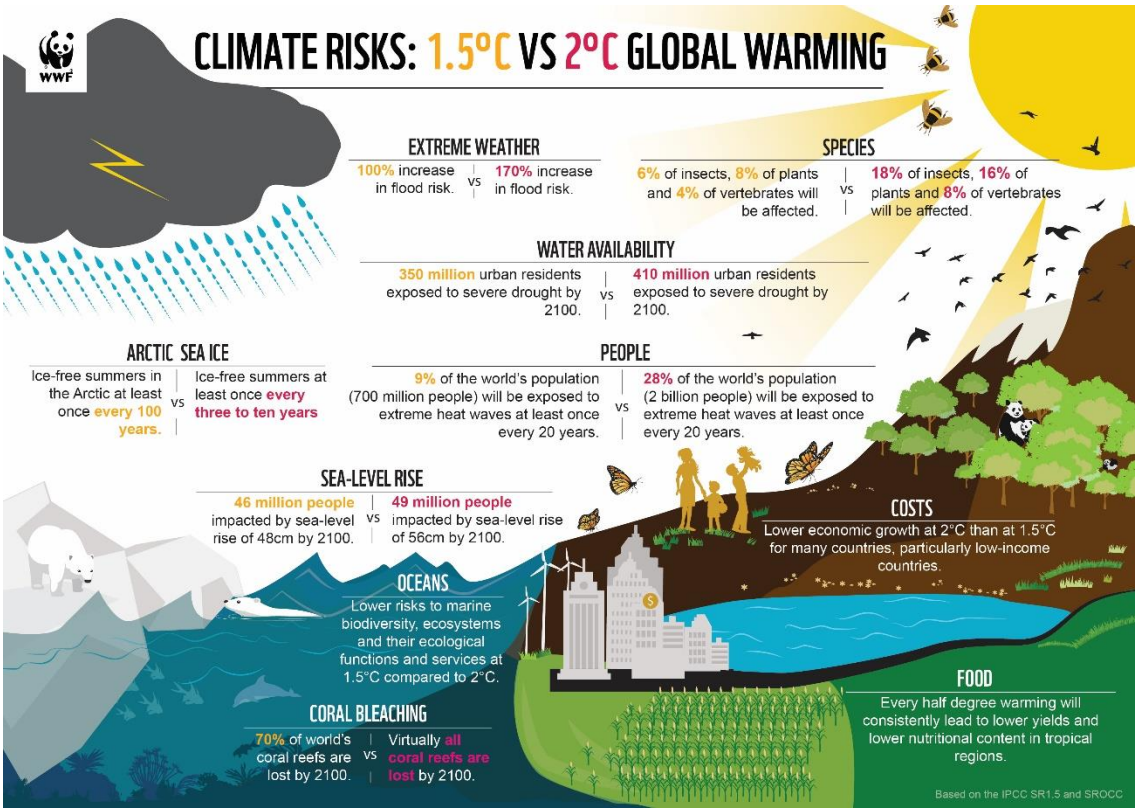


Figure 1. WWF, Climate risks: 1.5°Cvs 2.5°C Global Warming.
https://wwf.panda.org/our_work/our_focus/climate_and_energy_practice/?1070641/WWF-net-zero

The following infographics (Figure 2 and 3) based on two reports from Natural Resources Canada offer a way to unravel the complex issue of climate change. Canadian Geographic Magazine in partnership with the Canadian Museum of Science and Technology has created six infographics for educators to teach to students about climate change and its effects on environment. "Melting permafrost, ocean acidification, biodiversity, habitat destruction, the impacts on Canadian economy and the health of Canadians" topics have been designed into infographics to be taught to students. Adaptation and mitigation infographics discuss ways to reduce carbon footprint and adopt new habits and strategies to adjust to a changing climate.[2] Figure 2 and 3 are the Canadian climate infographics which are designed to be taught to grade 9 and 10 Canadian Students in geography and science classes. Climate change infographics have been designed in 5 different categories; on environment, Canada's biodiversity, adaptation and mitigation, economy, health and urban living. It is said that one of the aims of this course is to develop a variety of 21st-century skills such as critical thinking, creativity, collaboration and communication. Infographics can aid critical thinking and can develop communication skills of students. In this context visual literacy is an important factor in developing reading skills. According to O'Grady Visocky, (2008, s. 91) visual literacy focuses on ability to interpret, appreciate, gather and create images. Information literacy describes an individual's ability to recognize when information is needed and then have the skills to find, evaluate, analyse and effectively use that information. Infographics can aid thinking, clarify decision making, enhance learning and strengthen communication.

The infographics examined on figure 2 and 3 have a dense pack of information about climate change and environment. This complicated information needs to be organised by visual hierarchy principle that arranges elements to show their order of importance. The visual hierarchy can be done by using

[2] (Canadian geographic)

spacing, positioning elements to create focal points on the layout of the infographic. Designers structure visual characteristics in a logic that users can understand information easily. By laying out of visual elements logically and strategically, designers can influence users' perceptions and guide them to desired actions[3]. So it can be claimed that visual literacy and visual hierarchy are very important factors in directing people to desired behaviours.

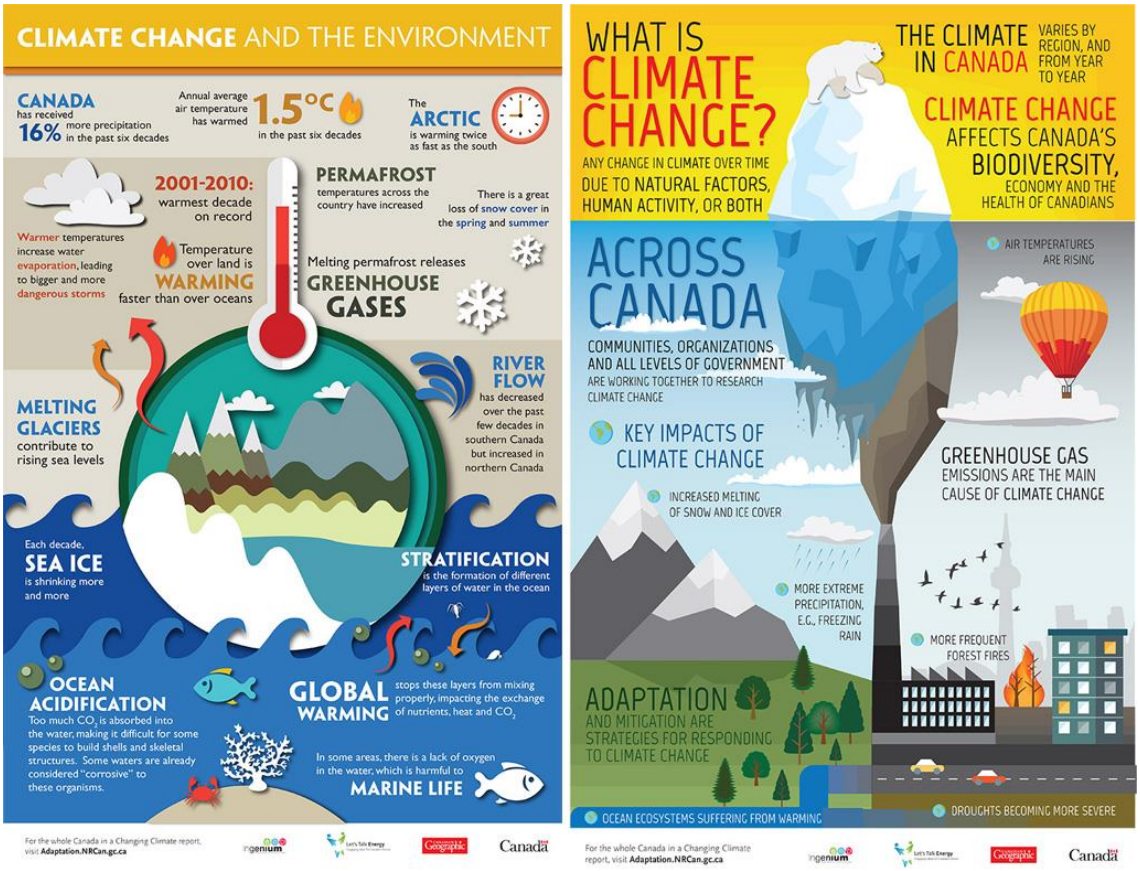


Figure 2. Canadian Climate Infographics
http://www.canadiangeographic.com/educational_products/products_climate_change.asp

The Canadian awareness infographics consists of a vector based illustration and clean usage of typography. In the infographic design entitled 'Climate Change and Environment' Figure 2 shows a natural cross section with a cutout effect. There are some blurred shadows under some of the vector images and this turned out to be paper cut out effect in design. The paper cut out effect seems to give a dimension in design which creates attention to the subject.

Another important factor is the selection of right typeface in the design. The designer needs to select the font according to the theme of the infographic. Typography is a complementary element of the theme of the design. Sans serif styles tend to work best for the headers, captions, lists and titles in infographics. Sans serifs do not have small lines or embellishments attached to the ends of letters.

3 (Visual Hierarchy)

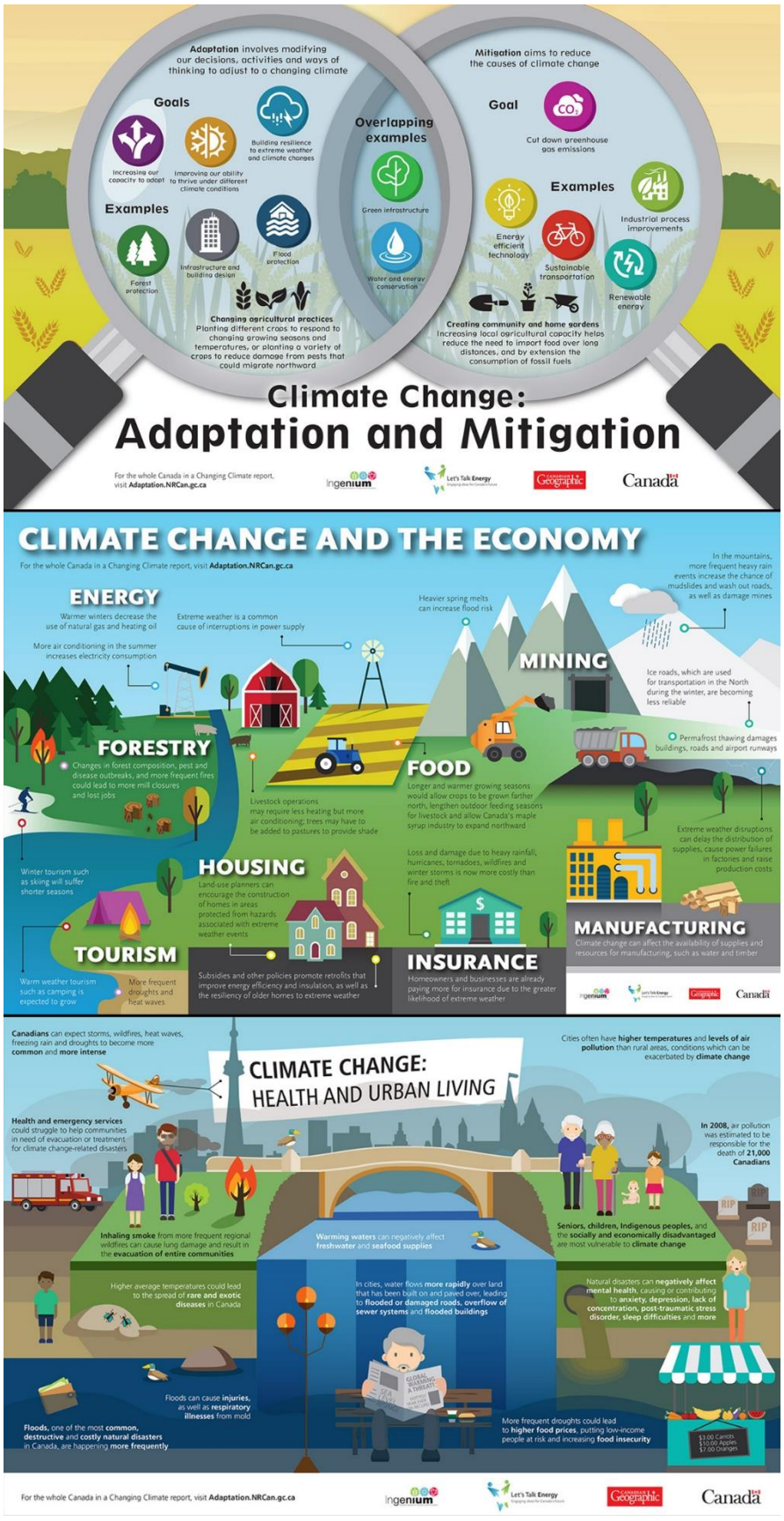


Figure 3. Canadian Climate Infographics
http://www.canadiangeographic.com/educational_products/products_climate_change.asp

For a well-designed infographic it's important to establish the size, weight of the font throughout different sections.[4] In Canadian environmental infographics sans serif typeface has been used to match with the content. The descriptive texts are aligned to right or left according to the position of the main titles. The viewer captures the message through the emphasized content. These infographics consist of excessive visual data on climate change and environment all over the design. When there are too much visual elements there will be less white space in the layout which makes it difficult to read and understand the content. White space doesn't need to be white, it can be any colour or texture in design, it is the space area between design elements. The white space balances design elements and organize content to improve the visual communication experience. White space has a direct impact on content legibility. When there is more information in the layout, there will be less amounts of white space. [5]

In these infographics there is less white space in the layout of the design. As shown in Figure 2 and 3 the dense information could be shared in two different infographic layout designs for an effective communication. The aim of the environmentally conscious infographics is to change people's daily actions and decisions. Everyday people make quick decisions on food, transportation, heating, clothing etc. and these choices determine and effect the future of the world. In this context infographics is a very powerful and a rapid way of visual communication method to clarify decisions. The designer of the infographic should master the subject context in order to create an impact on audience for change. Information designer is like an interpreter who helps to communicate and grap the reader's attention. Due to the fact that it is a well organised visual representation of complex information data, infographics are used to teach at schools as an effective communication tool. The use of infographics as a communication tool in education is significant in terms of teaching students the precautions to be taken in environmental matters. Students also learn visual literacy and critical thinking with infographics. Baker the SAT (College Board) and Common Core acknowledge the importance of having today's students be proficient in understanding graphic representations (Baker 2017). In their research entitled 'Putting Environmental Infographics Center Stage: The Role of Visuals at the Elaboration Likelihood Model's Critical Point of Persuasion', Lazard and Atkinson (2015, p. 12) claim that infographics are strongly communicative in the field of environmental issues and this idea is supported by experiments conducted with infographics. These experiments showed that when compared in terms of elaboration individuals experiencing infographics ranked higher than individuals experiencing text-based messages. Infographics also influence individual's eagerness about critical thinking concerning pro-environmental messages. Preference for visual or verbal information is very important for educational information. In this way individuals can be informed about pro-environmental behaviour and build up an attitude.

5. CONCLUSION

"I don't want your hope. I don't want you to be hopeful,
I want you to panic...and act if the house was on fire"
Greta Thunberg

Our world is running out of time. In the 21st century climate change and mass extinction of living beings are the greatest challenges facing humanity. Global environmental problems already have profound effects on health, livelihoods, food security, water supply and extinction of living beings. Animal agriculture and fossil fuels andoverconsumption is devastating our world. The tremendous

[4](Mighty)
[5](interaction design)

technological advances at industry created demands on consumer culture and exposed the occurrence of commercial advertising to sell more goods.

Graphic design is a needed necessary and valuable process of invention and innovation. Graphic design is related with human ingenuity and creative problem solving. Graphic design has the power to influence people for change. Designers try to help clients change the way people think or the way they act. The aim of graphic design must be to design in a way that promotes consumption models of long term sustainability. This article aims to question the effective role of infographics as a part of the solution of the environmental catastrophes. Information design can be entitled as a translator of complex, unorganized or unstructured data into valuable, meaning full information.

Today's deteriorating world is in need of clear compact information to create communication system for a sustainable future. In this context this article aims to analyze and show the impact of information design as a rapid visual message interpreter as a change for the better. Infographic designers as mediators of consumption culture carry a big responsibility to create innovative solutions for a sustainable future. Designers are becoming more critical participants in problem solving process due to global environmental problems. I believe infographics has an ethical mission as a challenge for reshaping the consumer culture's demands to create a sustainable future.

This research revealed that infographics as a visual representation of information is a strong and rapid way of communication method on sustainable actions. In order to create an effective communication with the audience the design problems need a creative brief and good planning and objective solutions. Information design should be clear and concise at a level which the audience can comprehend. The infographic should have consistency and visual harmony with usage of graphics, signs, symbols, colours, illustrations with the typography. Visual literacy and visual hierarchy are important factors to create a clear and effective communication in order to guide people to desired behaviours.

In this research Canadian Geographic's six different infographics on climate change has been examined as an educational material and as an effective visual communication method. Infographics as a visual representation can provide a visual method of engaging audiences with scientific information. This study has revealed that environmentally conscious infographics not only guide students to learn about environmental issues but also develops their critical thinking and visual literacy skills. Infographics can aid thinking, clarify decision making, evaluation, analysing, enhance learning and strengthen communication. We can claim that infographics is an essential factor in visual communication for educators, guiding people's expected actions. I believe infographics can create an environmental consciousness and can change people's old habits into sustainable actions. This is how infographics can pay forward of what commercial design has done so far with consumer culture. Infographics has the power to influence people for change. I think infographics can help to educate people to shape a sustainable future for our planet and all living beings.

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An Optimisation Study of Spatial Ad-Hoc Encounters with Quad-Tree Algorithms in the Context of Gldani Microrayons

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ABSTRACT

Soviet houses in Tbilisi were built low-budget, high-rise and brutalist in a collective mindset under the influence of socialism. Situated at the northern periphery of the city, the Gldani microrayons are representative to the post-Soviet living in Tbilisi. The spatial development of Gldani microrayons offers interesting evolution of informal architecture along with suburbs living conditions, which have been subject to radical changes since the fall of the Soviets. After the establishment of Georgia in 1991, different types of informal spaces emerged due to a variety of reasons. This study looks at the generative side of the social housing phenomenon of informal architecture which is instrumental to understanding the context. In this work, the recreation of building layouts which are correspondent with indoor and outdoor conditions of a set of selected houses in Gldani is displayed. By that, the arbitrary intervention of Gldani residents in the original syntax of Soviet housing blocks is decoded. First of all, the intervention motivation of the users is sought by analysing Gldani's existing typologies. The function, adjacency and the type of adjacency for each room constitutes computable architectural compositions. Based on these variables, we applied a quad-tree (q-tree) algorithm to optimise spatial ad-hoc encounters. In Gldani, designing an optimisation for housing typologies that can be adaptive to the users' needs reveals a series of novel spatial possibilities. In this work, it has been found suitable to use q-tree algorithm to simulate spatial optimisation for ad-hoc encounters.

Keywords: Informal architecture, Soviet architecture, quad-tree algorithm, ad-hoc encounter, space optimization.

1. INTRODUCTION

Soviet architecture is one of the topics in which social media users show keen interest. Brutalist and concrete buildings are the centre of attention regarding the tags of Soviet architecture. Evocative images of brutal forms receive commentary from users who superficially create a nostalgic anachronism over the architectural value. Along with the nostalgia surrounding the topic, vague apprehension of possible discomfort with the Soviet ideology is slowly vanishing and replaced by growing call for grabbing knowledge about the architectural and social impacts. Enduring impacts of Soviet architecture are mostly valid in the mass housing context.

Although the academic side of the subject has remained simplistic and marginal overall, recent research examines the postulation of Soviet mass housing that standardisation and industrialisation of residential architecture improve social integrity. The prevailing studies about Soviet mass housing are inclined towards a nexus between political history and theories of aesthetics [1-4].

Research tend to follow a de facto agreement on an unofficial naming convention regarding the historical timeline of Soviet mass housing. Three distinct types are distinguishable in succession. Each of the so-called *Stalinka*, *Khrushchevka* and *Brezhnevka* types is named after a political leader who initiated respective housing campaigns. Admittedly proposed to solve housing crisis, these three types of mass housing present similarities but distinct features in architectural and planning characteristics.

Preceded by the *Stalinka* houses which were famous for the *Kommunalka* (i.e. communal spaces in a single apartment unit, which is shared by at least 2 families), the *Krushchevka* were designed with emphasis on more private spaces [5,6]. The succeeding type of the *Brezhnevka* had minor technological and spatial upgrades over the *Krushchevka*. The work of [7] systematically catalogues the typologies between 1955 and 1991, covering the *Krushchevka* and the *Brezhnevka*. The both types were built by using cost-effective construction technologies of prefabricated concrete panels in the mass housing context [8,9]. These houses were also standardised under a new concept of neighbourhood called microrayon—also *microraion*, which means micro-district [10]. Containing computable parameters, microrayon settlements were conceived to behave like cybernetic systems solving a partially social problem like housing crisis with the mathematisation of spatial qualities [11].

Microrayons were experimental, optimised and ideal solutions applied to different locations during the Socialist Era between 1957 and 1989 [12,13]. As a planning concept to convey prosperity and equality through connectivity, microrayons were conceived with comprehensive planning rules that resemble algorithmic processes. The rules of microrayons ranged from its size to road network hierarchy and number of houses, schools and green zones.

After the Soviet Dissolution in 1990, new independent states, such as Georgia, emerged with new rules and law for the maintenance of microrayons. In Tbilisi, spatial transformation of Soviet houses was enforced by disordered interventions of users. For years, residents of microrayons were allowed to make indoor and outdoor spatial rearrangements until new state rules issued based mostly on safety concerns. This caused the emergence of informal architecture in Gldani [14-16]. Curatorial works interrogates the present conditions of microrayons through the articulation of informal architecture in Gldani [17-18].

The transformative power of informal architecture created by residents motivates this research to investigate alternative scenarios which may instigate the user-oriented progress instead of idling the embed complexity for the sake of over-control. Studying the computable spatial aspects of mass housing in microrayons may ascertain the continuation of the user-oriented spatial transformation. This study looks at the Gldani microrayons in Tbilisi, testing the use of quad-tree algorithms in

understanding the ability of mass housing layouts to transform in sequence. We first examined building typologies and forms used for Soviet mass housing. Experimenting with diverse layouts required to define a set of parameters to generate alternative scenarios for the dissolution of the original space into informal architecture. The function, adjacency and the type of adjacency for each room constitutes computable architectural compositions. Based on these parameters, we generated alternative layouts that resulted in ad-hoc spatial encounters in response to indoor and outdoor constraints.

The paper presents data collected regarding Soviet mass housing layouts and Gldani microrayons, supported with photographs taken on site. Then, a set of computational experiments are demonstrated with diagrams. Finally, the paper synthesises the qualitative findings and concludes with a discussion.

2. CONTEXT

Gldani is a satellite settlement in Tbilisi which is the capital of Georgia. Previously a village, Gldani was one of eleven locations in the city on which mass housing projects were implemented. Projected for housing supply for about 147.000 residents in 1968, the design and planning process had to follow the Soviet microrayon standards, which were at the disposal of Moscow (Figure 1) [15]. Leaving almost no space for the architect's creativity, some of these standards were slightly adapted to the context of Tbilisi. Non-standard balconies were inserted in the original plan as per traditional architectural norms [17]. Despite the repetitive design figures and forms of the original plan, Gldani offers an interesting architectural case that comes from the plurality of residents' involvement in the spatial evolution. Housing blocks of Gldani were erected under construction code norms of Moscow that prioritised standardization of prefabricated concrete panels and typological definition of buildings [7-9].



Figure 1. One of the conceptual models for Gldani microrayons from the archive of the project architect, Teimuraz Bochorishvili. Image from [15].

2.1. Soviet Mass Housing: Gldani Case

From the 1970s to the 1990s, the Soviets realised several social-housing projects in Tbilisi. Under the influence of socialism, mass housing projects were constructed low-budget, high-rise and brutalist in a collective mindset. Located on the northern periphery of the city, Gldani is one of these settlements that represent the rethinking of social neighbourhood.



Figure 2. 9-storey concrete panelled housing blocks in Gldani, Tbilisi. Photo by Authors.

Acting as social condensers, these microrayons reinvented everyday life in a communist style of openness and equality in the original plans. Families and individuals, mainly factory workers, brought from different locations lived and shared these apartment blocks, creating space for the Soviet definition of home until the Dissolution in 1990. From the foundation of the new state in 1991 up to the Rose Revolution in 2003, the economic impacts of change were felt in kind of a state of civil disobedience. And the main reason was seen as the lack of infrastructure and basic services for maintenance which used to be supplied and managed by the State prior to 1991 [14, 15, 18, 19].

Another reason of change was the privatization of urban properties in 1992. At this point, the fictionalized family model of the Capitalism replaced the Soviet model. Individuality and consumption gained importance and defined new user profiles. With consumerism, building additional space for more ownership and occupying communal areas to support domestic economies of houses became a common practice [17].

2.1. Spatial Evolution of Apartment Units: Gldani in the Post-Soviet Era

Along with the Soviet ideals of social housing, the Soviet urban picturesque of Gldani decayed due to economic collapse, civil disobedience, lack of state support for maintenance, and many other reasons but the addition of informal spaces. Garages, gardens and shops were added to the buildings. Residents even built multi-level joint spaces. These makeshift extensions did not go unnoticed to a Russian journalist who nicknamed them as *Kamikaze Loggias* because of their insecure conditions, in some cases allowing a residence to grow up to 40 square meters [15, 18] (Figure 3).



Figure 3. Makeshift extensions hanging from mass housing blocks turn microrayon living insecure. Photo by Authors.

Reading these informal spaces as nostalgic injection might reveal an operative anachronism. But that would not necessarily contribute to understanding such a complex phenomenon and to reinventing the embedded collective intelligence. Here, the objective happens to regenerate rather a forensic view than a subjective one. By that, our approach relies primarily on analysing the spatial information

coming from both the original plan typologies and their modified versions that create spatial encounters that belong to specific indoor and outdoor site conditions.

3. METHODOLOGY

3.1. Typology

In this research, understanding spatial improvisations relies on the challenging task of analysing Soviet mas-housing typologies. Due to limited publication records in English, drawing the plans of GIdani houses may require travelling to Tbilisi. At the end of a 3-day fieldwork including house visits, closer study reveals the concurrence between the *Krushchevka* and the *Brezhnevka* in Gldani. Figure 4 shows a selection of the *Krushchevka* plan typologies paired with standard forms of the *Brezhnevka*. However, one can still find out that the blocks are incomprehensively named by the GIdani residents [20], which indicates a lack of thorough documentation.

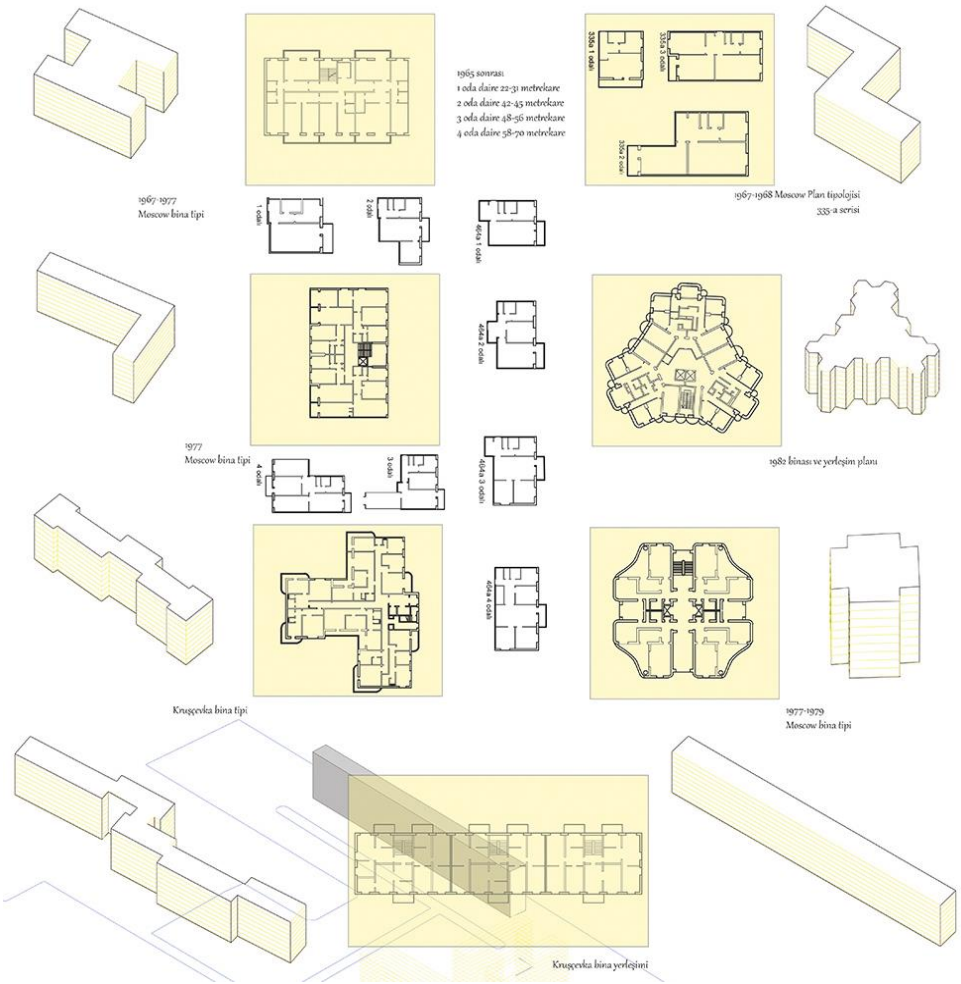


Figure 4. Standard building typologies of mass housing paired with standard building forms.

From the 1970s onwards, building typologies and forms were diverse and different layouts were executed in GIdani. A chronological diagram maps how the *Krushchevka* and the *Brezhnevka* evolved through time along with the gradual standardisation of their compound (Figure 5).

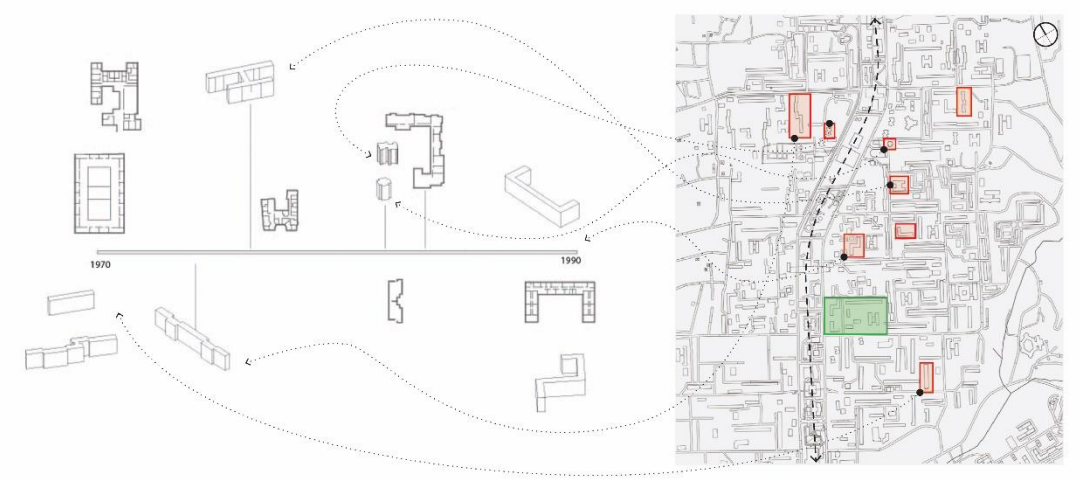


Figure 5. Compound of the *Krushchevka* and the *Brezhnevka* in time (left). GIdani map (right).

3.2. Typological Evolution

To further understand the composition of the *Krushchevka* and the *Brezhnevka*, we looked at the typological evolution and possible in-between scenarios. By reproducing housing typologies from in-between morphological transitions, user modifications were exaggerated to a degree where an array of possible relations between indoor and outdoor spaces is laid out. So, as two buildings with different typologies transform into each other, the transformation steps reveal morphological motivations for new plan layouts that go beyond the boundaries of the type (Figure 6).

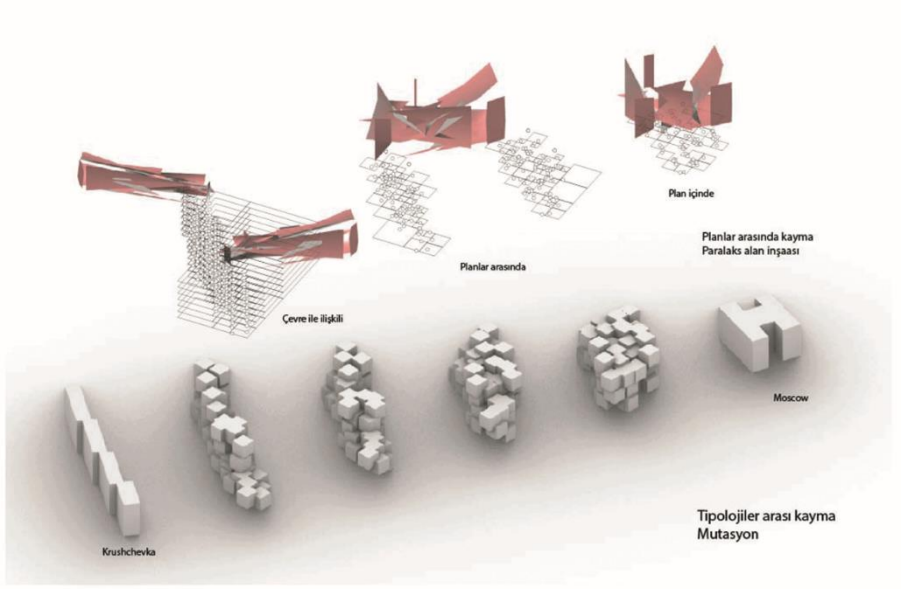


Figure 6.

Figure 7 demonstrates maximising user intervention with the typologies to generate an array of reproduced plans. The variables of this setup include the seating area and plan type. It distributes these items to the available space between the building blocks.

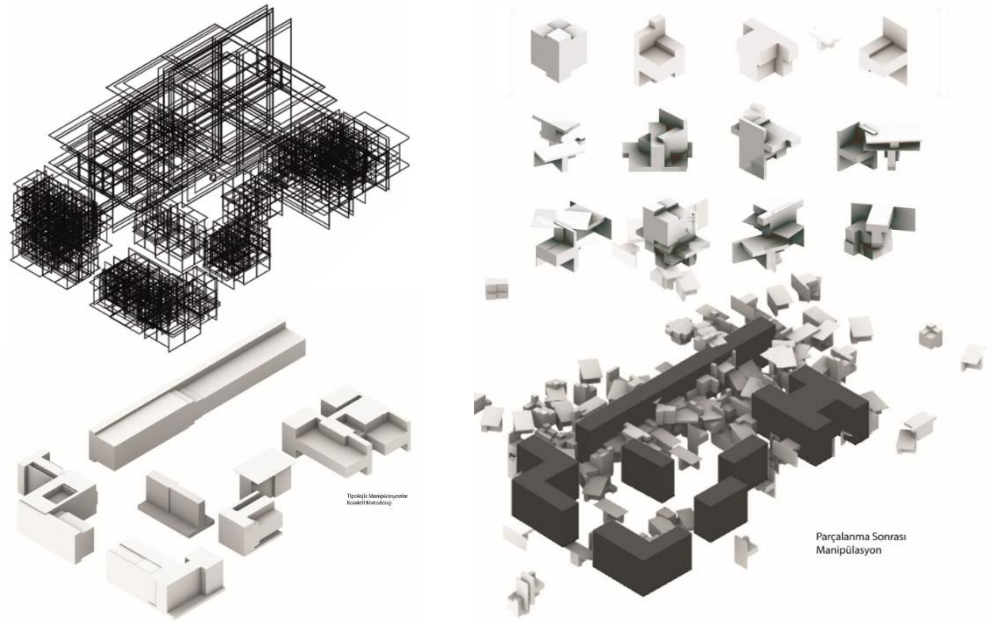


Figure 7. Morphological redefinition of a microrayon section based on typological components (left), maximising the composition of typological components that indicate the further evolution of the compound of the *Krushchevka* and the *Brezhnevka*.

3.3. Space Syntax and Quad-Tree Partitioning

This section explains the principles of spatial partitioning used in the study. In this step, we used the potentials of two computational design phenomenon for understanding and generating building layouts, one is space syntax and the other is quad-tree partitioning of space (Figure 8).

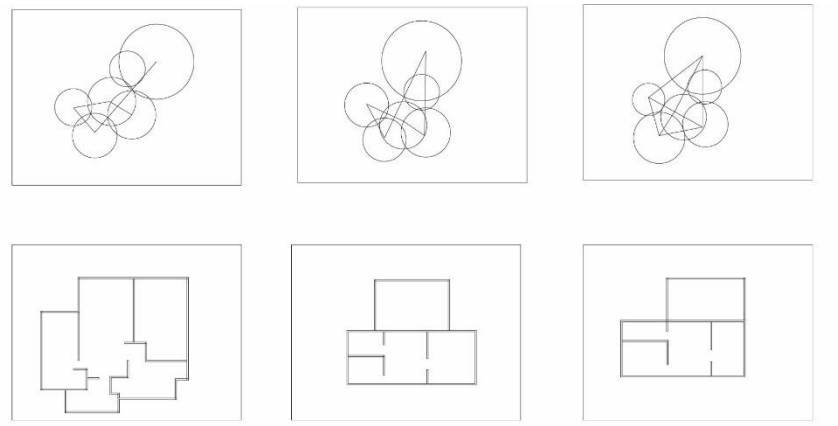


Figure 8. Plan typologies (below) and a set of their spatial syntaxes (above).

The q-tree algorithm is based on dividing a two-dimensional space into four equal parts. The partitioning automatically occurs when the number of objects to be kept for each node is exceeded. In this case, the tree node is split once more and the spatial objects are distributed to these nodes. These nodes are then customised with contextual parameters (Figure 9). The parameterisation helps for mapping new spatial distributions to intersections and encounters between original building typologies and user interventions in Gldani.

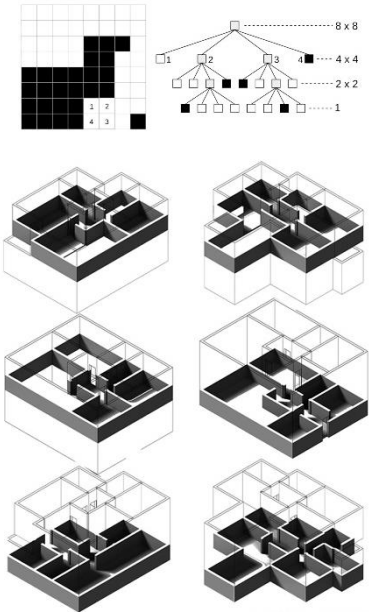


Figure 9. Selected plan typologies in 3D partitioned with quad-tree algorithm (below) and the diagram of the quad-tree partitioning (above).

A q-tree algorithm generates spatial database by dividing a two-dimensional space into four equal parts. Here the location of the bubbles changes the composition of the building layout in correspondence with q-tree partitioning. The function, adjacency and adjacency type of each room constitutes computable architectural compositions. The partitioning automatically occurs when the number of objects to be kept for each node is exceeded. In this case, the tree node is split once more and the spatial objects are redistributed to these nodes. These nodes are then re-customised with contextual parameters. The parameterisation helps for mapping new spatial distributions to intersections and encounters between original building typologies and user intervention. The code is written in a visual programming language, computing a series of plan types generated by calculating if the generation result fits into the contrasting relations between repulsion and attraction rules (Figure 10).

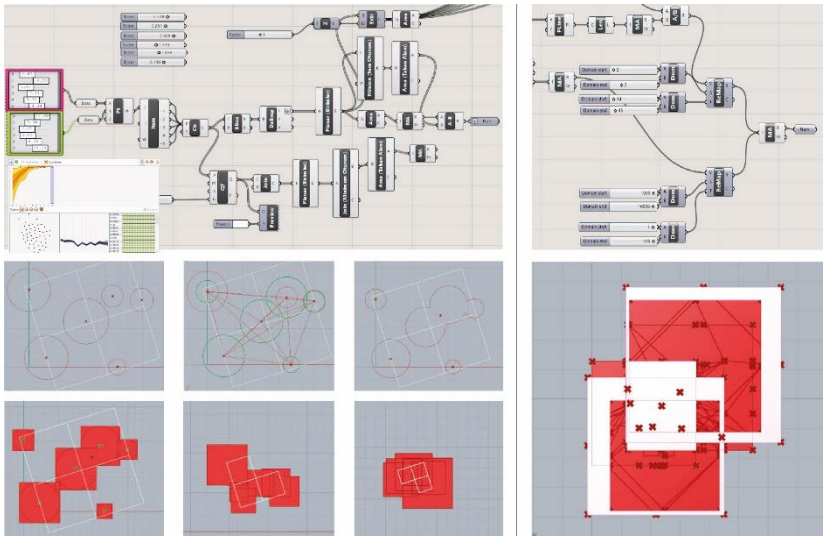


Figure 10. The visual code of the parameters that define the quad-tree partitioning of space based on the respective syntax (below). Pieces of the visual code (above).

3.4. Evolutionary Optimisation

Optimizing housing typologies that can change according to a set of rules is not the best, but rather revealing a series of possibilities. The algorithm was applied to all the layers of the building blocks within the boundary of the selected microrayon section (Figure 11). Multi-layering attractive and repulsive forces on the plans resulted in exploded new spaces which are intersecting in some cases and far-reaching in distance in some other cases.

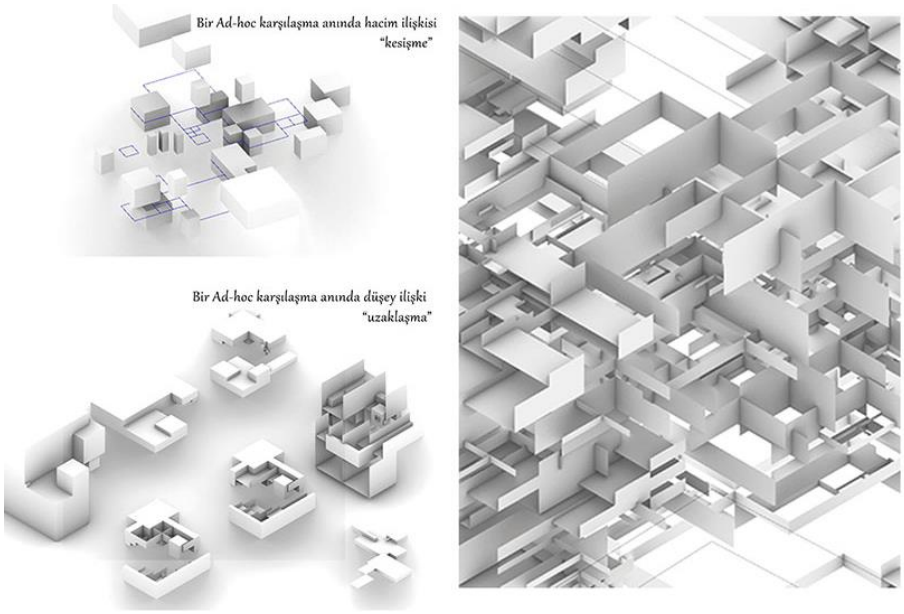


Figure X. The application of the spatial algorithmic process in 3D.

Here these ad-hoc encounters in houses represent novel interventions which are responsive to both the spatial syntax of the plan types and the physical integrity of the blocks. This is where the study proves itself as an investigation of both the typology and the morphology. And in this generative process, it has been found suitable to use q-tree algorithm to simulate spatial optimisation for ad-hoc encounters. In the next phase, this work will be advanced with semantic logic so that the code responds to the type of rooms.

4. SYNTHESIS

Based on the illustrative results and qualitative findings, the work proposes future integration to the Gldani housing phenomenon of *Kamikaze Loggias* by developing a vision for ad-hoc encounters which are decoded from Gldani blocks. An ad-hoc encounter area in a residence can interfere with both the spatial syntax and the physical integrity of the space. According to the French historian Fernand Braudel, in French residences the maids had to pass through the main bedroom to reach other rooms, and this connection built the intimate space by isolating the bedroom [21]. Connecting with such theoretical connotations, the paper discusses the spatial productions of new coincidences that may arise when the users' choices are compulsory ad-hoc optional, over the mixed use case.

In recent years, the informal architecture in Gldani is restricted by state laws due mainly to safety concerns, but also the complexity that it involves for the creation and maintenance of new spaces. In this study, a design-research approach is deployed along with an axial view which is obtained in Gldani by reconstructing the historical housing information produced with the existence of existing living spaces and the usage information by its users. Therefore, the paper emphasizes the plurality and diversity of the urban life in which individuals can transform and modify space within a participatory

housing phenomenon. On this line of discussion, the work computationally regenerates the process of spatial productions and new coincidences that have been put in stagnation by strict planning codes.

5. CONCLUSION

The paper sets forth a visionary, yet practical, spatial design approach for a social housing phenomenon in the context of Gldani apartment blocks. The housing phenomenon that this work is focused on is a consequence of user intervention on the spatial characteristics of the units in Gldani apartments. The study reveals the concurrence between the *Krushchevka* and the *Brezhnevka* by applying computational design methods in order to remap both typological and morphological features. The work emphasizes the plurality and diversity of urban life. In this study, design-research methods are deployed on a problem-finding process along with a forensic approach with data collected on site. And it is based on the processing of the historical housing information along with existing living spaces and usage information. Finally, the paper places a theoretical line of synthesis based on qualitative findings which are to be studied further in future publications.

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Investigation of Urban Scale Projects Developed Using Parametric Methods

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ABSTRACT

Urban pattern is formed by the effect of many factors such as building blocks, parcels, defined construction areas, setback distance limitations and the rules of historical buildings. Traditional and parametric design methods are used in the development process of urban scale projects.

In the traditional design method, urban projects are developed manually or with CAD software. Manual drawing method depends on the hand skill of the designer. The designer is expected to have a high knowledge of mathematics and geometry in order to design in different forms and geometries. In the use of CAD software in urban scale project design, all project elements must be drawn one by one, and all documents must be updated in the project while editing. Urban-scale projects include many sub-disciplines. The larger the scale, the harder it is to update the project and the more complicated the interactions are between project participants. Thus, some of the limiting factors for projects developed using traditional methods are form, time, and error risk. This led to the search for novel design methods in the development of urban projects.

With developing technology and software, parametric design tools have started to be used in urban scale projects. The parametric design environment is based on calculations and algorithms. While there is a visual thinking and drawing development approach in the traditional design method, the parametric design method requires numerical and algorithmic thinking. The parametric design approach allows the use of different forms, ease of making changes and the development of different design alternatives.

In this study, the development process of urban design methods will be examined and the transition process to parametric design method will be detailed. In this context differences between traditional urban design method and parametric design method will be compared and evaluated. The role of the designer in the parametric method and the development process in urban design will be explained. Three projects designed using parametric methods will be examined.

Keywords: Urban Design Methods, Parametric Design

1. INTRODUCTION

The development process of urban scale projects requires working with quantitative data (built environment, public spaces, local governments, rules, physical conditions, etc.) and qualitative data (social constructs, uses etc.) that direct the design and the relationships between them [1]. The development of urban scale projects is a complex process involving many factors. Comprehensive design methods are needed to incorporate qualitative and quantitative data that form the urban pattern into the design. Traditional and parametric design methods are used in the development process of urban scale projects.

In the traditional design method, urban projects are developed manually or with CAD software. Two-three dimensional drawings which drawn by hand are used in manual drawing method. This design method depends on the designer's skill. The designer is expected to have a high knowledge of mathematics and geometry in order to design in different forms and geometries [1]. Computer Aided Design (CAD) tools are also used in traditional design method to assist designers to develop urban scale projects. These tools support the development of urban scale projects in computer environment with the use of lines and geometric forms [2]. In the traditional design methods, all project elements must be drawn one by one, and all documents must be updated in the project while editing. The larger the scale, the harder it is to update the project and the more complicated the interactions are between project participants. In cases where there are many drawings affected by any change, making these changes one by one takes time that cannot be ignored and increases the possibility of making mistakes in the project. In this context, the limiting effect of traditional design method such as limited form, time and error risk led to the development of different approaches in the design of urban scale projects.

With developing technology and software, parametric design tools have started to be used in urban scale projects [3]. Parametric design tools, initially used in different industries, have made an impact primarily on building form design and interior design in the construction sector [4]. The different, complex, and free form demand of contemporary architecture has been met with the parametric design method [5]. Parametric design is a method of obtaining numerous results related with design problem by determining certain parameters. In the parametric design process, determining and organizing the data that will affect the design as parameters is essential. Once the system is set up by specifying the parameters, many alternatives can be tried by changing the parameter values. The parametric design approach allows the use of different forms, ease of making changes and the development of different design alternatives. These advantages provided by the parametric design method have caused an increase in the use and demand of parametric design tools in urban scale projects.

In this study, the importance of using parametric method tools in the design of urban scale projects will be explained. The working system of parametric methods will be explained. Three projects designed using parametric methods will be examined. Prepared papers should clearly describe the background of the subject, the authors work, including the methods used, results and concluding discussion on the importance of the work. Technical terms should be explained.

2. USE OF PARAMETRIC TOOLS IN THE DEVELOPMENT OF URBAN SCALE PROJECTS

It is predicted that the built environment and the cities of the future will change with various parameters such as climatic conditions, socio-economic changes, population growth and the impact of technology. The cities of the future will be shaped with different conditions and technology infrastructure than the characteristics of today's cities [1].

The urban growth rate, which started to increase in the twentieth century, continues to increase today. Cities, which developed using traditional design tools, are self-sufficient cities that provided minimum comfort and living conditions [1]. The continuous increase of the urban population and technological developments have made necessary to design cities suitable for the living conditions of today's and future cities. The cities of the future require an integrated planning and design approach, considering parameters such as water and energy supply, climatic conditions, economic and social factors etc [6]. This situation requires the development of the correct strategies and urban design method while defining the future scenarios of the cities.

2.1 Comparison of Urban Design Methods

In this study, urban design methods are classified as traditional and parametric methods. The working principle of traditional and parametric design method will be detailed in this section.

In the traditional design method, the entire project process is managed by the designer. Urban-scale projects designed either using hand drawings or traditional CAD software both depend on the skill of the designer. The relationships among various parameters considered and their effects on the final design is not formalized. Urban scale projects are designed using basic lines and geometric forms in CAD software [2]. Design elements such as main street, grid, parcel are drawn using CAD tools while semantic information such as public space, building type, building age and height are defined independently from drawings [2]. All drawing elements must be drawn one by one and all drawing documents must be updated in every revision made in the project. In the traditional design method, which depends on the skill of the designer, as the details and scale increase, the drawings become more complex and the possibility of error increases. Urban scale projects formed by many factors require the development and evaluation of multiple scenarios to find the most appropriate solution. Traditional design methods have become insufficient for today's large urban designs. The search for alternative design methods that will keep up with the rapidly increasing parameters that need to be considered in today's complex cities is attracting more attention.

Parametric design method focuses on a system of relationships between various parameters. In this method, it is possible to define qualitative and quantitative elements as parameters [7].

In the traditional design process, the entire design generation is managed by the designer. In the parametric design process, the design and many alternatives are generated by the system, but the designer still retains control over the project. The designer defines parameters, relationships, rules, bounds, and constraints; formalizing the design decisions and guiding the system [7].

In parametric design method, the designer must design the generation system. This system formalizes the design decisions and is based on parameters representing either geometric properties of design elements, semantic properties associated with the design problem, or performance indicators that will be considered. Bounds and constraints are defined for these parameters or their relationships. The performance of the design in various aspects can be predicted through simulations. This system of interconnected parameters generates design alternatives automatically. Once the system is in place, design progresses as generated alternatives are evaluated, and revisions to the system are made [8].

Design stages in non-parametric methods follow a strict sequential flow. Compared to parametric design method, traditional methods allow preliminary design to be completed faster. However, when problems are encountered in later stages, going back to any previous design stage is very costly since it requires a complete manual re-design. On the other hand, in parametric design, the initial system setup requires more time and expertise, but revisions and changes to the project based on the input of various project stakeholders can be implemented efficiently [9]. Since design alternatives are generated automatically, redrawing the project is not required. Moreover, the current state of the urban design project is preserved, and the old design varieties are accessible. The progress of the design is documented and can easily be followed.

By using parametric design methods, while projects are developed at urban scale, analysis, testing, evaluation, and comparisons are possible between design alternatives [10]. All aspects of the design (legal aspects, orientation, solar radiation, wind, etc.) can be considered for parametric analysis.

The ever-increasing variety of data and analysis techniques on cities have made large scale urban design too complex for manual design based on traditional workflows. Parametric design software applications have come to the fore. They facilitate a design method of urban projects that allows quick explorations of form and performance with accuracy. The success of future urban design projects depend on the architects' adaptation to this new generation of software [10].

2.2 Software for Parametric Design

Current parametric design tools have advanced to the extent where they are able manipulate complex geometries and allow integration of proposed and existing elements and provide performance analysis through simulations. A brief look into the history of parametric design approaches in architecture reveals that architect Luigi Moretti (1971), wrote about the "parametric design concept" in his "parametric architecture" article [11]. During the 1980's digital technologies developed rapidly, and the first computer aided architectural design (CAAD) system using parametric components (walls, floors, columns, etc.) ArchiCAD was released in 1986 and the first parametric solid modelling CAD software Pro/Engineer was released in 1988. The 1990's saw further development of parametric technologies in CAD. Shortly after parametric techniques proved useful in architectural design, they started to be used at urban scale projects. Starting with 2000, Building Information Modelling (BIM) technologies started a shift in the use of Information Technologies (IT) towards a full digitalization of the construction industry. BIM concept does not refer only to software tools but also the processes that are currently going through radical changes due to significantly more effective communication and collaboration opportunities offered by technology. The workflows of the new globally distributed design teams are supported by BIM project databases storing geometric and semantic data manipulated by parametric systems.

Urban design guided by parametric design enabling systematic evaluation, data and documentation has a great potential in its field [1]. Parametric design was first used in the architectural scale to develop design elements. For problems at the urban scale it started to be used by defining concepts such as density, usage, form, space and typology with parameters. [7]

Using BIM software together with parametric software, urban mapping, environmental analysis and easy access to all information about the city are provided. Design firms use parametric software tools in many urban projects developed in the world. e.g., firms such as SUBDV, DECOI Architects, Foster & Partners, UN studio, Zaha Hadid Architects, Atelier Jean Nouvelle, Gehry use parametric design tools in their design processes. Usage purposes of parametric tools span over generation of construction site detail alternatives to, designing architectural elements, and to architectural morphogenesis (transformation-development).

Parametric design tools can be used for various reasons at different scales, at different stages of design. For example, at Gehry Partners they are used for design, drawing and production of complex forms and surfaces. They are also necessary for cost estimation after design and enable effective collaboration between employers and subcontractors in manufacturing. On the other hand, at Zaha Hadid Architects parametric design methods are used for design throughout all stages guiding the design from beginning to end.

2.3 Examples of Parametric Urban Design

In literature, four different approaches to applying parametric tools in urban design exist [12]. First is, associating analytic parameters with 3D model elements to inform the design process. Second approach is to use parameters for complex form generation in developing iconic urban projects. Third approach is to conduct parametric analysis for specific purposes as design progresses. The fourth approach is to use fully rule-based parametric design generation.

Kartal-Pendik Project; Istanbul Kartal Master plan is developed by Zaha Hadid Architects. The project has an importance in terms of approaching urban design with parametric system instead of traditional design methods. In this project parametric design approach was used for dealing with the complex geometries involved in the iconic and sculptural urban design.

The design process is divided into two main parts: Road network and building block constructions. The road network was designed using parameters. The main design decision of the road system is to maximize areas defined by the main roads. This road network was then minimized using secondary roads and created the main pillar of the design [3].

After determining road axes, two basic design ideas were developed for urban structuring. First, cross towers were designed at the intersection of road axes, thus the road networks are emphasized [13]. The second is to design perimeter blocks with courtyards in proportion to height and size of the parcel. Courtyard size varies according to height increase and parcel width.

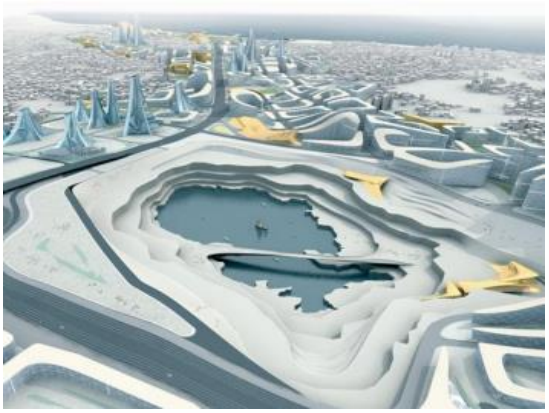


Figure 1. Kartal Pendik project

In the parametric design method, the design system is generally established and resulting alternatives are produced by varying the values of the parameters that set up the system. In this project, the parametric design method was used to generate alternatives, but at points of interest and where the designer felt it was necessary, the designs were taken out of the parametric system and developed further according to the designer's own artistic intent.

If we examine the design development phase in detail, MAYA software's hair-dynamics feature was used to generate road network alternatives (Figure 2).

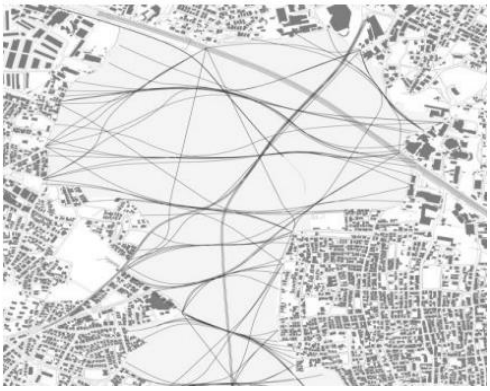


Figure 2. Maya, hair-dynamics created by the ring road study

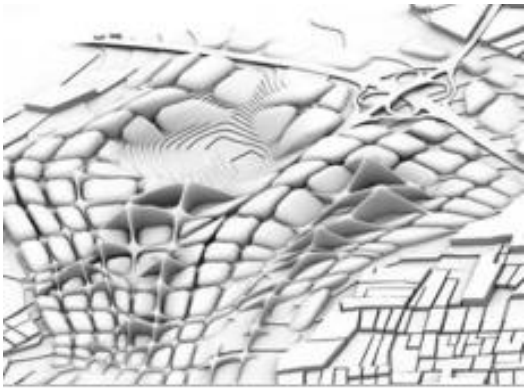


Figure 3. Intersection towers and perimeter-block locations



Figure 4. Orientation to the courtyard and the covering system.

Parametric Urban Design project in Qurm Region; An urban design project is developed by the Aurel VR architectural design office for the transformation from a low-density residential settlement to a large-scale and mixed-function settlement in the Qurm region in Oman [1]. In this project parametric design approach was used for associating analytic parameters with the design process.

The main design goal of this urban project is to achieve a high level of sustainability. Environmental analyses have been integrated with parametric design tools to optimize climatic performance, program distribution, accessibility, and land-use in developing a system for climate sensitive high-density urban settlement that can be applied to any location in the region.

To meet sustainability goals, generated urban forms are analysed in terms of climatic performance. The environmental characteristics of the region are defined in the system and guides the design generation by evaluating and comparing the performance of alternatives.

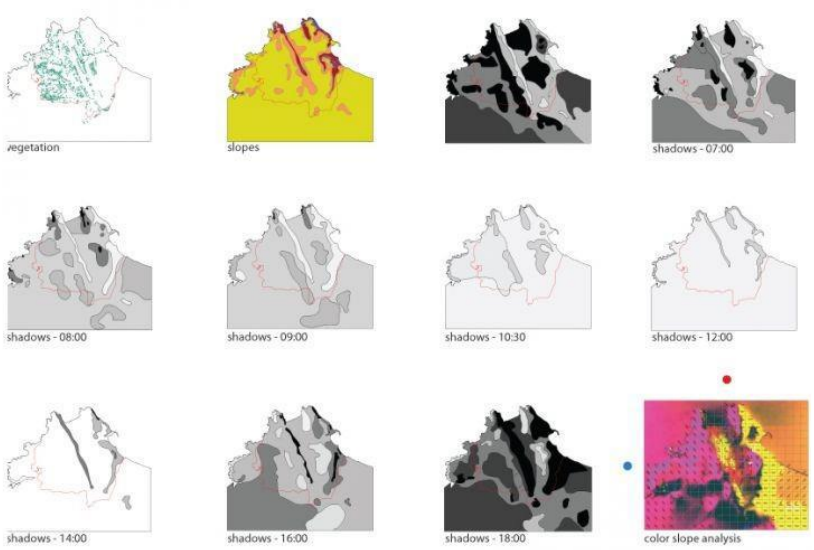


Figure 5: Analyzes (eco-diagrams) obtained in the region with parametric software

As a result, the system harmonizes the urban design principles with the climatic requirements. The forms are generated based on modules and support mass-production. The design consists of city blocks that can be appropriated to any location in the Qurm region based on data and analysis. Figures 6-10 show how the design of a 100 m x 100 m city block evolves as new parameters are added to the optimization algorithm.

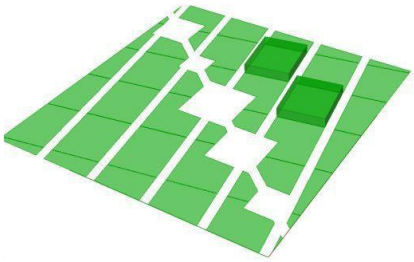


Figure 6. Parameter 1- Program

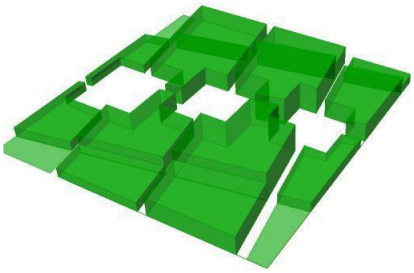


Figure 7. Parameter 2- Number of courtyards

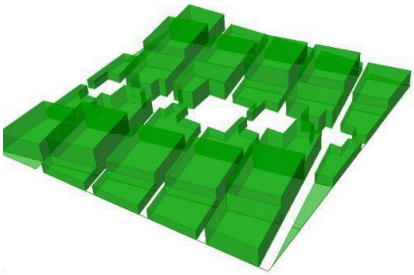


Figure 8. Parameter 3- Optimum wind direction

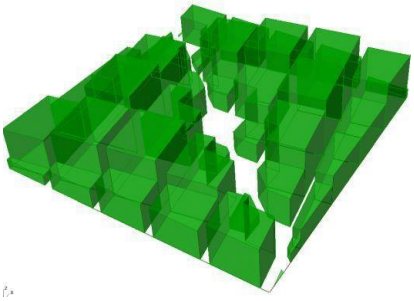


Figure 9. Parameter 4- Optimum daylight direction

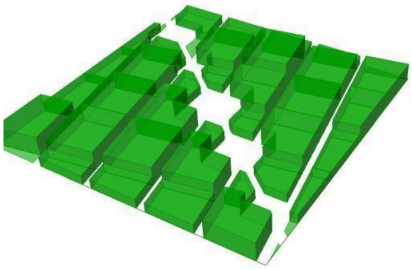


Figure 10. Parameter 5- Optimum sea view orientation

Longgang urban design project; Deep Ground project designed by GroundLab Collective won the Longgnang City Center and Longcheng Square (China) international competition in 2008. Project area was 11.8 km2 of the city with a population of 350,000. The project involves an estimated 9 million m2 of new constructions. It is a project of renovating the urban fabric of Longgang city.



Figure 11. Deep Ground project

Design strategy is centered around distributing high population density, outdoor use, high land values, and intensity of street life towards underused or abandoned areas [13].

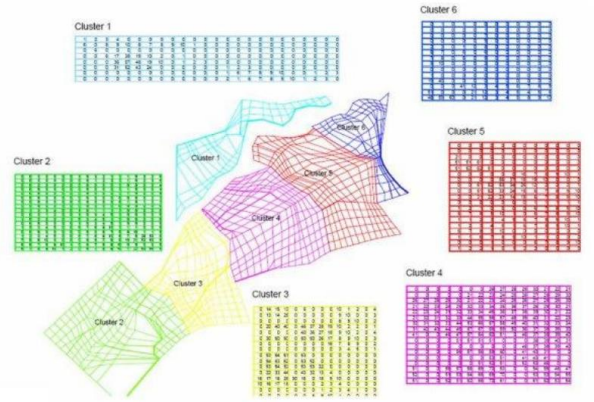
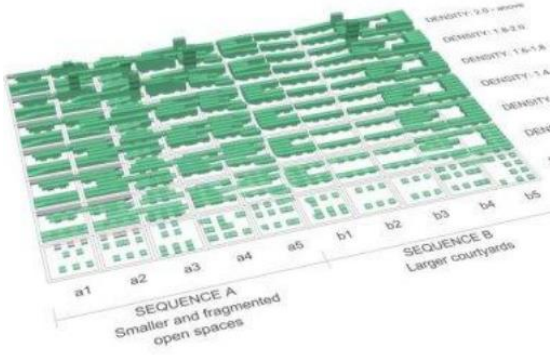


Figure 12. The city has been divided into regions and analyzed.



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Figure 13. Editing of the building layout by the software.

A parametric system was setup for the design, associating density related variables with typology related variables. The system generates a 3D model based on parameter values and allows quick exploration of design decisions. Figure 13 show design iterations as centre of intensity and the number of masses are varied.

3. CONCLUSION

Parametric design methods that have been developed for use at the building scale are proving to be effective at the urban scale as well. They are able to combine form generation with urban scale analytics and guide rule-based city generation algorithms that allow simulation based performance evaluations of alternative designs [1].

Parameterization requires formalization of design principles and makes the urban design process more transparent and opens it up to more effective collaboration. Project participants realize more detailed projects in less time. The examples presented within the scope of this study, demonstrate the possibilities offered by parametric methods: Generation of complex geometries and quick explorations of alternatives, as well as simulation based analysis in the project development process which enables the design of environmentally sensitive and sustainable cities.

In conclusion, parametric design methods driven by algorithms allow the use of complex forms, simplify making changes, and enables the exploration of design alternatives. They facilitate the use of dynamic, complex forms that are difficult to design using traditional methods in urban scale projects. Since geometry is generated based on parameter values, changing design decisions is possible at any stage and this flexibility of parametric systems allow alternative solutions for comparing and evaluating various implications of design decisions and urban policies. These advantages provided by the parametric design method have caused an increase in the use and demand of parametric design tools in urban scale projects as well as a demand for designers with the necessary technical knowledge such as algorithmic thinking and experience with parametric software.

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User-centered Design in Furniture Layout: Reviewing the Potential of Mobile Augmented Reality Technologies

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ABSTRACT

Augmented Reality is examined by many academic studies for its diverse uses in the field of architecture. However, its use for furniture layout is understudied since it is a relatively new area for these technologies. Today, AR technologies can superimpose virtual data onto real world objects with high precision. With the rise of mobile computing, they will become more accessible for everyone in the near future. This study aims to fill the research gap on mobile AR applications in architectural furniture layout by focusing on their potential to strengthen user's participation in the design process. Building on the concept of "user-centered design", the study traces how these applications can ensure an efficient exchange of ideas between the client and the designer and improve the decision-making processes by exploring many design alternatives quickly. By presenting a literature review on the methods of choosing and placing furniture in architectural design, offering a brief description for the concept of "user-centered design" and finally providing the definition, classification, development, history and usage areas of mobile AR technologies; the study discusses how mobile AR technologies can improve practices in architectural furniture layout.

Keywords: augmented reality, furniture layout, user-centered design, mobile AR

1. INTRODUCTION

From its recreational use in Pokemon Go to its serious use in NASA's spacecraft technology; Augmented Reality (AR) is a versatile technology. The availability of mobile AR systems has expanded the efficiency of this technology and architecture is one of the fields to be affected the most from these developments [1]. After all, AR can provide the substantially new techniques and strategies to transform the concept of "space" [1, p.169]. This study evaluates furniture layout applications of mobile AR technologies from a user-centered design perspective.

Designers try to empathize with users by developing various "user models" [2] [3] [4]. User experience is becoming more and more important in terms of product and service quality, which is why companies give importance to it and see it as an arena of competition [2] [5]. This is manifested in academia with an increase in the number of studies that focus on user-oriented design [2] [5]. However, there is a research gap regarding the use of mobile AR technologies in furniture layout. Considering their great potential to provide good design for a larger group of people, they certainly deserve more attention.

2. FURNITURE LAYOUT IN ARCHITECTURE

When creating an interior plan, furniture standards, building codes, restrictions of the fixed building elements, circulation, work flow, accessibility, security, privacy, flexibility and efficiency are the basic parameters to be taken into consideration [6, p. 161]. Furniture layout, which is one of the important factors that determine the quality of an interior, has its own parameters. These parameters include the volume, shape, function, illumination, focal point and projected traffic of the interior space [6, p. 161-168]. In his study that aims to determine the effective techniques for furniture placement Tantawy proposes a layout design that considers the volume, number of users and the duration of use for a certain interior space [6, p. 163]. He uses the term "focal point" for remarkable points such as a fireplace, a window with a view and television; arguing that the furniture should be directed towards these points [6, p. 164]. Evaluating the "traffic flow" according to the path between the two entrance doors, Tantawy also emphasizes that the aforementioned path should not be blocked with the placement of large furniture elements [6, p. 165].

Another issue that Tantawy emphasizes is the ease of use. He also points to the flexibility in using multifunctional furniture. In terms of user comfort, ergonomics is also on the agenda [6, p. 161-168]. Undoubtedly, the colour and material are also the significant parameters for furnishing. After all, they should be compatible with each other and with the building elements [7]. However, the choice of furniture reflects the thoughts, feelings and even ideologies of the users and each individual has a unique visual understanding and gusto depending on the social habits, education and cultural level [7]. Therefore, decisions regarding aesthetics are highly speculative and they require reconciliation between the designer and the user/customer. Ideally, the designer guides the user/customer with their enhanced sense of composition, scale and proportion. Without a doubt, a three dimensional visualization is vital for an effective dialogue between them. Regarding the construction of a realistic atmosphere, AR technology is superior to 3D simulation software programs.

3. USER CENTERED DESIGN

The term "User Centered Design" has been gaining a growing importance after the release of the book titled "User Centered System Design: Human-Computer Interaction on New Perspectives" (1986) by Norman and Draper [8]. Furniture designers often try to empathize with the users and never neglect the question "To what extent does the design meet the user's expectations?" [2, p.27].

First used in Donald Norman's research laboratory at San Diego University in the 1980s as a term [2, p.26], is often associated with the term "Design Thinking" [9, p.88]. This way of thinking is used in a wide area of operations ranging from problem solving to process development [9, p.88]. It deals with "more complex and abstract issues such as how a customer experiences a service" [10]. Another concept close to "User Oriented Design" is "Human Centred Design". This approach, which emerged in design terminology in the 90's, focuses directly on "human" without the need for a definition of a "user". It also includes social responsibility projects that bring different disciplines together and enables the personal, regional, urban and global problems to be solved by discovery, research, development, adaptation and application methods" [9, p.88].

4. AUGMENTED REALITY TECHNOLOGY: DEFINITION, CLASSIFICATION, FUNCTIONING AND DEVELOPMENT

Milgram, Takemura, Utsumi and Kishino (1994) define AR in two approaches: comprehensive approach and constrained approach [11]. In the comprehensive approach, AR means enhancing natural feedback to the operator with simulated cues while in a restricted approach it is defined as a form of virtual reality in which the participant can clearly view the real world with transparent headings [11, p. 283]. Azuma (1997) defines AR with three basic features: it is a combination of real and virtual worlds (1), it provides real-time interaction (2) and it establishes accurate 3D recording of both virtual and real objects (3) [12]. According to Klopfer and Squire (2008), the term AR can be applied to any technology that blends real and virtual information in a meaningful way. They define AR as "a situation where the real world context is dynamically covered with location or context sensitive virtual information" [13, p. 205]. Augmented Reality (AR), which offers users an interactive reality enriched with virtual objects, is included in a two-axis Mixed Reality (MR) spectrum that includes Virtual Reality (VR) [14, p.650]. The "Reality-Virtuality Process Diagram" [11, p.2] which has been a guiding reference to many researchers, describes an ongoing interaction process between the real environment and the virtual environment [1, p.172]. Virtual Reality technology provides an experience that detaches the virtual environment from the real world by making it real. On the other hand, in Augmented Reality technology, the real world is perceptible with all sensory abilities; because virtual objects are placed in the real world and / or combined with the real world [1, p.172]. Just like Augmented Reality, Augmented Virtuality (AV) is created by blending computer-generated information with the real world; however, while AR is closer to the real environment, AV is closer to the virtual environment.

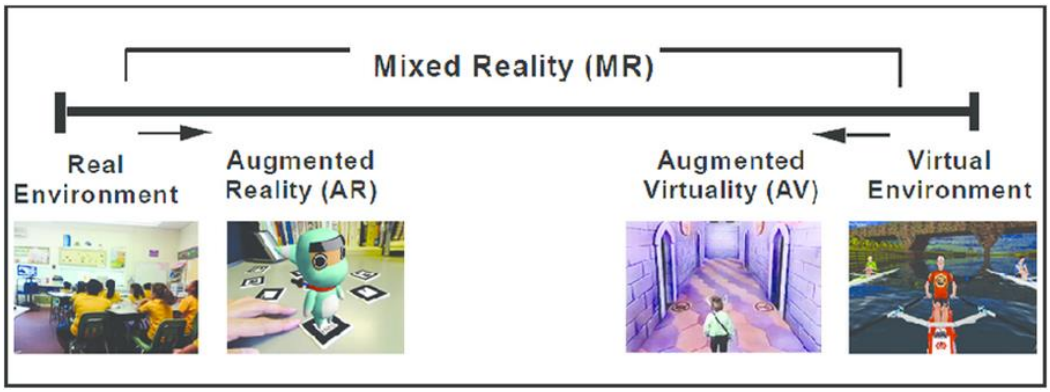


Figure 1. Reality-Virtuality Process Diagram (Milgram et al., 1994; Kılıç, 2018: 172)

Virtual objects that enrich the understanding of the real world in AR technologies are computer-generated 3D models, labels, text, pictures, videos, animations and similar media contents [15] [16]. These contents are detected through digital devices using general AR scanners (eg, Blippar, Junaio and Layar) or digital production AR applications [16, p.5]. Today, information processing and interaction devices that can use AR technology become easily accessible and widespread, allowing the development of new applications as well as increasing the quality of interaction [17]. When the AR first came out, its main components were a screen, camera and computer with application software, but nowadays, smartphones, PDAs (Personal Digital Assistant), laptops, HMDs (Head Mounted Display) and various types of hardware such as wearable computer systems can be used [14, p.651] [18, p.46]. Bülent Bingöl (2018) mentions three current methods for viewing AR content [18]. The first are web apps that capture QR codes from the webcam. A computer or console that can add digital information to images on paper, cards or other surfaces is used in this method. In the second method, head-worn shielded glasses are used. The last method works via AR applications installed on smartphones or tablets. There are many free or paid applications available on mobile platforms, from games to shopping. However, in order for the application to work, smartphones or tablets may need to have GPS, accelerometer and digital compass features [18, p.47]. The focus of this study is on these mobile devices, which are less expensive and more accessible than computer systems. These devices, which have sufficient technical equipment for AR provide mobility to the user, expanding the physical limits of reception [1, p.173] and reveal a user-centered, new approach in the context of interior design.

Before examining the AR applications in mobile devices, it is important to look at the evolution of AR technology. Reported today as an emerging and promising technology, AR became a research area supported by international workshops and symposiums in the late 1990s, but the first AR prototypes began in the 1960s with the students of computer graphics pioneer Ivan Sutherland at Harvard University and University of Utah [18, p.46]. The first laboratory dedicated to artificial reality was established in 1974 by Myron Kruger, a computer researcher and artist. However, the use of AR as a term is based on Boing Company researchers Thomas Caudell and David Mizell, who have designed a head-mounted screen in 1992 to facilitate the cable assembly process [19, p.659]. In 1997, Feiner, MacIntyre, Hollerer, and Webster used a mobile 2D display with a head-mounted 3D display and trackpad in their projects aimed at promoting a university campus. However, the project considered as the first "real" mobile application of AR is the ARQuake game, a modified version of the Quake game developed by Bruce Thomas was released in 1996 [20, p.121]. As an open source software library in 1999, ARToolKit is positioned at a critical point in AR history by helping other developers create augmented reality software programs. This library developed by Hirokazu Kato uses video tracking to capture real-world action and superimpose virtual graphics over the real world.

With the processor and monitoring devices getting powerful and small enough to support graphic layout in mobile settings mobile AR systems have become widespread in the 2000s [21, p.74]. Unlike fixed or static systems, mobile systems provide flexibility in movement and expand the productivity field for the AR platform [1:173). With their wireless network connection features, client-server architecture, advanced hardware and software systems; mobile devices have caused AR technology to come to the fore in many areas. When the AR systems became accessible for smartphones, many interior design applications have emerged. This paper focuses on the applications that aim to place virtual furniture in the physical environment by using markers that define the scale and coordinate system of the immediate surrounding [22, p.7]. Before doing that, it is useful to look at the general use of AR technologies.

5. USAGE AREAS OF AUGMENTED REALITY (AR) TECHNOLOGIES

Augmented Reality can be used for a life-saving surgery as well as for the animation of a prehistoric creature [18, p.44]. Entertainment, digital gaming, education, publishing, museums, tourism, medicine, aviation, defense, automotive, marketing, advertising, real estate, engineering and

architecture are the main areas where AR is used [14, p.650] [18, p.44]. It allows concerts and dance shows to be performed without the existence of actual human performers [18, p.50]. In the digital gaming industry, it builds an immersive user experience and is generally playable on smartphones, tablets and portable gaming systems; without requiring any special headset. The game is set up in a separate room or in a limited area for virtual reality technologies that require a headset [18, p.50]. Pokémon GO, the most prominent game among AR games, points to the locations of Pokémon characters on the user's map and makes it possible to capture them by touching the screen. Some of the other mobile games that project visual and audio content to the real environment in real time are Ingress, SpecTrek, Temple Treasure Hunt, Ghost Snap AR, Zombies, Run !, AR Invaders [18, p.51].

Apart from these recreational games that place fantastic creatures in everyday life, there are also educational games. For example, the game titled SimSnails is an interactive educational tool that aims to teach visitors the concepts of natural selection and evolution [18, p.50] [23]. In addition, AR can be adapted to the classroom with MOOCs (Massive Open Online Course). With AR, many educational institutions teach students the subjects they cannot experience firsthand, encourage them to explore the course content, trigger their creativity and create an authentic learning environment suitable for different learning styles [18, p.53] [24]. AR has also entered the publishing industry as pop-up books with 3D animations.

AR is particularly beneficial for the medical, engineering and architecture departments of universities [18, p.53]. Medical students use AR technology to perform surgery in a controlled environment [18, p.53]. AR can reduce the risk of an operation by improving the sensory perception of the surgeon, as well as help patients explain complex medical conditions with advanced visualization techniques [18, p.52]. More importantly, AR supports surgeons in the context of navigation and orientation. Thanks to its reliable and consistent feedback, it makes difficult operations performed with less intervention [18, p.52] [25]. Museums also use AR technologies for educational purposes. For example, the British Museum offers an AR game called A Gift for Athena to children to promote the Parthenon gallery since 2009 [18, p.53]. There are many applications of AR that show what historical places looked like centuries ago. In the field of tourism, applications such as the Yelp Monokle provide information on local organizations using AR. The Word Lens application added to Google Translate for foreign tourists can translate foreign signs into the user's native language [18, p.52]

In military, with its 3D imaging systems that prevent errors and provide more consistent maneuverability by encoding data from the center in different colors such as danger and critical points; AR is mostly used in aviation, but it can also be placed on the headgear of infantry in combat [18, p.52] [26]. In the automotive sector, it cannot go beyond the use for heads-up display purposes yet. AR has shown itself mostly in advertising and marketing [18, p.48]. Many brands use this technology to enhance the customer shopping experience, both in the real world and in online retail venues. For example, the American Postal Service gives customers the opportunity to judge the purchasable box size by reflecting the hologram boxes on the paper with the QR Code [18, p.48].

6. THE USE OF AUGMENTED REALITY IN ARCHITECTURE

Building industry is one of the few industries that are unlikely to use full-scale prototypes to evaluate and test their designs [27]. When the wide spectrum of stakeholders involved in the design, development and construction of a building are considered, the lack of prototypes becomes a serious problem. CAAD and 3D model based visualizations seem to have solved this problem; but still, they lack user interaction [27]. Although some of the 3D software programs offer walk-through and fly-over options, since they can only show the scenes selected for pre-visualization they don't provide user interaction [27, p.170]. The general trend in information technologies favors more "real" experiences. The rise of 3D is apparent through the 3D enhancements of CAAD applications such as AutoCad and MicroStation, which were originally designed to facilitate 2D drawings. The difference of AR technology is that it blends "real" with "virtual", allowing for measures and corrections that save money and time.

AR for interior design applications strengthen the space perception of users since they give realistic results in the representation of space and have a positive effect on the design choices [1, p.170].

The main use of AR systems in architecture is to experience the project area through virtual images [28]. It has various advantages for different actors of the field, including architects, interior designers, designers, users, employers and workers. For example, it can provide virtual images of underground electricity or plumbing pipes to workers on the construction site [18, p.49-50]. There are also training strategies that simulate construction accidents in the VR environment in order for workers to identify more hazards and risks [29, p.4]. It is also possible for this technology to improve budget and enhance scheduling. There is a research from 2018 that has used a real-time model to enable stakeholders and users to change the materials of walls, floors, and other elements whilst seeing the price impact in real-time [30]. There are also researches that aim closing the energy performance gap caused by occupants' behavior by helping designers detect design patterns that can predict actual occupant behaviors based on augmented settings [29, p.4].

Morpholio AR Sketchwalk is an application that allows getting into design sketches to illustrate a more accurate depiction of the space. Using an iPad, one can position sketch in the plan and walk through it while extruding the walls. Also available on smartphones, Augment is yet another application with 3D model view in real time and right scale, reducing prototyping costs. On the other hand, Fologram transforms the models into full-size construction instructions; providing a step-by-step criterion for masons; whereas GAMMA AR can overlay BIM 3D buildings. WakingApp, which is available for tablets and smartphones, is yet another important application. It has add-ons for Autodesk Revit and Fusion 360 users so that models can turn into augmented reality.

Overall, safety training, improving BIM visualization and communication, BIM-based immersive tools, energy savings, and understanding end-user (occupant) preferences are the potential uses of AR in the industry [29, p.5]. Residential and commercial sections make the most use [29, p.12-15]. One recent survey shows that although AR faces industrial limitations due to restricted budgets, upper management's lack of vision and design teams' lack of knowledge; a prominent increase in AR/VR utilization over the past year is reported and a big growth is expected over the next 5 to 10 years [29, p.12-15].

7. CONTRIBUTION OF MOBILE AR TECHNOLOGIES TO USER-CENTERED DESIGN IN FURNISHING

Since AR became accessible for smartphones, many applications for interior design have emerged. Smartphones equipped with 3D scanning capabilities are able to digitize real world objects into an AR environment and then place them in an AR environment while dynamically following user's vision [14, p.650] allowing for a user-centered approach in design. New technologies have enabled the development of many mobile AR applications that vary in terms of type, function, purpose of use, interface and benefits to the user. Especially preferred in the furniture industry, technology enables users to see the properties of the products such as material, size, colour, and texture [1, p.170]. Users who can view, rotate and resize furniture anywhere around them gain a more accurate visual impression of how the object will look in the real environment which it will be placed [1, p.48].

Tolga Kılıç has evaluated seven mobile interior AR applications in 2018. He compared 'Decolabs',' Ikea AR ',' Intiaro ',' Fingo ',' View AR ',' Houzz 'and' I Staging 'applications based on criteria that draws from the results of a field study conducted by Sanni Siltanen et al [31]. These criteria are, the existence of a space modelling feature, the user interface, the facility to interfere with the size, colour and texture of the virtual object, photorealism, interaction with existing furniture, trademark support, social media sharing feature, and the option to save the work [1, p.184]. "Another option that is critical for the user is the feature of removing the existing furniture by the application and replacing it with virtual furniture," says Kılıç, and emphasizes that this feature is not found in any AR application examined [1,

p. 184]. On the other hand, in the light of technological developments, it can be said that AR applications have a great potential in indoor use. However, at the moment, there is no application that can completely redesign a room [22, p.9]. Only a designer / interior designer / architect can do this. Long feedback sessions between the designer and the customer/user during the design process also means a waste of time and money. AR has the potential to reduce the frequency of feedback with interaction opportunity that it offers to the customer/user. It makes the user an active participant of the design process.

8. CONCLUSION

As a technology advancing from laboratories in different parts of the world to various industries and consumer markets [18, p.46]. AR provides immersive experiences in which real and virtual worlds are blended, and user interaction and engagement are increased. The use of AR technology in interior design is still very new [1]. However, with the widespread use of mobile smart devices, it is being experienced by a wide range of users. It should also be emphasized that even head-mounted devices are more affordable, efficient and appealing to non-professional users [18, p.50]. With the development of micro projectors [32] AR can even be incorporated into personal belongings, such as watches, glasses and clothes through microchips [33]. One of the sectors that will be very affected by this change will be architectural design since it deals directly with the three-dimensional physical environment. AR applications can administer precise views of the design proposal, which is often too complex for users to perceive through drawings. Thus, it can easily be predicted that the already popular "user-centered design" approach will become more participatory with AR technology.

9. REFERENCES

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Re-Formation of Waste Plastics through Digital Manufacturing: An architectural point of view

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ABSTRACT

Plastics are a vital component of thousands of products we rely upon every day. On the other hand, plastic wastes are major causes of environmental pollution, and for reducing the excessive use and then the harmful effects of plastics, several campaigns, policies, actions, agreements, etc. have been initiated. From this respect, studies on recycling and reusing plastic waste are significant. It is possible to say that, like in other designs the use of waste plastic in the architectural field with and without changing its physical and chemical properties can lead to promising developments. Main concepts like "sustainability in architecture" that discusses paradigms and practices for less footprint in the ecosystem and "digital technologies" that force buildings technologies re-think each phase of construction from early design phases to the final product have become prominent and promising. Architecture is being transformed through digital tools; digital fabrication methods, techniques, and processes are affecting the use of material, way of constructing, and craftsmanship so-called —the tectonics of architecture. This paper argues that using waste plastics in architecture has the potentials to explore new forms and structures. For this purpose, a literature survey has conducted to reveal the good practices performed in this context. Selected examples have been discussed according to parameters defined as sustainability, economy, an expedition of production, possibility to assemble into various forms, and usability. Results show that some projects have been actualized to use waste plastics through different manufacturing methods, accomplished the parameters mentioned above. This demonstrates the feasibility of using waste plastics in the context of architecture.

Keywords: Waste plastic, reuse-reshape, architectural tectonics, digital manufacturing, and sustainability.

1. INTRODUCTION

The invention of plastic has had a significant impact on human life. Especially with the increase in popularity in the last century, it is almost impossible to be in an environment that has no plastic material in the surroundings [1]. This material, which is included in every stage of human life, has advantages such as strength, flexibility, easy production, as well as various disadvantages [2]. Particularly, with the increase in mass production and consumption; plastic, which is not prone to extinction in nature, is gradually creating a cumulative source of pollution that adversely affects the ecosystem [3]. Reducing the usage, collecting and reusing, or recycling of waste products remain the most viable means of preventing both pollution and waste of natural resources. Sensitization and awareness of governments and communities, and the development of policies, technology, and behavior in this direction are extremely grave requirements [4].

The plastic's moldability, dyeability, and durability have increased its popularity among architectural applications and fittings [5]. Since "the building and construction sector is the second-largest plastic consuming market segment after packaging in Europe" [6], the architectural profession has the potential to play an important role both by reducing pollution and saving resources. The use of waste plastic in the architectural field with altering methods can generate a significant difference. This century has become noticeable with two important concepts having the potentials to shift the paradigms in the discipline of architecture. "The concept of sustainability in architecture that pursues essentially to improve built environments and reduce footprints"[7], and "the digital technologies that lead design disciplines to look through for new approaches for designing process and unique solutions" [8]. The transformation in the tectonics of architecture through digital tools, production processes, and applications, which allows transforming in conceptual design into the perceptible, and ever-buildable world of today, in the eyes of the architect.

It is crucial to research the possibilities offered by digital technologies in making use of plastic waste as a new formation and pattern generation that will have a contribution to recycling and to get the benefit of plastic materials durability and imperishableness in design, construction, and manufacturing fields. For this purpose, a literature survey has been conducted to reveal the examples of practices performed in this context. The data from the literature illustrates that waste plastic usage in architecture through integrating digital technologies has the potential to experiment alternative forms and structures. Selected examples have been discussed according to parameters defined as sustainability, economy, an expedition of production, possibility to assemble into various forms, and usability. Results show that some projects have been actualized to use waste plastics through different manufacturing methods, accomplished the parameters mentioned above, which demonstrates the feasibility of using waste plastics in the context of architecture.

2. LITRETATURE REVIEW

This chapter aimed to reveal and discuss the current situation, terms, terminologies, and definitions on the subject matter. For this purpose, first, plastic's brief history, its types and classifications, and architectural usages; later, its environmental effects and suitability to recycling and reshaping examples will examine.

2.1 Plastic: Material Matters

In this study, the potency of using waste plastic in architecture has been investigated, for utilizing the permanency of plastic into an advantage. To analyze this material, which has numerous types, this section will describe its short history, its properties and classifications, and how it used in architecture.

2.1.1 A Brief History of Plastic Material

Plastic is a word that originally comes from the Greek word *Plastikos* means "malleable and easily shaped" [9]. Recently, it is using to name polymer materials, which are composed of large molecules that consist of a chain of smaller molecules -monomers. The history of plastics based on natural polymers that abound in nature like cellulose, which makes up the cell walls of plants [10]. The first fabricated plastic is called Parkesine, which is an organic material derived from cellulose that was created by Alexander Parkes in 1862. Parkesine could mold when it is heated and maintains its shape when it is cooled [1].

In the mid-nineteenth century, with the spread of billiards, the demand for natural ivory had increased. Since billiard balls made of ivory, which has acquired through slaughter from wild elephants, caused a deficiency in natural ivory supplies. After several experiments with Parkesine, John Wesley Hyatt invented celluloid as a substitute for ivory and patented it in 1869. Celluloid was not only used over ivory but also used as a substance for tortoiseshell, horn, and linen. This invention was a starting point where people were no longer limited to use natural resources and now create new materials [10].

Although celluloid was a revolutionary invention, it was still a derivative of nature base material. "In 1907, the first fully synthetic plastic invented by Belgian chemist Leo Baekeland and named as Bakelite" [3]. Bakelite could be dyed and molded very quickly when it is heated. This material was a good insulator, heat resistant, and opposite to celluloid, it was cheaper and suitable for mass production [11]. Studies on the new types of synthetic polymer materials have accelerated by the need to preserve limited resources [12]. Also, the necessities of World War II expanded the plastic material production industry [5]. For instance, during WWII, acrylic glass, also known as Plexiglas, a lightweight material, was used for submarine ports and aircraft windshields and canopies [13]. Nylon, which was invented as synthetic silk by Wallace Carothers in 1935, was used for military purposes as parachutes, ropes, and body armors [5]. After the war times, the possibilities of various usage of plastics caused the development of a new industry that will have merged every small detail of human-daily life. At the beginning of the 20th century, petroleum and chemical industries began to work together to provide raw materials to feed the plastic industry [3]. In the following decades, new plastic types invented, and petrochemical resources became a grave provider for the plastic industry [9].

2.1.2 Types and Classification of Plastic

Plastics are polymers consist of very long carbon-base molecule links that can transform into a variety of products. Different types of plastics are available with different properties. The plastic is formulated with various features that make it optimal for the application it is intended to use [14]. By changing different molecular factors of the plastic, various properties can be obtain such as flexibility, transparency, durability, and more [2].

Plastics can be produced from several resources. "Their raw materials can be fossil based materials like crude oil and natural gas, plant origin as sugar cane, starch and vegetable oils, or mineral base materials like salt" [6]. Also some certain plastics can be biodegradable. However, majority of plastics are made from fossil fuels.

All plastics can be separated into three primary categories; Thermoplastics, Thermosets, and Elastomers. These terms refer to the different reaction types of plastics to heat. The reason for the difference in response to heat relates their chemical structures of the plastic types. Thermoplastics can be reformed over and over again while thermosets cannot be reformed and re-molded when they are heated. Elastomers have soft elasticity and usually cannot be melted [15]. Some sources classify elastomers under thermosets. In this study, elastomers have handled under an independent title.

Thermoplastics

Thermoplastics are "a group of plastics which can be melted when heated, and hardened when cooled. They can be reheated, reshaped and frozen several times" [6]. These features are reversible. Today, thermoplastic polymers are widely used in the plastics industry due to their lower cost and relatively easy processing capabilities [16]. Common thermoplastic examples and application areas are listed down below, as shown in Table 1.

Table 1. Table of thermoplastics, adapted from [17]

Thermoplastics	**Material Features**	**Fields of Usage**
Acrylonitrile Butadiene Styrene (ABS)	● Opaque ● Shiny ● Durable	● Wheel covers and Automotive body parts ● Pipes and Protective head gear
Polysulfone (PSU)	● Transparent and Pale ● Hydrolytic stability against hot water and steam sterilization	● Paints and Varnishes
Polycarbonate (PC)	● Rigid ● Hardly combustible	● Sun glasses ● Appliance housings ● Window glazing
Poly Methyl Methacrylate (PMMA, PLEXIGLASS)	● Transparent ● Rigid and tough ● Flexible	● Airplane windshields ● Skylights and Outdoor signs ● Automobile taillights
Expandable Polystyrene (EPS)	● Colorless ● Rigid	● Foam materials
Polyvinyl-Chloride (PVC)	● Rigid and Flame resistant ● Can become flexible with additives	● Pipes ● Window frames
Styrene-Acrylonitrile (SAN)	● Stress crack resistance ● Weatherability	● Drinking tumblers ● TV set screens and Kitchen wares
Polyethylene (PE)	● Cheap ● Easy to process	● Packaging films ● Rigid containers
Polyamides (PA / NYLON)	● Strong and elastic ● Smooth, soft, and lightweight	● Household appliances ● Electrical plugs
Polypropylene (PP)	● Has high melting point ● Tough	● Food packages ● Bottle caps
Polyethylene Terephthalate (PET)	● Can be transparent, opaque and white ● Stiff and hard	● Food containers ● Soft drink bottles
Polyoxymethylene (POM)	● Rigid ● Cold and Solvent resistant	● Piping ● Small connecting rods
Fluoropolymers (PTFE, PCTFE, PFA, ETFE)	● Chemical resistant	● Wire coating ● Electrical and electronic components

Polyether Ether Ketone (PEEK)	● Colorless ● Thermal stability ● Chemical resistant	● Automotive, chemical and aerospace industries
Polybutylene Terephthalate (PBT)	● Chemical resistant ● Flame resistant	● Food containers ● Electronic components
Ethylene Vinyl Alcohol Copolymer (EVOH)	● Flexible ● Glossy and Crystal clear	● Plastic fuel tanks ● Agrochemical containers

Thermosets

Thermosets "cannot be re-melted and reformed after being heated and shaped" [6]. In the state of application, thermosets are hard and brittle. "Their mechanical strength and elasticity are not temperature dependent, as with thermoplastics or elastomers, because of the strong resistance of molecular movement caused by the crosslinking" [14]. Common thermoset examples and application areas are listed down below, as shown in Table 2.

Table 2. Table of thermosets, adapted from [17]

Thermosets	**Material Features**	**Fields of Usage**
Unsaturated Polyesters Resins (UPR)	● Solid	● Construction, marine and land transportation industries
Epoxy Resins (EP)	● Heat and corrosion resistant	● Applications for electrical components and thermal interface materials.
Phenolic Resins (PF)	● Lightweight ● Heat and corrosion resistant	● Coatings, composites, adhesives, and molded parts
Melamine Formaldehyde (MF)	● Hard and Stiff ● Transparent and Flame retardant	● Wood adhesives, flooring, and insulation
Poly-Vinyl Esters	● Strong and Tough	● Used in glass, carbon, or aramid fiber reinforced plastics
Urea-Formaldehyde Resins (UF)	● Strong and Crease resistant	● Wood glue and surface coatings

Elastomers

Elastomers have "3D amorphous structure with light cross-linking that cannot be loosened through heat without the material decomposing for this reason they cannot be heat-deformed, melted or welded. The tangled structure of the polymer chains is the reason for its exceptional elasticity" [18]. Elastomers are mostly rubbers or rubber-like elastic materials [19]. Common elastomer examples and application areas are listed down below, as shown in Table 3.

Table 3. Table of elastomers, adapted from [17]

Elastomers	**Material Features**	**Fields of Usage**
Thermoplastic Elastomers (TPE)	● Flexible ● Can be Stretch Twice as Much at Room Temp. ● Can be Deformed or Recast as Ordinary Thermoplastics at Elevated Temp.	● Foot Wear ● Automotive Instrument Panels and Caster Wheels ● Synthetic Leather ● Building Materials ● Electronic Devices
Polyurethane (PUR)	● Abrasion resistant ● Tear propagation resistant (as a foil or membrane)	● Mattresses and Furniture ● Underlays for carpets ● Auto parts cushions ● Insulation sheets
Butadiene-Rubbers (BR)	● Very elastic rubber with a good resistance to abrasion ● Low heat build-up	● Tires ● Inner tubes of hoses for sandblasting
Styrene-Butadiene Elastomers (SBR)	● Resistant to abrasion ● Low heat build-up ● Flexible	● Sealants and Rubber bands ● Gasket materials and Toys ● Hot-melt adhesives
Silicone	● High temperature and oxidative stability ● Low-temperature flexibility ● Low friction and high weathering resistance	● Protective coatings and Sealants ● Adhesives and Rubber molds ● Textile finishes
Acrylic Resin	● High transparency ● Tough and Elastic ● Fairly good heat resistant under dry heat	● Adhesive applications (tags, labels, and specialized packaging)

2.1.3 Plastic Usage in Architecture

Plastics have changed the human lifestyle radically. Although its invention was to create a substitute material to meet the demand for ivory, the use of plastics has spread to other areas such as architecture and construction. One of the first use of plastic in architecture was cladding sheets for walls and doors. For instance, in Britain, a urea-formaldehyde resin, which is a thermoset plastic, was firstly produced and used to cover walls and doors for BBC studios. Many other early plastic types applied to laminate sheets and were used in increasing variety for architectural surfaces from doors to counter-tops [5]. Due to its "lightness, strength, transparency, thermal insulation, light penetrability, and loadbearing properties, and compatibility for making several numbers economically, plastic became an experimental material for designers" [20]. Also, it enables designers to think of futuristic architectural and urban visions and to revolutionize architecture through spatial forms or curving structures. For example, "Space House" designed ceilings, and columns would merge into one. However, the design did not turn into reality. In by Frederick Kiesler in 1933 which was to be mold completely in plastic so that the walls, floors, 1956 Alison and Peter Smithson demonstrated how life in the future would look with their "House of Future". The house-made from molded parts, which joined together floors, walls, and ceilings seamlessly, was the expression of a new image of civilization in the increasingly prosperous and individualized society of leisure. The geodesic dome, which is a modular assembly example from Buckminster Fuller, pneumatic dome from Walter Bird, or "Living Pod" from David Greene, and many other projects have emerged with the inspiration of this new material; Plastic [20].

Today, various types of plastics, such as polyvinyl chloride (PVC), polymethacrylate (PMMA), polystyrene (PS), polyethylene (PE), polyurethane (PUR), and polytetrafluoroethylene (PTFE) are in use for architecture and construction. "Apart from these basic types, several modifications are produces to meet specific purposes and needs" [18]. The use of plastics in building and construction can contribute to insulation, window-installation, wiring, piping, roofing, wallpapering, flooring, awnings, laminated kitchen, and bathroom furniture. Also, saves energy, reduces costs, and provides easy installation. For example, due to their durability and corrosion-free feature, plastic window frames can be used tens of years. Plastics are effective insulators from cold, heat, or sound. In addition to these, it is easier to handle, transport, and store plastic products due to their light-weighted structure.

2.2 Plastic: Environment Matters

Plastics are more than just ubiquitous manufactured products that are used all over the world. Due to its functionality and easy process of production, plastics began to spread in the daily experience of billions of people that causes severe environmental consequences. Today earth is facing major environmental problems that threaten the continuity of life for all its living beings. The accelerating change in the global climate is a fact that has been observed, studied, and declared its seriousness on the stability of the world that plastic pollution has an impact on this environmental issue cumulatively. "About every minute, one million plastic drinking bottles are purchased around the world, while almost five trillion single-use plastic bags are used every year worldwide. Ultimately, 50% of all plastic produced is designed to only be used once — and then thrown away" [21]. Also, it is notorious that "plastic is the main contributor to the growing accumulation of litter in the oceans of the world" [22]. It is necessary to control the use of plastic at its source. However, it is also crucial "to improve the way to manage plastic wastes before they end up in the environment" [21]. In this study, the effects of plastic pollution on the environment, and possible recycling solutions are investigated from the perspective of architecture and construction. This section will describe the environmental consequences caused by plastic usage and compliance with recycling and reshaping of plastic materials.

2.2.1 Environmental Issues Based On Plastic Usage

Plastic pollution is a critical environmental problem that increases rapidly due to drastically growing supply of single-use plastic goods, which overwhelms the competence of the planet to handle them. Plastic pollution is mostly common in countries that generally have inefficient or non-existent garbage collection systems. It is troublesome process to collect discarded plastics properly, particularly for the countries that have low recycling rates. Although plastics have a positive contribution to human life such as, life-saving devices, lightened cars and jets, drinking water apparatuses, and clean food, the amenities of plastics generated to a "throw-away culture" among users that reveals the negative impact of the material. Today, each year the plastic production is 300 million tons, which 50% of them for single-use items [23]. The majority of these plastic products, such as bags and food packages, have a life cycle for very short duration but abides in the environment for hundreds of years. It is a growing concern that the contamination of the natural environment with plastic wastes. Increasing popularity of plastic caused excessive production. "8.3 billion metric tons plastic have been produced since 1950s. 50% of them have been made in the last 15 years." Production is expected to increase twice as much by 2050 [23], [24]. Only 9% of all plastics the world has ever produced have recycled. The vast majority of the plastics, such as polyethylene and polypropylene, are derived from fossil resources which are not biodegradable [25]. Approximately 12% of the plastic has been burned and the rest, about 79%, has accumulated in landfills, and eventually in the natural environment where the decomposition of the plastic takes up to 1000 years [21], [26]. "Cigarette butts, drinking bottles, bottle caps, food wrappers, grocery bags, lids, straws and stirrers, and foam takeaway containers are the most common

single-use plastics found in the environment." These are the products that people use and throw away instantly. Plastic wastes can cause many problems when it leaks into the environment. They are slowly broken down into smaller particles known as microplastics. High concentrations of microplastic in the oceans and the landfills contaminate soil and water. Also, these toxic chemicals transfer to animals, especially sea animals. One eats the other and the chain continues, which causes a microplastic accumulation in the animal body, and eventually the chain reaches into the human food chain [27], [28].

2.2.2. Compliancy to Recycling and Reshaping

Contamination is one of the most common problems when it comes to recycling plastics. Plastic wastes can often be highly contaminated for recycling and instead must be sent to landfills or incinerated. This is because many users do not have any idea which plastic supposed to thrown in which bin. Also, in areas where all trashes are collected in a bin, one type of waste can contaminate another [29]. Among several types of plastics, six common types have been given codes which help identify them for recycling, as shown in Figure 1. Also, there is a seventh category for "other" plastics. Although there are different classification signs on plastic materials, this does not mean every plastic can get recycled. For example, since thermoset plastics contain cross-linked polymers, they cannot be re-melted into new material, opposite to the thermoplastic plastics which their main feature is to be able to re-melted and re-molded. Also, the separation of plastics and other materials is very crucial. For instance, a polypropylene (PP) coffee cup that people can get from any coffee shop, is composed of two materials: plastic and paper. Because two different materials are in use, the cups cannot be recycled unless these two materials are isolated from one another. So one of the simplest products to recycle in that case is the ones made from a single material such as polyethylene terephthalate (PET). Also, it should not be forgotten that only clean plastics can get recycled, any plastic that has residues of food cannot be recycled [30].



Figure 2. Types of Plastics, Adapted from [29]

3. Material and methodology

Since, plastic wastes are major causes of environmental pollution, studies on recycling and reusing of plastic waste is important, this study will be conducted to explore an innovative way to use waste plastics. Furthermore, this study has been planned to see the potentials to use of digital design and fabrication technologies to fulfil this aim. Recently digital design and technologies have been commonly used in building architectural design and construction. It is important to research the possibilities offered by these technologies in making use of plastic waste as an alternative material medium that will have contribution to reduce CO2 emission and excessive water usage, while advantaging plastic materials durability and imperishableness in design, construction and manufacturing fields.

Conceptual framework of this study is based on significant sections like Plastic: Material Matters, History of Plastic Material, Types and Classification of Plastic, Plastic Usage in Architecture, Plastic: Environment Matters, Environmental Issues Based on Plastic Usage and Compliancy to Recycling and Reshaping as indicated above. Scope and purpose of the study; aims to take a step towards the widespread use of discarded plastic in the architectural field and investigate the alternative solutions particularly through digital design and fabrication tools that have done so far. This study focuses on developing an approach for organizing digital design techniques to the production of recycled or upcycled plastic waste into architectural installations. Case studies will be examined to acknowledge possible techniques of recycling and utilize the outcomes effectively. To reach that goal various projects with different methods both digital technology related or not, will be examined and evaluated regarding parameters indicated below;

- Sustainability
- Economical contribution
- Expedition of production
- Simple assembling
- Flexibility in design

4. WASTE PLASTIC INSTALLATIONS IN ARCHITECTURE

In this section some of recycled plastic product examples will be examine in order to understand plastic material's potential in architecture. Case studies enumerated chronologically. Case studies 1 to 3 and 5 illustrates recycling techniques through heat compression method to reshape waste, while case 4 and 6 to 8 show examples of recycling methods including 3D printing and digital manufacturing.

Case 1 – Gert de Mulder: Recy Blocks, 2014

Recy Blocks are a form of building brick that is composed of discarded plastics such as bags, that designed by Gert de Mulder. These bricks merge a highly artistic approach with structural capabilities. They manufactured to use for wall separators, furniture, or lighting objects, as shown in Figure 2. The production process of these bricks requires appropriate plastic types to get semi-transparent and colorful building elements. The basic raw material of Recy Blocks is waste polyethylene, which is one of the major resources for plastic bags or food packaging. These bricks get their rectangular shape by molding with the help of high-temperature heat. An interconnection system is using to construct these bricks with holes and metal tubes. So, this system protects the units from shifting and connects them. Also, tubes allow for slight alterations that give enough flexibility to open and close the wall for light and view. According to the producer of Recy Blocks, "these bricks are available to use both indoor and outdoor applications" [31], [32].



Figure 3. Recy Blocks [33]

Case 2 - Conceptos Plásticos: Plastic House, 2014

Plastic House is a housing construction project (see Figure 3.) that aims to transform plastic and rubber remains as blocks. The company called Conceptos Plásticos, intention is "reducing plastic pollution by creating a suitable final disposition of these residues and transforming the biodegradation problem of the plastic into suitable materials for construction" [34]. The main material is supplied to work with from recyclers and factories that discard tons of plastic daily. Manufacturing of these plastic blocks require a process called "extrusion". This operation includes fusing and injecting plastic waste into a mold that creates conjugating pieces of blocks that fit together, as shown in Figure 3 (right). Interlocking block shape provides easy construction. According to the company, "production process also includes some additives that make them resistant to fire, acoustic isolation, impermeable and earthquake resistant regarding the country's high levels of seismic activity" [35]. Additionally, the company aims "to help needy people to build a 40 meter house with two bedrooms, a living room, a dining room, a bathroom and a kitchen in five days" [34].



Figure 4. Plastic House and Interlocking Bricks [36]

Case 3 - Byfusion: Byblock, 2015

ByFusion is the name of a company that produces plastic bricks out of waste plastics. This company developed a system called Blocker, which turns 100% of plastic wastes into bricks, as shown in Figure

4. Also, this system does not require any chemicals, additives, adhesives, or fillers to produce bricks. Instead, the Blocker system uses a steam-based process that first shreds the plastics without sorting and later compressing them into each other with high-temperature heat. These plastic bricks have good acoustic and thermal insulation according to the ByFusion Company. Also, the company underlines that these plastic bricks are ideal to use for retaining walls, privacy fencing, furniture, non-load bearing walls, and sound walls. Additionally, due to the interlocking system of these blocks, "installation does not require mortar or glue to hold them together. However, in practice, vertical steel guides are added to ease the construction and increase consistency between the units" [31], [37].



Figure 5. Byblock and Assemblage Illustration [38]

Case 4 – Emerging Objects: Rubber Pouff, 2016

Emerging Objects is a company that specialized in 3D printing technology with different materials. The company highlights the problem of waste car tires that are not biodegradable but robust. Due to increasing car tire waste pollution, the company has developed a solution to upcycle discarded tires. The company aims to create high-value products such as furniture, wall panels, rubber flooring, or acoustic isolation applications. The Rubber Pouff (see Figure 5.) is experimental furniture that can use as a footstool or low seat. It is composed of eight 3D printed pieces adhered together. The production process involves creating fine rubber powder from car tires and a mixture of powder with an organic binder to make the blend printable. The company's goal is to create other possible utilization by using waste car tires [39].

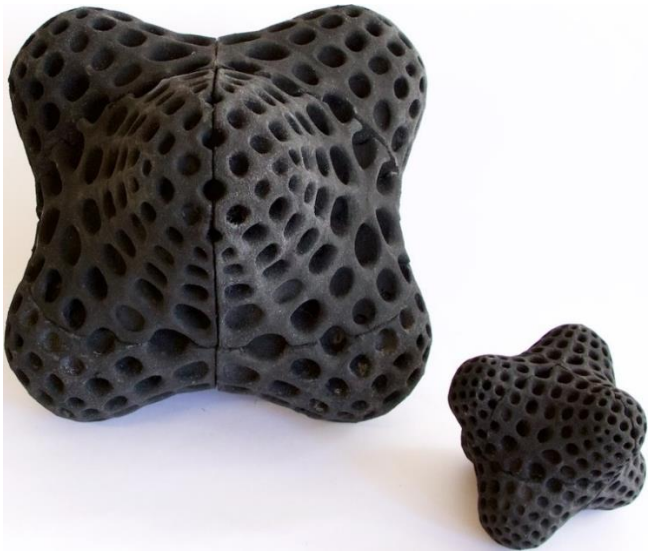


Figure 6. Rubber Pouff from Emerging Objects [40]

Case 5 – Plasticiet: Interior and Furniture Design, 2018

Plasticiet is a startup company that collects discarded plastic and turns it into sheets (see Figure 6.) of material that similar in appearance to manmade stone composites like terrazzo. The material is made with a mix of techniques used by industry and craftsmen. The company aims to create value for recycled plastic through using it in interior and furniture design as shown in Figure 7. The rock-like material is applicable in furniture making, interior design, displays and decoratively [41]. Plasticiet have several color combinations for those plastic sheets that are made up of different-sized pieces of colored plastic to produce a variety of effects. For instance, Rhinestone Black is black with colorful spots, made from Belgian household waste (HDPE) and Blizzard is white with black spots (see Figure 6.), made from discarded buckets (LDPE – HDPE). The company produce sheets constructive and non-constructive purposes according the feature of the waste materials [42], [43].



Figure 7. Plasticiet: Sheet-Plastic Material Examples, Rhinestone Black (Left), Blizzard (Right) [44]

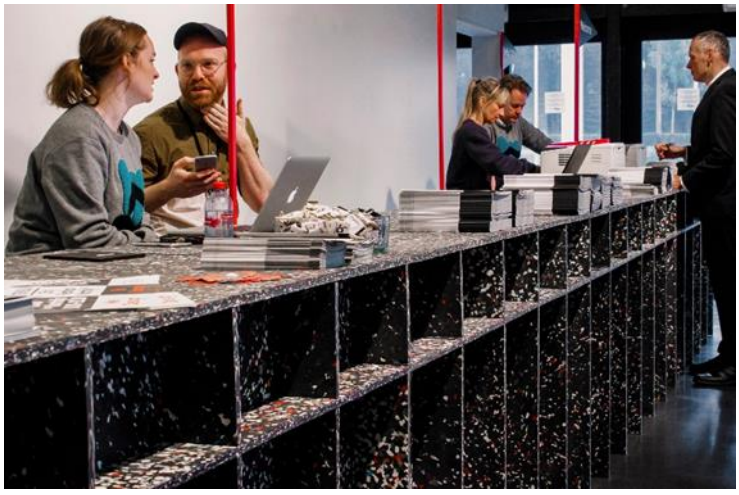


Figure 8. Plasticiet: the Entrance Desk for Biennale Interieur [45]

Case 6 - MEAN* (Middle East Architecture Network): DECIDUOUS - 3D Printed PETG Pavilion, 2019

Deciduous is a 3D printed pavilion (see Figure 8.) in front of Dubai International Financial Center (DIFC) by MEAN* —abbreviation for Middle East Architecture Network. The design aim is to invite people to reconsider a human relationship with nature through an experimental abstracted botanical form. The

structure of the pavilion includes "birch plywood flooring that CNC-milled, a robotically 3D-Printed concrete base, and a series of branching 3D-Printed PETG stems, a plastic polymer up-cycled from 30,000 discarded water bottles" [46]. Deciduous designed as modular parts, and whole structure prefabricated off-site. The modular pieces can be installed without needing heavy machinery, which eliminates noise pollution during its construction. The pavilion is approximately 4 meters tall and has an S-shaped pathway between the branches for visitors to walk through. MEAN's aim is to continue experiments with 3D printing in design on an architectural scale and to focus on exploring the possibilities that the two technologies can provide, robotic 3D printing, and materials such as plastic and concrete, while also contributing to ecological construction concept [46], [47], [48].



Figure 9. Deciduous - A 3D Printed Pavilion [47]

Case 7 – Print Your City: Zero Waste Lab, 2019

Print Your City is a circular design and production method by the New Raw Studio, which optimizes the recycling process of plastic into public furniture through the use of robotic-3d-printing. The New Raw Studio intends to explore possibilities to re-design urban space by applying 3D printing technology to plastic waste. "This zero-waste process empowers the local citizens to sustainably develop their urban regions by creating a short and circular material cycle for plastic. The outcomes of the project generating awareness among citizens and less CO2 emissions are street furniture designed for the Municipality of Thessaloniki" [49]. The project provides a recycling facility for the local public and allows people to choose what the waste will turn into via the website that offers users a set of customizing options for the furniture, regarding its color, function, and deciding which public space they want to see it in. The pieces of furniture are made primarily from PP and PE plastics commonly used in food packaging, which are donated to the Zero Waste Lab directly from the plastic waste source. The process includes several steps such as sorting waste, washing, and shredding before melting and combination with color pigments to create a printable material. PET and PS plastics are also proper materials to manufacture the furniture. The designers' intention with this project is to recycle four tons of plastic waste, which is equal to the plastic waste amount produced by 14 family households in Greece [49], [50].



Figure 10. Hanth Park in Thessaloniki Print Your City Furniture [50]

Case 8 – De Montfort University: Baya Weaver Brick, 2019

A new brick design has created by a group of the researcher at De Montfort University School of Mechanical Engineering. The brick is composed of upcycled waste plastic such as coffee cup lids and plastic bottles by using 3D printing technology. The brick design is inspired by nature that mimics the structure of Baya Weaver Bird's nest, as shown in Figure 10. The researchers have used lattice architecture technology that processes weave composition to achieve the woven configuration of the nest. The Baya Weaver Bird nest is known for its thermal insulation and micro-climate properties. The researchers have utilized these properties by applying the nest's system into construction bricks. The researchers aim to "improve the energy efficiency of modern buildings and reduce the carbon footprint" [51]. Also, the crisscrossing design of the brick provides lighter bricks that can reduce the dead-weight of buildings [52].



Figure 11. Baya Weaver Bird nest and the Brick Example [51]

5. DISCUSSION AND CONCLUSION

This study examines that waste plastic usage can be an alternative material in architecture, which allows designers to probe new forms and structures, at the same time contributing to the circular

economy of plastic. Therefore, a literature review has been performed, and selected examples have been analyzed regarding parameters: sustainability, economic contribution, speed of production, simple assembling, and flexibility in design. It is the goal of this study to understand the reformation of waste plastic through recent technological developments in digital design and fabrication, which seem to dissolve the limits in designing and fabricating complex architectural forms. Hence, it is possible to examine new approaches to the design and fabrication of building elements that rely primarily on material properties and geometry. A table indicated below shows the conformance of each case study to the selected parameters.

Table 4. Evaluation of case studies

Parameters							
Recycling/Upcycling Method		**Sustainability**	**Economical Contribution**	**Expedition of Production**		**Simple Assembling**	**Design Flexibility**
Heat Compression				**Phase 1**	**Phase 2**		
Case1	RecyBlocks	√	√	√	~	√	×
Case2	Plastic House	√	√	√	~	√	×
Case3	ByBlocks	√	√	√	√	√	×
Case5	Plasticiet Sheets	√	√	√	~	×	×
3D Printing and Digital Manufacturing							
Case4	Rubber Pouff	√	√	√	√	√	√
Case6	Deciduous	√	√	√	√	√	√
Case7	Print Your City	√	√	√	√	√	√
Case8	Baya Weaver Brick	√	√	√	√	~	√
		√ - Positive × - Negative ~ - Indefinite					

Sustainability - The research concludes that both the heat compression and 3D printing and digital manufacturing methods can use to upcycle waste plastic. Even though these methods have differences, they still contribute to reducing new plastic production by using the discarded ones, which helps to decrease extra energy consumption as well as carbon emission and mass plastic pollution. Since all the case studies above use discarded plastic as a base medium, these methods can be evaluated as sustainable.

Economical Contribution - The reason why plastics are in use so widely is that they are inexpensive. So, the waste of this cheap material is also not costly. Therefore, the companies that are analyzed in the case studies above are advantages in terms of supplying affordable material for their work. Except for the cost of mechanical equipment, using waste plastic for these companies can be evaluated as economically beneficial.

Expedition of Production - In this paper, two main recycling/upcycling techniques had investigated from an architectural point of view. These two methods have similar phases to process waste plastic, which are discarded plastic collection, sorting, cleaning, and shredding [53]. Hence, the examined case studies are accepted as at the same speed level until the shredding phase (Phase 1). After the shredding stage, the production methods differ from each other for both types of examples. Some of

the case studies, which use the heat compression method need to wait for a while, depending on the object that is produced, for material to sit properly, and some of them do not require that amount of time. For example, while Plasticiet Sheets (Case 5) need to stay in a mold for a time to dry out, Byblock bricks (Case 3) are immediately ready to use after steam compression application. That is why, it is observed that heat compression method time duration is very various, thus evaluated as indefinite (Phase 2). On the other hand, the case studies that use 3D Printing technology as a manufacturing method show that the 3D Printing process enables producers to use the design output right after the printing, and only some of them require minor adhesive application later, such as Rubber Pouff example (Case 4). Consequently, the analyzed case studies illustrate that 3D Printing and Digital Manufacturing is completing the entire production process one at a time, after the proper printable material is ready, which accelerates the production speed. That is why the 3D Printing and Digital Manufacturing method is evaluated as a fast production practice.

Simple Assembling - The case studies except for Plasticiet (Case 5) are considered as simple assembling methods. In the first three projects, the end products whether have an interlocking brick design or have an interconnection system with holes on bricks and metal tubes. So these examples available for installation without the need for any adhesives. However, since the Plasticiet sheets are only a plane surface, those products require more time and various methods for creating furniture or other elements out of them. The case studies 4 and 6 to 8 are manufactured digitally with 3D Printer. Only Rubber Pouff (Case 4) and Deciduous (Case 6) required assembling duration after manufacturing. The Rubber Pouff was printed as eight pieces and later combined with an adhesive, and the Deciduous Pavilion has several printed parts that interconnected later with other elements of the pavilion without the need for heavy machinery. The Print Your City project (Case 7) is immediately available after printing and does not require any assembling procedure. So, these cases are considered as convenient for easy assembling. However, since the Baya Weaver Brick (Case 8) is a very new research project, there is no specific indication about its assembling method. Thus, Baya Weaver Brick example is evaluated as indefinite in terms of simple assembling.

Design Flexibility - The case studies (1 to 3 and 5) are selected to understand one of the most common ways of reshaping the plastic method from an architectural perspective. These examples are mainly based on generating a rectangular block geometry that can use as a wall or furniture element. Since the method is compressing plastic granules into a mold with heat application, this does not allow the designers about the geometric variety. So, for this method, it is easier to manufacture basic geometric forms, which limits the possible diversity of the design. The common approach in these projects is to designing interlocking modular pieces that will simplify the assemblage (except Plasticiet Company). On the other hand, the other case studies (4 and 6 to 8) that are selected to acknowledge the current limits of 3D Print and Digital Manufacturing technology, which use discarded plastics as a medium. 3D printing technologies used in these examples enables the designers to create much more complex geometries with the help of parametric design software. It is understood that these studies are mostly done experimentally to discover possibilities of discarded plastic potential as a material with digital manufacturing tools and push the limits of current design tectonics to find a proper way to apply the output product into architectural usage. Therefore, 3D Printing and Digital Manufacturing method evaluated as flexible in design, while the heat compression method is not.

This study argues that the future of plastic waste can change by redesigning, reusing, recycling, or upcycling and can use an architectural element instead of end up in landfills. The research has provided a comprehensive idea about the world's plastic pollution crisis and has created awareness of the issue. The common ways of waste plastic's architectural usage methods have been investigated through eight different case studies and evaluated according to designated parameters. The results indicate

that discarded plastic can be an architecturally alternative material and can provide an adequate medium for designers to experiment on new configurations.

Future Remarks - This study investigates the existing examples of discarded plastic usage in architecture by focusing on 3D Printing and Digital Manufacturing methods. For future works, waste plastic as a medium can be used experimentally to discover alternative applications in architecture through the contribution of 3D Printing and Manufacturing technologies.

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An Evaluation on Low Cost and Energy Efficient Housing Design in Tropical Climates

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ABSTRACT

One of the most basic human needs can be called as proper housing. Today, there are millions of people who cannot meet this basic requirement. It is quite important to give efforts on the design and production of low-cost, comfortable, environmentally friendly and sustainable houses for providing shelter for these people. Especially, there are countries with limited energy supplies in tropical regions, the population increases rapidly and thus the need for housing increases. Yet, it can be easily seen that climatic conditions are highly ignored in newly built homes. It is possible to claim that "low cost" and "energy efficient" housing design, in which the economic conditions of the local people are considered, is a solution to overcome these problems. In this context, this study examines good practices selected from low-cost and energy-efficient housing designs in tropical regions, and it is aimed to determine a road map for new designs in the region. The parameters like "land use, sun protection, natural ventilation, sustainable building material, local workmanship, renewable energy use, rainwater harvesting and natural lighting" features were studied and evaluated in detail. The evaluation of the data obtained from the examples shows that low-cost housing design, which is comfortable, compatible with climate data, and integrates sustainable design principles, is possible for low-income groups. Finally, a roadmap is proposed for low cost, energy efficient and comfortable building design with spatial characteristics suitable for the living culture of the local people with local materials and local workmanship.

Keywords: Energy efficient architectural design, Sustainability, Tropical climate, Low cost housing

1. INTRODUCTION

Climate is one of the most important parameters to be considered in building design. A building's exterior shaped according to climatic characteristics not only maintains the user's comfort to higher levels, but also contributes positively to the sustainability of the building and its interaction with the environment. Today, it is a known fact that the building outer format is not shaped according to climate data, especially in the houses where low-income people live in underdeveloped or developing countries.

It is safe to say that "climatic conditions" are not considered in housing projects made in countries with tropical climates as in other climatic zones. When the subject that needs to be addressed during the design phase is neglected, indoor comfort conditions decrease and energy consumption increases. In these countries, the economy is generally weak, and the population is growing rapid. A rapid and unplanned development is observed mainly in urban areas, especially due to migration from rural to urban areas.

This study focuses on the sheltering problems of the countries with the climate zone mentioned previously like Guinea. The study is aimed to investigate how to make an energy efficient building design in the easiest, cheapest and sustainable way possible. This will be done by examining best practice examples with both low cost and energy efficient features in tropical climatic regions, and especially in the country where this field study will be taking place in.

As a result of the literature review that has been made, made it important to start with this study, due to the absence of an academic study that has spatial characteristics suitable for the living culture of the people, provides comfort conditions for the tropical climate in question, and offers solutions to meet the housing needs of energy efficient and low income groups. Considering the current settlement situation of Africa in tropical climates and especially in Guinea and the economic conditions of the local people, it is predicted that the later stages of this study, which is carried out within the scope of a master's thesis, will fill up an important gap for the region.

2. ENERGY-EFFICIENT ARCHITECTURAL DESIGN PRINCIPLES IN TROPICAL CLIMATE ZONES

Energy efficiency in buildings is a research topic that aims to develop strategies to reduce the energy consumption of the building while maintaining user comfort [1]. In residential development, energy efficient house design is one of the approaches that support renewable energy concepts [2]. It is possible to say that feasible "passive design" approaches to improve the energy performance of the house are also a low-cost solution. Passive design is crucial to sustainable architectural design. It includes solutions suitable for the local climate and land conditions to maximize the comfort and health of building users while minimizing energy consumption [3].

Energy efficiency is an inevitable necessity for all countries and societies in different climate zones. It is also important in this context to determine and apply the basic principles of passive design that can provide energy efficiency in residences in the tropical climate zone. A comprehensive literature review of different journals, books, researches and related websites was conducted to identify basic passive principles for the design of energy efficient residential buildings. Listed below are the issues related to energy efficient residential buildings, which were summarized from the literature review, then studied in the context of tropical climate:

- Site selection
- Building orientation
- Building envelope
- Shading

- Natural ventilation
- Building material and construction methods
- Integration of renewable energy sources in buildings
- Rainwater harvesting through buildings

2.1 Site selection

Site selection, which is an important step in the design process, should consider the influence of the local climate. In particular, the following issues should be examined in detail [4, 5];

- How the building will be exposed to winds, moisture and sunlight;
- Factors of the surrounding environment (topography, vegetation, proximity to the sea, *etc*.);
- The function of the surrounding area (*e.g.* urbanization).

2.2 Orientation of building

Once the location has been chosen, the second step is to examine the optimal positioning of the building. This will enable the building's envelope to limit exposure to solar radiation while maximizing the potential for natural lighting and ventilation [4]. The angles of incidence in the west and east are higher than in the south and north, and for this the sun radiations penetrate more. For this reason, the most suitable positioning in tropical climates is along the east-west sides. For example, the longest sides of a rectangular building must face north and south. Since the north façade will receive less sunlight, it is exposed to little heat absorption. Since sunlight is perpendicular in tropical regions, southern exposure can be easily controlled with an overhanging roof or cantilever beam [6].

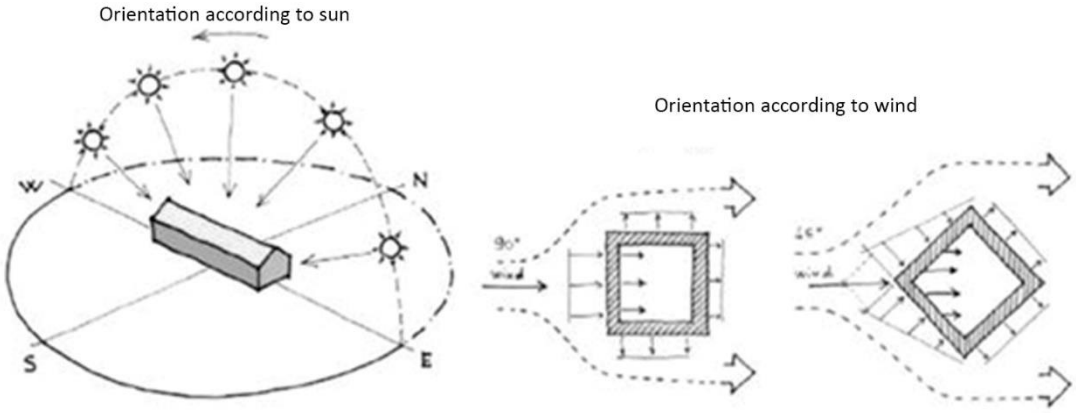


Figure 1. Building orientation according to the sun and wind's direction [5]

2.3 Building Envelope

The building envelope consists of structural elements such as roof, walls, windows, doors, floor and ceiling that separate the interior environment of the building from the external environment [7]. Through these building elements, heat flows in and out of a building. Interior walls, doors, and room arrangements also affect the heat distribution inside a building [8]. The design of the building envelope is the integrated design of the building form and materials that provide optimum comfort and energy efficiency. A good envelope design adapts to climate and terrain conditions to optimize thermal performance [8]. In the tropical climate, the design of a building envelope's elements such as the roof, walls and windows play an important role in the energy efficiency of the building. Descriptions and explanations of these elements are given in the following sections.

Roof

In tropical regions, roofs receive more solar radiation than other surfaces of the building. The heat absorption through the roof increases as the ratio of roof area to building volume increases. Roof design is extremely important to keep the indoor temperature at a level not higher than the outdoor temperature. Some solutions will perform better than others in certain conditions. For example, an uninsulated double skin roof, also known as a "parasol" roof, can function well, especially at high daytime temperatures. In such a case, the lower part of the roof and the upper part of the roof should be reflective to minimize both emission and absorption [7].

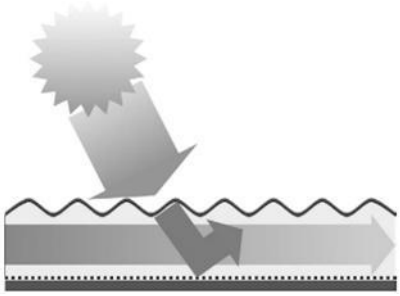


Figure 2. Parasol roof (Bromberek, 2009)

Wall

External walls, which are an important component of the building shell, play an important role in maintaining the energy efficiency and thermal comfort of the building [9]. A wall that is not protected from the sun warms up and transfers the heat to the interior part of the building. The thickness and material of a wall can be changed to control heat absorption. Heat resistance flow in walls exposed to sunlight can be increased in the following ways [5]:

- Increasing the wall thickness;
- Sandwich wall application;
- Using walls made of suitable thermal insulation material;
- Placing the thermal insulation material inside or outside the wall exposed to the sun;
- Using radiant barriers;
- Painting the wall exposed to the sun with a light color.

Windows

Most windows combine three functions: view, daylight and airflow. To improve the performance of these functions, it should be considered that the structure is well located, and the windows are conveniently positioned in the building envelope part. Window shading can also indirectly affect the thermal environment by affecting the airflow inside the building. When insect grids are used, they should be installed at the greatest possible distance from the protected opening [7].
According to IFFD (2015), in one structure;

- To prevent excessive heat ingress,
- To provide natural lighting by reducing the brightness,
- Providing natural ventilation by reducing noise pollution caused by very fast wind circulation and external noise,
- It undertakes tasks such as creating a beautiful view by protecting the privacy of the building.

Along with the orientation of the building, the size and number of windows and their placement in the building envelope should be taken into consideration at the design stage.

2.4 Shading

In building design, whether air-conditioned or not, the main purpose is to control direct solar radiation to minimize thermal comfort, lighting, and energy consumption. Shading can be unintentional or independent of design options, or it can be designed specifically to control the flow of solar energy into a building [5]. In building design, whether air-conditioned or not, the main purpose is to control direct solar radiation to minimize thermal comfort, lighting, and energy consumption. Shading can be unintentional or independent of design options, or it can be designed specifically to control the flow of solar energy into a building [10]. Victor and Odeyemi (2013) state that the desired shading can be provided for windows and walls in tropical climates with horizontal projections and wide roof eaves [11]. In the hot and humid tropical climate, one of the most important concepts is to protect windows and walls from the sun. It is important to use terraces, balconies, pergolas to let sunlight in without excessive heat gain. The use of balconies and terraces around the building is an effective way to create shadow [12].

2.5 Natural ventilation

Natural ventilation is the most energy efficient and easiest source of cooling. It is determined by the difference in temperature and pressure between the inside and outside of a closed space and the difference in height between the air inlet and outlet [6]. In tropical climates, natural ventilation is the most energy efficient solution to achieve comfort conditions in residences. The basic principle is to create an enough opening on several facades. It is important to create facing facades for ventilation from windows in the wall. Natural ventilation should be able to work at night without the risk of attack and with protection against rain [13]. According to IFFD (2015), natural ventilation of a building is based on two separate and complementary methods:

- Cross ventilation based on air circulation caused by external winds entering the building and thus evacuating polluted air;
- Chimney ventilation based on external and internal temperature changes and the expansion of air under the influence of heat.

2.6 Building material and construction methods

Sustainable building materials, construction methods and innovations in architectural design can be based on traditional knowledge and practices that generally adapt well to local climates and use locally available materials [5]. Considering the climate and sustainability, suggestions for material and product selection can be listed as follows [5]:

- Minimizing the amount of resources used and using materials efficiently in the construction process;
- Choosing materials with low energy and energy efficient construction systems; for example, locally certified timber instead of concrete for beams, lime and pozzolana mortars instead of cement mortar; using soil, stabilized earth blocks or sand-lime blocks instead of burnt clay bricks, and gypsum plasters instead of cement plaster;
- Natural materials, especially timber, trees, straw, grass, bamboo, etc. using renewable organic materials. Even non-renewable inorganic materials such as stone and clay can be reused or recycled;
- Using durable materials and components;
- Using locally available building materials, technologies and local workmanship;
- Using reusable and recyclable building materials;
- Using water-based acrylics for paints;
- Minimizing the use of metallic surfaces and metallic pipes, fittings and fixtures.

2.7 Integration of renewable energy sources in buildings

Integration of renewable energy sources into buildings can increase the efficiency of the structure, reduce energy bills, save installation costs and limit the negative environmental impact of the building. According to the IFFD (2015), attention should be paid to technologies that allow the use of solar energy in tropical climates, especially for domestic hot water and electricity generation:

- Hot water production with solar panels;
- Photovoltaics;
- Other renewable energies, such as; wind and biomass.

2.8 Rainwater harvesting through buildings

Rainwater harvesting is a technique applied to collect, store and reuse rainwater for various purposes. Rainwater has a great value for its purity and softness, because its pH rate is almost neutral immediately after rainfall [14]. It can be said that there are two types of rainwater collecting methods through buildings, both traditional and modern. Traditional rainwater harvesting method is the oldest method, it's used both to meet basic needs and to contribute to the sustainability of water resources. This method is used in water tanks, wells, cisterns, various water structures, water channels, artificial ponds or pools, *etc*. As for the modern rainwater harvesting method, it is possible to say that traditional rainwater harvesting techniques are adapted to modern systems [15]. Since the tropical climate is both rainy and hot, it rains for days in some regions and very little in others. For this reason, it can be said that the integration of the rainwater collection system into existing or new building designs is a must.

3. HOUSING FOR LOW INCOME GROUP

One of the most basic human needs is proper sheltering. There are currently millions of people without even a roof over their heads. In developing and underdeveloped countries around the world, low-cost environmentally friendly sustainable housing is needed to accommodate millions of people in need [16]. Low-cost housing is a term used to describe housing units designed for the low-income group and considered affordable [17]. Low cost housing standard and ideal for low and middle income groups in terms location [18].

3.1 Current situation and needs analysis

According to the data shared by the American Population Reference Bureau in 2018, there are 20 countries in Africa and Asia with rapidly increasing populations. This rapid population growth is expected to continue until 2050 [19]. Among these 20 countries with the fastest growing population are Guinea, Comoros, Mozambique, Uganda, Gambia, Somalia, Tanzania, Burkina Faso and Burundi, 9 of which are in the tropical climates of Africa [19, 20]. Throughout these countries, irregular urbanization and relatively large number of shanty towns are observed. For this reason, it is important to develop energy-efficient and low-cost designs that will meet the needs of the people in order to meet the housing needs of the poor people in rural and urban areas, and to find solutions to the increasing housing shortage in countries with tropical climates in general and especially in Guinea.

3.2 Design principles of low-cost housing

Wainer, Ndengeyingoma and Murray (2016), claim that there are four design principles for providing efficient low-cost housing: design principles for land use, housing architecture, infrastructure and building material.

Land use
The design principles for land use emphasize the achievement of density without compromising habitability, achieved through an effective grid and structures for the management of neighborhood evolution that encourages neighborhood density without forcing, promotes a managed increase in density over time, and protects public and private open spaces [21, 22].

Infrastructure
According to Wainer *et.al* (2016), the concept of sites-and-services can be a good solution. The concept of fields and services has been applied with the help of the World Bank for nearly two decades in many developing countries, particularly in the 1970s and 1980s. It targets the housing needs of the poorest population and has emerged in the context of the failure of conventional housing approaches and structural adjustment pressure to reduce public expenditure [22].

Housing architecture
The key methodology described here is the "incremental building" concept. Incremental building is a small, comfortable and tailored residence that can be expanded later. The incremental building, although habitable, is delivered incompletely and is gradually complemented over time and to the needs of the house owner [22].

Building materials
The first step in low-cost housing material selection is to choose environmentally friendly building materials. This also supports the principle of sustainable design [17]. In terms of materials and construction, it is important to adopt the use of natural and recycled materials, low-tangible energy materials and efficient construction techniques [16].

4. LOW-COST AND ENERGY EFFICIENT HOUSING DESIGN IN TROPICAL CLIMATES: selected good practices

The optimum design of low-cost housing offers opportunities to obtain affordable and acceptable comfortable housing for the low-income group. The following examples are examples of low-cost housing that have been obtained from the literature review and studied in the context of a tropical climate.

4.1 Maputo's slums compact housing / Casas Melhoradas

Casas Melhoradas is a residential project for low-income groups in the slums of Maputo, Mozambique. The project shows how the space and infrastructure can be used more economically. The design takes a stand against urban sprawl and the growing infrastructure shortage. In the common space and kitchen designs, references to the social and cultural lifestyles of the project are seen. The project has a green roof to which an additional floor can be added, which contributes to the sustainability of the project in case of greater urban density in the area. In addition, the evaporation provided on the roof increases the indoor climate quality of the houses. The project was built using locally produced compacted soil blocks. Thus, the same red hue of the local soil was added to the project while reducing the energy consumption during the construction process [23].



Ground floor First Floor Section

Figure 3. Maputo's slums compact housing [23].

4.2 Passive house prototype with bioclimatic design / Comprehensive Design Service (CDS) in Nigeria

CDS is an initiative started by architect and social entrepreneur Chinwe Ohajuruka, who received the Sub-Saharan Africa Award of the Cartier Women's Initiative Awards in 2015. The firm caters to people who do not have access to hosting. It aims to improve the living standards of Nigerians by providing low-cost housing, reliable renewable energy, clean water and recycling strategies. The project is a bioclimatic design that includes the use of locally available renewable materials such as natural ventilation, wide overhangs, cool roof, shading from the landscape, energy from the sun, wind and biogas, rainwater harvesting, and stabilized soil for construction. The main factor in design is that it is cost effective for low-income families. This prototype was built 0.60 meters above ground level to prevent flooding. The building design includes two courtyards for cooling, ventilation and communal activities. It uses solar panels to illuminate and power small appliances, and solar energy for drilling and pumping water, as well as recycling waste and sewage with bio-digesters, thereby generating biogas for cooking [24].

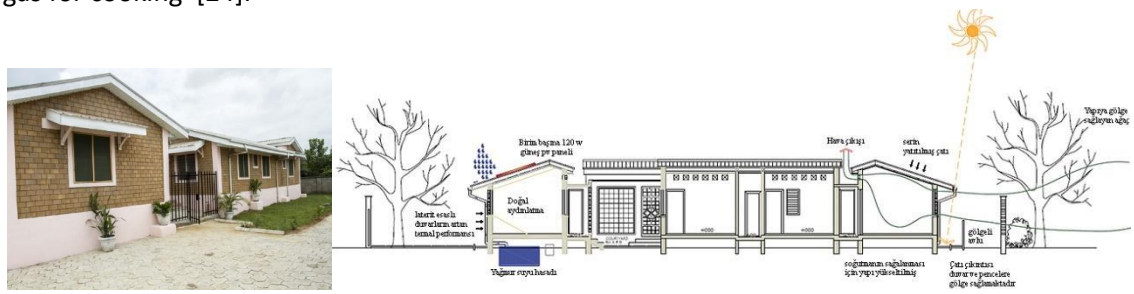


Figure 4. Passive house prototype with bioclimatic design [25].

4.3 Low cost bamboo house

Designed by the Mexican studio Comunal Taller de Arquitectura, the low-cost bamboo house was built in less than a week with the help of residents. The house consists of a prefabricated bamboo frame. The walls and window shutters are made of bamboo panels coated with ixtle; a local plant fiber commonly used to make coffee sacks. The floors are made of stone. Some walls have red brick masonry. The voids help the air to circulate naturally into the interior and allow smoke to escape from the kitchen. According to its architects, this house represents a promising low-cost housing model for the area as it can be built easily and quickly by the locals [26].

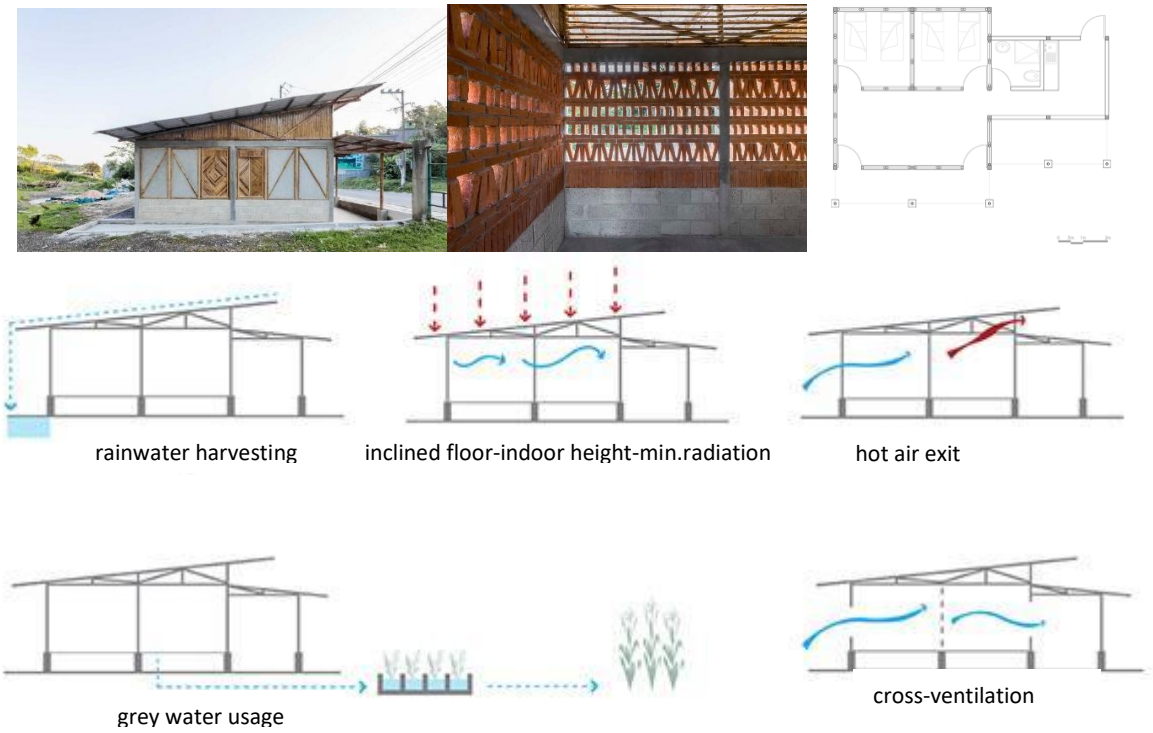


Figure 5. Bamboo house [27].

4.4 Nakasone House / Escobedo Soliz

The house is in an informal neighborhood outside of Mexico City. This tiny house of 100 m^2, spread over just 50 m^2 on two floors, was built for a retired teacher. The client's limited budget forced the designer to use the most common and affordable building materials and systems on the market. During the project, the architects worked alongside the local builders to re-emphasize their experience with traditional architectural systems. Volcanic stones found in the land were used while the foundation, platforms, stairs and surrounding walls of the house were constructed [28].



Figure 6. Nakasone house [28].

4.5 Expandable house / the studio Urban Renewal System

The expandable house is designed to be part of a sustainable solution to the problems of rapidly developing cities such as Batam in Indonesia. This house has the potential to be lifted with a roof and

up to three floors according to need. The foundation and structure made of concrete is planned to be able to withstand three floors. Thus, it will continue to be a comfortable home according to the possibilities and needs of the landlord. The house also has a "decentralized" infrastructure that uses rainwater harvesting and solar powered electricity, as well as passive cooling and sewage tanks [29].



Figure 7. Expandable house [29].

4.6 Magoda Project / Ingvartsen Architects

The Magoda Project is a project series consisting of eight prototype houses located in Tanzania. Prototypes designed in collaboration with the local community are prime examples of innovative architecture used to improve health and well-being in sub-Saharan Africa. These low-cost homes combine Asian architectural features (to optimize airflow) with traditional African building methods known locally. Locally found wood, bamboo, brick and shade net are used as building materials to provide cross ventilation, lighting and protection from mosquitoes. In order to prevent flood effects, the structures were raised above ground level with concrete [30].
This optimized combination of the two building styles enhances the hygiene and well-being of the local people. It is also an indicator of how innovative solutions can come from cultural information exchange. Ingvartsen Architects used this cultural change as a research opportunity to evaluate the efficiency of different microclimates resulting from a variety of materials and building designs and of insect screens (canopy mesh) covering all open windows. Their aim is to work with local community leaders and key stakeholders, increase the adoption of new design techniques, expand architecture, and minimize disease on a wider scale [30].



Figure 8. Mogoda project [30].

4.7 LT House / Tropical Space

Tropical Space has designed LT House as a solution to low cost and comfortable housing demand according to the needs and lifestyles of workers in Vietnam. Since the furniture is planned in a simple and easy way, the homeowner bought the materials in order to reduce the costs and made them all himself. The two short sides of the house were made entirely of brick with a hollow wall, providing shade with two small and continuously open windows, while illuminating the interiors adequately [31].



Figure 9. LT house [31].

4.8 Niamey 2000 / United4design

Figure Niamey 2000 is a 1,700 m^2 residential building designed as a solution to the existing housing crisis in Niamey, the capital of Niger. The project proposes a new model for urban housing, increasing the density. The Niamey 2000 project was inspired by the pre-colonial cities of the region, all of which are busy urban centers, such as Timbuktu in Mali, Kano in Nigeria or Zinder in Niger. Compacted soil masonry and passive cooling techniques have been used to protect against Niger scorching temperatures. The contemporary design of the project reintroduces local materials and techniques to the construction industry and provides a low-cost and comfortable housing alternative to the city's rapidly developing population [32].

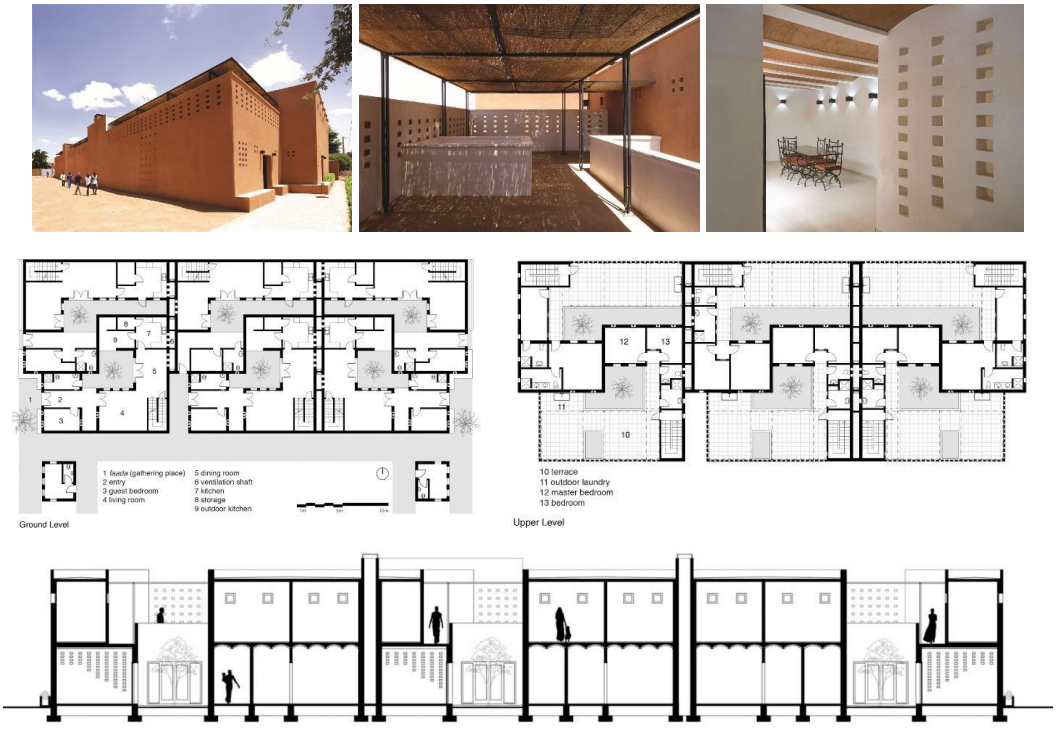


Figure 10. Niamey 2000 project [32].

4.9 Surabaya Boarding House / Andyrahman Architect

Located in Surabaya, Indonesia, this boarding house was designed by Andyrahman Architect, which looks at contemporary issues in a broader context with bioclimatic and biophilic approaches. Perforated wall frames allow for natural ventilation and lighting while allowing division of spaces [33]. This house has entered the literature as an example that a low-energy, low-cost house will not compromise its aesthetics and performance by combining different materials and textures. Low construction and maintenance costs were suggested for the finishing of the building, and wall coverings were carried out using cement paint, plaster and cement rolls that do not require complex maintenance and painting. In addition, recycling products were preferred in many materials, and it was stated that the building saves costs and resources with this recycling principle [33].



Figure 11. Surabaya Boarding House project [33].

5. EVALUATION AND CONCLUSION

As seen in the low-cost housing examples examined, designing affordable housing for the low-income group does not mean to not obtaining health and comfortable housing. When sustainable design principles are integrated into low-cost housing projects, it is possible to achieve a more comfortable, affordable and energy efficient design.

Table 1. An evaluation on selected good practices regarding energy efficiency

			Optimum use of the land	Shading	Natural ventilation	Sustainable Building material	Local workmanship	Renewable energy	Rainwater harvesting	Natural lighting
Compact house/ Maputo	m^2	230 m^2	X	O	X	X	X	?	O	X
	year	2018								
	material	rammed earth								
Passive house prototype/ Nigeria	m^2	166 m^2	?	X	X	X	X	X	X	X
	year	2012								
	material	rammed earth								
Bamboo house/ Mexica	m^2	36 m^2	?	X	X	X	X	O	X	X
	year	2016								
	material	bamboo, stone								
Nakasone house/ Mexica	m^2	100 m^2	X	X	X	X	X	?	O	X
	year	2020								
	material	volcanic stone, brick, timber								
Expandable house/ Indonesia	m^2	36 m^2	X	X	X	O	?	X	X	X
	year	2018								
	material	brick								
Magoda Project/ Tanzania	m^2	48m^2, 63m^2 and 45m^2	?	X	X	X	X	O	X	X
	year	2015								
	material	timber, bamboo, brick								
LT house/ Vietnam	m^2	108m^2	X	X	X	X	X	?	O	X
	year	2016								
	material	brick								
Niamey 2000/ Niger	m^2	1700m^2	X	X	X	X	X	?	?	X
	year	2016								
	material	rammed earth								
Surabaya Boarding House/ Indonesia	m^2	370m^2	X	X	X	X	X	?	?	X
	year	2016								
	material	brick, timber								
x: exist			o: doesn't exist				?: information not accessible			

The points to be considered in the low-cost housing design process highlighted in the examples examined above can be summarized as follows;

- Optimum use of the land
- Shading
- Natural ventilation
- Sustainable Building material
- Local workmanship
- Renewable energy
- Rainwater harvesting
- Natural lighting

The table below presents a collective evaluation of low-cost housing examples in the context of these parameters, which were obtained from the literature review and studied in the context of tropical climate.

In the Table 1 in question, the situation of the selected houses having the features of land use, sun protection, natural ventilation, sustainable building materials, local workmanship, renewable energy use, rainwater collection and natural lighting are presented. As can be seen, it is possible to "build low-cost energy efficient housing" in tropical regions, but there are no houses that meet all these expectations, except for the "passive house prototype in Nigeria". For this reason, it is possible to say that in projects to be carried out in tropical climates, a project that complies with all the energy efficiency criteria listed is required.

The issues to be considered in the low-cost housing design process emphasized in the examples examined above should respond to the parameters listed below. In other words, these parameters should be considered as a guide in the early design stages of the project.

- Economical use of space and infrastructure;
- Paying attention to the social and cultural lifestyles of the user;
- Sustainable use of materials;
- Application of passive design principles;
- Use of local labor;
- A healthy and comfortable home design according to the user's abilities and needs;
- Developing innovative design techniques;
- Modernization of traditional architectural techniques.
-

As a result, it can be said that low-cost, energy-efficient and comfortable buildings can be designed for low-income people based on the climatic conditions of countries in tropical climates using local materials and local labor in the region. This design can be carried out based on energy efficient housing principles demonstrated in the literature and issues summarized in low cost housing design.

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Transformation of Hospital Areas in the world after Covid-19 Pandemy

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ABSTRACT

Covid-19 is an airborne infectious disease that affects the entire world. Since this disaster profoundly affects human health, community psychology and the country's economy, interest in related hospital and ward design has increased around the world in order to prevent the spread of covid-19, and improve the treatment process. While some design strategies focus on improving existing buildings against pandemic conditions, some others try to overcome the disaster by planning new health care extension regions with the use of modular systems. In this article, the proposed modular hospital ideas for pandemic process will be investigated and their similarities and differences will be discussed in tabular format. First, STAAT Mod Units designed by HGA, CURA Pods designed by Italian Architects Carlo Ratti and Italo Rota, Losberger Emergency Modular Hospital System designed by Evolve Emergency + Losberger de Boer, Covid-19 Hospital Ship designed by Weston Williamson + partners, Emergency Modular Hospital designed by MMW architects, Field Rescue Center designed by HAHA Architects Group, Mobile Modular Hospital designed by Golden Hour MMH, Modular Hospital Ward Prototype designed by Miniwiz, and QurE Circular Negative Pressure Quarantine Unit designed by Bio-architecture Formosana (BaF) will be examined according to their layout strategies, building features, ventilation systems, air borne filter usage. Then, suitability of these design ideas to future adaptations will be compared. Since covid-19 is not believed to be the final contagious health threat for communities of the world, to examine the available adaptations and derive further planning and design strategies for treatment and well-being areas is crucial to study on. Adaptations will also be analyzed to improve the mechanical and architectural design coherence of applications prepared for pandemic diseases.

Keywords: Covid-19, hospital, modular design, disaster, transformation of space

1.INTRODUCTION

In December 2019, China reported that a virus identified as new coronavirus spreads out in Wuhan. In January 2020, China shared the genetic sequence of COVID-19 the new coronavirus in the light of the experience with SARS and MERS, and WHO (World Health Organization) published a guidance to protect health workers from infection and prevent transmission of viruses via droplet (World Health Organization, 2020). Since the Covid-19 pandemia is progressing rapidly, leading to an increased need for hospitalization (Zhang et al., 2020). For that, some hospitals have been converted into pandemic hospitals, while designers from some countries have also offered to build specialized modular hospitals near or far from existing hospitals. Proposals analyzed through this research are 13 modular hospitals designed during Covid-19 pandemia from all around the world and accessed from the websites based on design, production or architecture. WHO declares that the most affected countries within three weeks are the USA and Italy (Duddu, 2020). It is interesting to see the examples come from countries which harmed the most. All proposals examined in detail. 4 of them then eliminated because of inadequate information about filtration and mechanical design, and 9 of 13 hospitals were examined in detail related to the scope of study (coherence of mechanical design –air control design- with architectural design for alternative disease control spaces.

2.BACKGROUND STUDY

To understand the background of the subject, 79 studies in indexed related to hospital design reviewed. 16 of these studies were about the indoor air quality of hospital interiors, and 1 of these studies was about the transformation of hospital spaces after covid-19 pandemia. Natural ventilation is recommended to reduce the risk of airborne infection spread in healthcare facilities by WHO. However, it is also stated that natural ventilation does not allow negative pressure in isolation areas (WHO 2009 as cited in Salonen et al., 2013). HEPA filters and MERV 8, MERV 14 and MERV 17 are recommended for mechanical ventilation in healthcare facilities (ASHRAE 2003b as cited in Salonen et al., 2013).

Not only the filter system but also the adjustment of right air change cycle is also important to provide clean air and prevent infection. ANSI/ASHRAE/ASHE Standard 170 recommends at least 20 total air changes per hour and at least 4 external air changes per hour in operating rooms (ANSI/ASHRAE/ASHE, 2008 as cited in Spagnolo et al., 2013).

Studies show that preference of high air change rate within spaces and the low location of return openings can reduce exposure to infection (Nielsen et al., 2010). This result is emphasized also in another study. The study conducted by researchers who has studied on ventilation design strategies for effective removal of pollutant in the isolation room of a hospital assert show that low-level extraction is better than ceiling level (Cheong, & Phua, 2006). For operating theatre rooms, the use of laminar airflow (LAF) rather than turbulent flow is suggested to prevent infection (Spagnolo et al.,2013).

Besides ventilation, there are some other important suggestions to ensure suitable pandemia environment in hospitals. In order to prevent infection, it is suggested to minimize edges and corners, provide seperated dirty and clean pathways, easily cleanable surfaces and areas, and safety patient flow (Spagnolo et al., 2013). The ways for providing effective spatial layout in hospital interiors is discussed in several studies. It is stated that minimizing the distance between patient room and nurse station can improve health outcomes (MacAllister et al., 2016; Fay et al., 2017; Gharaveis et al., 2019).

In addition, layout is a key for infection control. Separating hospital into zones is suggested to get infection under control. In order to inhibit infection and control airflow, a conducted study during Covid-19 pandemia in China suggests separating hospitals into three zones (cleaning zone, semi-contaminated zone, contaminated zone), and three channels (medical personnel channel, patient channel and simple delivery channel) (Zhang et al., 2020). Journal of the Academy of Hospital Administration suggests to separate into four zones. These are protective zone (reception, waiting area, trolley bay, changing room), clean zone (pre-op room and recovery room, plaster room, staff room, store), sterile zone (operating suite, scrub room, anesthesia induction room and set up room), disposal zone (sluice dirty utility and disposal corridor) (Gupta et al., 2005).

3.MODULAR HOSPITAL PROPOSALS

As Covid-19 is a disease affecting the world, interest in easy built modular hospitals in many countries has increased in order to prevent the spread of the virus and ensure an effective treatment process. In this direction, architects and engineers worked on the development of modular hospitals. Some modular systems are derived from shipping containers while some of them are made of steel, aluminium constructions or tent structures. Some are designed to be near or adjacent to the hospital, while others are designed to be located on a field independent from hospital area. In this section, modular hospital proposals from all around the world is examined. All proposals aim to prevent the spread of covid-19 and provide a healing environment. In total 13 proposals reviewed and 4 of them were eliminated due to the lack of information about filtration or mechanical design. Eliminated proposals are not built. 9 of 13 proposals are examined in detail. 6 of 9 proposals are already built and used during Covid-19 pandemia.

In order to understand approaches for designing modular hospital layout and filtration, 9 proposals was selected. These are STAAT Mod Units from the USA, Mobile Modular Hospital from Esthonia, CURA Pods from Italy, Losberger Emergency Modular Hospital System from the USA, Emergency Modular Hospital from the USA, Field Rescue Center from Poland, Modular Hospital Ward Prototype from Taiwan, CNC-Medical Emergency Module from Taiwan, Covid-19 Hospital Ship from UK. These proposals will be analyzed in detail, respectively. Location of filter types, filtration system, direction of pressure and the used materials are factors to be analyzed and have great importance for contagious healthcare environments. In order to assess suitability of modules, these criteria will be considered.

Common features to ensure suitable pandemia environment in hospitals are considered in the design of new modular proposals: to minimize edges and corners, provide seperated dirty and clean pathways, easily cleanable surfaces and areas, and safety patient flow (Spagnolo et al., 2013); providing effective spatial layout in hospital interiors (MacAllister et al., 2016; Fay et al., 2017; Gharaveis et al., 2019), with right zoning air system. Modular units either have self-sustaining air ventilation or combined air ventilation where mostly they have HEPA in air-inlet and MERV in air-oulet ideally.

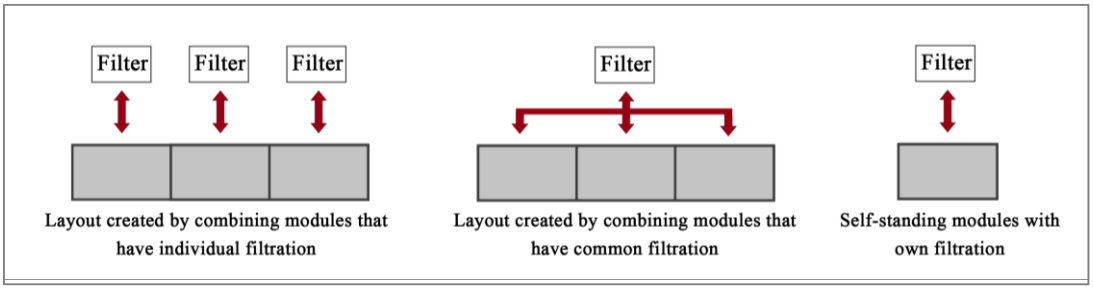


Figure 1. Categorization of the analyzed hospitals

According to the filtration and layout features of the analyzed 9 modular hospitals, they are categorized into three as is seen in Figure 1. These are layout created by combining modules that have individual filtration, layout created by combining modules that have common filtration, and self-standing modules with own filtration, respectively.

3.1. Layout Created by Combining Modules That Have Individual Filtration

In this section, combined modules with individual filtration system are analyzed. Layouts of the module combinations are also part of the analysis and believe to lead us for future design/ planning alternatives. In this context, module layout, pathways, entrances, air filtration, filter type, location of filteration system, pressure direction, ventilation isolation are analyzed for each hospital. STAAT Mod Units, CURA Pods, Losberger Emergency Modular Hospital System and Covid-19 Hospital Ship are examined in detail, respectively.

3.1.1.STAAT Mod Units

STAAT Mod Units were designed by HGA in USA in order to prevent infection, provide effective treatment for patients and safety environments for patients and healthcare workers during covid-19 pandemia. It is stated that while designing these units, the recommendations of CDC (Centers for Disease Control and Prevention) for Airborne Infection Isolation rooms were considered (HGA, 2020). It is stated that the first STAAT Mod Units was built in Fort Washington, Maryland (Buckley, 2020).

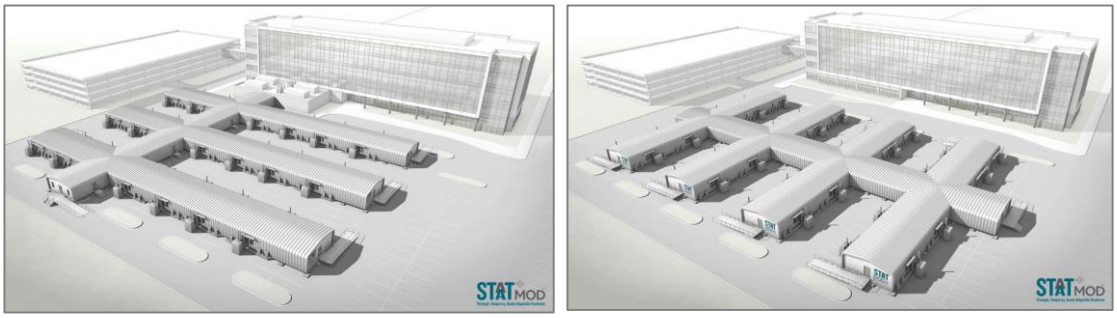


Figure 2. STAAT Mod Units self-sufficient view
(Access date 7th November 2020, Retrieved from https://hga.com/staat-mod-media-assets/)
Figure 3. STAAT Mod Units adjacent view
(Access date 7th November 2020, Retrieved from https://hga.com/staat-mod-media-assets/)

Figure 2 and 3 show the installed units. It is suitable to use as either adjacent to existing building or self-sufficient. The capacity can be enlarged with end-to-end additions (HGA, 2020). It is understood that the layout of STAAT Mod Units was designed to provide entrance from outside for each module.

This is the right approach in terms of preventing infection and virus transmission. Figure 4 shows the layout of STAAT Mod Units. It is seen that mid modules 1-2-3-4-5 are used only by staff and, patient rooms are located at the sides of the middle modules.

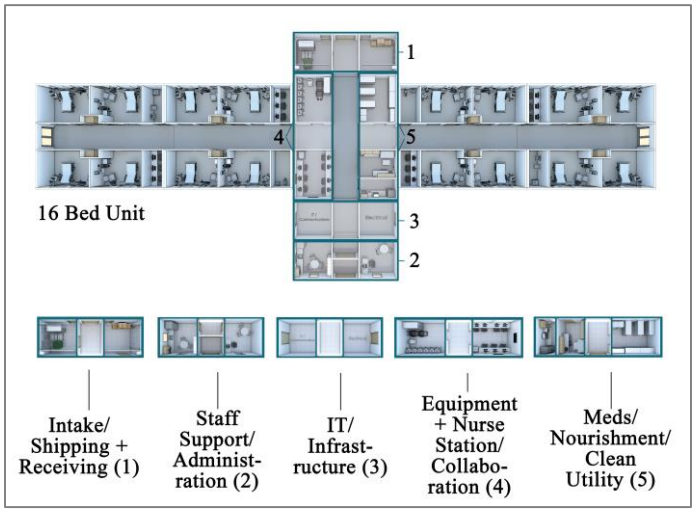


Figure 4. STAAT Mod Units layout design
(Access date 7th November 2020, Redrawn from info,
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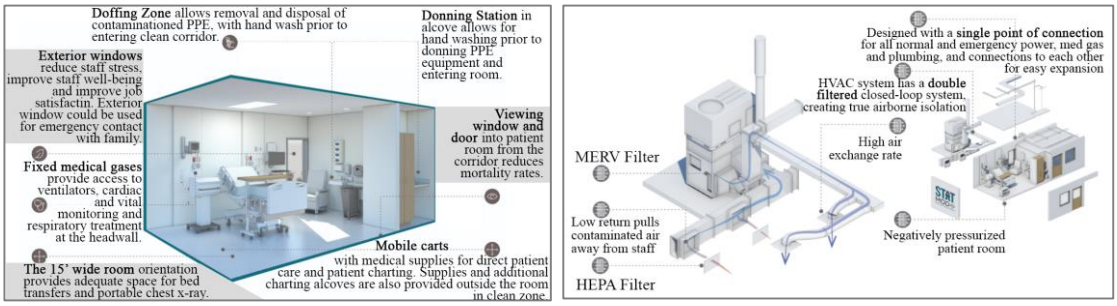


Figure 5. STAAT Mod Unit interior view zoning (Access date 7th November 2020, Redrawn from info retrieved from https://hga.com/staat-mod-media-assets/)

Figure 6. HVAC system of STAAT Mod Units' HVAC design (Access date 7th November 2020, Redrawn from info retrieved from https://hga.com/staat-mod-media-assets/)

Figure 5. shows the interior view of the unit by zoning and placement of the equipment. Figure 6. shows the HVAC system of isolation rooms in detail with filters and pressurization methods. It is seen that double-filtered systems are used. Both HEPA in inlet and MERV filters at outlet with closed-loop HVAC system. Each module has own filter and negative pressure is applied in interiors. According to the Figures 2, 3 and 6, it is seen that HVAC unit built next to the module at the ground level. It can be inferred that the air inlet mechanism is placed at ceiling level while outlet mechanism is placed at the ground level for each module. It is the analyzed as the right precaution to prevent cross-infection.

3.1.2.CURA Pods

CURA Pods were designed as an intensive care unit by Italian architects Carlo Ratti and Italo Rota during covid-19 pandemia, and installed at a hospital in Turin. It is transformed from shipping container (Ravenscroft, 2020).

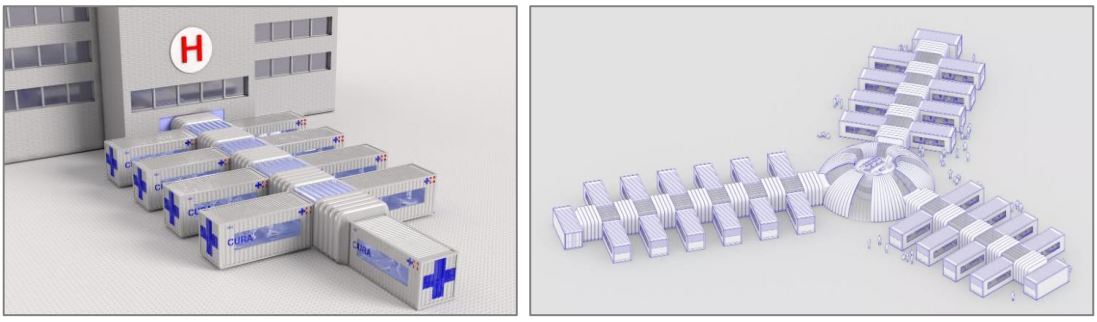


Figure 7 & 8. CURA Pods (Access date 6th November 2020, Retrieved from https://www.dezeen.com/2020/04/21/shipping-container-intensive-care-unit-installed-at-turin-hospital/)

Figure 7 and 8 show the placement of CURA Pods. They can be installed both adjacent to the hospital, and as self-standing field hospitals (Alter, 2020). CURA Pod can be easily installed and combined with quickly assembled hospital tents. It can be used as single or combined with inflatable tunnels. (Ravenscroft, 2020). As can be seen from Figure 7, the modules are not given separate access, and the modules use a common corridor. There is no given information about separating clean and dirty pathways. If they are not separated, the preference of the common corridor for modules would have a great potential to spread infection.

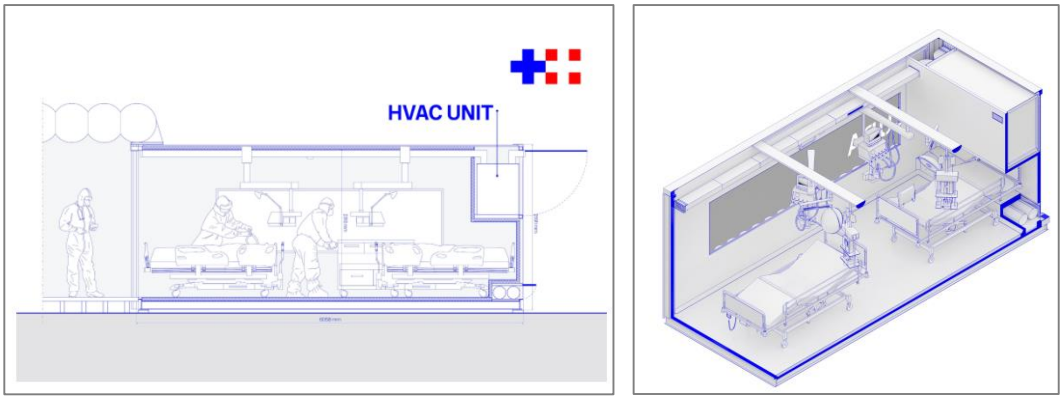


Figure 9 & 10. HVAC unit inside the pod (Access date 6th November 2020, Retrieved from https://curapods.org/open-source-files)

Figure 9 and 10 show the HVAC unit embedded to the pod's wall. It is stated that each module uses its own HVAC unit. In addition, HEPA filter is preferred for the filtration at the inlet side. It is provided at least 12 air changes per hour, and there is negative pressure inside each pod (Ravenscroft, 2020). These approaches are identical with set standards and other given example to prevent infection. According to mechanical analysis, it is observed from Figure 9 that the air inlet and outlet are placed at the ceiling level. However, it is expressed that low-level extraction is better than ceiling level (Cheong & Phua, 2006).

Besides, there is no information found about interior materials used. It is believed the materials will follow the hospital design standards set.



Figure 11 & 12. Installation of the CURA Pods (Access date 6th November 2020, Retrieved from https://www.dezeen.com/2020/04/21/shipping-container-intensive-care-unit-installed-at-turin-hospital/)

Figure 11 and 12 show the installation of the CURA Pod at a temporary hospital. It is built inside the Officine Grandi Riparazioni in Turin (Ravenscroft, 2020), and this can be problematic in terms of interior air quality within the complex if the return air is not filtered by MERV filters and returned to interior space of the complex. No info related found.

3.1.3.Losberger Emergency Modular Hospital System

Evolve Emergency is a firm of the USA origin that specialized on designing technological products. Evolve Technologies Corporation, 2020). Losberger de Boer produces Losberger Shelters and provides quarantine tents, triage tents, wards and morgues (Losberger, 2020). With the collaboration of Losberger de Boer and Evolve Emergency, a modular hospital system for the state of emergency is offered.



Figure 13 & 14. Losberger Emergency Modular Hospital System exterior and interior view (Access Date 7th November 2020, Retrieved from http://www.evolvetechcorp.com/emergency-modular-hospital.aspx)

Figure 13 and 14 show the exterior and interior of the module. PVC coated fabric is preferred for shelters, and the use of hard flooring is offered optionally (Evolve Technologies Corporation, 2020). Preferring hard floor can help to sanitize ground easier.

According to Figure 14, all modules have their own entrance, and the middle wards also serve as corridors. There is no given information about separation of clean and dirty pathways for corridor. It they are not separated, this situation may cause spreading of infection.

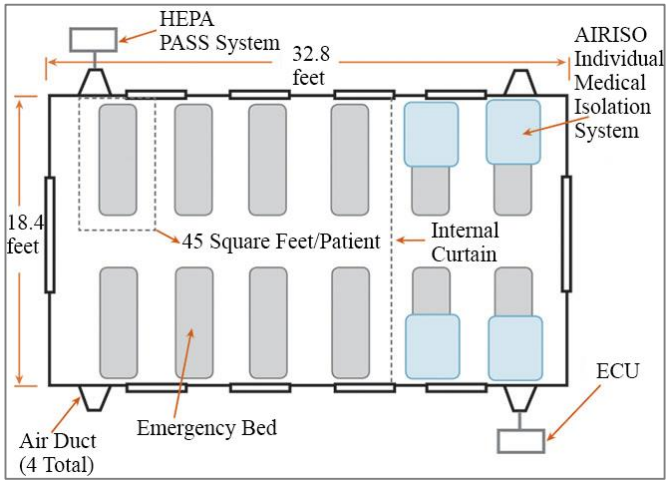


Figure 15. Layout of a module interior (Access Date 7th November 2020, Redrawn from info retrieved from http://www.evolvetechcorp.com/emergency-modular-hospital.aspx)

Figure 15 shows the placement of 12 beds in a module. It is seen that HEPA filter is next to the module, and UVC irradiation and automatic pressure control system are preferred in HVAC system. Isolation in modules is provided with the use of internal curtains. It is stated that the use of individual HEPA filtration enables to maximize bed space for shelters provided (Evolve Technologies Corporation, 2020).

3.1.4.Covid-19 Hospital Ship

Covid-19 Hospital Ship modular hospital is the other proposal against covid-19. Weston Williamson + Partners from UK proposed the use of ship as a modular hospital. In countries that do not have easy access to clean water, where hygiene and social distance are difficult to implement, such as Africa, India, it was thought that the use of the ship as a hospital would eliminate these problems (Iype, 2020).

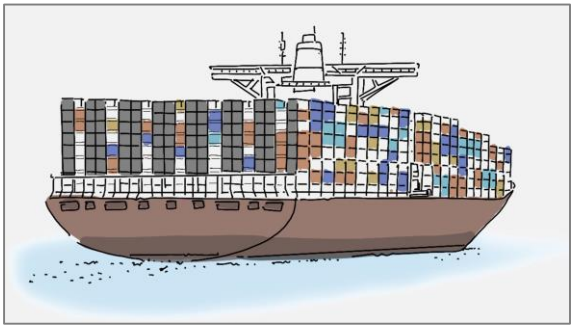




Figure 16 & 17. COVID–19 hospital ship design proposal (Access date 6th November 2020, Retrieved from https://www.stirworld.com/see-features-ready-to-sail-to-emergency-container-ship-hospitals-by-weston-williamson-partners)

Figure 16, 17, 18 & 19. show the design proposal for hospital ship. It is thought 2000 beds per ship. The use of lift/elevator between floors, and the use of crane use for easy construction of container modules are suggested. (Iype, 2020). It is seen that clean and dirty pathways for lift/elevator are not separated. If necessary precautions are not taken, spread of infection via these vertical circulation elements can not be prevented.

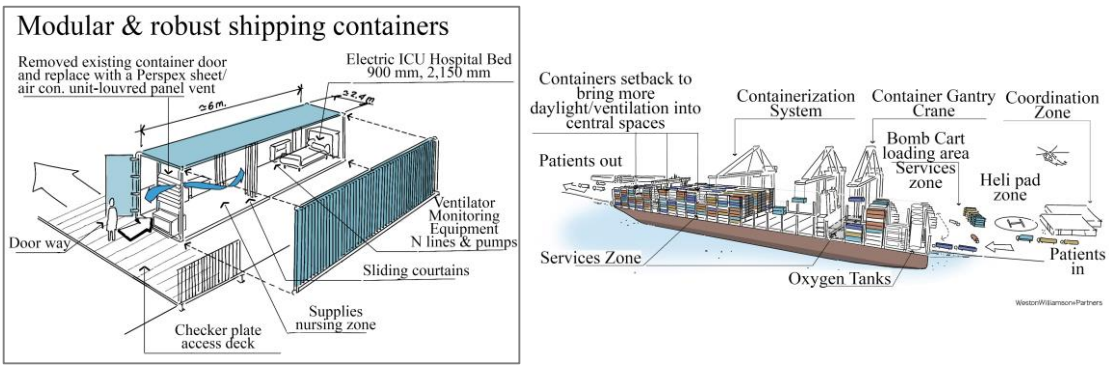


Figure 18 & 19. COVID–19 hospital ship design proposal (Access date 6th November 2020, Redrawn from info, Retrieved from https://www.stirworld.com/see-features-ready-to-sail-to-emergency-container-ship-hospitals-by-weston-williamson-partners)

It is understood from Figure 18 and 19 that the hospital ship is separated into zones. Containers are also separated as services zone and supplies nursing zone. Sliding curtains are used to separate. However, the use of air tight door rather than sliding curtains can be more sufficient to prevent infection.

According to the proposal, existing container door will be replaced with a perspex sheet, and air conditioning unit and louvered panel will be located (Iype, 2020). Air conditioning is placed to the ground. It is a more preferable approach to prevent spread of infection. Both natural ventilation and mechanical ventilation are taken into consideration. However, there is no information about filter type that can be used for modules.

3.2.Layout Created by Combining Modules That Have Common Filtration

In this section, combined modules with common filtration system are analyzed. Layouts of the module combinations are also part of the analysis and believe to lead us for future design/ planning alternatives. In this context, module layout, pathways, entrances, air filtration, filter type, location of filter system, pressure direction, ventilation isolation are analyzed for each hospital. Emergency Modular Hospital, Field Rescue Center and Mobile Modular Hospital are examined in detail, respectively.

3.2.1. Emergency Modular Hospital

MMW Architects designed the Emergency Modular Hospital to ensure protection against covid-19 in USA. This proposal is not only developed against pandemia, but also to provide effective layout. By means of horseshoe-shaped plan, patients can be directly transported into isolation. It is claimed that for any future crisis, the current layout is open to adaptation and different scenarios. The construction is made of recycled shipping-containers (steel) and inflatable fabrics for circulation areas in between in order to prevent air contamination (Architizer, 2020).

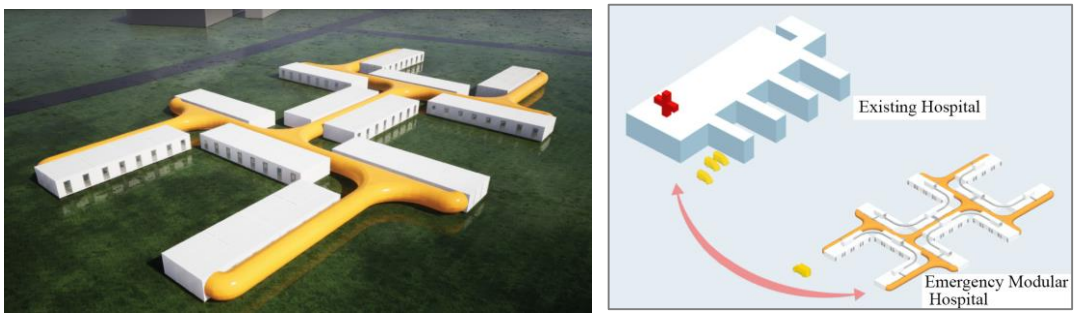


Figure 20 & 21. Emergency Modular Hospital
(Access date 6th November 2020, Redrawn from info
retrieved from https://architizer.com/projects/emergency-modular-hospital/)

Figure 20 and 21 show the exterior view of modular hospital. Emergency Modular Hospital is located to near of the existing hospital. Yellow areas defined in Figure 20 & 21 are the inflated corridor spaces between rooms and modules.

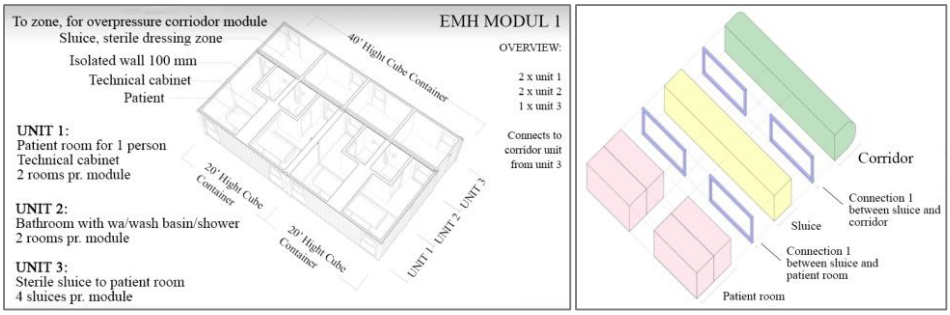


Figure 22. Axonometric view of module (Access date 6th November 2020, Redrawn from info, Retrieved from https://architizer.com/projects/emergency-modular-hospital/)
Figure 23. Shematic view of module (Access date 6th November 2020, Redrawn from info, Retrieved from https://architizer.com/projects/emergency-modular-hospital/)

Figure 22 and 23 give information about module layout. There is no information about separation of corridors as clean and dirty pathways, but there is a sluice zone between each patient room and corridor. It provides disposal of human waste, so the placement of sluice zone in modular hospital layout is a positive approach to prevent infection and this area can be stated as dirty/buffer zone before entering the clean corridor zone.

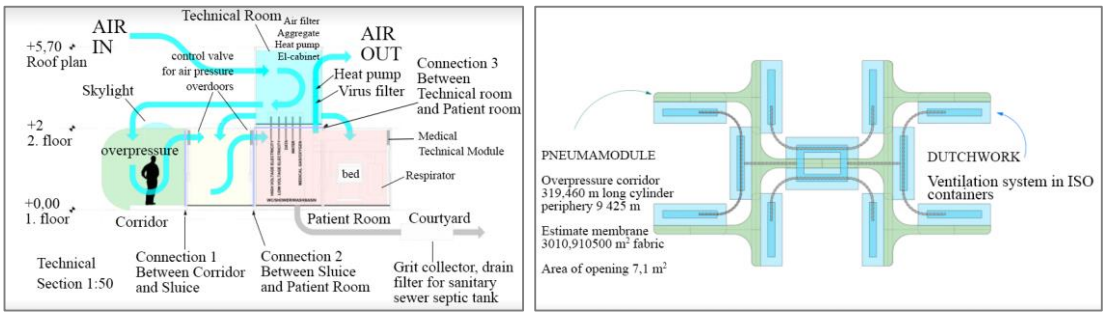


Figure 24. Technical section of the module (Access date 6th November 2020, Redrawn from info, Retrieved from https://architizer.com/projects/emergency-modular-hospital/)
Figure 25. Ventilation system of modules (Access date 6th November 2020, Redrawn from info, Retrieved from https://architizer.com/projects/emergency-modular-hospital/)

Figure 24 and 25 show the filtration and ventilation of modules. Because it is at the concept stage, there was no finding about the type of filtering. It is understood from Figure 24. that the filter is located on top of the module, and air inlet and outlet are placed at the ceiling level. However, it is stated that in order to prevent infection, the preference of low-level extraction is accepted better than ceiling level (Cheong & Phua, 2006).

According to Figure 25, in this horseshoe layout, the ventilation of each 3-module is combined in a single center, and thus center consists of 4 groups. Air get distributed throughout every module via dutchwork. Since Ductwork is a self-contained ventilation system, the ventilation entrances and exits must be controlled, otherwise it will be inevitable to cause the spread of the virus.

3.2.2.Field Rescure Center

Field Rescure Center is a proposal of HAHA Architects Group from Poland. This modular hospital is designed to be used during crisis such as epidemic, pandemic, natural disaster, refugee crisis etc. Figure 26 and 27 show the placement options of the Field Rescure Center. Thanks to the self- sustainability characteristic, modules can be built either next to the hospital, near or far from hospital. Besides, modules can be used as single or united (HAHA Architects Group, n.d.). It is built to provide operating rooms during emergency. Therefore, there is no defined quarantine zone for patients.

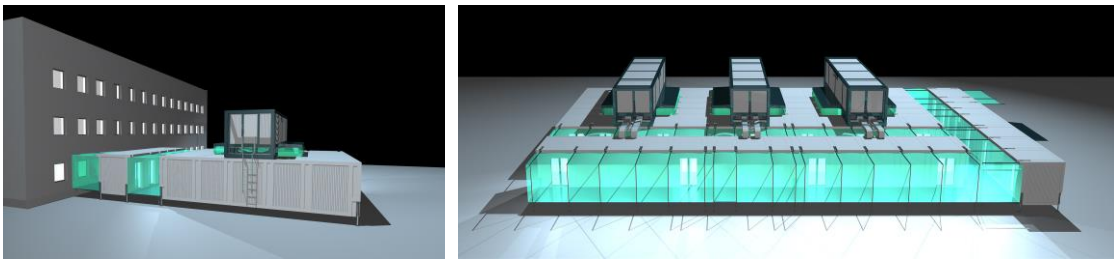


Figure 26 & 27. Field Rescure Center placement options (Access Date 8th November 2020, Retrieved from http://hahagroup.pl/Field-Rescue-Center.php)

Green ones refer to EPDM (Ethylene Propylene Diene Monomer) membrane structure. TEU containers are compound with membranes, and membranes are used through corridors. This area is believed to state as the clean operating zone and adjacent hospital is converted according to pandemic needs in this specific case.

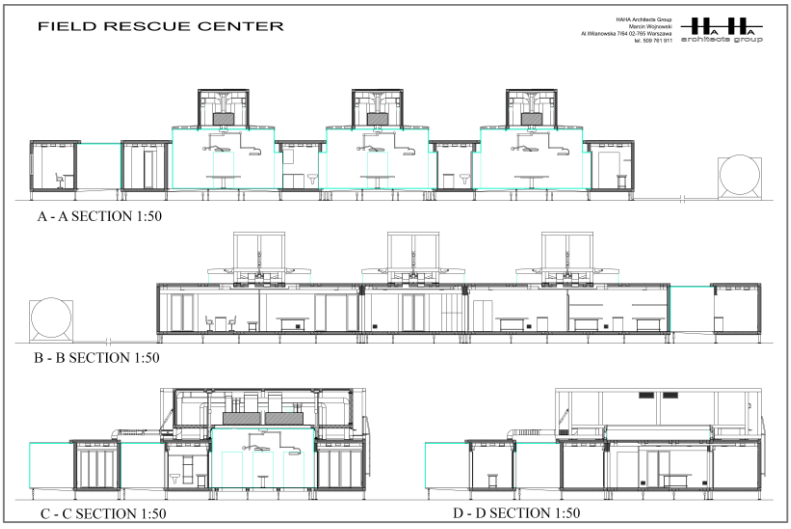


Figure 28. Field Rescure Center section drawings of modules (Access Date 8th November 2020, Redrawn from info retrieved from http://hahagroup.pl/Field-Rescue-Center.php)

Figure 28 shows the sections of modules and air conditionings. There is no given information about filter type and pressure direction. It is understood that inlet and outlets of mechanical systems are placed on top of the modules. HVAC units of each operating room are separated. This is a correct approach to prevent different infections.

3.2.3.Mobile Modular Hospital

Golden Hour MMH is a firm of Esthonia origin that produces modular hospitals according to needs. Birth, dental, surgical, gynecological, dermatological, general treatment are some function configurations that have defined for these modules previously. HEPA filters and the use of negative pressure modules are preferred for the hospital design adapted for Covid-19 (Golden Hour MMH, 2020). In order to prevent infection, this is the correct approach. However, there is no given information about interior materials of modules.





Figure 29 & 30. Mobile Modular Hospital exterior and interior view
(Access Date 7th November 2020, Retrieved from https://mmh.ee/)

Figure 29 and 30 show the exterior and interior view of mobile modular hospital. It is located as self-sufficient on the land.

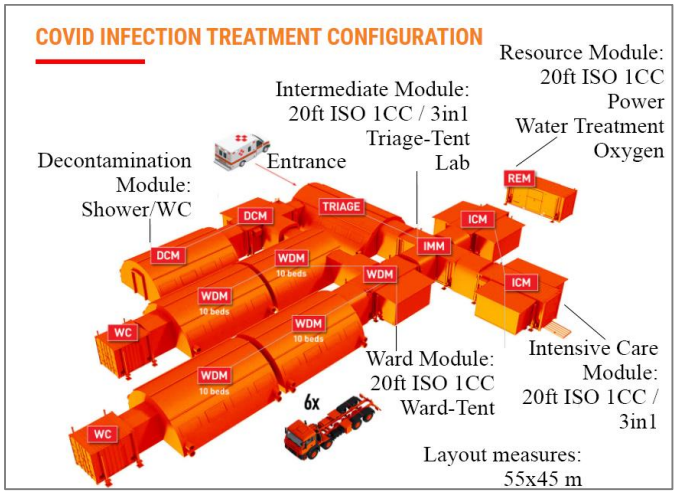


Figure 31. Covid infection treatment configuration
(Access Date 7th November 2020, Redrawn from info, Retrieved from https://mmh.ee/)

Figure 31 shows the defined configuration for treatment of covid infection. According to the configurations, it is understood that there are two main differences between other configurations and covid infection treatment configuration. These are the increased bed numbers and the use of DCM. DCM (Decontamination module) is only included in covid-19 infection mobile modular hospital. As can be seen from Figure 29 and 30, not all modules were given separate entrance. This can affect internal circulation and cause cross-infection. Intensive care modules have separate exit for patient loading. HEPA filter is included in operating room modules of the configurations (Golden Hour MMH, 2020), however there is no given information about whether it is in the decontamination module.

3.3. Self-standing Modules with Own Filtration

In this section, self-standing modules with own filtration system are analyzed. Layouts of the modules is part of the analysis and believe to lead us for future design/ planning alternatives. In this context, module layout, pathways, entrances, air filtration, filter type, location of filter system, pressure direction, ventilation isolation are analyzed for each hospital. Modular Hospital Ward Prototype and QurE Circular Negative Pressure Quarantine Unit are examined in detail, respectively.

3.3.1. Modular Hospital Ward Prototype

In order to control infection and provide treatment during pandemia, a firm of Taiwan origin Miniwiz proposed the use of Modular Hospital Ward Prototype and built its first module at Taipei Hospital. Miniwiz is a firm that aims to show how post-consumer waste could be recycled into useful products, so recycled materials such as aluminium panels, aluminium cans and polyethylene terephthalate (PET) are used in this hospital. Walls are made of recycled anti-viral and bacterial panels. With the help of the anti-bacterial coating that provides ultraviolet self-cleaning system, 99.9 percent of bacteria can be reduced. In addition, wall panels are designed with curved corners for easy cleaning (Ravenscroft, 2020).



Figure 32, 33 & 34. Modular Hospital Ward Prototype
(Access Date 7th November, Retrieved from https://www.dezeen.com/2020/06/04/miniwiz-taiwan-modular-hospital-ward/)

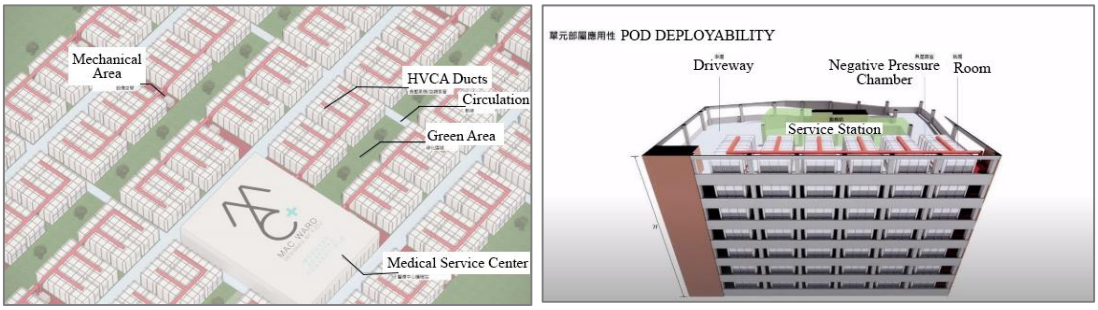


Figure 35 & 36. Open field or existing building options for modules
(Access Date 7th November, Redrawn from info, Retrieved from merxwire.com)

Figure 32, 33 & 34. show the module exterior and interior. Figure 35 & 36. show the options for modules placement. They can be built in an open land as in Figure 35. Or else, in part of an existing building as shown in Figure 36, at 7 stories parking tower. It is seen that there is no separation for clean and dirty pathways.

It is understood from figure 35, red lines refer to ducts for HVAC. Ducts are placed on top of the modules. Mechanical area is placed next to the modules, and according to Figure 33, each module has its own inlet mechanism placed at ceiling level and outlet mechanism placed at ground level. It is a correct approach to prevent infection among modules. However, there is no given information about preferred filter type. Besides, it is stated that negative pressure is preferred to prevent spread of virus (Ravenscroft, 2020). All decisions given for this specific design example given about cleaning and ventilation are contemplated to prevent infection.

3.3.2. QurE Circular Negative Pressure Quarantine Unit

Bio-architecture Formosana (BAF) is a firm of Taiwan origin proposed an emergency quarantine hospital for covid-19 pandemia in cooperation with National Cheng Kung University (NCKU). It is easy to install, and the unit is protective against cross-infection between patients (National Cheng Kung University, 2020).



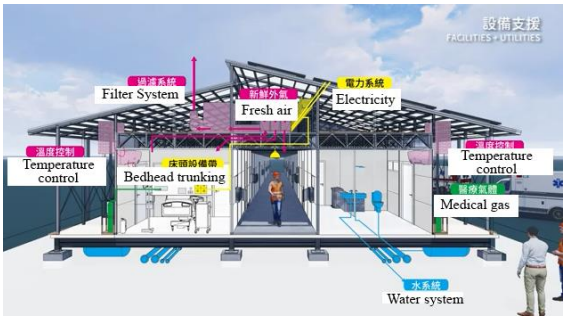


Figure 37 & 38. Covid-19 prototype of emergency quarantine hospital (Access Date 8th November 2020, Redrawn from info retrieved from https://web.ncku.edu.tw/p/406-1000-206984,r2845.php?Lang=en)

Figure 37 shows the built unit, and Figure 38 shows the mechanical system of the unit. It is seen that there is an open-sided corridor between wards. The corridor in the center is defined as a clean pathway and the two sides as a dirty pathway. It is a correct approach to prevent infection.

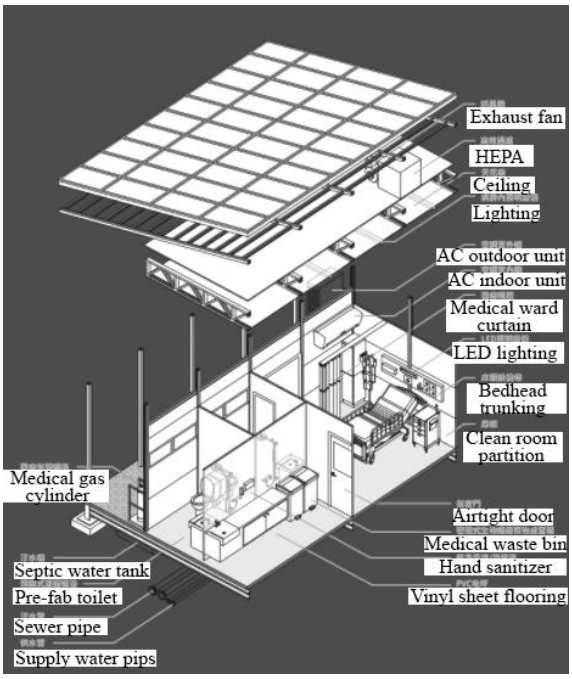


Figure 39. Structure of Circular Negative Pressure Quarantine Unit (Access Date 8th November 2020, Redrawn from info retrieved from https://web.ncku.edu.tw/p/406-1000-206984,r2845.php?Lang=en)

Figure 39 shows the exploded version of the unit's one side. Solar panel system is used to generate own energy for electricity. Vinyl sheet is preferred for flooring and steel for the structure (National Cheng Kung University, 2020). There is no given more information about interior materials and their cleansability. As is understood from Figure 38, airtight door is preferred, and HEPA filter is preferred for filtration and located on top of the module. These are important precautions to prevent infection.

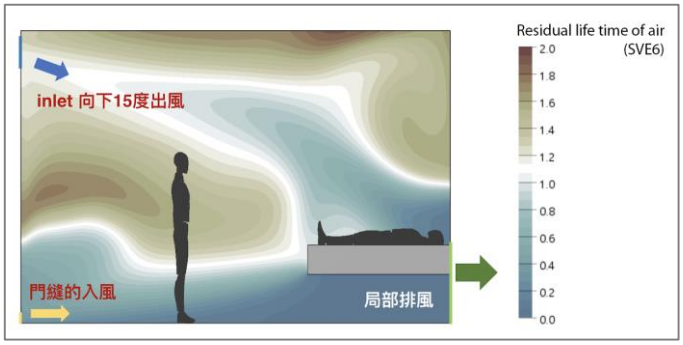


Figure 40. Air flow in the module (Access Date 8th November 2020, Redrawn from info retrieved from https://qure.gs.ncku.edu.tw/facilities/air-flow-analysis)

As the low-level extraction is strongly suggested to prevent infection (Cheong & Phua, 2006), Figure 40 shows that the module has its inlet mechanism at ceiling level and the outlet mechanism placed at ground level, and it is supported with laminar flow. However, there is an important issue that needs to be discussed is the use of the AC unit -probably added for cooling purposes only- in such indoor spaces, which are designed to prevent the spread of virus is problematic.

4.DISCUSSION

In this study, 9 modular hospitals in total are examined, and their pros and cons related with the intend to prevent infection are determined. Since these hospitals were designed against covid-19 pandemia, their features must meet the guidelines for infection control. In this context, design of edges and corners, suitability of surfaces for easy cleaning, determination of dirty and clean pathways, safety patient flow, spatial layout in hospital interiors, the distance between patient room and nurse station, filter type , filtration system and pressure direction were evaluated.

According to the results, only 1 of 9 (Modular Hospital Ward Prototype) has curved edges and corners in module interior, and 1 of 9 (Emergency Modular Hospital) has curved corridors. It might cause difficulty in cleaning of infectious interiors. Eventhough the use of curved surfaces is suggested for hospital environments (Spagnolo et al., 2013), this suggestion had not been considered for other proposals that have hard edges and corners. This may be related with use of previously defined modules or containers in various cases for fast resolving actions taken under pandemic conditions.

Only 1 of 9 (Modular Hospital Ward Prototype) stated that anti-viral and bacterial materials, and self cleaning materials' system are preferred. It is a favorable approach against infection. However, there is no found information about the use of such materials in other hospital proposals.

Most of the hospitals, 6 of 9 were derived from containers, 1 of 9 (Modular Hospital Ward Prototype) is made of recycled aluminium panels, 1 of 9 is made of fabric, and there is no information about structural materials of STAAT Mod Units.

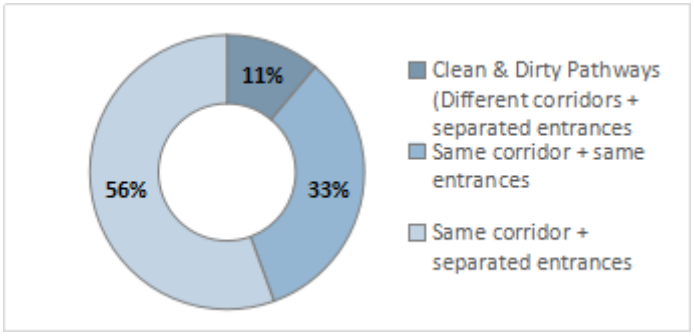


Figure 41. Layout types of the modular hospitals

Figure 41 shows the layout types in terms of corridors and entrances of the modular hospitals. 2 of 9 (STAAT Mod Units, Emergency Modular Hospital) have horseshoe-shaped plan. The preference of this layout type can provide protection against infection thanks to the separated entrances. Including them totally 5 of 9 hospitals (56%) use same corridor and have separated entrances. While 3 of 9 use same corridor and entrance, only 1 of 9 (QurE Circular Negative Pressure Quarantine Unit) prefers dividing coridors as clean and dirty pathways. Others (STAAT Mod Units, Mobile Modular Hospital, CURA Pods, Losberger Emergency Modular Hospital System, Emergency Modular Hospital, Field Rescure Center, Modular Hospital Ward Prototype, and Covid-19 Hospital Ship) do not have separated clean and dirty pathways. This might cause spreading of infection and affect treatment process negatively. However, it must not be ignored that the STAAT Mod Units' corridors are used by only healthcare workers, and both STAAT Mod Units and Emergency Modular Hospitals give entrance to patient rooms from outside for patients.

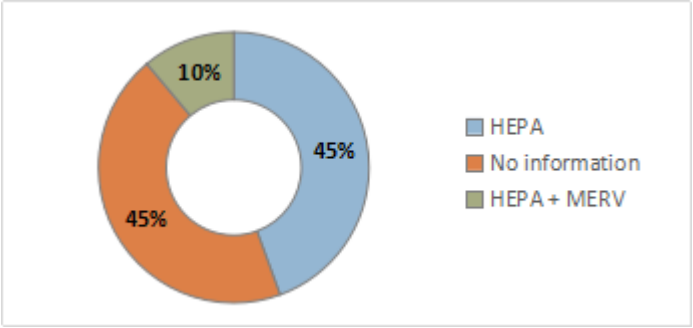


Figure 42. Percentage of preferred filter types

Figure 42 shows the percentage of filter types preferred for the modular hospitals. 4 of 9 proposals (Mobile Modular Hospital, CURA Pods, QurE Circular Negative Pressure Quarantine Unit, Losberger Emergency Modular Hospital System) stated that they prefer HEPA filter, 1 of 9 (STAAT Mod Units) stated that they prefer doubled filtered system (HEPA and MERV). 4 of 9 (Modular hospital ward prototype, Emergency Modular Hospital, Covid-19 Hospital Ship, Field Rescue Center) have not given any information about filter type. As is mentioned in literature review, HEPA filters and MERV 8, MERV 14 and MERV 17 are recommended filters by ASHRAE (Salonen et al., 2013). It can be inferred that 55% of proposals are complied with this criteria and they consider ASHRAE Standards. In addition, while all proposals have mechanical ventilation system, only 1 of 9 considers both mechanical and natural ventilation. The reason might be that natural ventilation does not allow negative pressure, as WHO stated (WHO 2009 as cited in Salonen et al., 2013). Since some proposals are not at the stage of being constructed filter needs my not be designed yet.

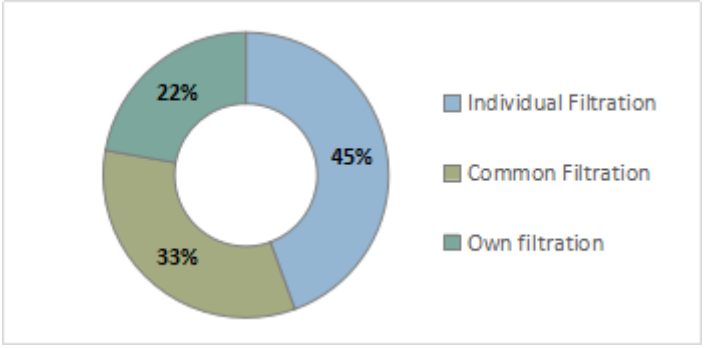


Figure 43. Filtration type of modular hospitals

Figure 43 shows the preferred filtration types of modules. The most preferred type (45%) is individual filtration. While 4 of 9 hospitals use individual filtration in layout created by combining modules, 3 of 9 use common filtration. Besides, 2 of 9 which are defined as self-standing modules use their own filtration. The use of common filtration may cause spread of virus if not well controlled with filters and right pressurization –negative pressurization of patient rooms and other infectious risk spaces. Therefore, preferring separated filtration for both -layout created by combining modules- and -self standing modules- is important to prevent infection.

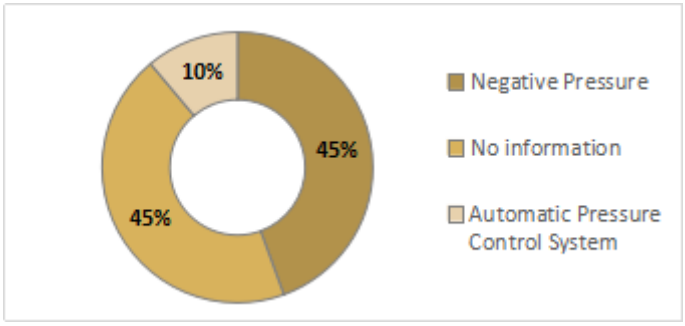


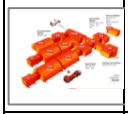
Figure 44. Pressure directions

Figure 44 shows the preferred pressure types. WHO strongly suggests the use of negative pressure in isolation areas (Salonen et al., 2013). 4 of 9 hospitals prefer the use of negative pressure, 1 of 9 prefer automatic pressure control system, while 4 of 9 do not give any information about pressure direction. 8 of 9 examples consider the requirement of negative pressure needs within infection control modular hospital designs.

Preferring low-level extraction is suggested rather than ceiling level (Cheong & Phua, 2006), and it is clearly understood that only 3 of 9 proposals –STAAT Mod Units by HGA-, -Emergency Modular Hospital designed by MMW Architects-, and –Modular Hospital Ward type by Miniwiz Architects- takes into consideration the low-level extraction.

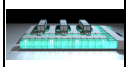
Table 1. shows the all examined modular hospital proposals and the features of their filtration system. Some modules have been built and used during covid-19 pandemia (STAAT Mod Units, Mobile Modular Hospital, CURA Pods, Modular hospital ward prototype, QurE Circular Negative Pressure Quarantine, Losberger Emergency Modular Hospital System) while others have remained just proposals (Emergency Modular Hospital, Covid-19 Hospital Ship, Field Rescue Center). Implemented proposals enable to have more information and concrete evidence about the systems integration.

Table 1. Characterization of the modules

Image	Project	Designer	Built	Origin	Module Location	Module Material	Filter Type	Filter Location	Pressure Direction	Ventilation Type	Ventilation Isolation
	STAAT Mod Units	HGA	✓	USA	Near or far from hospital	No information	MERV and HEPA	No information	Negative pressure	MV	Individual Filtration
	Mobile Modular Hospital	Golden Hour MMH	✓	Esthonia	Open field	Containers	HEPA	In a separated module	Negative pressure	MV	Common filtration
	CURA Pods	Carlo Ratti and Italo Rota	✓	Italy	Near or far from hospital	Shipping containers	HEPA	Embedded to the pod's wall	Negative pressure	MV	Individual Filtration
	Modular hospital ward prototype	Miniwiz	✓	Taiwan	Inside existing buildings or on land adjacent to hospitals	PET wallpanels, nano coated with recycled aluminum panels	No information	Next to the module	Negative pressure	MV	Own Filtration
	QurE Circular Negative Pressure Quarantine Unit	Bio-architecture Formosana (BaF)	✓	Taiwan	Open field	Container, Vinyl sheet flooring, steel	HEPA	Top of the module	No information	MV	Own Filtration

MV: Mechanical Ventilation, NV: Natural Ventilation

Table 1. Characterization of the modules (continued)

Image	Project	Designer	Built	Origin	Module Location	Module Material	Filter Type	Filter Location	Pressure Direction	Ventilation Type	Ventilation Isolation
	Losberger Emergency Modular Hospital System	Evolve Emergency & Losberger de Boer	✓	USA	Open field	PVC coated fabric	HEPA	Next to the module	Automatic pressure control system	MV	Individual Filtration
	Emergency Modular Hospital	Mmw Architect	X	USA	Near the hospital, on the same field	Recycled shipping-containers (steel), inflatable fabric	No information	On top of the module	No information	MV	Common filtration
	Covid-19 Hospital Ship	Weston Williamson + Partners	X	UK	Ship	Shipping containers, Perspex	No information	Next to the module	No information	MV & NV	Individual Filtration
	Field Rescue Center	HAHA Architects Group	X	Poland	Next to the hospital, near or far from hospital	TEU containers, Epdm membrane	No information	Top of the module	No information	MV	Common filtration

MV: Mechanical Ventilation, NV: Natural Ventilation

5.CONCLUSION

Covid-19 is a kind of pandemia that infects through air and affects human health, community psychology and the country economy in global scale. Therefore, in order to tackle this pandemia and improve the treatment process, hospital and ward design gain prominence around the world. In order to win this battle against infection in this process, while some hospitals suitable for conversion are transformed into pandemic hospitals, for the others which are not be suitable for transformation, the use of modular hospital systems are proposed to extend capacity of hospitals. Also for preventing the spread of virus in dense urban areas planning of off-city areas for pandemic health care facilities is recognized as a right alternative. In example Staat Mod Units, CURA Pods and Field Rescue Center, we can see the options of off-site planning of alternative solution. These hospitals are designed for two conditions: Adjacent to building and self-standing, as is seen in Figure 45 and 46. To build adjacent building, transition space / buffer zone can be located between existing building and modular hospitals. It provides both separation and controlled connection option. When hospitals are inadequate, modular hospitals can be banded to the existing building so that they can be used to treat patients during pandemia by taking advantage of the hospitals' facilities as in Figure 45, or else modular hospitals can be built as self-standing on any land as is illustrated in Figure 46.

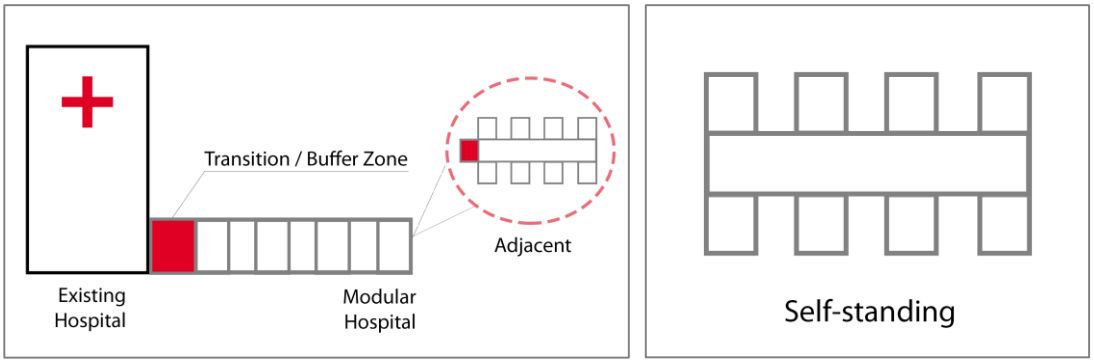


Figure 45. The proposal to use modular hospitals as adjacent building

Figure 46. Self-standing layout for modular hospitals

Since examination of modular hospitals can give us a direction to build proper hospitals during pandemia, this study focuses on figuring out modular hospital systems and whether they are designed in accordance with general standards. For this purpose, 9 different proposals from all around the world were examined. The coherence of their air control design with architectural design were evaluated by taking into consideration the set standards in literature and new COVID-19 related suggestions by mechanical and architectural specialists.

As a result of a detailed examiation, it is inferred that some proposals believed to show deficiencies to prevent infection while some of them conform to guidelines. Layout arrangements, filtration preferences and surfaces applications defined for these modular hospitals are gathered as considered recommendations to prevent infection. These suggestions can be accepted as recommendatory for future designs.

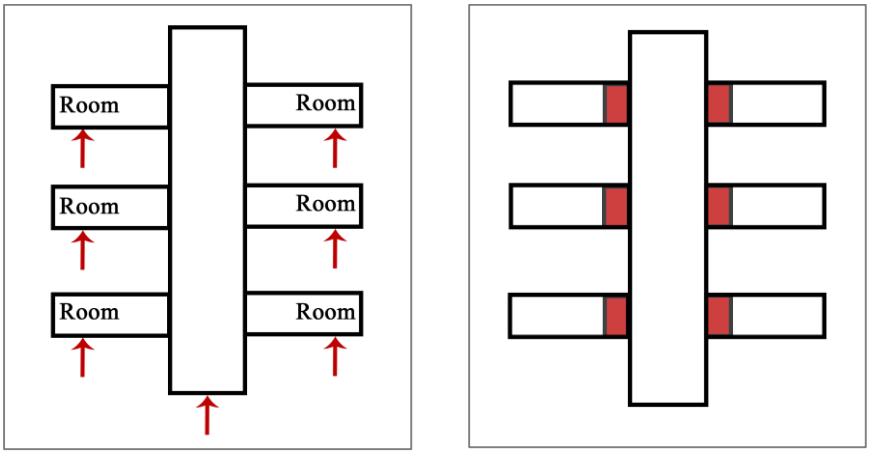


Figure 47. Own entrance for each module
Figure 48. Buffer zone (Sluice) for each module

As is seen in Figure 47, to provide safety in patient flow (Spagnolo et al., 2013) and worker flow, a different entrance can be given for each module of modular hospitals. It provides both openings to outside and reduces of encountering. In order to prevent virus transmission, this layout can be implemented. The mid circulation area / corridor can be kept patient and infection free under these conditions.

Figure 48 shows a buffer zone (sluice) proposal for modular hospitals. Before entering the patient's room and after leaving, the disposal zone is a need to prevent infection. Since it is suggested to separate zones as clean, buffer and dirty (Gupta et al., 2005; Zhang et al., 2020), this layout can be implemented.

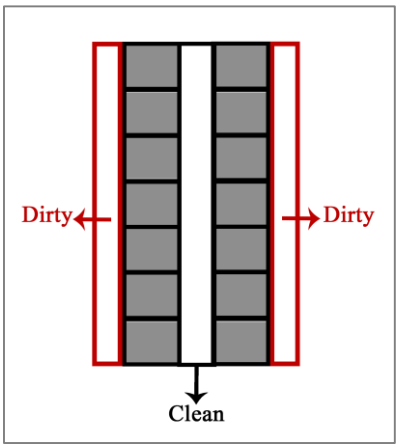


Figure 49. Clean and dirty pathways for modular hospital (By Author, 2020)

Figure 49 shows a proposal to separate pathways in modular hospitals. It is recommended to separate pathways as dirty and clean pathways in hospitals (Spagnolo et al., 2013) in order to prevent virus transmission in cases, where patients use the circulation areas for reaching various parts of the hospital for treatment. Gray ones refer to patient rooms. To each patient room, two different entrances can be given, one opening to a clean and the other to a dirty pathway so that prevent infection among healthcare workers.

As a result of the study, it is clearly understood that filtration system has great importance to protect people from infection. Unfortunately, as in 45% of analyzed modular hospitals, information is not given dabout proper filtration system. To give individual filtration for layout created by combining modules, and to give own filtration for self-standing modules must be considered. In addition to chose HEPA in inlet / MERV filters in outlet for hospital environments (ASHRAE 2003b as cited in Salonen et al., 2013), the importance of providing low- level extraction / air outlet (Nielsen et al., 2010) which is better than ceiling level (Cheong, & Phua, 2006) is overemphasized. However, the required importance for low-level extraction has not be given to some hospital proposals. Air outlet must not be located at the ceiling level for effective removal of pollutant in the rooms of a hospital.

Besides, it is suggested to minimize edges and corners to provide easily cleansable surfaces and areas (Spagnolo et al., 2013). However, most of the analyzed modular hospitals (67%) derived from ready set containers. Therefore, to provide curved edges and corners might be challenging for such cases. Curved inner coating may be recommended for such modules. For modules that will be produced by using aluminum panels instead of containers, easy-to-clean curved surfaces can be taken into consideration in the early design stage.

As the problems experienced in the pandemic process affect psychology, economy and human health, it is aimed to get rid of this process with minimal damage. By conisdering these recommendations, modular hospitals suitable to use for pandemia process can be designed faster. For future studies, applicable scenarios can be generated for hospital transformations and pandemic hospital designs to enable better coping with unpredictable disasters.

5.ACKNOWLEDGEMENTS

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Who is Living Next Door? The Perception and Attitude Towards Each other: Turkish Citizens and Syrian Refugees in Konak, İzmir

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ABSTRACT

This study is a part of a conjoint research funded by Turkish Scientific and Research Council 1003 Prioritized Fields and R&D Projects Programme; entitled "A New Perspective on the Processes of Adaptation and Integration of Urban Refugees: A Social Innovation Experiment Aimed at Building Inclusive Cities", coded 117K826 (main project and two sub projects coded 117K805 and 117K829). The conjoint study is conducted in three cities -İstanbul, Hatay and İzmir- offering different characteristics as host cities in Turkey with a vast number of emigrants.

In this paper, we will discuss findings of İzmir case. We aim to discover and discuss the general perception and attitudes of "the new neighbors" through statistical findings that the questionnaires and interviews provide. We discuss living together experiences, attitude and perception of urban refugees and Turkish citizens living in the same neighborhood. Our findings briefly show that both groups are urban poor and have similar roots, native language, and cultural habits. In some cases, they are relatives by affinity. However, the attitude towards each other does not reflect their similarities. Main reasons lying behind this perception and attitude are labor market relations, attitude of the government.

Keywords: Migration, Syrian Refugees, Perception and Attitude, Neighborhoods of Migrant Populations, İzmir

1. INTRODUCTION

More than 22 millions of refugees have been putting effort to be included in labour market in mostly developing countries more than a decade and this population makes 85% of total refugees in the world (UNHCR, 2017). Huang and Graham (2018) state that there is an overlapping relation between employment opportunities and metropolitan areas and cities for refugees. Since 2011, Turkey has been a host country to those who seek asylum and migrated from Syria. According to World Migration Report (IOM, 2017), affection level of global flow of migration is higher for urban areas. With Open Door Policy on Turkey's side, a lot of Turkish cities began hosting Syrians, and Turkey became the most populated Syrian Emigrant country in the World. According to Directorate General of Migration Management latest stats of November 2020, there are 3.365.410 Syrians under temporary protection in dispersed throughout the provinces of Turkey.

It has been 9 years since the first refugees entered the country, and the host cities have become new hometowns to those asylum seekers. The host is no more a host and the guest are no more guests, but citizens of those cities; and therefore, they are our neighbors now and since then, İzmir transformed from a «transit city» to a host city. Special issue of HABITAT III of which theme is "Migration and Refugees in Urban Areas" (2015) emphasize agglomeration of refugees who are exposed to forced migration in urban areas in developing countries. However, the same issue show that these countries run general and local policies, integration and inclusion practice on empty.

This study is a part of a conjoint research funded by Turkish Scientific and Research Council 1003 Prioritized Fields and R&D Projects Programme; entitled "A New Perspective on the Processes of Adaptation and Integration of Urban Refugees: A Social Innovation Experiment Aimed at Building Inclusive Cities", coded 117K826 (main project and two sub projects coded 117K805 and 117K829). In short, the Project was named as POT-A, meaning "Pot of Acculturation". Acculturation is a process of living together as well as bringing the cultures of different backgrounds in all one place into one pot: hence the name POT-A.

This study has simultaneously been conducted in 3 different cities as they are auld migrant cities: Izmir, Istanbul and Hatay. The study narrates Izmir Experience on how neighbors perceive each other, attitude towards each other and how they define problems and potentials for a "living together" practive. The results of our research depend primarily on field work which is composed of questionnaires conducted with Turkish citizens and in-depth interviews conducted with refugees. The study involves household population living in a ten-neighborhood area located in central area of Basmane, İzmir.

2. METHOD

The method of the study encompasses ethnographic methods. Questionnaires -with Turkish citizens-, and in-depth interviews-with urban refugees- that live in the same neighborhood in İzmir, Konak County were conducted. The questionnaires and interviews were held within the same neighborhoods that the Syrian refugees were densely situated. Therefore, 10 neighborhoods were chosen as the research site in Konak County according to 2017 statistics of Directorate General of Migration Management. Furthermore, data through interviews with government officers, mukhtars and NGO representatives were collected. A focus group meeting with participation of 36 participants from 24 different local institutions, international institutions, NGOs and local government officers was also documented.

Among these data sources, a total sum of 231 questionnaires with Turkish citizens and 60 in-depth interviews with emigrants of mostly Syrian Refugee and Asylum Seekers were conducted with a method of geographical weighted sampling. The questionnaires consisted of households and workplaces, while the in-depth interviews are carried out with the household members. The household questionnaire consisted of eleven sections of total 52 questions which are General Profile, Living Conditions and spatial preferences, Labor market, Safety, perception and values, rights and protection, social rights, education and health, daily life and integration including living together and public exclusion, migration and reactions to migration policies, and participation preferences to attend a living together experience. In-depth interviews were consisting of six main thematic frames such as General Profile, Migration Story, Labor Market, Urban Relations, Access to public services and preferences to participate to Living Lab.

Table 1. Distribution of Syrians Under Temporary Protection in İzmir Counties

County	Registered to Temporary Protection[4]	Population[6]	County	Registered to Temporary Protection [4]	Population [6]
İzmir	138.742	4.279.677	Tire	445	83.829
Konak	32.718	363.181	Ödemiş	328	132.241
Karabağlar	28.131	480.790	Çeşme	315	41.278
Bornova	24.716	442.839	Aliağa	307	94.070
Buca	13.250	492.252	Karaburun	252	9.812
Torbalı	9.314	172.359	Dikili	189	41.697
Bayraklı	7.754	314.402	Urla	151	64.895
Menemen	2.049	170.090	Bergama	143	102.961
Menderes	1.803	89.777	Selçuk	143	35.991
Gaziemir	1.555	136.273	Narlıdere	140	66.269
Kemalpaşa	1.482	105.506	Kınık	72	28.271
Çiğli	1.344	190.607	Balçova	65	78.442
Karşıyaka	971	342.062	Kiraz	48	43.859
Bayındır	624	40.258	Beydağ	30	12.391
Seferihisar	616	40.785	Güzelbahçe	15	31.429
Foça	544	31.061	Not known	9.228	

Source: 4] Republic of Turkey, Ministry of Interior, Directorate General of Migration Management Access: (08.2018); İzmir Governor's Office Official Website, İzmir in Statistics, Access: 16.08.2018.

The questionnaires and interviews were held within the same neighborhoods that the Syrian refugees were densely situated. Although the Syrians refugees were dispersed all through different counties of İzmir, the majority of urban refugees in İzmir are living at the historical city center. Therefore, 10 neighborhoods were chosen as the research site in İzmir, Konak county in the district called Basmane by the locals can be followed by the map.

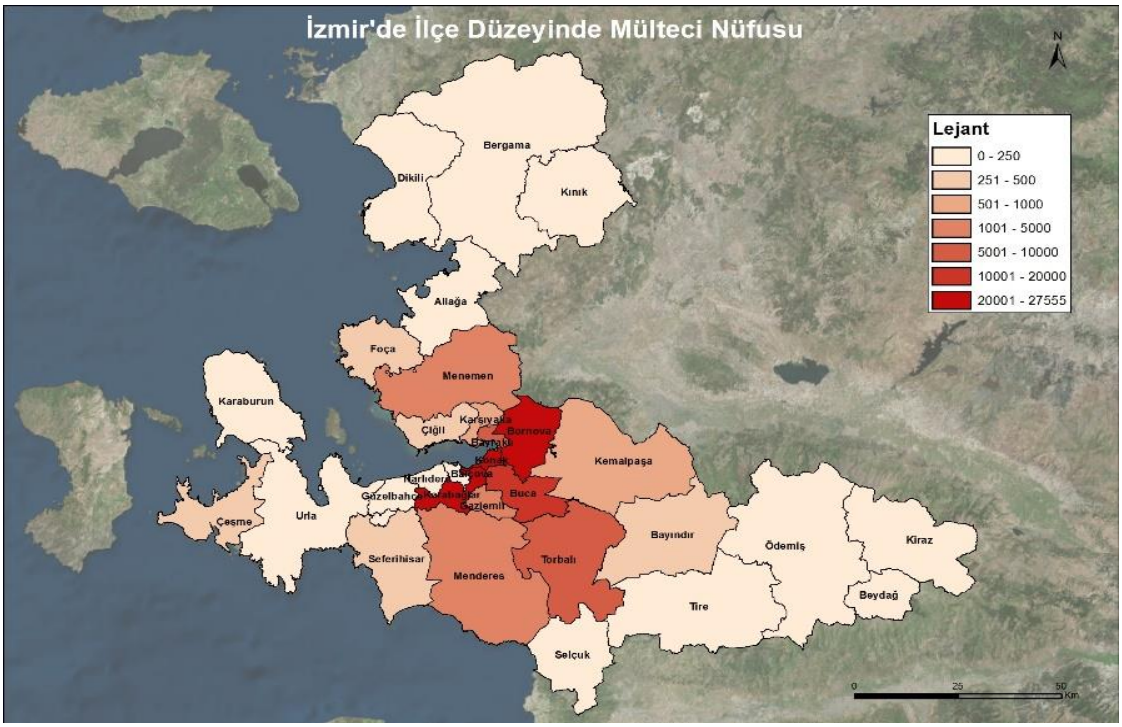


Figure 1. Map of Distribution of Syrians Under Temporary Protection in İzmir Counties

3. THE SITE STUDY AT BASMANE

Since the ancient times, Basmane is a district of hosting communities of different ethnicities. Basmane provides the ancient gate to the city and the visitors and/or travelers used to enter İzmir from this district. It even has a district named "Kapılar", meaning literally "Gates" at the site. The district is located at the historical city center of İzmir and located near ancient city Gates, close to the amenities, the port and local bazaar. It also offers cheap places to stay or rent as the urban poor are also living densely at the site. Therefore, the locals of the districts are Turkish citizens as well as the urban refugees.

The profile of the host community is mostly consisting of people from the southwest of Turkey that emigrated more than 30 years ago because of mandatory village evictions and due to terrorist attacks. So, the host community profile is the people who were forced to migrate and their 2nd and third generations. Although the research was not limited to Syrians, at the time study was conducted, the majority of the new-comers and willing to participate (especially for further collaborations to form a "living together experience") in the study was mostly consisted of Syrian refugees. Furthermore, the so called "host" and "guest" community had similarities. Findings briefly show that both groups are urban poor and have similar roots, native language, and cultural habits. In some cases, they are relatives by affinity. Space which two groups most come together, or encounter is neighborhood or street. However, the attitude towards each other does not reflect their similarities. Especially challenges faced in labour market cause opposition for newcomers.

4. GENERAL PERCEPTION AND ATTITUDES OF "HOST COMMUNITY" AND "THE NEW NEIGHBORS"

The primary aim of the conjoint project was achieving inclusive cities which works both ways rather than an integration and adaptation process. In this part of the study, the general perception and attitudes of "the new neighbors" will be revealed through statistics that the questionnaires and interviews provide against refugees and vice-versa. As mentioned before, a total sum of 231 questionnaires with Turkish citizens and 60 in-depth interviews with emigrants of mostly Syrian Refugee and Asylum Seekers were conducted.

The household questionnaire consisted of eleven sections while in-depth interviews were composed of six main thematic frames. In this study, the evaluation will be composed of six themes of; General Profile, Living Conditions, Community and urban Life, Access to Public Services, Labour Market, Safety, and Problems and Expectations.

To find out about the perceptions of host community, they were asked "who are the refugees?". The majority of the interviewees (170 people) defined refugees as "Syrians". Just a few people mentioned other ethnicities such as Afghans (16), Blacks (5), Iraqis (4), Africans (3), Somalians (2), etc.

4.1 General Profile

Since the ancient times, Basmane is a district of hosting communities of different ethnicities. The profile of the host community is mostly consisting of people from the southwest of Turkey that emigrated more than 30 years ago because of mandatory village evictions and due to terrorist attacks. So, the host community profile is the people who were forced to migrate and their second and third generations.

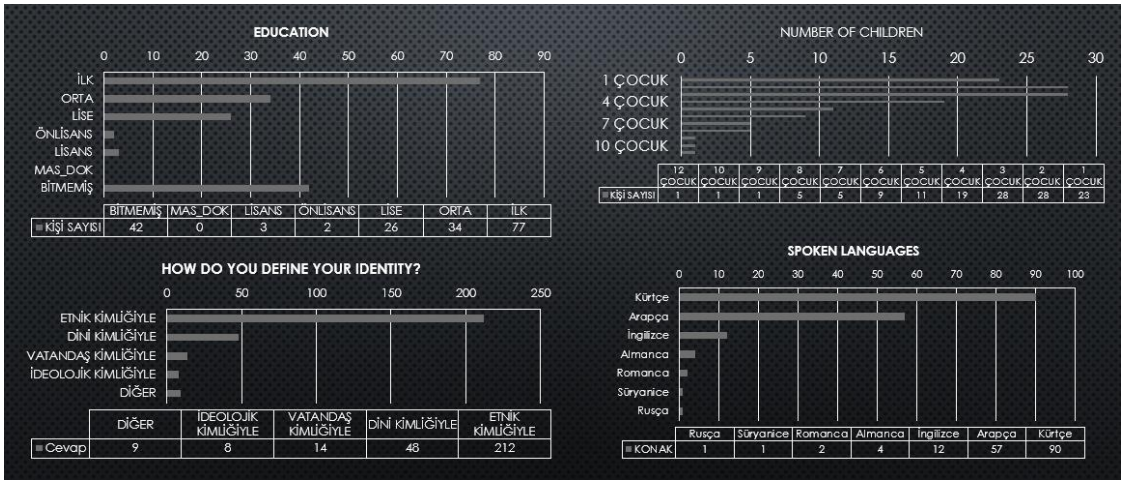


Figure 2. Profile of Host Community

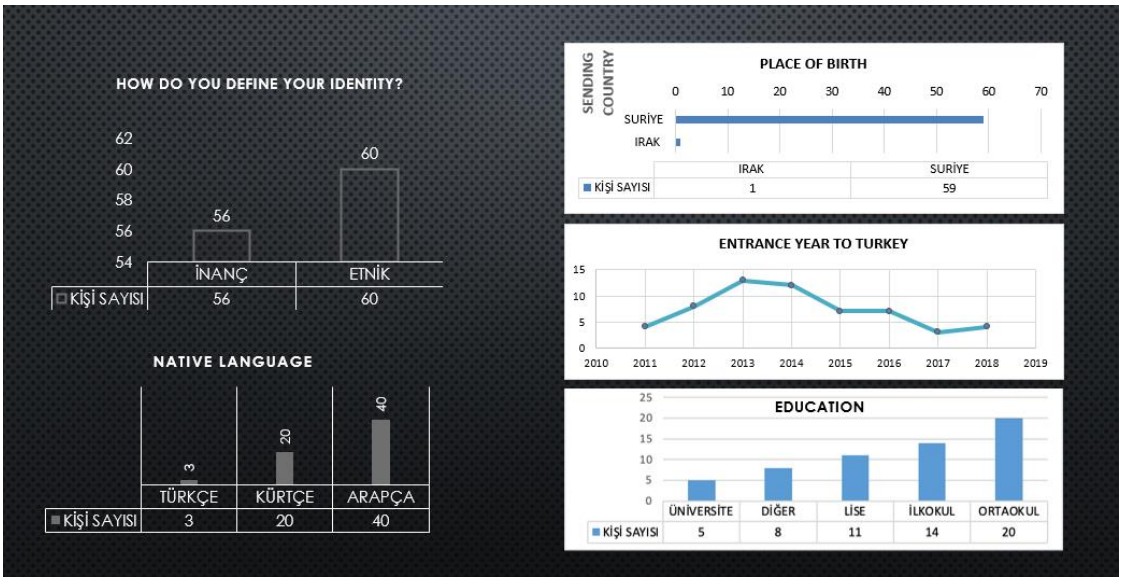


Figure 3. Profile of Urban Refugees

In terms of geographical distribution according to their migration profiles, both communities came from nearby areas. Also, the spoken languages are mostly Kurdish and Arabic other than Turkish. This is an important finding since it shows that they are able to communicate with neighbors in terms of either native or the spoken languages.
The host community are mostly undereducated or without a university degree with big families while the urban refugees' education profile is slightly better and they both define themselves mostly with their ethnic background.

4.2 Urban Conditions, Community and Urban Life

As the research findings of UNESCO that is conducted in 20 cities in Europe show the most critical difficulties emerging with arrival of migrants and refugees to cities are housing, education and employment (UNESCO, 2016). To provide support for these difficulties, accompany of a relative or a friend is an essential role for the urban refugees in choosing a city for settling and İzmir is no exception. As for the neighborhoods, the existence of job opportunities and low rents are the key points. Although half of the interviewees admitted to migrating to another place, whether it would be European Union or another city, they also consider investing in a job opportunity if they have the means to do so and majority wants their children to stay in İzmir.

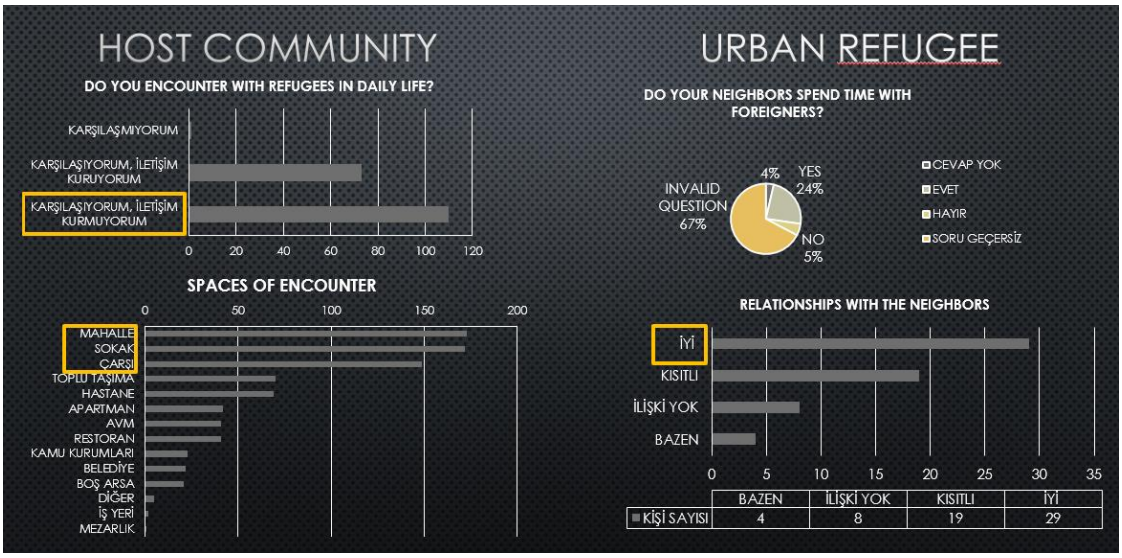


Figure 4. Daily Life Routines and Encounters

When asked about the daily life routines and encounters with each other, most of them do not communicate with each other although they live side by side in their neighborhoods. But when they do, they are in good terms with each other.

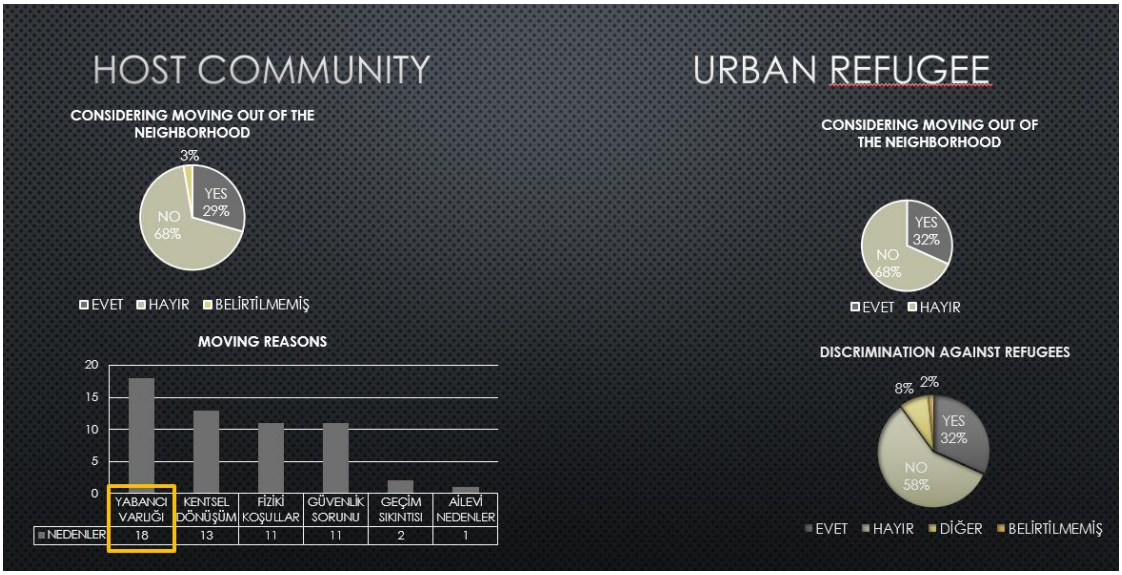


Figure 5. Housing Issues

This topic is an essential part of the study. The concept of inclusiveness and living lab experiences are to create a "living together experience" in forming bond between the host community and the urban refugees. Their daily practices give important clues about their perceptions and attitutes towards their neighbors. Most of the urban refugees have trouble in finding decent rental houses at reasonable prices since more than 60% of the landlords do not want Syrians as their renters. On the other hand, urban refugees don't want to move either and 68% said they didn't face discrimination from their neighbors.

Since the host community has been living in the area for more than 3 decades, they do not want to move to another neighborhood and the main reason for moving out is the very presence of urban refugees. On the other hand, urban refugees don't want to move either and 68% said they didn't face discrimination from their neighbors.

4.3 Labour Market

Access to labour market for urban refugees is a hard task since the host community is reluctant on the policy of whether working permit should be provided. The host community declares that since the urban refugees arrive, the economy is in downfall and joblessness increased. On the other hand one of the reasons for settling in Basmane is the opportunities in finding jobs and access to labour markets. Although the host community seems to be a little on the negative side about working permits, it is hopeful to a good amount of people are on the positive side.

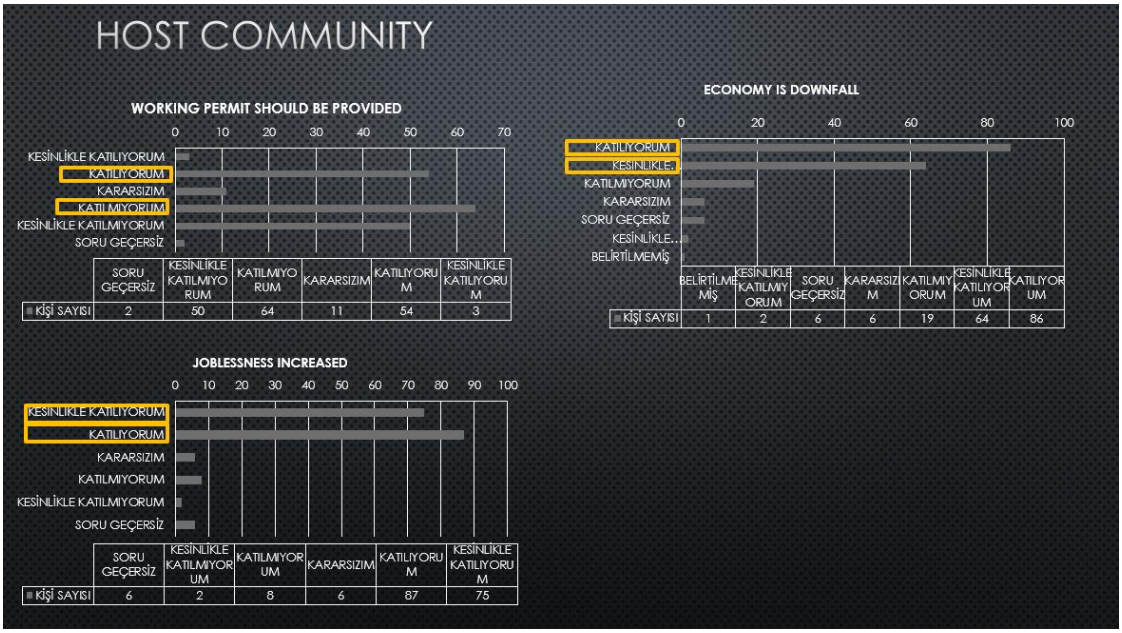


Figure 6. Labour Market Issues

4.4 Access to Public Services

Although the host community is reluctant on the labour market issues of urban refugees, they do have an open mind about access to public services. The public services in question included socio-cultural services, education, pro-bono healthcare, sheltering/housing etc. The majority of the host community is affirmative on the issue of public services for urban refugees. 92% of urban refugees claim that they do have access to these public services. Supporting the results identified in questionnaires and similar to the attitude of Turkish citizens, Kolocek (2017) underline the role of state for the right to housing by establishing institutions to support social housing development, developing procedures, making spatial plans and taking action for resource mobilization.

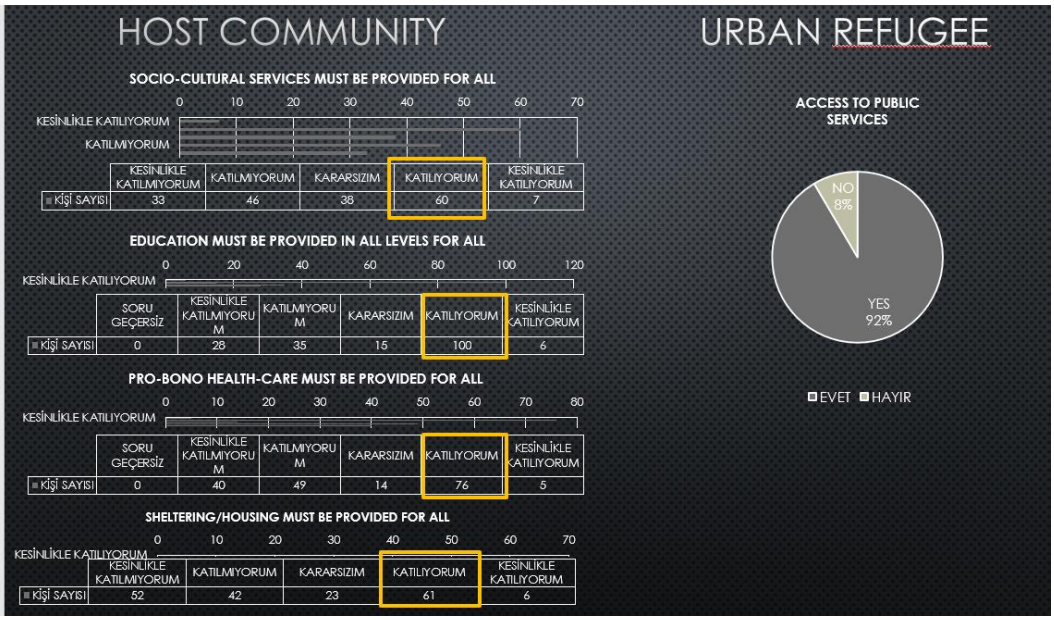


Figure 7. Access to public services

4.5 Safety

When both communities asked about the safety of the living space and neighborhood it is obvious that both parties refer to their neighborhoods as unsafe. The host community perceives urban refugees as a safety threat. On the other hand, when the urban refugees were asked about the problems in the neighborhoods, although 81% of the interviewees feel safe in Turkey, they feel unsecure at their neighborhood. Their worst fear is to be deported or send back to Syria. Albeit some of them declared that they do not have any problems, some of them referred to lack of open areas, social amenities, healthcare centers, as well as the steep slope of the neighborhood, fights at the neighborhood, and urban renewal are some of their main concerns.

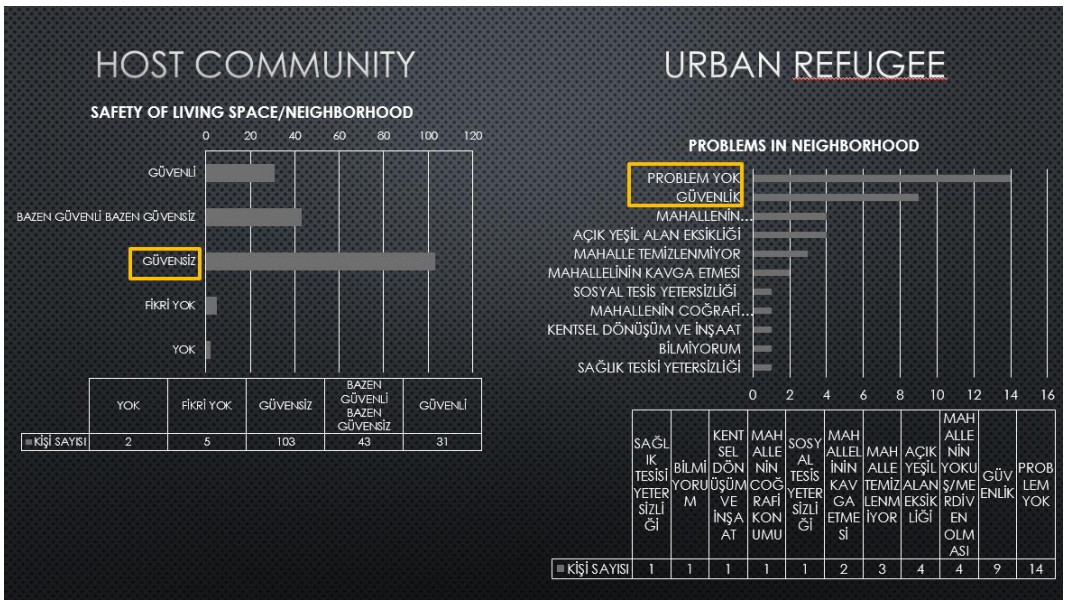


Figure 8. Safety issues and problems in the neighborhood

4.6 Problems and Expectations

There are many challenges urban refugees face in Turkey. The main problem that they refer is the barrier of language and the living expenses. Another important problem is the discrimination against the urban refugees and lack of jobs. The perception of discrimination is an interesting issue in this study. So forth, as for the community and urban life, only 32% of the urban refugees declared that they faced discrimination, when asked about the discrimination only 21% declares it as a problem. Their issues are mainly referring to lack of housing, living expenses and job opportunities, discrimination and language with a lesser note on legal issues, uneven pay for work, the bureaucracy and paperwork, getting a working or residence permit, and lack of healthcare.

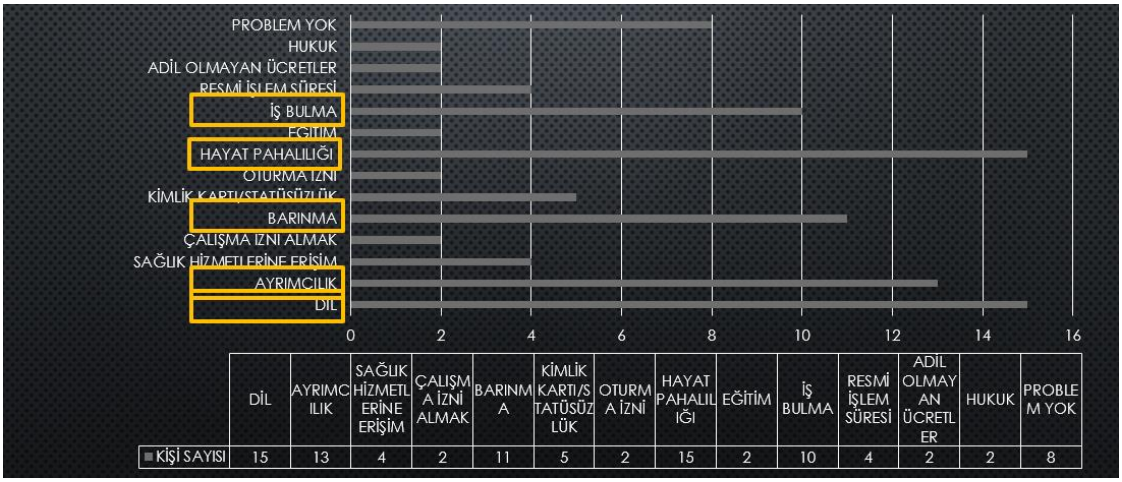


Figure 9. Problems of Urban Refugees in Turkey

As for the host community, the majority think that they should be deported and should not be given citizenship rights.



Figure 10. Host Community on Legal Issues

Since the urban refugees are trying to settle in and form bonds with the host community, they have some expectations about the changes in their status. For urban refugees, citizenship to Turkey is the only way out. It is not just a matter of working permit, they have concerns about deportation and the lack of legal status.

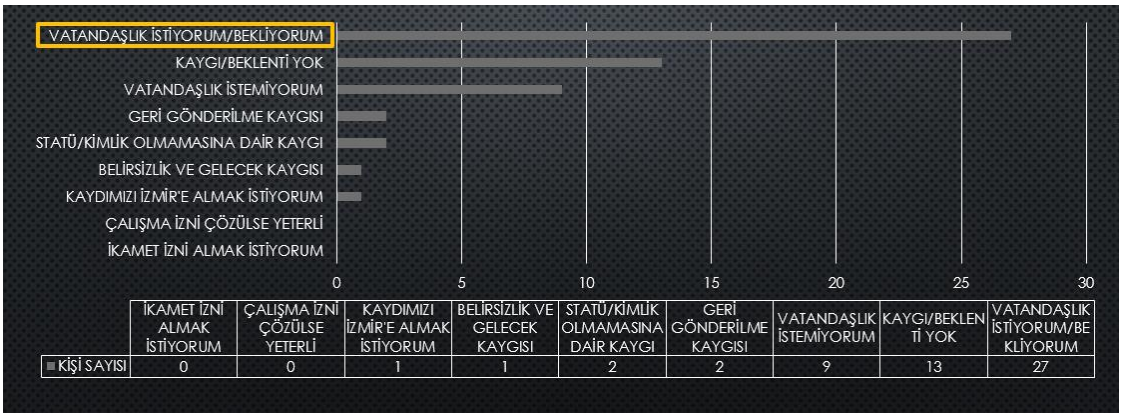


Figure 11. Progress Expectations of Change in Status

5. CONCLUSION

With the help of the statistics, five main points were derived from this study.

- Both groups have similar MIGRATION STORIES, have RELATIONSHIP BY AFFINITY, speak SAME LANGUAGES, come together in the SAME NEIGHBORHOOD and even NEXT DOOR,
- Both are URBAN POOR, can find place in labour market as CHEAP LABOUR, have limited access to PUBLIC SERVICES, have problems with RIGHT TO HOUSING AND URBAN SERVICES,
- Both are nervous for SAFETY OF THEIR LIVES AND FUTURE,
- They face off against each other IN LABOUR MARKET,
- One group expect to STAY while the other expect REVERSE.

Main reasons lying behind this perception and attitude are labor market relations, attitude of the government.

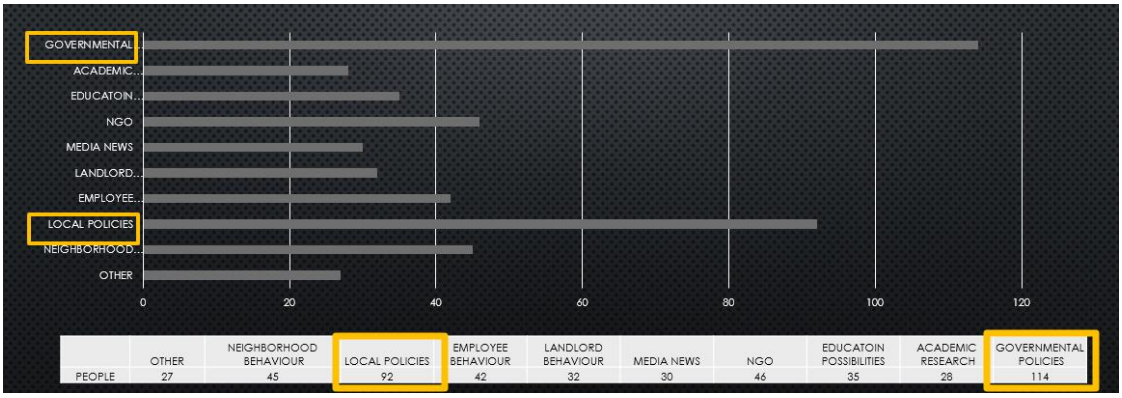


Figure 11. Progress Expectations of Change in Status

Beyond attitude and perception, changes for the better and living together can only be achieved through policy and policy making. Research Reports which handle international migration and refugee problems (IOM, 2017; UCLG-MEWA, 2014; HABITAT III, 2015) point out the discipline of urban planning for supporting related politics and policy making processes. Moreover, it is obligatory to adopt inclusion of refugees to processes of strategic planning and decision making in to establish an inclusive local policy making process (Daudov, 2013; Çakırer-Özservet, 2015).

6. ACKNOWLEDGEMENTS

This study is a part of a conjoint research funded by Turkish Scientific and Research Council 1003 Prioritized Fields and R&D Projects Programme; entitled "A New Perspective on the Processes of Adaptation and Integration of Urban Refugees: A Social Innovation Experiment Aimed at Building Inclusive Cities", coded 117K826 (main project and two sub projects coded 117K805 and 117K829). We thank to all researchers and project team that contributed to this study.

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Landscape Fragmentation Caused by Urban Transportation Network; Sample of İzmir Bayraklı - Adnan Menderes Airport Route

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ABSTRACT

Transportation network is a vital need of modern cities. However, building comprehensive highway networks has some adverse consequences such as fragmentation of natural landscapes and reduction of ecosystem services both in quantity and quality. Reduction of the ecosystem services of the natural landscapes in a city causes inconveniences in whole city ecosystem, which is the main reason of environmental problems caused by human activities. İzmir is the third large populated city of Turkey with a rich range of natural and cultural landscape features. As in many parts of the world, city centers are in high demand among people to work, live or migrate from rural areas. İzmir is one of the most immigrant receiving cities which means the urbanization will even get more rapid year by year. Therefore, this study aims to investigate the landscape fragmentation caused by transportation network in İzmir, sampling one of the highways that have the heaviest traffic in city, the highway between Bayraklı district to İzmir Adnan Menderes airport. For this purpose, the fragmentation rate of natural landscapes of the sample area was calculated and compared within the years of 1984 and 2020 via Geographical Information system and Arcgis software.

According to the results of this study, generally, the fragmentation rate has started to increase since 2005, while the fragmentation of urban green areas is at a very low rate in 1984, it has started to increase with the increase of highway numbers. Additionally, the increase of transportation construction causes an increase in carbon rate and unhealthy environmental conditions both in rural and urban areas day by day. At the final part of the study a solution landscape plan for the case area was proposed aiming to reduce the fragmentation and carbon rate.

Keywords: Landscape fragmentation, low carbon solution, GIS,İzmir.

1. INTRODUCTION

Urban areas began to expand with the beginning of rapid migrations from rural areas to urban areas since the industrial revolution. The distance between the places has increased and big highway roads have been started to be built. The construction of highways has led to the disintegration of natural areas that are intact, which ended up by the fragmentation of landscape. This situation affects ecological services, social life welfare, and quality of life deeply. Green spaces have started to be replaced by concrete surfaces, as a result of which environmental problems have emerged. Green areas have started to transform into built areas. Big highways occupy natural areas that are hosting many animal species such as squirrel, hedgehog and snake. The means of transportation that cause to release of poisonous gas negatively affect the ecological cycle and the life pyramid that is important for all creatures. In addition to these, both city dwellers and people living in rural areas have lost their bonds with natural areas and this situation has caused many problems such as obesity, respiratory disease and various mental problems (Gündel, 2018)

The landscape shows a structure that is open to change in terms of its character. It encounters various changes over time. These changes result from the natural process, and they also undergo a great deal of changes as a result of human activities. Richard Forman (1995) who is a landscape ecologist at Harvard University evaluated landscape as a mosaic structure that consists of patch, corridor, matrix, and he emphasized that every structure has a function and it changed depending on the time. Any breaks within this system causes vital environmental problems in long term periods.

The main reason of the landscape fragmentation is transportation, followed by industrial activities, agriculture and housing. According to Jongman (2019), fragmentation is the result of the dominant movements around the world, and in the last 50 years the urban landscape, highway landscape, recreational landscape and industrial landscape have become globally dominant.

The urban-rural periphery has disappeared, and land and railway transportation networks have started to expand as the distances get longer. Considering the need of researches aiming at landscape fragmentation, the research questions of this study were determined as following;

- What extend is the landscape fragmentation caused by transportation?
- What are the problems due to landscape fragmentation caused by transportation? And what are the possible solutions of these problems?

Landscape fragmentation is the most significant problem for wild life and habitat. The most negative effect is the loss of the ecological cycle. In addition, this negative situation impacts urban life and social life. For example; the problems such as, flood risk, air pollution, water scarcity can take place due to the fragmentation of landscape, and loss of life can occur. This study aims to find the reason of fragmentation and then, aims at production of solutions.

2. LITERATURE REVIEW

The origin and the effects of fragmentation were studied in various researches. Many researches explain the effects of fragmentation on landscape. In a research conducted at the University of Mexico between 1954 and 2015, it was stated that fragmentation had negative effects on ecosystem, biodiversity, rainwater filtration, human well-being and bicycle and walking road (Zambrano et. al., 2019),in United States, highway constructions had the most dominant role in habitat fragmentation (Beaudry, 2017), in Fujian city of China, it was observed that the increase in the population and the growth of the economy caused serious effects on the landscape and three important sectors such as agriculture, industry and transportation were found to be the sectors that accelerated this process (Luo, Zhang and Wang, 2015), Tabor and Maiklejohn (2020) drew attention to the phenomenon of climate change and evaluated the cause of habitat losses and fragmentation as negative effects of climate change, in the city of Bartın, it has been stated that plant texture and wildlife have suffered

great damage in the last 40 years due to road constructions(Nayım and Uzun 2018), in addition to these, in the city of Malatya, in the 20-year period that biodiversity is damaged and therefore steps should be taken to reduce the ecological footprint (Görmüş, Cengiz and Yılmaz, 2018), In Denizli, due to urbanization, such as road construction and urbanization, perforation in the landscape ecosystem has been seen as perforation, splitting, fragmentation and consequent destruction (Tağıl, Görmüş and Cengiz, 2016), and finally,in İzmir, the places where is the most seen landscape fragmentation in 1984, 1990, 2000, and 2009 was determined (Barut, 2011).

On the other hand, besides the above studies, in some researches, the concept and process of fragmentation is explained. Jeager (2000) stated that motorway, rail way, and land where fragments major structures as a landscape anthropogenic fragmentation and identified new three fragmentation standard; effective mesh size, degree of landscape division, division index. Landscape anthropogenic penetration by characterizing, patch functions created with fragmentation have been tried to assess. Jaeger (2007) characterized the fragmentation of the landscape in terms of the anthropogenic penetration of thelandscape in terms of various geometric forms, and they stated that especially the highways built after 1930 created great changes on the natural characteristics of the landscape. European Environment Agency (2011) interpreted landscape fragmentation as the separation of the major patches into smaller patches and more isolated habitat fragmentations.

3. MATERIAL AND METHODS

Material

The main material of this study is the case area which has been determined as the section of Bayraklı to İzmir Adnan Menderes Airport. The satellite images that were used to analyse the fragmentation rate were the secondary materials of the study; while Adobe Photoshop and ArcGIS software were used during analysis process.

Method

The method of this study consists of three phases. At the first step, the literature review was conducted and the satellite images were provided. Within the second phase; the satellite images were clarified viaAdobePhotoshopsoftware. On the next step of the method the satellite images were georeferenced and the border of the project area was identified and then the supervised classification was conducted. At the third and last stepof the research method, the fragmentation occurred during the period between 1984-2020 years was investigated.

4. RESULTS

Temporal analysis was used within the scope of the study, because land use change is significant indetermination the rate of fragmentation. The satellite images from June 1984 to May 2020, which were obtained from United States Geological Survey (USGS)as georeferenced tagged image files, derived from Landsat 4, 5 and 8 were investigated (Figure 1).

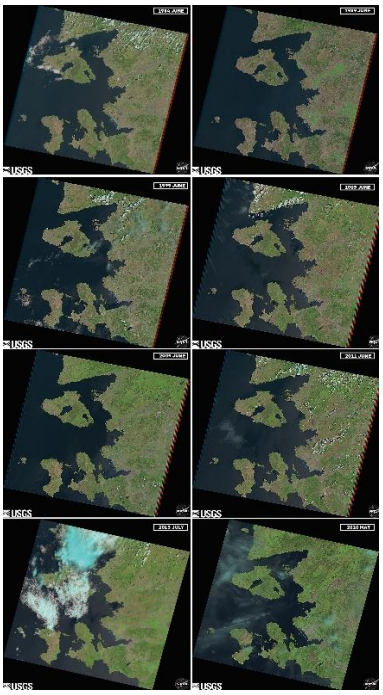


Figure12. Landsat Satellite Views1984-2020

Adope Photoshop CS6 program was used to sharpen the image to provide more visible colors. These images were evaluated in 5 classes via unsupervised classification method by automatic calculation via the ArcGIS software. It was seen during the analysis phase that unsupervised classification process does not give 100% correct results. For this reason, "supervised classification" process, which is an analysis add-on tool, was performed in ArcGIS (Figure 2). It has been observed that it gives more accurate results than the unsupervised classification process and the processes have continued through the controlled classification. After this process, pixel classification, which is an inter-process for measuring landscape fragmentation, was conducted and created a base to measure the fragmentation rate. Two classes were created in the pixel classification process. In these classes, the green surfaces are kept as a class and separated from the others. In this way, it is aimed to see the effects of fragmentation more clearly (Figure 3).

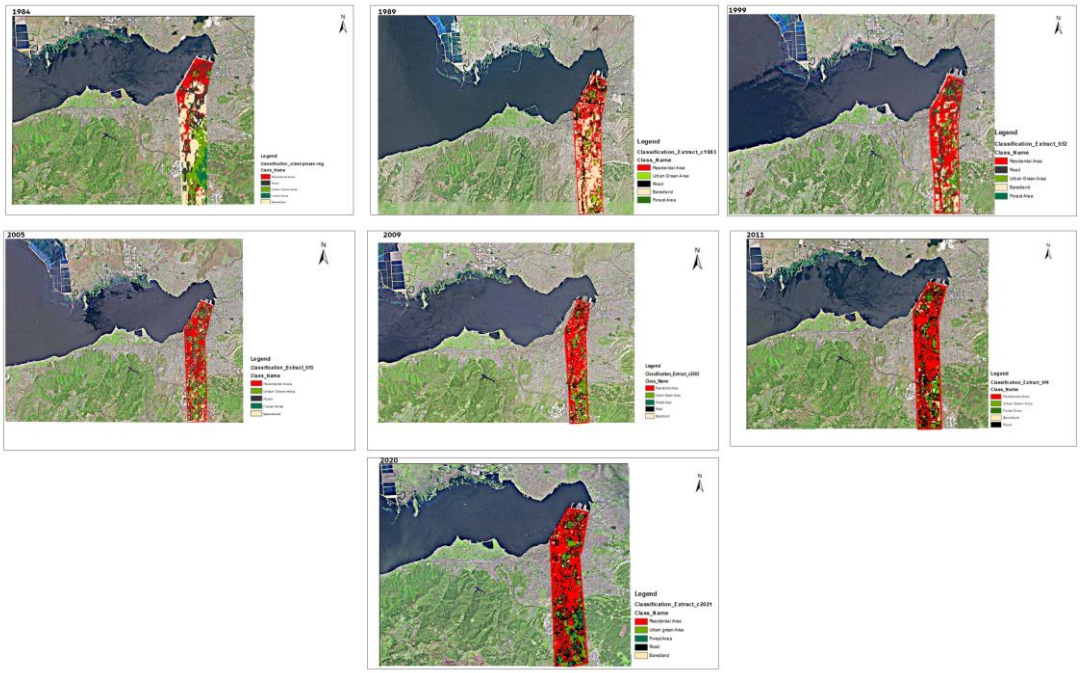


Figure 13. 1984-2020 Supervised Classification

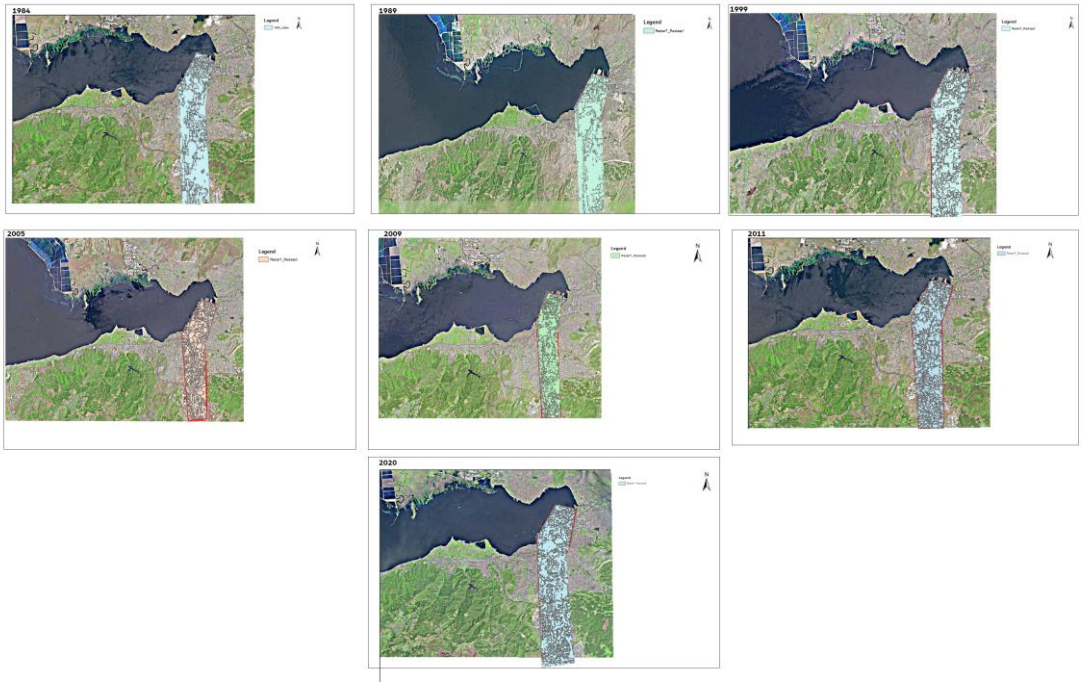


Figure 14. 1984-2020 Pixel based Classification

According to the results of supervised classification process, the green areas were widest in the year of 1984, while the residential area increased until 2020. And transportation started to increase since 1999, whereas the fragmentation rate has started to increase since 2005. The green areas was the most fragmented in 2005. In 1984, the fragmentation of the green area is at the lowest degree. The rate of fragmentation of transportation increased in 2009 (Figure 2).

5. CONCLUSION

The fragmentation is mostly seen in green areas which causes decrease of green areas in both amount and quality. Residential growth has increased fragmentation year by year, the least fragmentation wasobserved in 1989.The period with the highest number of green fragments is calculated in 2005.The green area decreases with the increase in transportation infrastructure. It is determined that the main source of the fragmentation is transportation and housing.

It is observed that the transportation infrastructure increases year by year. As a result, there is a decrease in the amount of thegreen areas. In this case, it causes an increase in carbon rate and unhealthy environmental conditions both in rural and urban areas day by day. As urbanization increases, the expansion of transportation networks is inevitable. the existence of a particular urbanization phenomenon must be acknowledged and solutions to the increased carbon rate must be produced. The first solution to this problem can bethe usage of carbonless transportation vehicles. Bicycle and walking paths should be developed in both urban and rural areas. As the modes of transportation will differ depending on the slope of the area, while mountain biking can be preferred in some places, road biking should be preferred in some places. Emphasis should also be given to electric vehicles. Ecological network is significant for landscape habitat, so transit roadsshould be built for wild life. Ecological bridgesprevent the landscape, the urban ecosystem and enable to provide the continuity of mobility.

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City Square Design: The Case of Çanakkale Republic Square

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ABSTRACT

The most common usage area of urban life since history is urban open spaces. City squares also are among the most effectively used urban open spaces. They reflect the urban identity due to their characteristic of being unique to the city they are located in. The squares, which are the focus of social activities, carry the history of the city to the place. The squares, which have undergone less change despite the changes and developments of the cities, have continued their existence for a long time as an important public and urban element that reflects and determines the culture and identity of that city. "Çanakkale Republic Square" also has these features. Cumhuriyet Republic, which is the focal point in the center of Çanakkale and has witnessed important events in the city's history, was chosen as the subject of study due to its qualities. The area should also be reconsidered and designed in accordance with today's needs in terms of landscape architecture. In the study, it was opened to make a future design proposal by making an environmental analysis of the square. In the study, Republic Square was examined and the occupancy gap analysis, environmental analysis, transportation analysis, function analysis, green area analysis of the area were made. Thus, all the components that make up the area (physical environment, reinforcements, plant elements, etc.) and their compatibility with each other were evaluated. As a result of the evaluation, it had been deemed necessary to reconsider the field in terms of functionality and aesthetics. As a result of the study, design suggestions has been made that will contribute to the implementation of the public and private sector in the field.

Keywords: Çanakkale, Cumhuriyet Square, Urban spatial, Square design, Landscape design

1. INTRODUCTION

Urban open spaces have been the most commonly used areas of urban life from past to present. Urban squares, on the other hand, are of the most effectively used urban open spaces. Urban squares are the open spaces from where the citizens benefit extensively. They are often located either in or close to the city center and are expected to reflect the city characteristics (Figure 1).



Figure 1. Square examples [1]

These squares, which have public characteristics, are the parts of the whole city and include symbols that affect the city perception of the citizens. The symbols, artistic objects, living components and other elements used on these squares and the harmony of texture and color are important urban images. These symbols must be suitable for the main intended use of the square (Figure 2).



Figure 2. Cumhuriyet (Republic) square1940 years

1.1 The Basic Features of a Square

Its characteristics are shaped by the cultural and social habits of society. It is physically, socially, culturally, and historically integrated with the city. It is specific and reflects the region where it is located. It contains a combination of different functions. It contributes to the aesthetical values of the

city. It reflects the identity of the city. It creates a meeting place for the city people by initiating and directing urban circulation. It serves as a focal point. [2,3]. It is a significant criteria for the physical shaping of the city. It is one of the first public places where urban life took place in the historical process [4].

It undergoes less change despite the changes and developments that cities go through [3] (Figure 3). While urban squares have been the focal points that reveal the identity and personality of the city throughout history, today some of them lose their originality by being used as vehicle squares or parking lots [2,4,5]. This situation causes the squares to lose their quality of spatial perception and image and to turn into undefined areas that are only used as transition areas [6].

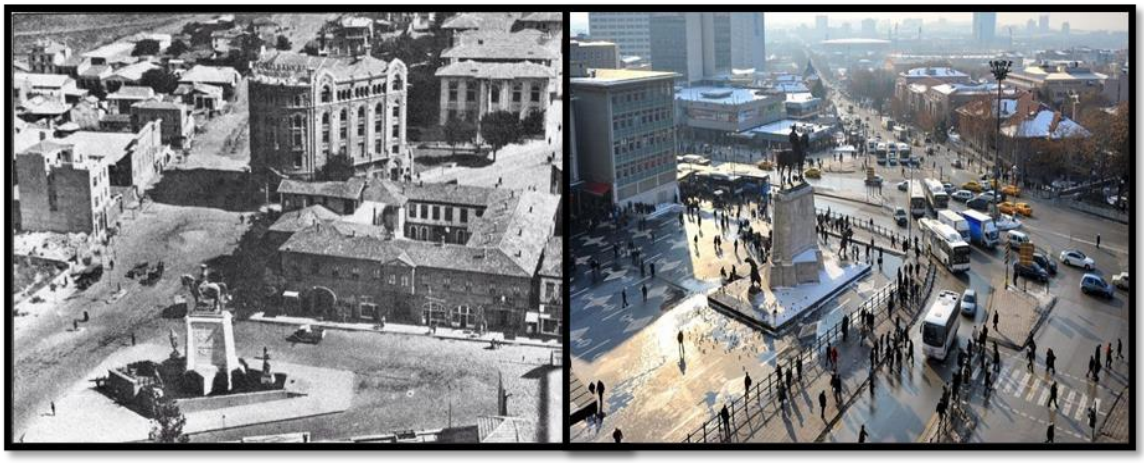


Figure 3. Ulus Square from past to present in Ankara city history [7,8]

The working area is specified as Çanakkale Republic Square. The square is the key point that intersects land and marine transport. It has also witnessed important events in the history of the city (Figure 4). Although it is used for ceremonial purposes today on important days, it has not been able to maintain its focal character with the change of road connections, dense urban development, and wrong plant use. In the study, it is aimed to make future planning and a design proposal through an environmental analysis of the square.



Figure 4. Republic (Cumhuriyet) Square 1950 years

2. MATERIAL, METHOD

The main material of the study is Republic Square with its surroundings in Çanakkale city center. The working area starting from Republic Square and ending at 'Muammer Aksoy Park' includes 'Eski Hükümet Street' and 'Kızılay CaferTürker Street' (Figure 5).

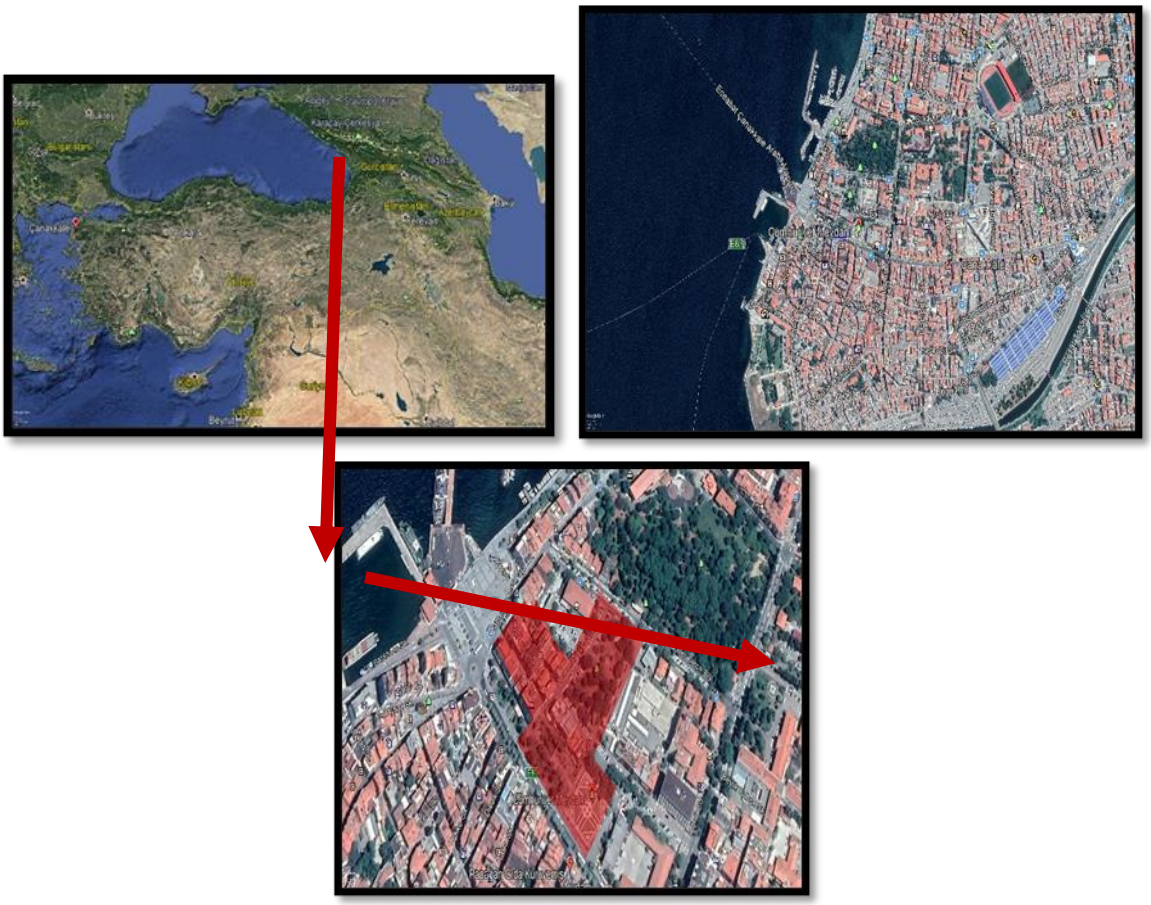


Figure 5. Canakkale and Republic Square (From Google Earth, 2020)

The method of the study consists of observation, analysis, and evaluation.

1-On-site observation of the Square and its surroundings, determining their locations on the map by photographing.

2- Obtaining information from written and visual sources about the past and future plans of the area; the physical and geological structure; current and past states of the area.

3- Discussing with Çanakkale Municipality and Çanakkale City Museum.

4- Making a survey in line with the gathered data.

5- Making the occupancy, transportation, function, green space, and environmental analyses of the Square.

Thus, all components that make up the area (physical environment, urban furniture elements, plant elements, etc.) and their compatibility with each other have been evaluated in line with planning and design criteria.

6- The evaluations have been converted into tables.

7- Analyzes made using Adobe Photoshop CC 2015 software have been shown on maps.

8- As a result, design suggestions have been developed to contribute to the practices of the public and private sectors on the site with 3D models developed using Sketchup 2014, Lumion 6, and Autocad 2013 software.

3. RESULTS

3.1 The Definition of The Working Area

Çanakkale is located in northwestern Turkey lying both on the Gallipoli and Biga Peninsulas (Troas), which is an extension of Anatolia. It is the second city of Turkey with lands in both Asia and Europe (like İstanbul). The city is also quite important in terms of history. The working area starts from İskele (Pier) Square including the clock tower and lies towards the bazaar and has the most intense circulation (Figure 6). The mentioned area is surrounded by plenty of historical places and lots of important official and civil buildings (Figure7).

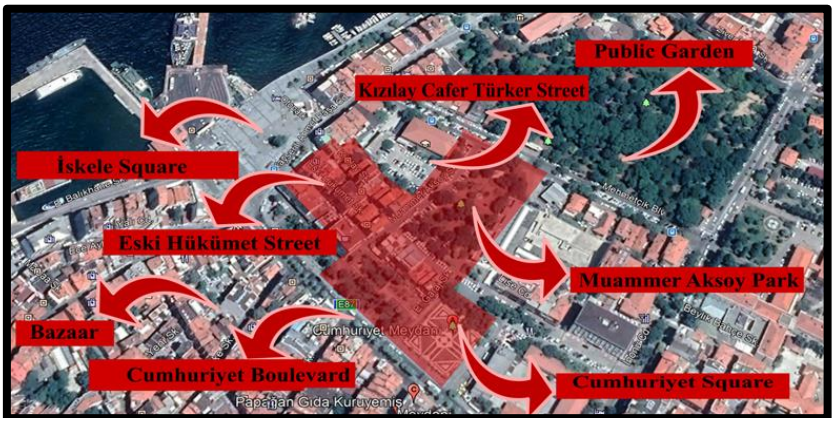


Figure 6. The location of Republic Square and its surroundings (Derived from Google Earth, 2020)

The part from the south of Republic Square, which is the old settlement area of Çanakkale city, to Sarıçay is designated as "Protected Area". All maintenance and restoration works are carried out within the framework of the provisions of the conservation plan implementations by the City Conservation Council [9] (Figure 8).



Figure 7. General view of Republic Square and its surroundings (2019)



Figure 8. 1-Muammer Aksoy Park, 2- Eski Hükümet Street, 3- Kızılay Cafer Türker Street, 4- Working area (derived from Google Earth) 5- Republic Square and its surroundings today [10]

3.2 Time-Flow on The Square

Republic Square was designed right after the proclamation of the republic and has witnessed ceremonies since then. The square still has to reflect the historical, cultural, and social values of the city today, but not yet. The square has been maintained by the municipality since city settlement plans started to be prepared. In addition to official ceremonies concerts, exhibitions, fairs, and other outdoor activities are being organized on the Square [11]. The most significant symbol on the square is the statue of Atatürk modeled by Nejat Sirel in 1034 and opened in 1937 [12]. The square that has undergone constant changes in time experienced the latest one in 2000.

The Statue used to face the sea in the past, whereas it was located in its current position following the latest change (Figure 9). The Square used to form integrity with its surroundings but now it creates a perception of an isolated semi-closed space (Figure 10).



Figure 9. Salvation of Çanakkale, 18 March Ceremony in 1968



Figure 10. A- The position of the Statute and a view from a ceremony [1], B- The first design of the Square a photo from the past [13], C- Current state (2019), D- Municipality ceremony (2020)

In total, three registered buildings exist on the streets of the working area: One on Eski Hükümet Street currently used as a hostel and two on Kızılay Cafer Türker Street one of which is currently in use and the other is under construction (Figure 11).



Figure 11. The registered building on Kızılay Cafer Türker Street, Eski Hükümet Street and restoreted old residence (2020) [14]

Eski Hükümet Street and Kızılay CaferTürker Street are the important junctions that connect the Square and the park to Bazaar Street and the coast. These streets have lost their historical characteristics over time.

3.3 Working Area Analysis

The occupancy, transportation, function, green space, and environmental analyses of the working area have been carried out (Figure 12). According to Figure 12, the position of the sun in the area, the dominant wind direction, and the direction of the scenery have been created by environmental analysis. In the function analysis, the conditions of the buildings around the working area are shown by color. In the transportation analysis, road conditions, bus stops, and ferry departure points are shown with signs. In the green-field analysis, the area and the existing green areas around it are specified. As the square is surrounded by tall structures, its connection with the sea has been severed. At the same time, the ratio between the city center and its size has lost its effect (Table 1).

The Surrounding of The Square and Muammer Aksu Park

Cumhuriyet Square, Muammer Aksoy Park and its surroundings have been discussed in general terms in the evaluation study. As a result of observations, it has been concluded that the park had lost its characteristics and it is used as a passageway. Its potential for recreational use is low and cannot be perceived since its surrounding is used as a parking lot. The mentioned area is dangerous for its users and causes visual pollution. Since the multi-storey car park is insufficient, the surrounding area of the park is filled with vehicles. Vehicle entrance to this area should be banned (Figure 13).

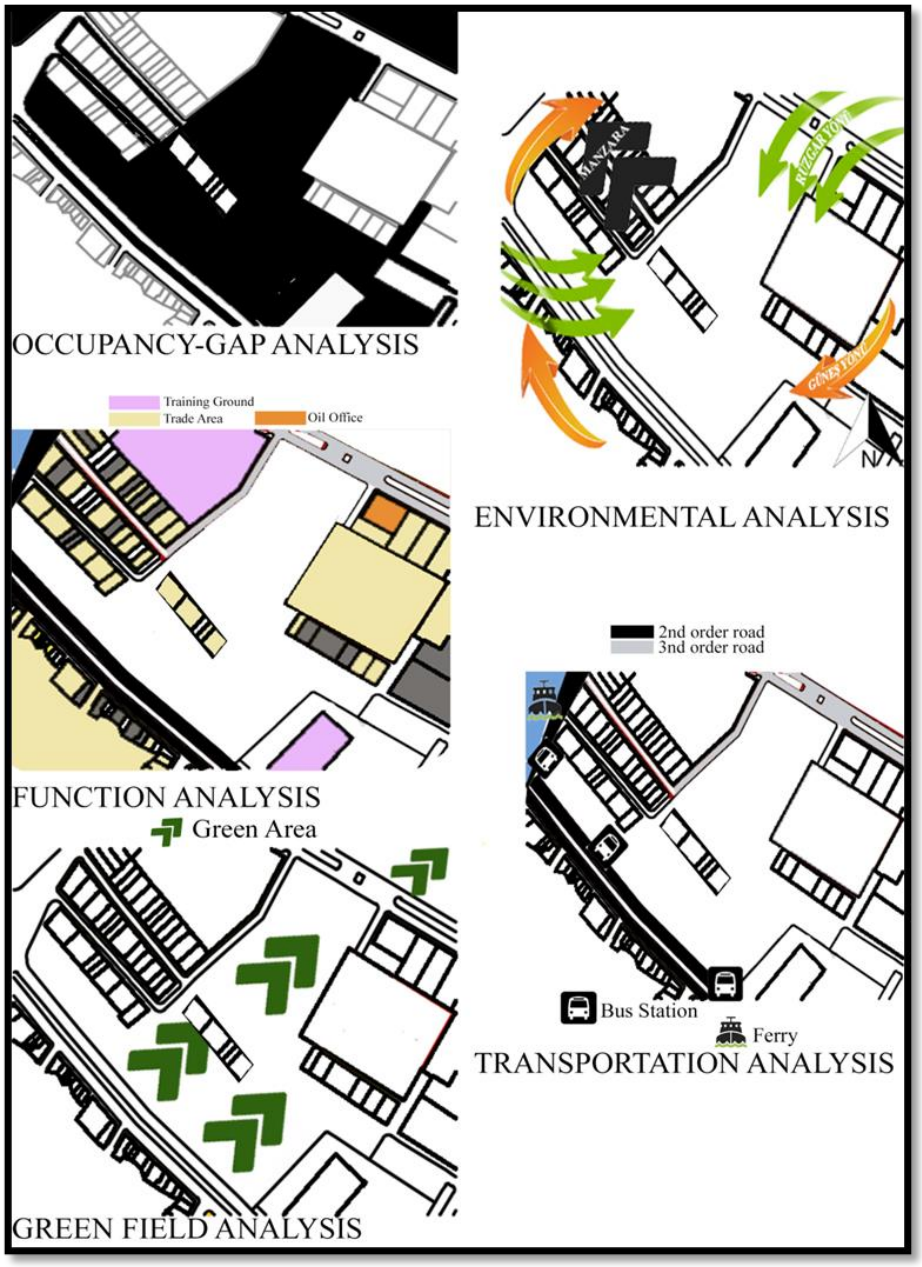


Figure 12. The analysis of the working area

Table 1. Land status and scale of square

Land Status	Scale
The elevation level is zero in the working area. The creek previously located beside the Public Garden was flowing towards the sea below this area. Therefore, the ground level of the area starts from 2 meters and the underground is risky.	The buildings around the area create a feeling of closed space. The area also loses its urban space scale. Although the area is close to the sea, due to the high-rise buildings in the direction where the scenery is dominant, the sea can't be seen. The urban furniture elements that are of the other components and plants are sufficient to preserve the spatial characteristics of the area.

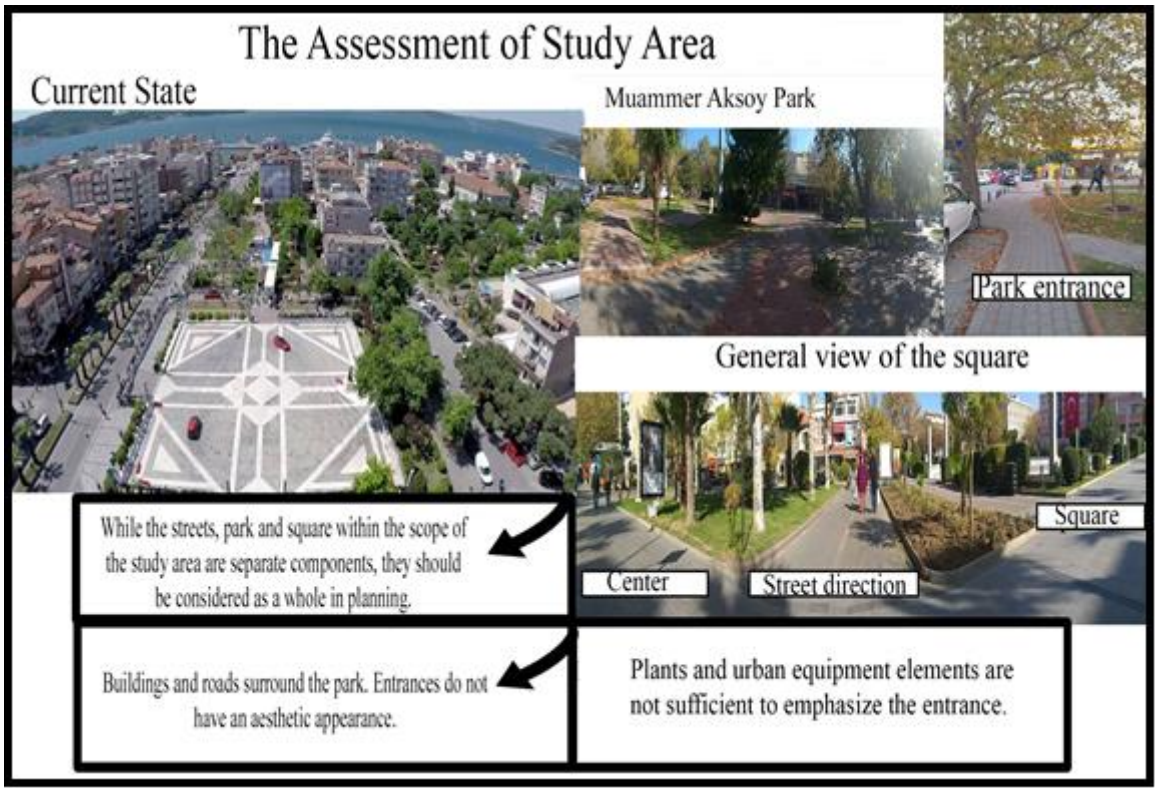


Figure 13. General evaluation of the working area (2019)

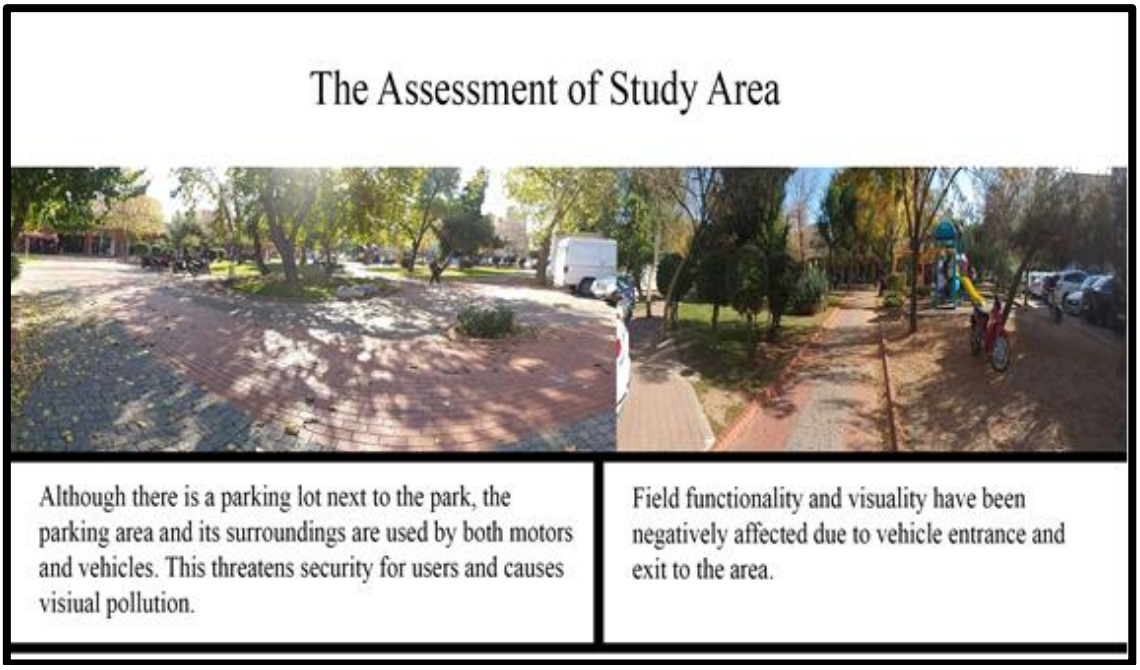


Figure 14. General evaluation of the working area (2019)

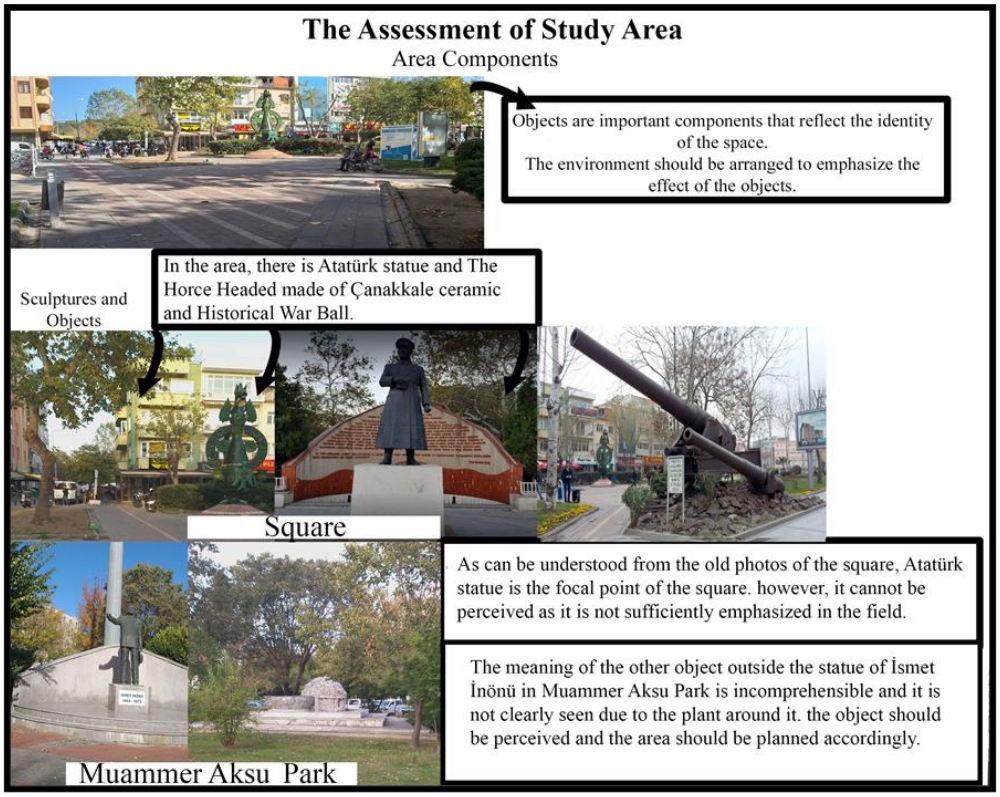


Figure 15. Component evaluation (Urban Equipment Elements), (2019), [15]

The working area requires infrastructural practices and arrangements on the physical environment. Urban Equipment Elements should be set on a standard taking all kinds of objects into consideration. Proper routes and paths for walking should be determined, and the area should be ensured to provide 4 season walking opportunities walkways. Small and local architecture compatible recreational spaces where the visitors spend time and view the scenery should be created (Figure 16).

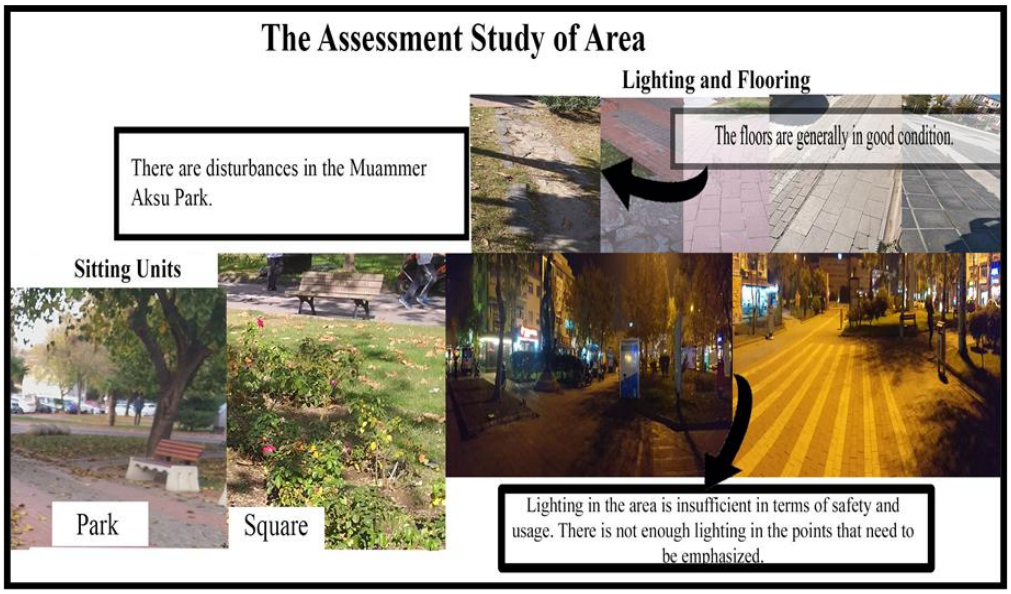


Figure. 16 Component evaluation 2 (Urban equipment elements), (2019)

The vegetative potential of the study area was examined. It can be seen in Figure 17, that the design plants in the area are insufficient.

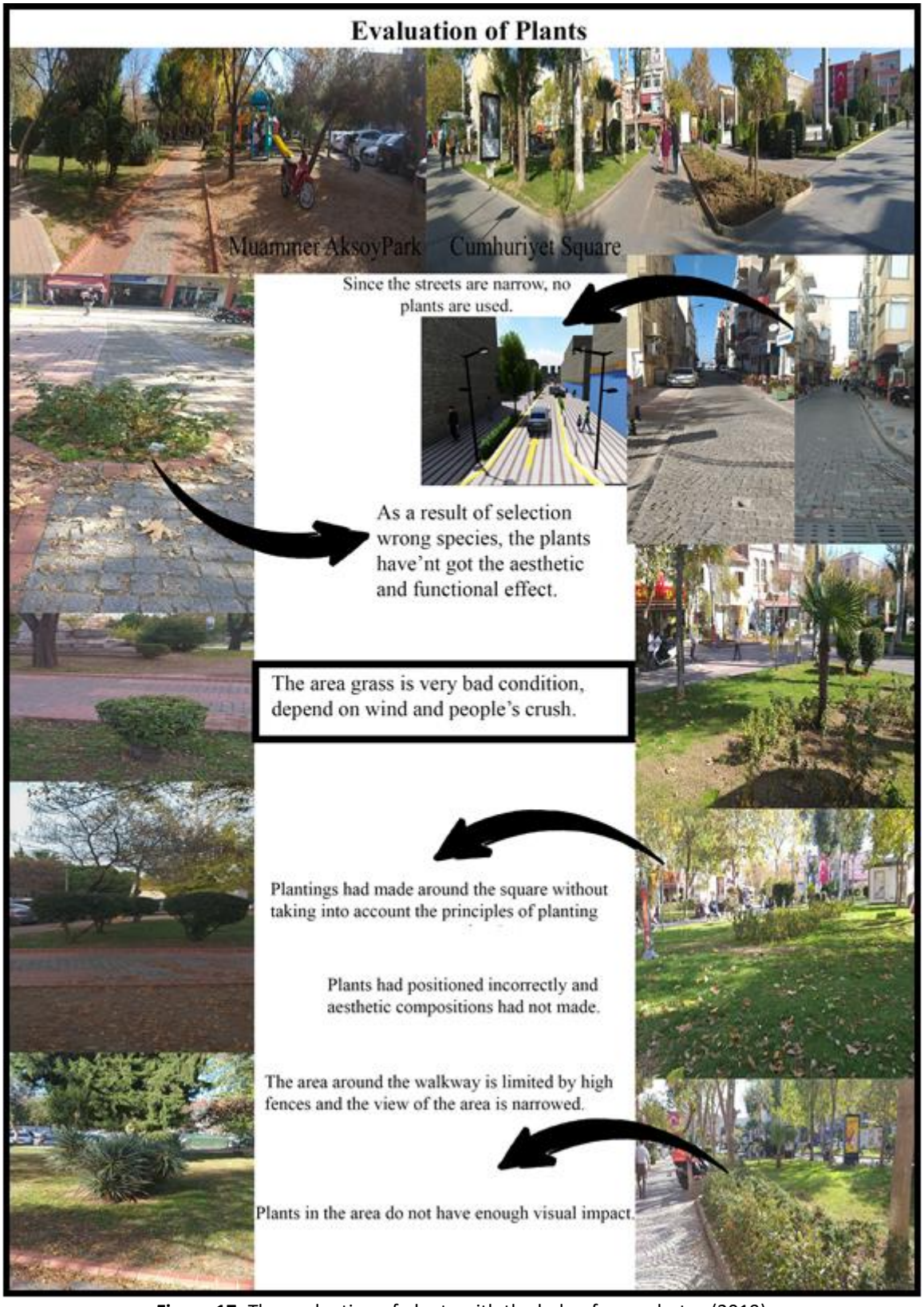


Figure 17. The evaluation of plants with the help of area photos (2019)

Aesthetic and functional evaluation of the plants used in the square and its surroundings is made in Table 2.

Table 2. Evaluation of the planting elements on the working area in terms of aesthetics and functionality

The Evaluation of Planting Elements	
Aesthetics	Functionality
Diversity-Weak	Being instructive- Weak
Emphasis-Deficient	Shading-Good
Color-Medium	Spatial perception-Medium
Harmony-Medium	Compatibility with the urban ecology-Good
Balance-Medium	Appropriate area choice-Weak

It is possible to provide attractive natural views along the road with the use of a greenbelt system. Plant-care practices such as spraying, pruning, etc. should be carried out for the plants located in the city, and those that ruin the silhouette of urban objects should be arranged and redesigned.

Urban Equipment Elements and plants should be preferred among attractive and highlighting ones that reflect the characteristics of the working area. The Square, park, and the streets should be considered and designed as a whole. Functional areas should be created to increase the use and functionality should be added with the use of Urban Equipment Elements (Figure 18).



Figure 18. Functional Urban Equipment Elements suggestions for the working area (A- Originaly 2019, B- [16])

4. CONCLUSION

Çanakkale has important resources with its location, cultural values, archaeological and historical sites, and buildings. Representing these resources in open spaces shall create an attractive and aesthetic urban identity. Since the urban square is the focus area that identifies the city, it requires an aesthetic and contemporary design approach.

Çanakkale is a city that attracts plenty of tourists every season. These tourist groups gather at Cumhuriyet Square but unfortunately, they are not able to get any information about the history and the importance of the Square. It is possible to explain the spatial history using simulations and lightings. The conditions of the surrounding buildings should be enhanced, and Street improvements should be fulfilled so that the visitors spend longer time on the Square. It is possible to promote and sell local

products in semi-open spaces. Cultural activities that shall ensure more effective social use of the area should be organized. Integration with the city can be achieved with the definition of the area and with appropriate guidance for the other uses of the surroundings. Certified historical buildings exist around the Square. These buildings can be re-functionalized by integrating them with today's economic and social life.

Cumhuriyet Square is stuck among the surrounding buildings and has lost its urban characteristics at the city scale. Some non-aesthetic residences exist in the sea direction and expropriation of these residences is necessary to expand the Square. While bringing the Square new functions, it is necessary to choose appropriate elements, colors, and vegetation so that the Square shall bear an aesthetical image. The vegetative design of the area, on the other hand, should emphasize the image of the square. Today, poplars that have completed their life span are improper trees for urban use and they cause the Square to be perceived as a closed area. In order to achieve these, authorized institutions, municipalities, universities and non-governmental organizations should necessarily take joint decisions. With the cooperation of different disciplines, the area shall gain a contemporary, functional, and aesthetic urban appearance.

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Public Parks as Health Infrastructures: Branch Brook Park

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ABSTRACT

It was 1870, when Olmsted illustrated his social theory in his speech of Public Parks and the Enlargement of the Towns. The smog-shrouded and overcrowded environment of 19th century's urban districts was struggling with unhealthy conditions, when nature has become to be considered as a redeemer of industrialized societies. As a landscape architect, Fredric Law Olmsted acknowledges park systems as an infrastructure to gather all different social classes in a healthy environment. His vision was creation of vast recreational and cultural facilities in American cities would improve American society and so would bring about a harmony to regain the sanity. This study unearths the improvement of public health by sanitation measures. How were parks designed as health infrastructures? How could it be possible to provide provisions of urban facilities to people in a democratic way? Following these questions, the study focuses on Fredric Law Olmsted's very rare known park design of Branch Brook Park, in NJ, in USA. The study envisions to make connections to ill-conditioned cities of 19th century and contemporary condition of urban life under Covid-19.

Keywords: parks, health infrastructures, Fredric Law Olmsted

1. INTRODUCTION

It was 1870, when Olmsted illustrated his social theory in his speech of Public Parks and the Enlargement of the Towns. The smog-shrouded and overcrowded environment of the 19th century's urban districts was struggling with unhealthy conditions, when nature had come to be considered as a redeemer of industrialized societies. As a landscape architect, Fredric Law Olmsted acknowledges park systems as an infrastructure to gather all different social classes in a healthy environment. His vision was that creation of vast recreational and cultural facilities in American cities would improve American society, and so, it would bring about a harmony to regain sanity. This study unearths improvement of public health by sanitation measures. How were parks designed as health infrastructures? How could it be possible to provide provisions of urban facilities for people in a democratic way? Following these questions, the study focuses on Fredric Law Olmsted's very rare known park design of Branch Brook Park, in NJ, USA.

2. A SOCIAL AND SPATIAL CHANGE

"Air is disinfected by sunlight and foliage. Foliage also acts mechanically to purify the air by screening it. Opportunity and inducement to escape at frequent intervals from the confined and vitrified air of the commercial quarter, and to supply the lungs with air screened and purified by trees, and recently acted upon by sunlight, together with opportunity and inducement to escape from conditions requiring vigilance, weariness, and activity toward other men, —if these could be supplied economically, our problem would be solved."[1]

It was 1870, when Olmsted illustrated his social theory in his speech of Public Parks and the Enlargement of the Towns. The smog-shrouded and overcrowded environment of the 19th century's urban districts was struggling with unhealthy conditions, when nature had come to be considered as a redeemer of industrialized societies. As a landscape architect, Fredric Law Olmsted acknowledges park systems as an infrastructure to gather all different social classes in a healthy environment. His vision was that creation of vast recreational and cultural facilities in American cities would improve American society, and so, it would bring about a harmony to regain sanity. Having an advanced feeling of communitiveness, Olmsted projected parks to be available to all people. Located in the heart of cities, public parks and park systems were to shape the American societies to meet the recreational needs of wide range of people. A picturesque park idea was at the core of his landscape design approaches, which would promote the sense of tranquility amongst the artificialness of the existing urban pattern. That picturesque and pastoral landscape would contrast the *ill-ventilated, crowded* and *noisome* atmosphere of cities and would serve the growing population mingling with playgrounds.

Since a new vocabulary of urban beatification was created with the design of Central Park and Brooklyn Park in New York, New Jersey, which has a strong commercial connection to New York, was influenced by the events in the metropolis gathering all citizens in pastoral scenery. As William Cullen Bryant, a leader of the Central Park movement, noted, many prominent New York businessmen chose to reside away from the city's turmoil among the more "serene quiet and sylvan charms of rural life" in northern New Jersey.[2]

Achieving similar improvements in their Newark, like ample open spaces for health and pleasure for the growing population of the city, became a concern of Newark leaders, which sparked out local initiatives. From January 12 through February 7, 1867, the *Newark Daily Advertiser* urged their readers to pressure the legislature to create such a park in a 420-acre tract, bounded by Bathgate's Lane (now

Roseville Ave), the Bloomfield Turnpike, Broad and North Broad Streets in its southeast and in the south by the Morris and Essex railroad. [3]

In response, the New Jersey state legislature passed an act in April of 1867, authorizing the organization of a Newark Park Commission with a mandate to locate grounds for a municipal park of suitable size to accommodate the growing city [3]. The Executive Committee of this 26-man Commission toured "the new public park at Brooklyn," and then, requested the nation's premier park architects, Olmsted and Vaux, to prepare a report for a park for Newark. [3]

Olmsted and Vaux inspected various potential sites for a park in Newark and responded to the Commission on October 5th, 1867 with a report suggesting a larger tract of 700 acres, encompassing the 420 acres that was offered by the newspaper (Figure 1).

The larger the area of the park, the longer will be its boundary, and the longer its boundary, the greater will be the amount of the land which will be directly advanced in value, was in the architect's purpose to take advantage of **the** probable cost of construction over any other part of the region and over the regions in a rapid drive of about ten miles through the Southern, Western and Northern suburbs [4]. Olmsted reported that the county was still largely suburban and rural, the majority of its people lived among factories in Newark, whose growing population would soon obliterate the nearby scenic and recreative opportunities[4]. He set forth various types of desired public recreation grounds—two classes of reservations (one for spacious scenery, the other, on the Orange Mountain, to preserve the view), neighborhood grounds, smaller squares and playgrounds, promenades and boat landings along the Passaic, and finally, two kinds of parkways, one "formal and stately," the other expanding at intervals into playgrounds or scenic features [3].

The architects thought that the ravine and quarries were at present an obstacle to free communication between an important district within the city limits and central parts of the city itself. It would be remedied with the arrangement of a park with a clear profit at no distant day to the city treasury. The report of Olmsted and Vaux consisted of suggestions about that the park should cover the lands of the ravine and old quarries: *It would follow up the ravine which is now crossed by a bridge at the north end of the principal street of the city, the besides of which –together with the abandoned quarries which adjoin it-are susceptible of picturesque treatment. After passing the quarries it would continue around the pond above the reservoirs. [4]* After the investigation of the site, Olmsted drew a sketch for evolution of the possible alternatives for the location of the park (Figure 2, Figure 3). According to the architects' interpretation,

> A is a small park of a very desirable character
>
> Addition of B is an admirable approach. It would secure the advantages of a fine prospect over the city
>
> Addition of C adds much value, and with connection to A, plot C adds healthfulness and availability as a place of residence of the region
>
> Addition of D provides very great advantage
>
> A strip (2-4 hundred feet) reaching from the park site in different directions and running through pleasant neighborhoods where land is cheap. These strips being secured with reference to the future construction thereon of pleasure drives and walks, which would be attractive places of residence.[4]

In the report, Olmsted and Vaux also mentioned that Newark is so situated with reference to the harbor of New York and the great mining and manufacturing region growing up West of it, that a park of ample dimensions, which shall compare favorably with other notable parks, cannot fail to establish in a few years a great number of taxpaying residents upon its border. In their report, the architects stated that the confined, stimulated and overworked inhabitants of large towns are habitually suffering, and from the wearing and disorganizing effects of which they most need to find conditions favorable to recreation. Giving a reference to Brooklyn Park, Olmsted and Vaux pointed out the character of scenery best fitted to the land: It consists of combinations of trees standing singly or in groups and casting their shadows over broad stretches of turf or repeating their beauty by reflection upon the calm surface of pools, and predominant associations are in the highest degree tranquilizing and grateful. [4]

Evaluating the existing situation, Olmsted and Vaux discussed the potential sites for a new park in Newark and stated that the ground is at present (Boiling Spring) water soaked and unproductive, and its appearance is unattractive, which may be transformed into a pleasure ground of the character required. The scope within which it would be desirable to operate in the formation of pastoral landscapes of a refined and complete character, the central parts of which would be near the point indicated, would extend nearly to the Railroad on the South, the Turnpike on the North, a little beyond Bathgate's lane on the East and to the further slope of the rising ground west of the road which leads from the turnpike to the neighborhood of the German Catholic Church on the West.[4]

One could argue that it is a means to a slum clearance bringing with it the need for operatives' housing because it was reported in the documents of Essex County Alliance that the park would cost over $1.2 million, of which over $500,000 was for buildings to be demolished. While this proposal died in the legislature with a negative vote in 1871, the idea remained alive. In its second iteration, the park idea had progressed from a unitary site to a more comprehensive regional system with greater voter appeal [3]. It is interesting that there had been a great effort of businessmen both from Newark and the Oranges for stimulating the public interest in the park issue. In April 1894, these efforts began to coalesce into a formulated plan to seek once again legislative action to create a park system. This time, the approach was county-wide rather than local. [3]

Tuttle argues that, according to an 1885 study, Newark contained but eleven small parks, 18.6 preserved acres in total. By contrast, two cities with similar populations-- Buffalo and Washington, DC—had 620 acres and 1000 acres of the parkland, respectively. Newark signed over 60 acres of swampy reservoir and hilly land north west of downtown to the newly created Essex County Park Commission. Studies had been conducted as early as 1867 about creating a park 700 acres in size around the reservoir. Decades passed before any action was taken, however, and when it was, in 1895, only one-third of the originally proposed site was still undeveloped. The Ballantines and other families donated land to the long, narrow Branch Brook Park, which eventually expanded to 360 beautiful acres [5]. The city pushed further improvements along involving roads, public transportation, electricity and other conveniences, and the tax rate was bound to rise.

Suburban towns not only lost interest in consolidating with Newark, but they also steadfastly opposed such a measure. In the fall of 1894, with rumors spreading that Newark had its sights on acquiring several adjoining Essex county towns, a movement began to consolidate the Oranges and thereby present a united front against Newark overtures. It was believed that Newark would target Bloomfield, Montclair, Belleville, Irvington, Vailsburg, Millburn, Short Hills, Caldwell, Roseland, Livingston and Verona. [5]

In 1895, the Park Commissioners of Essex County, including Cyrus Peck, the President, F.W. Kelsey, the Vice President and S.J. Meeker, the treasurer, came together again for the park idea. In their report, there existed longings for a park in Newark, saying the benefits of ample open spaces for the health, pleasure and profit for its growing population. Communion with nature is always elevating, and good done to overworked denizens of crowded city streets in wandering through green pastures and beside still waters could be incalculable, was the another point the Commissioners made. The economic return of a park operation was also included in the report; they stated that the pecuniary benefit of parks to surrounding property was clearly demonstrable. A system of parks could be constructed which would rank among the highest in its beauty and usefulness to the people, and at the same time, greatly enhance the value of property throughout the County. [6]

The commissioners stated that there was a growing inclination among the residents of the Metropolis to settle in attractive suburban localities, and Essex County was, so to say, in competition with other residential districts about New York in an effort to obtain this desirable class, and their County should not be behind offering inducements to building up of its towns and cities, to increase of its ratable and to the growth of its population. A system of parks could be constructed which would rank among the highest in its beauty and usefulness to the people, and at the same time, greatly enhance the value of property throughout the County. According to the commissioners' report, the Orange Mountain was even now succumbing to the hand of spoiler, and large sections of its striking picturesque trap formation were being turned into quarries. The Second River District, too, was being bereft of some its finest stretches of first-growth forest, and the same might be said as to other natural beauties in other sections of the County. [6]

The commissioners suggested that the more densely populated parts of the County would be better for creation of parks containing a playground for both sexes, tennis courts and other facilities for exercise in the open air, both on the land and on the water, sand heaps and spaces of usable lawn for children, and to be at points convenient to those who are compelled to reside in such districts, to many whom the acre fare is a forbidding expense to their yearnings for the open and the green. [6]

That the park would be equally enjoyed by all classes in their leisure time was another aspect that was encapsulated in the documents of the commissioners. The commission avoided specific boundaries in the report and recommend a park system, connecting boulevards. However, they argued that four reservation or parks (4000-4500 acres) were candidate lands for the park because these places were the centers of a substantial population. The northern part of the County, western part of the County, southwestern part of the County and southern part of the County were the potential sites that the commissioners considered. That the site for a park should be easily accessible by means of a trolley and other methods of rapid transit, was another point of the commissioners (Figure 4). [6]

In 1895, Nathan Barrett, who was a landscape architect of considerable standing with ties to New Jersey, was invited to Newark to design the park. [3]

The first assignment for Barrett and Bogart was to consider and draw up the boundary lines for the sixty acres of Reservoir Park, which had been transferred to the Park Commission in July 1895. Their task was to locate park areas to make use of these features, determine the boundaries and connect these with parkways. To be effective, their planning had to anticipate lines of population expansion and development of desirable residential districts, influenced by the pattern of streets and railways, as well as economic conditions (Figure 5). [3]

The current boundaries of the Southern Park around the lake south of Fifth Avenue had been drawn by Barret and Bogart's plan. The architects strived to shape the lake shores. Since the 'Branch Brook lake' (the largest of the ponds stretching south of Fifth Avenue) had been long used for ice skating, the Commission did not want to interrupt the public enjoyment of this space. The lake extended from the south into the middle section, with a place on its western bank for music gatherings away from the crowds. More than a circulation necessity for Barrett and Bogart's Branch Brook plan, where linkage between paths and drives was often unrelated and inconsistent, the use of this underpass device seemed to be yet another ornamental feature, a concession to the fashion created by Olmsted and Vaux in their New York park work. [3]

In 1898, the Essex County Park Commission turned once again to the Olmsted firm for advice. Since Frederick Law Olmsted, his firm was newly formed with the partnership of Olmsted Brothers. Sr. His renamed firm was in the experienced hands of John Charles Olmsted, the senior Olmsted's nephew, in partnership with his young half-brother, Frederick Law Olmsted. The project was handled as a typical Olmsted project, making a detailed survey of topographic analyses of the site, which would record the terrain, including vegetation, water conditions and any other special features (Figure 6). By the time, much of the Barrett and Bogart plan had been constructed on both sides of the lake south of Fifth Avenue, although some of it was still quite rough. Thus, while less than a third of the nearly two hundred and eighty acres of Branch Brook Park had been developed, the rest was mostly available for reinterpretation and reshaping according to the Olmsted aesthetic. [3]

For the recommendations for change in the Southern Division of the park, paths ending in cul-de-sacs were included. In the recommendations for change in the Middle Division of the park, removal of the Concert Grove from the middle section to the northern part was offered. Most of the road rearrangements of the southern end of the Northern Division were from the Barrett and Bogart plan, but John Olmsted changed them to provide more screening for roads. Complete seclusion from the noise and smell of factories would not be achievable in this narrow part of the park. Therefore, he concluded that the main drive should be on the east side, with a narrower drive carried along close to the west side of the brook, leaving room along the canal banks for planting. Along lakeside paths and drive, around the lawn at the children's playground, and covering the steep banks along the Morris Canal or railroad, the special vegetation was chosen for screening at the Canal (Figure 7). [3]

By 1913, because of the population growth, the increase in property values partly due to the park system and the increased use of automobiles, the Park Commission considered the parkway issue and hired Olmsted Brothers to do a comprehensive study for pleasure driving and walking. In 1915, with acquisition of land for Belleville Park, this region was also designed by the Olmsted firm. In 1928, cherry Trees in bloom along the banks of Second River were donated by Caroline Bamberger Fuld, who was the sister of Louis Bamberger, the businessman, philanthropist and the leading citizen of Newark (Figure 8). [3]

The residents of Newark seemed eager to upgrade the city's old, neglected residences. A series of 1949 articles in the Newark Evening News decrying slum conditions culminated in a meeting of five hundred clergy members, civic group leaders, politicians and citizens seeking to eliminate blighted areas. Simple rehabilitation would be useless in many of the slum areas. In the National Housing Conference, the executive director pointed to a vote the previous year as an indication of just how supportive Newark was of public housing. A referendum had been approved to appropriate fifteen acres of Branch Brook Park for a low-rent housing project. By 1956, when the Columbus Homes officially opened, the NHA operated 7385 apartments in the city. Since Louis Danzig had taken charge of the authority, the number of public housing units had more than doubled, up from 3008 at the end of WWII. [7]

Besides providing a picturesque beauty to the citizens of Newark, Branch Brook Park and the subsequent Urban Renewal Projects caused segregation in concentration and centralization in the city. The dwellings around the park were settled by mostly white citizens, leaving the Central Ward to the black population. By 1911, mostly German and Italian populations were living in the Central Ward and around the park. By 1960, Mumford stated that Newark was a city of many ethnic groups, but most African Americans still resided in the central area, the Central Ward. Racial isolation had increased dramatically in forty years from 1930 to 1970. The first wave of urban renewal had countered segregation by dispersing residents of blighted areas into first fourteen projects erected between 1940 and 1955 in every major white neighborhood. Yet, referring to Turner, Mumford argues that new public housing contributed to more desegregation and dramatic isolation of the black population. [8]

According to the Census 2000, it was remarkable that the Central Ward was still resided by mostly people of color (Appendix, Section A). The different demographic profile of the residents refined from the Southern Division of the park to the Northern Division. One could consider that the backdrop behind this segregation was related to the design strategies of different landscape architecture firms and the borders. The different sections of the park exhibit distinguishing characteristics of demographic structures through distinguishing design principles. The park is a design of the Olmsted Firm, but after all, the boundaries of the Southern Division was the design of Barret and Bogart's firms with regard to creation of more local park (garden) concerns. According to the Census 2000, this region was settled by mostly low-income Black and Hispanic populations, mostly settled in the last 20 years. Furthermore, the railroads and the roads in the Southwestern part of the park, for instance, disconnect the neighborhood's residents from park use (Appendix, Section A). The fences around the Southern Division are also remarkable and could be considered as the elements that are blocking the park from serving its neighborhood. The Northern part of the park, which is a design of Olmsted's firm, on the other hand, exhibits different features. It is resided by mostly middle income and White population. In the Northern Division, the dwellings are mostly connected to the park with their backyards. The "picturesque beauty" of Olmsted seamlessly conjuncts with the built environment.

Today, The Branch Brook Park is still administrated by the Branch Brook Park Alliance (BBPA), which commits to increase the awareness of the tranquility that Branch Brook Park offers to the local community as a sacred, democratic space where people from diverse backgrounds can meet on a common ground. The mission of the Branch Brook Park Alliance is defined as accomplishing objectives it considers essential to restoration and revitalization of Essex County Branch Brook Park. The Branch Brook Park Alliance, in partnership with the Essex County Department of Parks, Recreation and Cultural Affairs, also provides community-based programs and outreach initiatives. These include an Annual Fishing and Boating Derby for school-aged children, a Farmers' and Community Market, Community Lecture Series, Movies and Dancing Under the Stars, Global Volunteer Day with Prudential, New Jersey Symphony Independence Day Concert and Fireworks Display and Annual Cherry Blossom Festival.

The Branch Brook Park Alliance is supported by civil and non-governmental initiatives, such as the Casino Reinvestment Development Authority, City National Bank, City of Newark, Essex County Open Space Trust, Gallagher Family Legacy of the Community, Geraldine R. Dodge Foundation, Healthcare Foundation, Horizon/Blue Cross Blue Shield of New Jersey, Hyde & Watson Foundation, Independence Community Foundation, Johanette Wallerstein Institute, Leavens Foundation, MCJ Amelior Foundation, New Jersey Devils, New Jersey Historical Commission — a division of Cultural Affairs of the State of New Jersey, New Jersey Historic Trust, Prudential Financial, Prudential Foundation, PSE&G, Schumann Fund for New Jersey, State of New Jersey Community Affairs, State of New Jersey Treasury, State Of New Jersey Department of Environmental Protection Green Acres Program and Victoria Foundation. Currently under construction is the replanting of the Branch Brook Lake Edge in the

Southern Division, a demonstration project of both historical and ecological importance. The goal of the restoration project is to reestablish a naturalistic lake shore in the Olmsted style. The replanting project follows the original Olmsted design with plant substitutions made in some cases to replace plants that have been deemed inappropriate. The boulders will both control access and protect the shoreline. The project includes restoration of the pedestrian paths. Funding for the project is generously provided by the Casino Reinvestment Development Authority, the New Jersey Department of Environmental Protection Office of Natural Resource Restoration and the Branch Brook Park Alliance. [9]

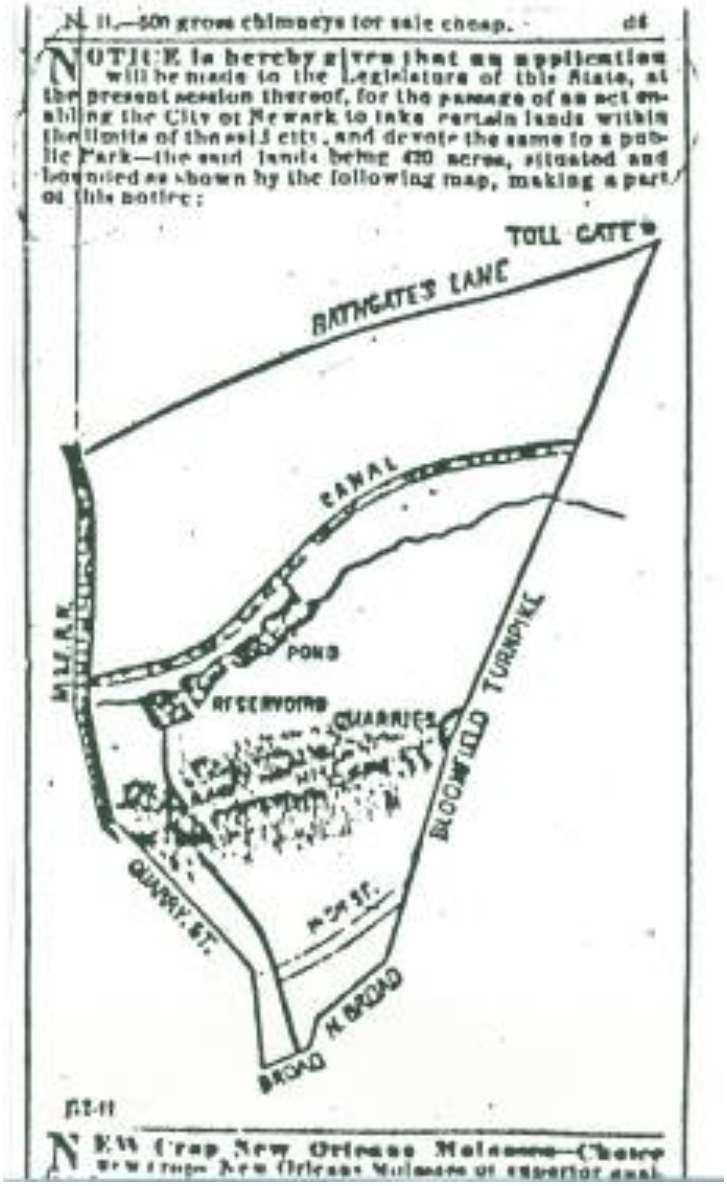


Figure 1: Sketch of land to be taken for a proposed park. Newark Daily Advertiser, January-February 1867.

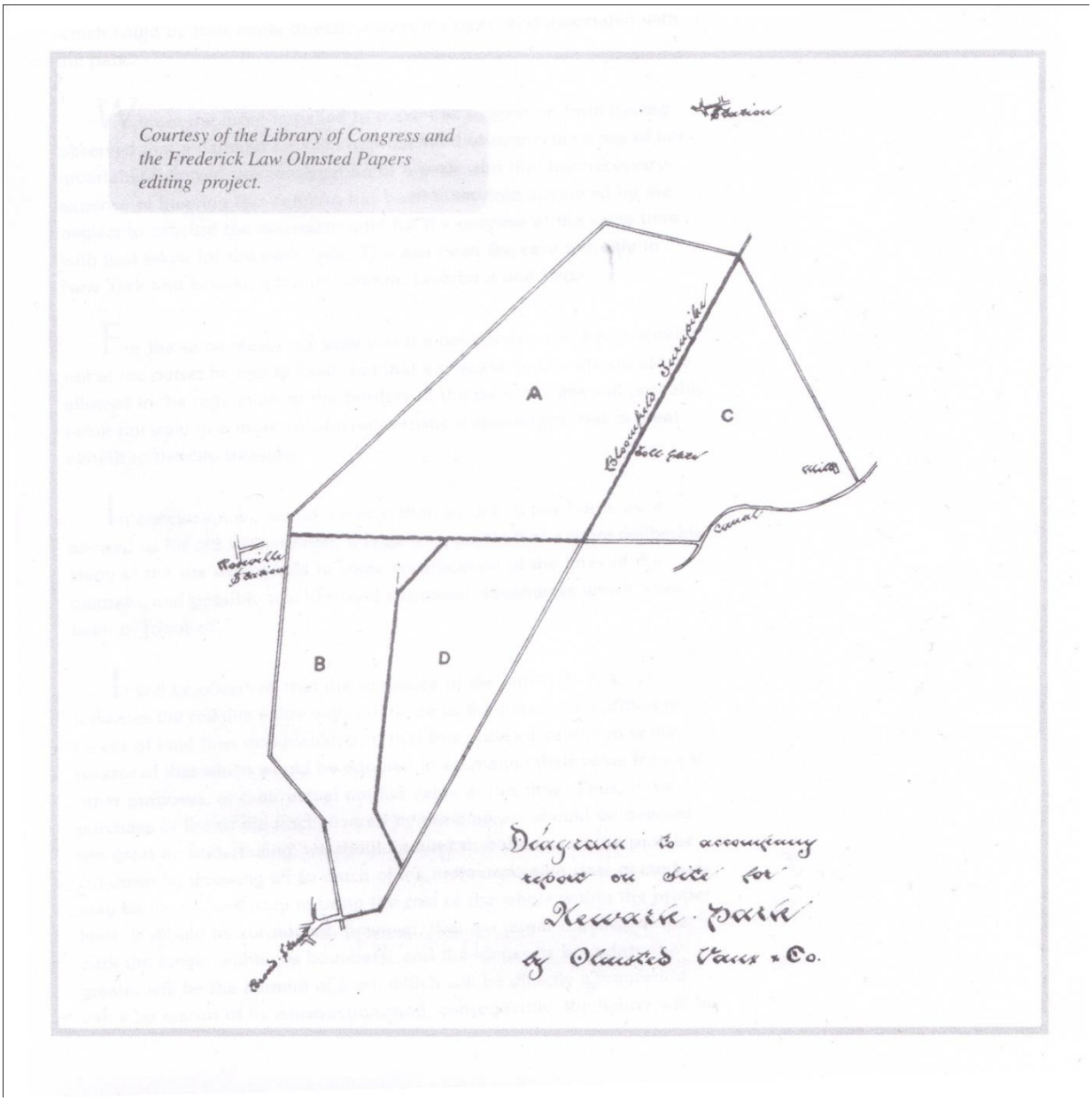


Figure 2: Olmsted & Vaux sketch of lands suggested for their proposed park, 1867.

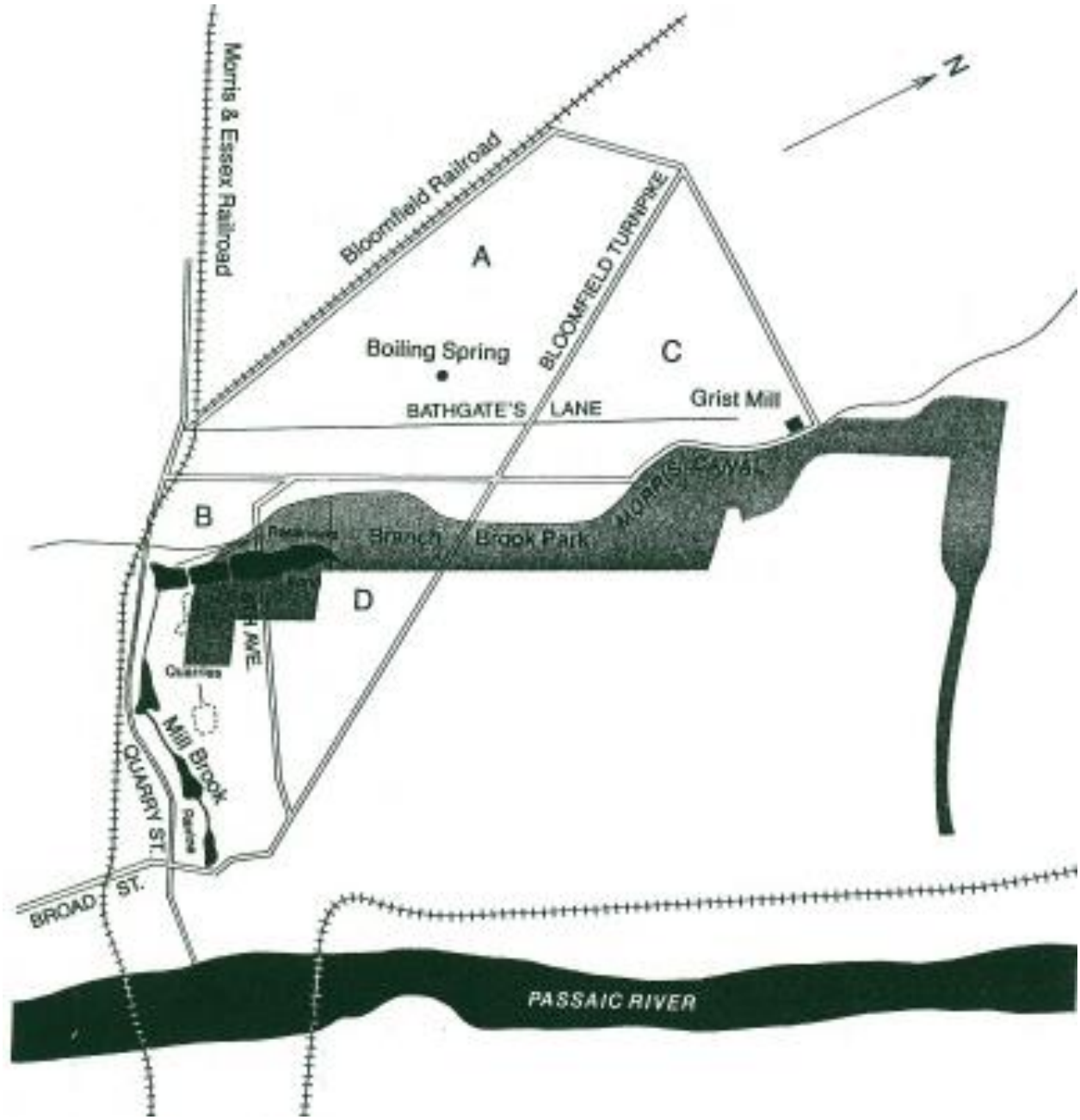


Figure 3: Sketch comparing Olmsted & Vaux 1867 park proposal to present day outline of Branch Brook Park.

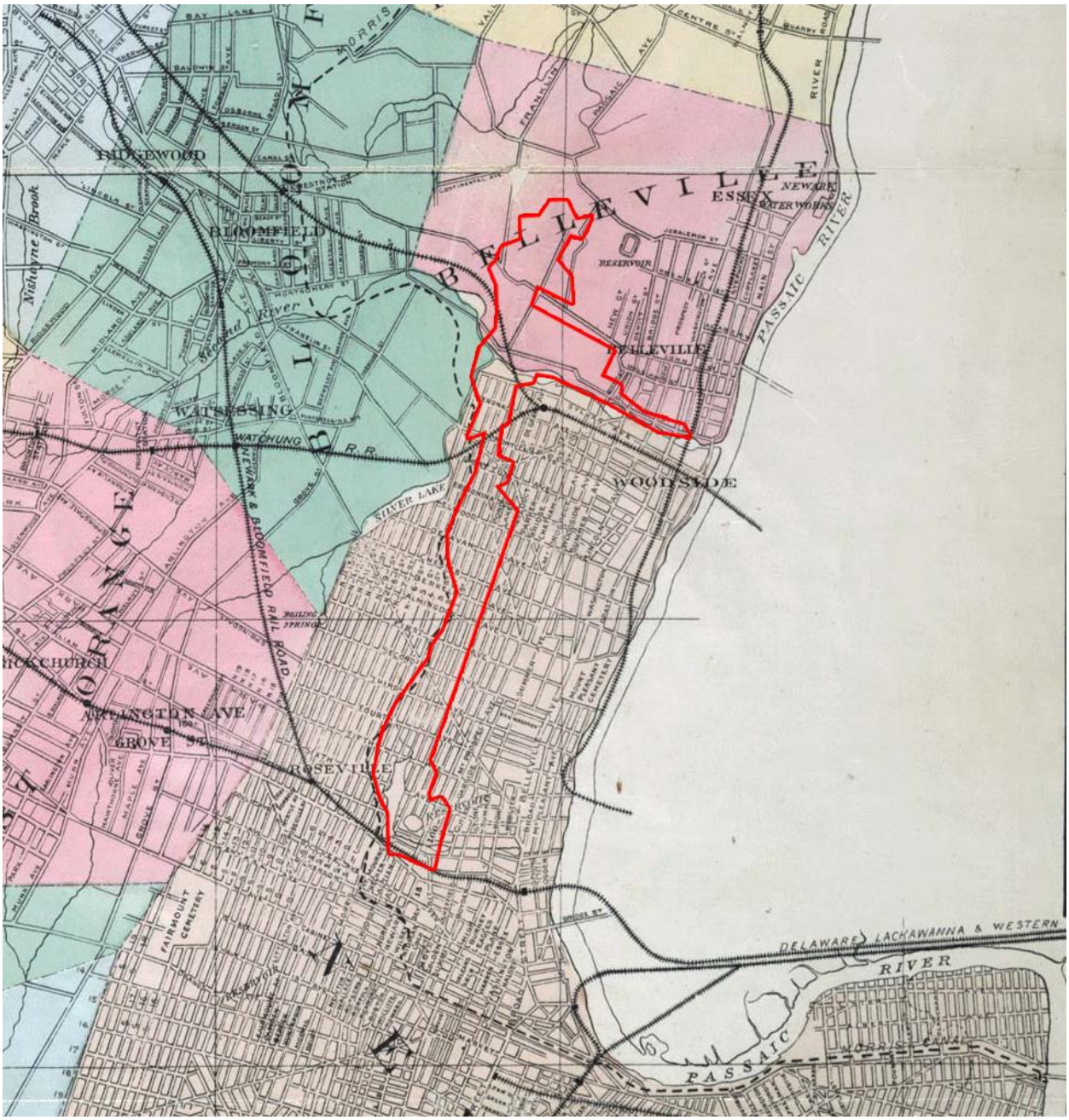


Figure 4: A Map from 1889 showing the current condition of the city of Newark with the current boundaries of the park, Rutgers Library

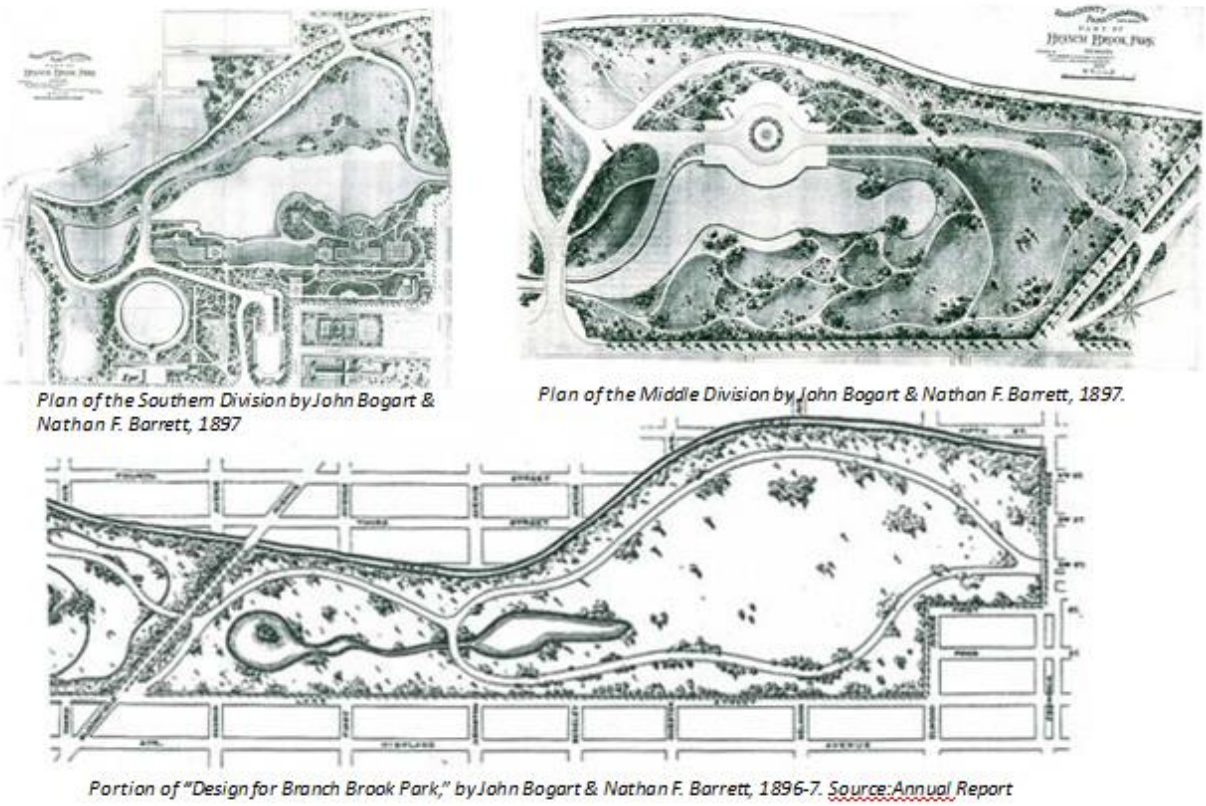


Figure 5: Design of Barret and Bogart's proposal for Branch Brook Park.

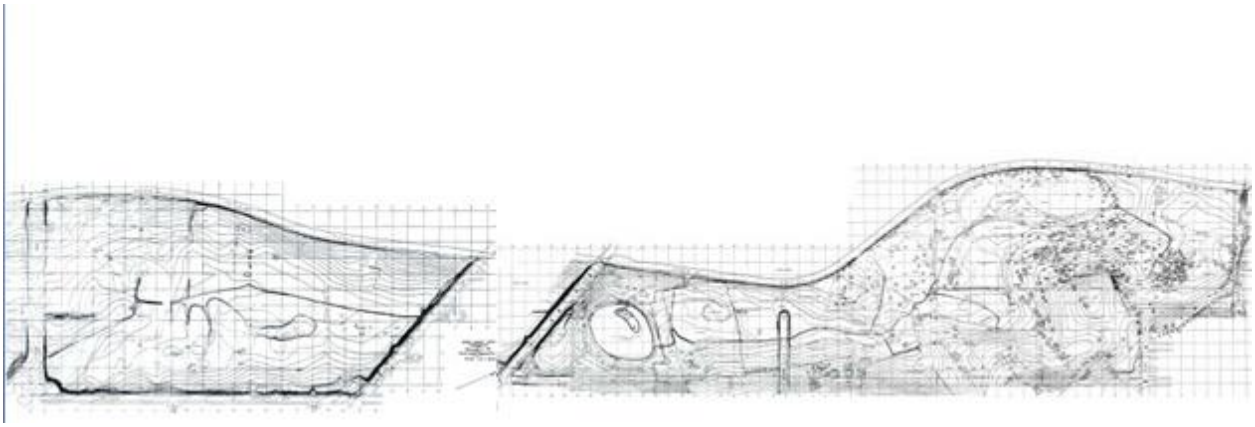


Figure 6: Topographic Survey of Olmsted Brothers, Fifth Avenue- Bloomfield Avenue-Fredonia Avenue

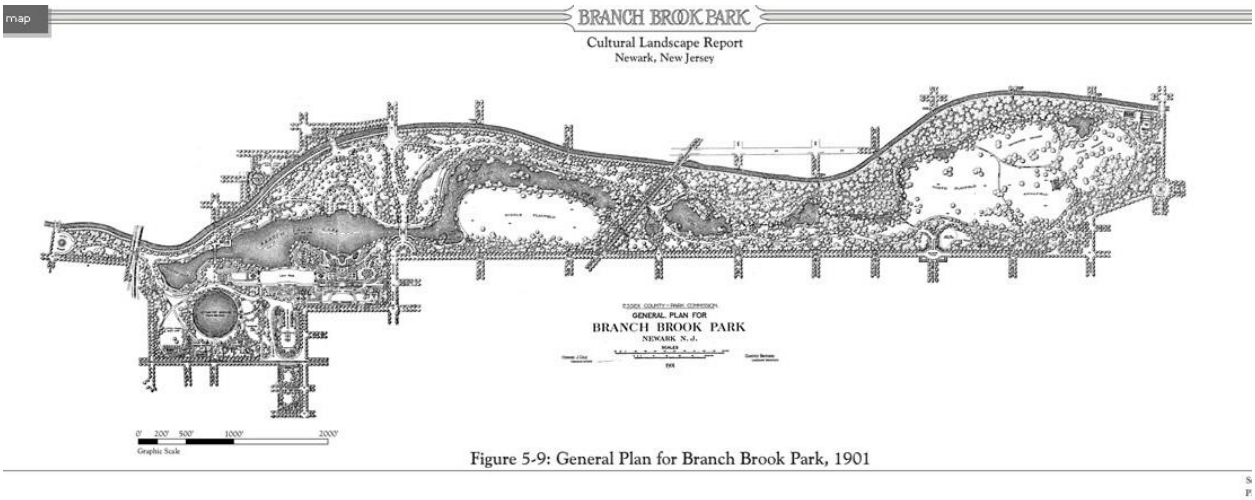


Figure 7: Design proposal of Olmsted Brothers

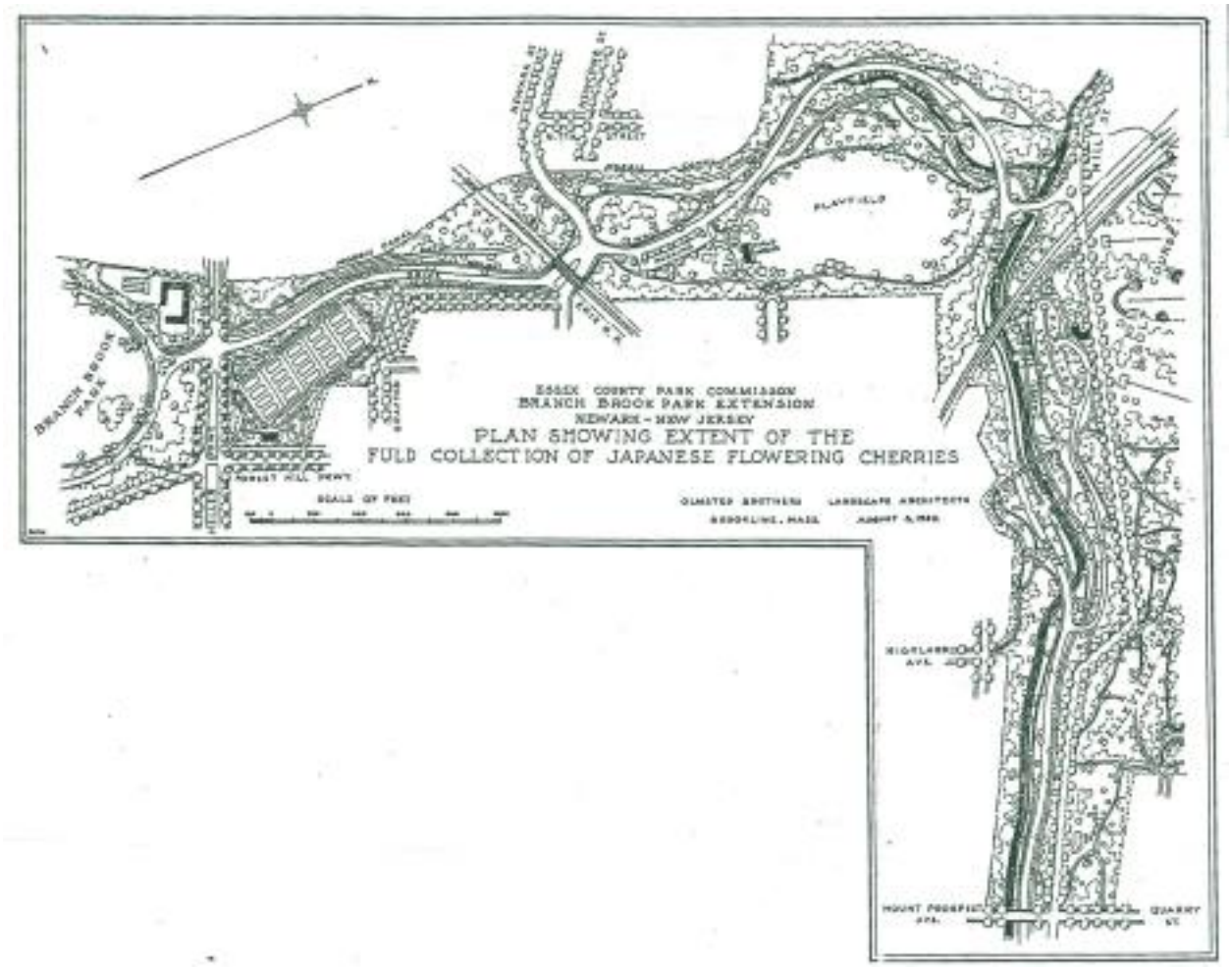
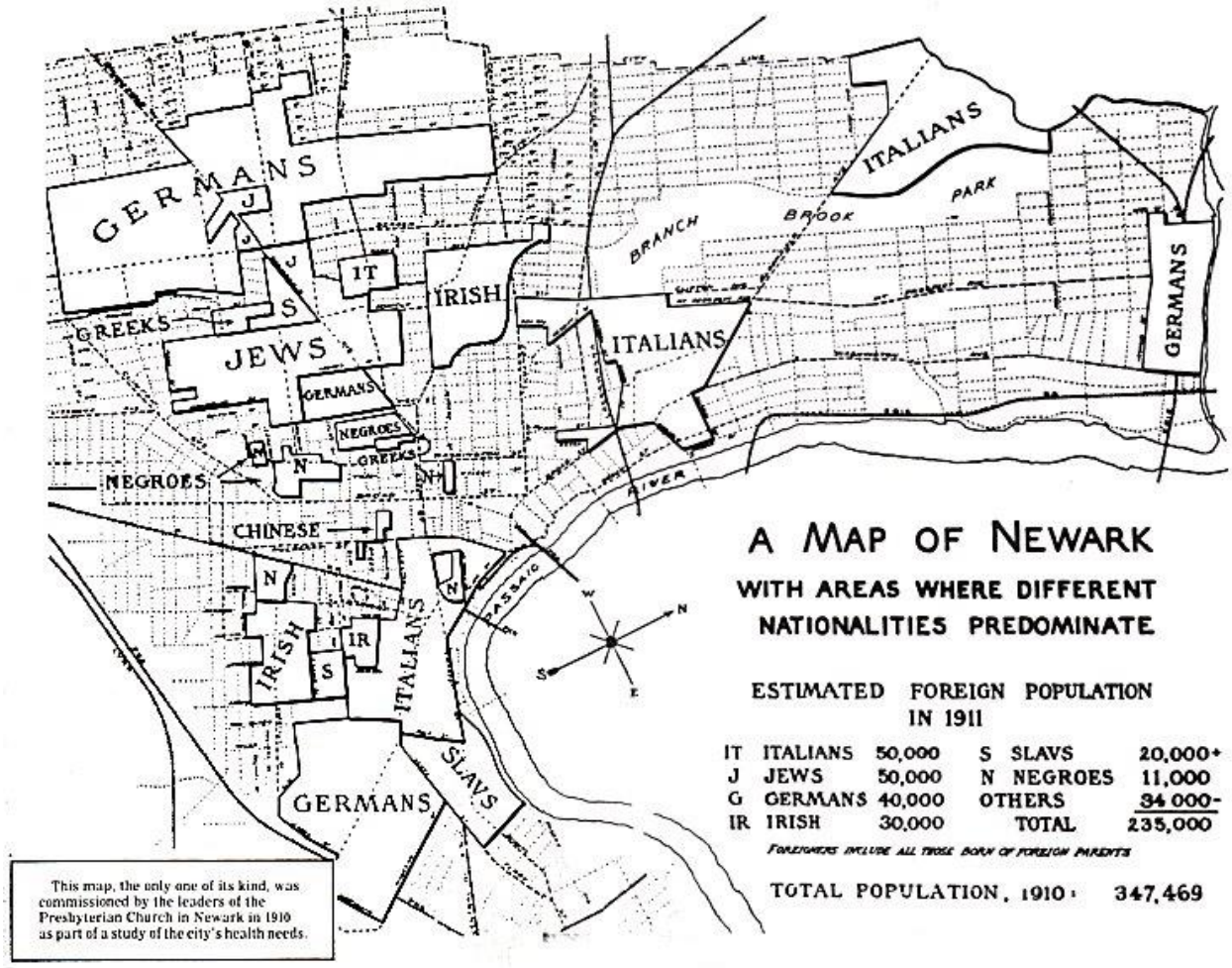


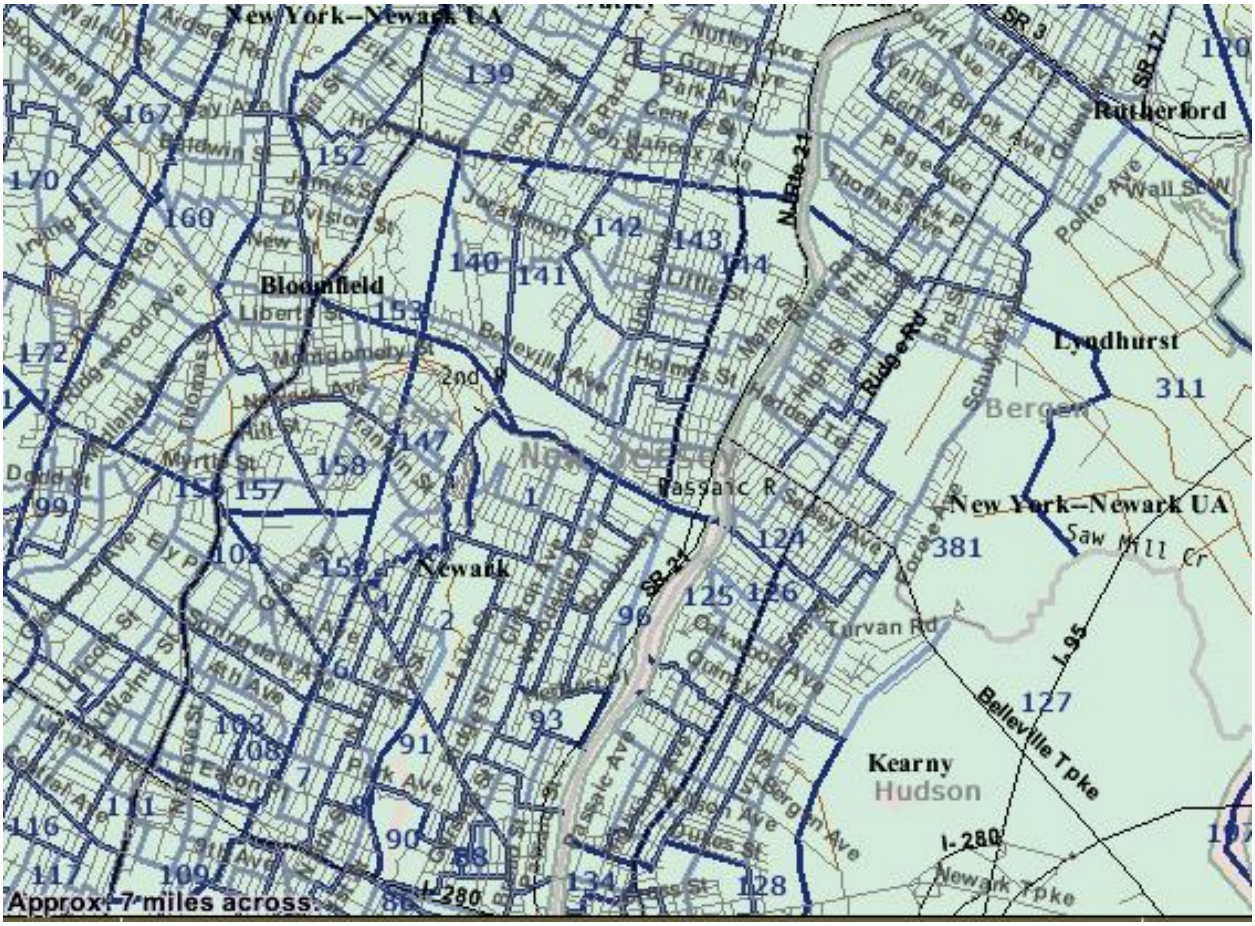
Figure 8: Exhibition plan showing the Extent of the Fuld Collection of Japanese Flowering Cherries, August 1928

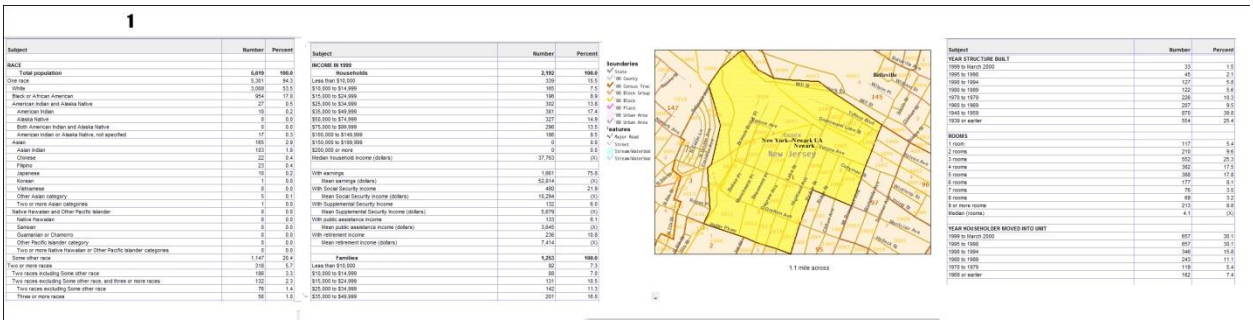


Map from Lonna Doyle

Figure 9: A Map of Newark, 1911, Rutgers Library

Appendix, Section A





1

Subject	Number	Percent
RACE		
Total population	5,619	100.0
One race	5,391	94.3
White	3,068	53.5
Black or African American	954	17.0
American Indian and Alaska Native	27	0.5
American Indian	10	0.2
Alaska Native	0	0.0
Both American Indian and Alaska Native	0	0.0
American Indian or Alaska Native, not specified	17	0.3
Asian	165	2.9
Asian Indian	103	1.8
Chinese	22	0.4
Filipino	23	0.4
Japanese	10	0.2
Korean	1	0.0
Vietnamese	0	0.0
Other Asian category	5	0.1
Two or more Asian categories	1	0.0
Native Hawaiian and Other Pacific Islander	0	0.0
Native Hawaiian	0	0.0
Samoan	0	0.0
Guamanian or Chamorro	0	0.0
Other Pacific Islander category	0	0.0
Two or more Native Hawaiian or Other Pacific Islander categories	0	0.0
Some other race	1,147	20.4
Two or more races	315	5.7
Two races including Some other race	186	3.3
Two races excluding Some other race, and three or more races	132	2.3
Two races excluding Some other race	79	1.4
Three or more races	56	1.0

Subject	Number	Percent
INCOME IN 1999		
Households	2,192	100.0
Less than $10,000	339	15.5
$10,000 to $14,999	165	7.5
$15,000 to $24,999	196	8.9
$25,000 to $34,999	302	13.8
$35,000 to $49,999	381	17.4
$50,000 to $74,999	327	14.9
$75,000 to $99,999	296	13.5
$100,000 to $149,999	186	8.5
$150,000 to $199,999	0	0.0
$200,000 or more	0	0.0
Median household income (dollars)	37,763	(X)
With earnings	1,661	75.8
Mean earnings (dollars)	52,614	(X)
With Social Security income	480	21.9
Mean Social Security income (dollars)	10,284	(X)
With Supplemental Security Income	132	6.0
Mean Supplemental Security Income (dollars)	5,879	(X)
With public assistance income	133	6.1
Mean public assistance income (dollars)	3,640	(X)
With retirement income	236	10.8
Mean retirement income (dollars)	7,414	(X)
Families	1,253	100.0
Less than $10,000	92	7.3
$10,000 to $14,999	88	7.0
$15,000 to $24,999	131	10.5
$25,000 to $34,999	142	11.3
$35,000 to $49,999	201	16.0

Subject	Number	Percent
YEAR STRUCTURE BUILT		
1999 to March 2000	33	1.5
1995 to 1998	45	2.1
1990 to 1994	127	5.8
1980 to 1989	122	5.6
1970 to 1979	226	10.3
1960 to 1969	207	9.5
1940 to 1959	873	39.8
1939 or earlier	554	25.4
ROOMS		
1 room	117	5.4
2 rooms	210	9.6
3 rooms	552	25.3
4 rooms	382	17.5
5 rooms	388	17.8
6 rooms	177	8.1
7 rooms	76	3.5
8 rooms	69	3.2
9 or more rooms	213	9.8
Median (rooms)	4.1	(X)
YEAR HOUSEHOLDER MOVED INTO UNIT		
1999 to March 2000	657	30.1
1995 to 1998	657	30.1
1990 to 1994	346	15.8
1980 to 1989	243	11.1
1970 to 1979	118	5.4
1969 or earlier	162	7.4

2

Subject	Number	Percent
White	1,062	42.7
Black or African American	390	15.7
American Indian and Alaska Native	21	0.8
American Indian	8	0.3
Alaska Native	0	0.0
Both American Indian and Alaska Native	0	0.0
American Indian or Alaska Native, not specified	13	0.5
Asian	39	1.6
Asian Indian	26	1.0
Chinese	0	0.0
Filipino	10	0.4
Japanese	0	0.0
Korean	0	0.0
Vietnamese	0	0.0
Other Asian category	3	0.1
Two or more Asian categories	1	0.0
Native Hawaiian and Other Pacific Islander	1	0.0
Native Hawaiian	0	0.0
Samoan	0	0.0
Guamanian or Chamorro	0	0.0
Other Pacific Islander category	1	0.0
Two or more Native Hawaiian or Other Pacific Islander categories	0	0.0
Some other race	846	34.0
Two or more races	131	5.3
Two races including Some other race	100	4.0
Two races including Some other race, and three or more races	31	1.2
Two races excluding Some other race	26	1.0
Three or more races	5	0.2
HISPANIC OR LATINO		
Total population	**2,490**	**100.0**
Hispanic or Latino (of any race)	1,537	61.7

Subject	Number	Percent
INCOME IN 1999		
Households	**904**	**100.0**
Less than $10,000	401	44.4
$10,000 to $14,999	154	17.0
$15,000 to $24,999	129	14.3
$25,000 to $34,999	66	7.3
$35,000 to $49,999	110	12.2
$50,000 to $74,999	67	7.4
$75,000 to $99,999	39	4.3
$100,000 to $149,999	0	0.0
$150,000 to $199,999	16	1.8
$200,000 or more	0	0.0
Median household income (dollars)	12,446	(X)
With earnings	529	58.5
Mean earnings (dollars)	32,866	(X)
With Social Security income	320	35.4
Mean Social Security income (dollars)	7,591	(X)
With Supplemental Security Income	152	16.8
Mean Supplemental Security Income (dollars)	5,726	(X)
With public assistance income	87	9.6
Mean public assistance income (dollars)	5,211	(X)
With retirement income	120	13.3
Mean retirement income (dollars)	16,342	(X)
Families	**535**	**100.0**
Less than $10,000	174	32.5
$10,000 to $14,999	60	11.2
$15,000 to $24,999	74	13.8
$25,000 to $34,999	36	6.7
$35,000 to $49,999	84	15.7
$50,000 to $74,999	52	9.7



1.1 mile across

Subject	Number	Percent
YEAR STRUCTURE BUILT		
1999 to March 2000	10	1.0
1995 to 1998	9	0.9
1990 to 1994	0	0.0
1980 to 1989	46	4.6
1970 to 1979	83	8.3
1960 to 1969	190	19.0
1940 to 1959	445	44.5
1939 or earlier	266	26.6
ROOMS		
1 room	93	9.3
2 rooms	239	23.9
3 rooms	259	25.9
4 rooms	268	26.8
5 rooms	131	13.1
6 rooms	27	2.7
7 rooms	4	0.4
8 rooms	11	1.1
9 or more rooms	10	1.0
Median (rooms)	3.3	(X)
YEAR HOUSEHOLDER MOVED INTO UNIT		
1999 to March 2000	192	19.2
1995 to 1998	342	34.2
1990 to 1994	196	19.6
1980 to 1989	158	15.8
1970 to 1979	22	2.2
1969 or earlier	89	8.9

3

Subject	Number	Percent
White	1,481	43.3
Black or African American	849	24.8
American Indian and Alaska Native	29	0.8
American Indian	7	0.2
Alaska Native	0	0.0
Both American Indian and Alaska Native	0	0.0
American Indian or Alaska Native, not specified	13	0.4
Asian	101	2.9
Asian Indian	15	0.4
Chinese	9	0.2
Filipino	76	2.2
Japanese	0	0.0
Korean	0	0.0
Vietnamese	1	0.0
Other Asian category	0	0.0
Two or more Asian categories	1	0.0
Native Hawaiian and Other Pacific Islander	0	0.0
Native Hawaiian	0	0.0
Samoan	0	0.0
Guamanian or Chamorro	0	0.0
Other Pacific Islander category	0	0.0
Two or more Native Hawaiian or Other Pacific Islander categories	0	0.0
Some other race	779	22.7
Two or more races	195	5.7
Two races including Some other race	159	4.6
Two races excluding Some other race, and three or more races	37	1.1
Two races excluding Some other race	36	0.9
Three or more races	7	0.2
HISPANIC OR LATINO		
Total population	**3,424**	**100.0**
Hispanic or Latino (of any race)	1,661	48.5

Subject	Number	Percent
INCOME IN 1999		
Households	**1,536**	**100.0**
Less than $10,000	567	36.9
$10,000 to $14,999	188	12.2
$15,000 to $24,999	225	14.6
$25,000 to $34,999	135	8.5
$35,000 to $49,999	143	9.3
$50,000 to $74,999	167	10.9
$75,000 to $99,999	63	4.1
$100,000 to $149,999	37	2.4
$150,000 to $199,999	8	0.5
$200,000 or more	8	0.5
Median household income (dollars)	15,422	(X)
With earnings	798	52.0
Mean earnings (dollars)	37,086	(X)
With Social Security income	572	37.2
Mean Social Security income (dollars)	9,117	(X)
With Supplemental Security Income	221	14.4
Mean Supplemental Security Income (dollars)	6,015	(X)
With public assistance income	129	8.4
Mean public assistance income (dollars)	3,667	(X)
With retirement income	222	14.5
Mean retirement income (dollars)	21,576	(X)
Families	**764**	**100.0**
Less than $10,000	178	23.3
$10,000 to $14,999	69	9.0
$15,000 to $24,999	89	11.6
$25,000 to $34,999	127	16.6
$35,000 to $49,999	82	10.7
$50,000 to $74,999	130	17.0



1.1 mile across

Subject	Number	Percent
YEAR STRUCTURE BUILT		
1999 to March 2000	0	0.0
1995 to 1998	21	1.3
1990 to 1994	29	1.8
1980 to 1989	54	3.4
1970 to 1979	166	10.4
1960 to 1969	500	31.6
1940 to 1959	484	30.5
1939 or earlier	330	20.8
ROOMS		
1 room	203	12.8
2 rooms	253	15.9
3 rooms	345	21.7
4 rooms	358	22.5
5 rooms	300	18.9
6 rooms	69	4.3
7 rooms	20	1.3
8 rooms	24	1.5
9 or more rooms	17	1.1
Median (rooms)	3.5	(X)
YEAR HOUSEHOLDER MOVED INTO UNIT		
1999 to March 2000	334	21.8
1995 to 1998	545	34.3
1990 to 1994	244	15.4
1980 to 1989	275	17.3
1970 to 1979	61	3.8
1969 or earlier	130	8.2

8

Subject	Number	Percent
RACE		
Total population	**4,410**	**100.0**
One race	4,116	93.3
White	1,551	35.2
Black or African American	797	18.1
American Indian and Alaska Native	29	0.7
American Indian	9	0.2
Alaska Native	0	0.0
Both American Indian and Alaska Native	0	0.0
American Indian or Alaska Native, not specified	20	0.5
Asian	64	1.5
Asian Indian	40	0.9
Chinese	9	0.2
Filipino	7	0.2
Japanese	8	0.2
Korean	0	0.0
Vietnamese	0	0.0
Other Asian category	0	0.0
Two or more Asian categories	0	0.0
Native Hawaiian and Other Pacific Islander	0	0.0
Native Hawaiian	0	0.0
Samoan	0	0.0
Guamanian or Chamorro	0	0.0
Other Pacific Islander category	0	0.0
Two or more Native Hawaiian or Other Pacific Islander categories	0	0.0
Some other race	1,674	38.0
Two or more races	295	6.7
Two races including Some other race	243	5.5
Two races excluding Some other race, and three or more races	52	1.2
Two races excluding Some other race	40	0.9
Three or more races	12	0.3

Subject	Number	Percent
INCOME IN 1999		
Households	**1,202**	**100.0**
Less than $10,000	195	16.2
$10,000 to $14,999	87	7.2
$15,000 to $24,999	187	15.6
$25,000 to $34,999	119	9.9
$35,000 to $49,999	238	19.8
$50,000 to $74,999	176	14.6
$75,000 to $99,999	110	9.2
$100,000 to $149,999	55	4.6
$150,000 to $199,999	22	1.8
$200,000 or more	13	1.1
Median household income (dollars)	35,833	(X)
With earnings	992	82.5
Mean earnings (dollars)	46,637	(X)
With Social Security income	209	17.4
Mean Social Security income (dollars)	7,353	(X)
With Supplemental Security Income	104	8.7
Mean Supplemental Security Income (dollars)	7,736	(X)
With public assistance income	102	8.5
Mean public assistance income (dollars)	2,535	(X)
With retirement income	92	7.7
Mean retirement income (dollars)	6,945	(X)
Families	**1,035**	**100.0**
Less than $10,000	150	14.5
$10,000 to $14,999	73	7.1
$15,000 to $24,999	158	15.3
$25,000 to $34,999	122	11.8
$35,000 to $49,999	191	18.5
$50,000 to $74,999	147	14.2



1.1 mile across

Subject	Number	Percent
YEAR STRUCTURE BUILT		
1999 to March 2000	23	1.9
1995 to 1998	50	4.1
1990 to 1994	34	2.8
1980 to 1989	82	6.8
1970 to 1979	89	7.4
1960 to 1969	132	10.9
1940 to 1959	421	34.9
1939 or earlier	375	31.1
ROOMS		
1 room	19	1.6
2 rooms	59	4.9
3 rooms	166	13.8
4 rooms	282	23.4
5 rooms	339	28.1
6 rooms	143	11.9
7 rooms	122	10.1
8 rooms	4	0.3
9 or more rooms	72	6.0
Median (rooms)	4.7	(X)
YEAR HOUSEHOLDER MOVED INTO UNIT		
1999 to March 2000	318	26.4
1995 to 1998	363	30.1
1990 to 1994	207	17.2
1980 to 1989	283	19.5
1970 to 1979	78	6.5
1969 or earlier	37	3.1

9

Subject	Number	Percent
White	819	15.2
Black or African American	2,162	54.5
American Indian and Alaska Native	17	0.4
American Indian	2	0.0
Alaska Native	0	0.0
Both American Indian and Alaska Native	0	0.0
American Indian or Alaska Native, not specified	15	0.4
Asian	18	0.4
Asian Indian	10	0.2
Chinese	0	0.0
Filipino	1	0.0
Japanese	1	0.0
Korean	1	0.0
Vietnamese	0	0.0
Other Asian category	5	0.1
Two or more Asian categories	0	0.0
Native Hawaiian and Other Pacific Islander	0	0.0
Native Hawaiian	0	0.0
Samoan	0	0.0
Guamanian or Chamorro	0	0.0
Other Pacific Islander category	0	0.0
Two or more Native Hawaiian or Other Pacific Islander categories	0	0.0
Some other race	1,039	25.9
Two or more races	146	3.5
Two races including Some other race	112	2.8
Two races excluding Some other race, and three or more races	28	0.7
Two races excluding Some other race	22	0.5
Three or more races	6	0.1
HISPANIC OR LATINO		
Total population	**4,006**	**100.0**
Hispanic or Latino (of any race)	1,783	44.5

Subject	Number	Percent
INCOME IN 1999		
Households	**1,268**	**100.0**
Less than $10,000	399	31.5
$10,000 to $14,999	139	11.0
$15,000 to $24,999	207	16.3
$25,000 to $34,999	131	10.3
$35,000 to $49,999	205	16.2
$50,000 to $74,999	112	8.8
$75,000 to $99,999	48	3.8
$100,000 to $149,999	31	2.4
$150,000 to $199,999	5	0.4
$200,000 or more	0	0.0
Median household income (dollars)	20,192	(X)
With earnings	813	64.1
Mean earnings (dollars)	35,394	(X)
With Social Security income	278	21.9
Mean Social Security income (dollars)	7,585	(X)
With Supplemental Security Income	113	8.9
Mean Supplemental Security Income (dollars)	6,035	(X)
With public assistance income	281	22.2
Mean public assistance income (dollars)	3,278	(X)
With retirement income	99	7.8
Mean retirement income (dollars)	10,288	(X)
Families	**967**	**100.0**
Less than $10,000	306	31.6
$10,000 to $14,999	43	4.4
$15,000 to $24,999	189	19.5
$25,000 to $34,999	97	10.0
$35,000 to $49,999	189	19.5
$50,000 to $74,999	80	8.3



1.1 mile across

Subject	Number	Percent
YEAR STRUCTURE BUILT		
1999 to March 2000	7	0.6
1995 to 1998	36	3.0
1990 to 1994	10	0.8
1980 to 1989	43	3.4
1970 to 1979	160	12.7
1960 to 1969	432	34.4
1940 to 1959	266	21.2
1939 or earlier	300	23.9
ROOMS		
1 room	96	7.6
2 rooms	65	5.2
3 rooms	336	26.8
4 rooms	232	18.5
5 rooms	219	17.4
6 rooms	105	8.4
7 rooms	36	2.9
8 rooms	60	4.8
9 or more rooms	107	8.5
Median (rooms)	4.1	(X)
YEAR HOUSEHOLDER MOVED INTO UNIT		
1999 to March 2000	196	15.6
1995 to 1998	450	35.8
1990 to 1994	197	15.7
1980 to 1989	116	9.2
1970 to 1979	184	15.0
1969 or earlier	109	8.7

10

Subject	Number	Percent
White	700	17.2
Black or African American	2,613	64.1
American Indian and Alaska Native	25	0.6
American Indian	4	0.1
Alaska Native	0	0.0
Both American Indian and Alaska Native	0	0.0
American Indian or Alaska Native, not specified	21	0.5
Asian	61	1.3
Asian Indian	27	0.6
Chinese	19	0.4
Filipino	6	0.1
Japanese	0	0.0
Korean	9	0.2
Vietnamese	0	0.0
Other Asian category	0	0.0
Two or more Asian categories	0	0.0
Native Hawaiian and Other Pacific Islander	1	0.0
Native Hawaiian	1	0.0
Samoan	0	0.0
Guamanian or Chamorro	0	0.0
Other Pacific Islander category	0	0.0
Two or more Native Hawaiian or Other Pacific Islander categories	0	0.0
Some other race	711	15.7
Two or more races	151	3.3
Two races including Some other race	108	2.4
Two races excluding Some other race, and three or more races	42	0.9
Two races excluding Some other race	32	0.7
Three or more races	10	0.2
HISPANIC OR LATINO		
Total population	**4,542**	**100.0**
Hispanic or Latino (of any race)	1,483	32.7

Subject	Number	Percent
INCOME IN 1999		
Households	**1,322**	**100.0**
Less than $10,000	513	38.8
$10,000 to $14,999	120	9.1
$15,000 to $24,999	166	12.6
$25,000 to $34,999	186	14.0
$35,000 to $49,999	131	9.9
$50,000 to $74,999	91	6.9
$75,000 to $99,999	61	4.6
$100,000 to $149,999	19	1.4
$150,000 to $199,999	23	1.7
$200,000 or more	0	0.0
Median household income (dollars)	16,522	(X)
With earnings	831	62.9
Mean earnings (dollars)	30,898	(X)
With Social Security income	265	20.0
Mean Social Security income (dollars)	10,511	(X)
With Supplemental Security Income	167	12.6
Mean Supplemental Security Income (dollars)	7,375	(X)
With public assistance income	337	25.5
Mean public assistance income (dollars)	3,407	(X)
With retirement income	118	8.9
Mean retirement income (dollars)	20,499	(X)
Families	**850**	**100.0**
Less than $10,000	270	31.8
$10,000 to $14,999	77	9.1
$15,000 to $24,999	125	14.7
$25,000 to $34,999	146	17.2
$35,000 to $49,999	119	14.0
$50,000 to $74,999	59	6.8
$75,000 to $99,999	31	3.6



1.1 mile across

Subject	Number	Percent
YEAR STRUCTURE BUILT		
1999 to March 2000	25	2.0
1995 to 1998	14	1.1
1990 to 1994	11	0.9
1980 to 1989	10	0.8
1970 to 1979	131	10.3
1960 to 1969	177	13.9
1940 to 1959	437	34.3
1939 or earlier	468	36.8
ROOMS		
1 room	64	5.0
2 rooms	199	15.6
3 rooms	235	18.5
4 rooms	342	26.9
5 rooms	258	20.3
6 rooms	83	6.5
7 rooms	18	1.4
8 rooms	12	0.9
9 or more rooms	64	5.0
Median (rooms)	3.9	(X)
YEAR HOUSEHOLDER MOVED INTO UNIT		
1999 to March 2000	147	11.5
1995 to 1998	480	37.7
1990 to 1994	229	18.0
1980 to 1989	229	18.0
1970 to 1979	92	7.2
1969 or earlier	96	7.5

19

Subject	Number	Percent
White	92	4.1
Black or African American	2,058	91.4
American Indian and Alaska Native	3	0.1
American Indian	0	0.0
Alaska Native	0	0.0
Both American Indian and Alaska Native	0	0.0
American Indian or Alaska Native, not specified	3	0.1
Asian	4	0.2
Asian Indian	4	0.2
Chinese	0	0.0
Filipino	0	0.0
Japanese	0	0.0
Korean	0	0.0
Vietnamese	0	0.0
Other Asian category	0	0.0
Two or more Asian categories	0	0.0
Native Hawaiian and Other Pacific Islander	1	0.0
Native Hawaiian	0	0.0
Samoan	0	0.0
Guamanian or Chamorro	1	0.0
Other Pacific Islander category	0	0.0
Two or more Native Hawaiian or Other Pacific Islander categories	0	0.0
Some other race	52	2.3
Two or more races	35	1.6
Two races including Some other race	19	0.8
Two races excluding Some other race, and three or more races	16	0.7
Two races excluding Some other race	16	0.7
Three or more races	0	0.0
HISPANIC OR LATINO		
Total population	**2,251**	**100.0**
Hispanic or Latino (of any race)	174	7.7

Subject	Number	Percent
Households	**779**	**100.0**
Less than $10,000	201	26.1
$10,000 to $14,999	116	15.1
$15,000 to $24,999	133	17.3
$25,000 to $34,999	87	11.3
$35,000 to $49,999	60	7.8
$50,000 to $74,999	98	12.7
$75,000 to $99,999	75	9.7
$100,000 to $149,999	0	0.0
$150,000 to $199,999	0	0.0
$200,000 or more	9	0.0
Median household income (dollars)	20,602	(X)
With earnings	455	59.1
Mean earnings (dollars)	37,776	(X)
With Social Security income	132	17.1
Mean Social Security income (dollars)	9,693	(X)
With Supplemental Security Income	90	11.7
Mean Supplemental Security Income (dollars)	6,562	(X)
With public assistance income	131	17.0
Mean public assistance income (dollars)	6,488	(X)
With retirement income	82	10.6
Mean retirement income (dollars)	6,934	(X)
Families	**608**	**100.0**
Less than $10,000	118	19.3
$10,000 to $14,999	95	15.6
$15,000 to $24,999	100	16.7
$25,000 to $34,999	80	13.3
$35,000 to $49,999	50	8.3
$50,000 to $74,999	95	15.8
$75,000 to $99,999	64	10.7



Subject	Number	Percent
YEAR STRUCTURE BUILT		
1999 to March 2000	0	0.0
1995 to 1998	0	0.0
1990 to 1994	0	0.0
1980 to 1989	55	7.0
1970 to 1979	94	12.0
1960 to 1969	105	14.3
1940 to 1959	290	40.2
1939 or earlier	180	24.5
ROOMS		
1 room	9	1.2
2 rooms	51	6.9
3 rooms	88	12.0
4 rooms	180	24.5
5 rooms	246	33.9
6 rooms	93	12.7
7 rooms	9	1.2
8 rooms	25	3.4
9 or more rooms	30	4.1
Median (rooms)	4.7	(X)
YEAR HOUSEHOLDER MOVED INTO UNIT		
1999 to March 2000	149	20.3
1995 to 1998	199	27.1
1990 to 1994	133	18.1
1980 to 1989	119	16.2
1970 to 1979	77	10.5
1969 or earlier	57	7.8

86

Subject	Number	Percent
White	146	10.8
Black or African American	933	69.0
American Indian and Alaska Native	2	0.1
American Indian	0	0.0
Alaska Native	0	0.0
Both American Indian and Alaska Native	0	0.0
American Indian or Alaska Native, not specified	2	0.1
Asian	86	6.4
Asian Indian	34	2.5
Chinese	16	1.2
Filipino	16	1.2
Japanese	6	0.4
Korean	12	0.9
Vietnamese	0	0.0
Other Asian category	1	0.1
Two or more Asian categories	1	0.1
Native Hawaiian and Other Pacific Islander	10	0.7
Native Hawaiian	0	0.0
Samoan	0	0.0
Guamanian or Chamorro	0	0.0
Other Pacific Islander category	10	0.7
Two or more Native Hawaiian or Other Pacific Islander categories	0	0.0
Some other race	77	5.6
Two or more races	81	6.1
Two races including Some other race	63	4.7
Two races excluding Some other race, and three or more races	18	1.2
Two races excluding Some other race	13	1.0
Three or more races	5	0.4
HISPANIC OR LATINO		
Total population	**1,336**	**100.0**
Hispanic or Latino (of any race)	190	14.2

Subject	Number	Percent
INCOME IN 1999		
Households	**633**	**100.0**
Less than $10,000	160	25.3
$10,000 to $14,999	16	2.5
$15,000 to $24,999	99	15.6
$25,000 to $34,999	109	15.8
$35,000 to $49,999	115	18.2
$50,000 to $74,999	91	14.4
$75,000 to $99,999	34	5.4
$100,000 to $149,999	18	2.8
$150,000 to $199,999	0	0.0
$200,000 or more	0	0.0
Median household income (dollars)	28,706	(X)
With earnings	521	82.3
Mean earnings (dollars)	37,647	(X)
With Social Security income	63	10.0
Mean Social Security income (dollars)	2,854	(X)
With Supplemental Security Income	23	3.6
Mean Supplemental Security Income (dollars)	9,239	(X)
With public assistance income	23	3.6
Mean public assistance income (dollars)	378	(X)
With retirement income	13	2.1
Mean retirement income (dollars)	3,846	(X)
Families	**265**	**100.0**
Less than $10,000	40	15.1
$10,000 to $14,999	16	6.0
$15,000 to $24,999	54	20.4
$25,000 to $34,999	39	14.7
$35,000 to $49,999	52	19.6
$50,000 to $74,999	30	11.3



Subject	Number	Percent
YEAR STRUCTURE BUILT		
1999 to March 2000	0	0.0
1995 to 1998	0	0.0
1990 to 1994	0	0.0
1980 to 1989	46	5.9
1970 to 1979	107	14.1
1960 to 1969	299	39.5
1940 to 1959	239	31.6
1939 or earlier	67	8.9
ROOMS		
1 room	369	48.7
2 rooms	223	29.5
3 rooms	85	11.2
4 rooms	47	6.2
5 rooms	33	4.4
6 rooms	0	0.0
7 rooms	0	0.0
8 rooms	0	0.0
9 or more rooms	0	0.0
Median (rooms)	1.5	(X)
YEAR HOUSEHOLDER MOVED INTO UNIT		
1999 to March 2000	293	38.7
1995 to 1998	262	34.6
1990 to 1994	71	9.4
1980 to 1989	28	3.7
1970 to 1979	76	10.0
1969 or earlier	27	3.6

88

Subject	Number	Percent
White	625	28.7
Black or African American	342	21.2
American Indian and Alaska Native	26	1.6
American Indian	11	0.7
Alaska Native	0	0.0
Both American Indian and Alaska Native	0	0.0
American Indian or Alaska Native, not specified	15	0.9
Asian	2	0.1
Asian Indian	1	0.1
Chinese	0	0.0
Filipino	1	0.1
Japanese	0	0.0
Korean	0	0.0
Vietnamese	0	0.0
Other Asian category	0	0.0
Two or more Asian categories	0	0.0
Native Hawaiian and Other Pacific Islander	0	0.0
Native Hawaiian	0	0.0
Samoan	0	0.0
Guamanian or Chamorro	0	0.0
Other Pacific Islander category	0	0.0
Two or more Native Hawaiian or Other Pacific Islander categories	0	0.0
Some other race	482	29.9
Two or more races	137	8.5
Two races including Some other race	130	8.1
Two races excluding Some other race, and three or more races	7	0.4
Two races excluding Some other race	7	0.4
Three or more races	0	0.0
HISPANIC OR LATINO		
Total population	**1,614**	**100.0**
Hispanic or Latino (of any race)	1,225	75.9

Subject	Number	Percent
Households	**505**	**100.0**
Less than $10,000	106	21.0
$10,000 to $14,999	104	20.6
$15,000 to $24,999	34	6.7
$25,000 to $34,999	114	22.6
$35,000 to $49,999	67	13.3
$50,000 to $74,999	32	6.3
$75,000 to $99,999	21	4.2
$100,000 to $149,999	20	4.0
$150,000 to $199,999	7	1.4
$200,000 or more	0	0.0
Median household income (dollars)	25,394	(X)
With earnings	328	65.0
Mean earnings (dollars)	32,535	(X)
With Social Security income	160	31.7
Mean Social Security income (dollars)	12,051	(X)
With Supplemental Security Income	66	13.1
Mean Supplemental Security Income (dollars)	5,539	(X)
With public assistance income	99	19.6
Mean public assistance income (dollars)	2,796	(X)
With retirement income	58	11.5
Mean retirement income (dollars)	14,290	(X)
Families	**377**	**100.0**
Less than $10,000	97	25.7
$10,000 to $14,999	49	13.0
$15,000 to $24,999	36	9.5
$25,000 to $34,999	77	20.4
$35,000 to $49,999	57	15.1
$50,000 to $74,999	33	8.8
$75,000 to $99,999	21	5.6

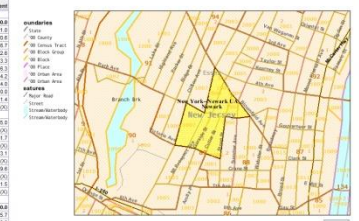


Subject	Number	Percent
YEAR STRUCTURE BUILT		
1999 to March 2000	0	0.0
1995 to 1998	0	0.0
1990 to 1994	0	0.0
1980 to 1989	45	5.6
1970 to 1979	107	14.1
1960 to 1969	299	39.5
1940 to 1959	239	31.6
1939 or earlier	67	8.9
ROOMS		
1 room	369	48.7
2 rooms	223	29.5
3 rooms	85	11.2
4 rooms	47	6.2
5 rooms	33	4.4
6 rooms	0	0.0
7 rooms	0	0.0
8 rooms	0	0.0
9 or more rooms	0	0.0
Median (rooms)	1.5	(X)
YEAR HOUSEHOLDER MOVED INTO UNIT		
1999 to March 2000	293	38.7
1995 to 1998	262	34.6
1990 to 1994	71	9.4
1980 to 1989	28	3.7
1970 to 1979	76	10.0
1969 or earlier	27	3.6

89

Subject	Number	Percent
White	625	38.7
Black or African American	342	21.2
American Indian and Alaska Native	26	1.6
American Indian	11	0.7
Alaska Native	0	0.0
Both American Indian and Alaska Native	0	0.0
American Indian or Alaska Native, not specified	15	0.9
Asian	2	0.1
Asian Indian	1	0.1
Chinese	0	0.0
Filipino	1	0.1
Japanese	0	0.0
Korean	0	0.0
Vietnamese	0	0.0
Other Asian category	0	0.0
Two or more Asian categories	0	0.0
Native Hawaiian and Other Pacific Islander	0	0.0
Native Hawaiian	0	0.0
Samoan	0	0.0
Guamanian or Chamorro	0	0.0
Other Pacific Islander category	0	0.0
Two or more Native Hawaiian or Other Pacific Islander categories	0	0.0
Some other race	482	29.9
Two or more races	137	8.5
Two races including Some other race	130	8.1
Two races excluding Some other race, and three or more races	7	0.4
Two races excluding Some other race	7	0.4
Three or more races	0	0.0
HISPANIC OR LATINO		
Total population	**1,614**	**100.0**
Hispanic or Latino (of any race)	1,225	75.9

Subject	Number	Percent
INCOME IN 1999		
Households	**505**	**100.0**
Less than $10,000	106	21.0
$10,000 to $14,999	104	20.6
$15,000 to $24,999	34	6.7
$25,000 to $34,999	114	22.6
$35,000 to $49,999	67	13.3
$50,000 to $74,999	32	6.3
$75,000 to $99,999	21	4.2
$100,000 to $149,999	20	4.0
$150,000 to $199,999	7	1.4
$200,000 or more	0	0.0
Median household income (dollars)	25,394	(X)
With earnings	328	65.0
Mean earnings (dollars)	32,535	(X)
With Social Security income	160	31.7
Mean Social Security income (dollars)	12,051	(X)
With Supplemental Security Income	66	13.1
Mean Supplemental Security Income (dollars)	5,539	(X)
With public assistance income	99	19.6
Mean public assistance income (dollars)	2,796	(X)
With retirement income	58	11.5
Mean retirement income (dollars)	14,290	(X)
Families	**377**	**100.0**
Less than $10,000	97	25.7
$10,000 to $14,999	49	13.0
$15,000 to $24,999	36	9.5
$25,000 to $34,999	77	20.4
$35,000 to $49,999	57	15.1
$50,000 to $74,999	33	8.8
$75,000 to $99,999	21	5.6



Subject	Number	Percent
YEAR STRUCTURE BUILT		
1999 to March 2000	32	4.8
1995 to 1998	23	3.5
1990 to 1994	28	4.2
1980 to 1989	6	0.9
1970 to 1979	52	7.9
1960 to 1969	43	6.5
1940 to 1959	221	33.4
1939 or earlier	257	38.8
ROOMS		
1 room	18	2.7
2 rooms	75	11.3
3 rooms	162	24.5
4 rooms	160	24.2
5 rooms	140	21.1
6 rooms	39	5.9
7 rooms	13	2.0
8 rooms	23	3.5
9 or more rooms	32	4.8
Median (rooms)	4.9	(X)
YEAR HOUSEHOLDER MOVED INTO UNIT		
1999 to March 2000	181	27.3
1995 to 1998	225	34.0
1990 to 1994	79	10.8
1980 to 1989	67	10.1
1970 to 1979	46	6.9
1969 or earlier	73	11.0

90

Subject	Number	Percent
RACE		
Total population	**1,885**	**100.0**
One race	1,881	93.6
White	387	19.5
Black or African American	1,220	61.7
American Indian and Alaska Native	4	0.2
American Indian	4	0.2
Alaska Native	0	0.0
Both American Indian and Alaska Native	0	0.0
American Indian or Alaska Native, not specified	0	0.0
Asian	15	0.8
Asian Indian	11	0.6
Chinese	1	0.1
Filipino	0	0.0
Japanese	0	0.0
Korean	3	0.2
Vietnamese	0	0.0
Other Asian category	0	0.0
Two or more Asian categories	0	0.0
Native Hawaiian and Other Pacific Islander	0	0.0
Native Hawaiian	0	0.0
Samoan	0	0.0
Guamanian or Chamorro	0	0.0
Other Pacific Islander category	0	0.0
Two or more Native Hawaiian or Other Pacific Islander categories	0	0.0
Some other race	230	11.6
Two or more races	124	6.2
Two races including Some other race	94	4.7
Two races excluding Some other race, and three or more races	30	1.5
Two races excluding Some other race	22	1.1
Three or more races	8	0.4

Subject	Number	Percent
INCOME IN 1999		
Households	**955**	**100.0**
Less than $10,000	239	25.4
$10,000 to $14,999	42	4.6
$15,000 to $24,999	122	13.5
$25,000 to $34,999	103	11.4
$35,000 to $49,999	158	17.5
$50,000 to $74,999	163	18.0
$75,000 to $99,999	50	5.5
$100,000 to $149,999	20	2.2
$150,000 to $199,999	9	0.9
$200,000 or more	9	0.9
Median household income (dollars)	29,386	(X)
With earnings	657	72.6
Mean earnings (dollars)	40,318	(X)
With Social Security income	124	13.7
Mean Social Security income (dollars)	6,896	(X)
With Supplemental Security Income	102	11.3
Mean Supplemental Security Income (dollars)	6,790	(X)
With public assistance income	125	13.8
Mean public assistance income (dollars)	3,968	(X)
With retirement income	37	4.1
Mean retirement income (dollars)	4,751	(X)
Families	**491**	**100.0**
Less than $10,000	140	28.5
$10,000 to $14,999	19	3.9
$15,000 to $24,999	80	16.3
$25,000 to $34,999	43	8.8
$35,000 to $49,999	87	17.7
$50,000 to $74,999	81	16.5



Subject	Number	Percent
YEAR STRUCTURE BUILT		
1999 to March 2000	11	1.2
1995 to 1998	17	1.8
1990 to 1994	0	0.0
1980 to 1989	229	24.9
1970 to 1979	199	21.6
1960 to 1969	292	31.7
1940 to 1959	158	17.2
1939 or earlier	15	1.6
ROOMS		
1 room	94	10.2
2 rooms	160	17.4
3 rooms	228	24.8
4 rooms	190	20.6
5 rooms	131	14.2
6 rooms	41	4.5
7 rooms	60	6.5
8 rooms	0	0.0
9 or more rooms	17	1.8
Median (rooms)	3.4	(X)
YEAR HOUSEHOLDER MOVED INTO UNIT		
1999 to March 2000	148	16.1
1995 to 1998	330	35.8
1990 to 1994	180	19.5
1980 to 1989	252	27.4
1970 to 1979	11	1.2
1969 or earlier	0	0.0

91

Subject	Number	Percent
RACE		
Total population	3,216	100.0
One race	3,025	94.1
White	1,229	38.2
Black or African American	324	10.1
American Indian and Alaska Native	29	0.9
American Indian	4	0.1
Alaska Native	1	0.0
Both American Indian and Alaska Native	0	0.0
American Indian or Alaska Native, not specified	24	0.7
Asian	26	0.8
Asian Indian	19	0.6
Chinese	6	0.2
Filipino	1	0.0
Japanese	0	0.0
Korean	0	0.0
Vietnamese	0	0.0
Other Asian category	0	0.0
Two or more Asian categories	0	0.0
Native Hawaiian and Other Pacific Islander	2	0.1
Native Hawaiian	0	0.0
Samoan	0	0.0
Guamanian or Chamorro	2	0.1
Other Pacific Islander category	0	0.0
Two or more Native Hawaiian or Other Pacific Islander categories	0	0.0
Some other race	1,415	44.0
Two or more races	191	5.9
Two races including Some other race	154	4.8
Two races excluding Some other race, and three or more races	37	1.2
Two races excluding Some other race	30	0.9
Three or more races	7	0.2

Subject	Number	Percent
INCOME IN 1999		
Households	874	100.0
Less than $10,000	147	16.8
$10,000 to $14,999	78	8.9
$15,000 to $24,999	177	20.3
$25,000 to $34,999	140	16.0
$35,000 to $49,999	105	13.7
$50,000 to $74,999	148	16.9
$75,000 to $99,999	30	3.4
$100,000 to $149,999	34	3.9
$150,000 to $199,999	6	0.6
$200,000 or more	0	0.0
Median household income (dollars)	25,931	(X)
With earnings	670	76.7
Mean earnings (dollars)	36,153	(X)
With Social Security income	191	21.9
Mean Social Security income (dollars)	9,884	(X)
With Supplemental Security Income	142	16.2
Mean Supplemental Security Income (dollars)	6,851	(X)
With public assistance income	186	21.3
Mean public assistance income (dollars)	3,723	(X)
With retirement income	61	7.0
Mean retirement income (dollars)	10,599	(X)
Families	686	100.0
Less than $10,000	148	21.6
$10,000 to $14,999	31	4.5
$15,000 to $24,999	142	20.7
$25,000 to $34,999	108	15.7
$35,000 to $49,999	76	11.1
$50,000 to $74,999	123	17.9



Subject	Number	Percent
YEAR STRUCTURE BUILT		
1999 to March 2000	17	1.9
1995 to 1998	35	3.9
1990 to 1994	33	3.7
1980 to 1989	46	5.2
1970 to 1979	42	4.7
1960 to 1969	125	13.8
1940 to 1959	168	18.7
1939 or earlier	428	48.1
ROOMS		
1 room	31	3.5
2 rooms	56	6.6
3 rooms	177	19.9
4 rooms	218	24.5
5 rooms	251	28.2
6 rooms	67	7.5
7 rooms	15	1.7
8 rooms	38	4.3
9 or more rooms	43	4.8
Median (rooms)	4.4	(X)
YEAR HOUSEHOLDER MOVED INTO UNIT		
1999 to March 2000	169	19.0
1995 to 1998	302	33.9
1990 to 1994	174	19.6
1980 to 1989	132	14.8
1970 to 1979	34	3.8
1969 or earlier	79	8.9

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94

Subject	Number	Percent
RACE		
Total population	6,085	100.0
One race	5,617	92.3
White	2,439	39.9
Black or African American	1,531	25.2
American Indian and Alaska Native	21	0.3
American Indian	3	0.0
Alaska Native	0	0.0
Both American Indian and Alaska Native	0	0.0
American Indian or Alaska Native, not specified	18	0.3
Asian	104	1.7
Asian Indian	49	0.8
Chinese	17	0.3
Filipino	24	0.4
Japanese	6	0.1
Korean	2	0.0
Vietnamese	0	0.0
Other Asian category	5	0.1
Two or more Asian categories	1	0.0
Native Hawaiian and Other Pacific Islander	5	0.1
Native Hawaiian	0	0.0
Samoan	0	0.0
Guamanian or Chamorro	5	0.1
Other Pacific Islander category	0	0.0
Two or more Native Hawaiian or Other Pacific Islander categories	0	0.0
Some other race	1,726	28.4
Two or more races	268	4.4
Two races including Some other race	216	3.5
Two races excluding Some other race, and three or more races	52	0.9
Two races excluding Some other race	38	0.6
Three or more races	14	0.2

Subject	Number	Percent
INCOME IN 1999		
Households	2,321	100.0
Less than $10,000	523	22.5
$10,000 to $14,999	221	9.5
$15,000 to $24,999	397	17.1
$25,000 to $34,999	211	9.1
$35,000 to $49,999	233	10.0
$50,000 to $74,999	404	17.4
$75,000 to $99,999	124	5.3
$100,000 to $149,999	164	7.1
$150,000 to $199,999	24	1.0
$200,000 or more	20	0.9
Median household income (dollars)	25,567	(X)
With earnings	1,631	70.3
Mean earnings (dollars)	47,414	(X)
With Social Security income	612	26.4
Mean Social Security income (dollars)	8,997	(X)
With Supplemental Security Income	192	8.3
Mean Supplemental Security Income (dollars)	5,956	(X)
With public assistance income	212	9.1
Mean public assistance income (dollars)	2,901	(X)
With retirement income	225	9.7
Mean retirement income (dollars)	13,488	(X)
Families	1,363	100.0
Less than $10,000	190	13.9
$10,000 to $14,999	36	2.6
$15,000 to $24,999	238	17.5
$25,000 to $34,999	140	10.3
$35,000 to $49,999	160	11.7
$50,000 to $74,999	289	21.2



Subject	Number	Percent
YEAR STRUCTURE BUILT		
1999 to March 2000	20	0.8
1995 to 1998	24	1.0
1990 to 1994	20	0.8
1980 to 1989	109	4.7
1970 to 1979	213	9.2
1960 to 1969	380	16.4
1940 to 1959	969	41.8
1939 or earlier	579	25.0
ROOMS		
1 room	318	13.7
2 rooms	252	10.9
3 rooms	565	24.4
4 rooms	283	12.2
5 rooms	335	14.5
6 rooms	199	8.6
7 rooms	92	3.9
8 rooms	66	2.8
9 or more rooms	229	9.9
Median (rooms)	3.6	(X)
YEAR HOUSEHOLDER MOVED INTO UNIT		
1999 to March 2000	616	26.6
1995 to 1998	773	33.4
1990 to 1994	476	20.6
1980 to 1989	254	11.0
1970 to 1979	130	5.6
1969 or earlier	65	2.8

95

Subject	Number	Percent
Total population	6,600	100.0
One race	6,283	95.2
White	2,965	44.9
Black or African American	931	14.1
American Indian and Alaska Native	39	0.6
American Indian	12	0.2
Alaska Native	0	0.0
Both American Indian and Alaska Native	0	0.0
American Indian or Alaska Native, not specified	27	0.4
Asian	90	1.4
Asian Indian	29	0.4
Chinese	21	0.3
Filipino	10	0.2
Japanese	5	0.1
Korean	15	0.2
Vietnamese	2	0.0
Other Asian category	8	0.1
Two or more Asian categories	0	0.0
Native Hawaiian and Other Pacific Islander	7	0.1
Native Hawaiian	1	0.0
Samoan	1	0.0
Guamanian or Chamorro	0	0.0
Other Pacific Islander category	5	0.1
Two or more Native Hawaiian or Other Pacific Islander categories	0	0.0
Some other race	2,251	34.1
Two or more races	317	4.8
Two races including Some other race	255	3.9
Two races excluding Some other race, and three or more races	62	0.9
Two races excluding Some other race	45	0.7
Three or more races	17	0.3

Subject	Number	Percent
INCOME IN 1999		
Households	2,283	100.0
Less than $10,000	545	23.9
$10,000 to $14,999	153	6.7
$15,000 to $24,999	285	12.5
$25,000 to $34,999	229	10.0
$35,000 to $49,999	283	12.4
$50,000 to $74,999	319	14.0
$75,000 to $99,999	236	10.3
$100,000 to $149,999	163	7.1
$150,000 to $199,999	33	1.4
$200,000 or more	38	1.7
Median household income (dollars)	31,710	(X)
With earnings	1,668	73.1
Mean earnings (dollars)	53,395	(X)
With Social Security income	545	23.9
Mean Social Security income (dollars)	10,724	(X)
With Supplemental Security Income	287	12.6
Mean Supplemental Security Income (dollars)	6,616	(X)
With public assistance income	266	11.7
Mean public assistance income (dollars)	4,185	(X)
With retirement income	188	8.2
Mean retirement income (dollars)	13,899	(X)
Families	1,449	100.0
Less than $10,000	197	13.6
$10,000 to $14,999	97	6.7
$15,000 to $24,999	236	16.3
$25,000 to $34,999	159	11.0
$35,000 to $49,999	187	12.9
$50,000 to $74,999	254	17.5



Subject	Number	Percent
YEAR STRUCTURE BUILT		
1999 to March 2000	48	2.1
1995 to 1998	55	2.4
1990 to 1994	21	0.9
1980 to 1989	234	10.3
1970 to 1979	238	10.4
1960 to 1969	290	12.7
1940 to 1959	726	31.8
1939 or earlier	665	29.1
ROOMS		
1 room	124	5.4
2 rooms	221	9.7
3 rooms	608	26.7
4 rooms	327	14.3
5 rooms	409	17.9
6 rooms	204	8.9
7 rooms	103	4.5
8 rooms	54	2.4
9 or more rooms	235	10.3
Median (rooms)	4.1	(X)
YEAR HOUSEHOLDER MOVED INTO UNIT		
1999 to March 2000	613	26.9
1995 to 1998	647	28.4
1990 to 1994	332	14.6
1980 to 1989	360	15.8
1970 to 1979	223	9.8
1969 or earlier	108	4.8

139

Subject	Number	Percent
White	4,366	89.7
Black or African American	163	3.2
American Indian and Alaska Native	2	0.0
American Indian	1	0.0
Alaska Native	0	0.0
Both American Indian and Alaska Native	0	0.0
American Indian or Alaska Native, not specified	1	0.0
Asian	419	8.2
Asian Indian	151	3.0
Chinese	66	1.3
Filipino	128	2.5
Japanese	11	0.2
Korean	28	0.6
Vietnamese	5	0.1
Other Asian category	19	0.4
Two or more Asian categories	9	0.2
Native Hawaiian and Other Pacific Islander	0	0.0
Native Hawaiian	0	0.0
Samoan	0	0.0
Guamanian or Chamorro	0	0.0
Other Pacific Islander category	0	0.0
Two or more Native Hawaiian or Other Pacific Islander categories	0	0.0
Some other race	66	1.7
Two or more races	54	1.1
Two races including Some other race	26	0.5
Two races excluding Some other race, and three or more races	28	0.6
Two races excluding Some other race	26	0.5
Three or more races	2	0.0
HISPANIC OR LATINO		
Total population	5,001	100.0
Hispanic or Latino (of any race)	321	6.3

Subject	Number	Percent
INCOME IN 1999		
Households	1,939	100.0
Less than $10,000	145	7.5
$10,000 to $14,999	118	6.1
$15,000 to $24,999	151	7.8
$25,000 to $34,999	166	8.6
$35,000 to $49,999	191	9.9
$50,000 to $74,999	446	23.0
$75,000 to $99,999	321	16.6
$100,000 to $149,999	334	17.2
$150,000 to $199,999	46	2.1
$200,000 or more	27	1.4
Median household income (dollars)	61,923	(X)
With earnings	1,516	78.2
Mean earnings (dollars)	68,750	(X)
With Social Security income	682	35.2
Mean Social Security income (dollars)	12,688	(X)
With Supplemental Security Income	73	3.8
Mean Supplemental Security Income (dollars)	9,651	(X)
With public assistance income	24	1.2
Mean public assistance income (dollars)	1,596	(X)
With retirement income	348	17.9
Mean retirement income (dollars)	12,967	(X)
Families	1,357	100.0
Less than $10,000	197	14.5
$10,000 to $14,999	33	2.4
$15,000 to $24,999	75	5.5
$25,000 to $34,999	104	7.7
$35,000 to $49,999	119	8.8
$50,000 to $74,999	349	25.7



Subject	Number	Percent
YEAR STRUCTURE BUILT		
1999 to March 2000	6	0.3
1995 to 1998	5	0.3
1990 to 1994	21	1.1
1980 to 1989	39	2.0
1970 to 1979	156	8.1
1960 to 1969	387	20.1
1940 to 1959	777	40.3
1939 or earlier	561	29.1
ROOMS		
1 room	12	0.6
2 rooms	44	2.3
3 rooms	179	9.8
4 rooms	252	13.1
5 rooms	439	22.3
6 rooms	423	22.0
7 rooms	337	17.5
8 rooms	143	7.4
9 or more rooms	115	6.0
Median (rooms)	5.6	(X)
YEAR HOUSEHOLDER MOVED INTO UNIT		
1999 to March 2000	292	15.2
1995 to 1998	454	23.6
1990 to 1994	177	9.2
1980 to 1989	188	9.8
1970 to 1979	296	15.4
1969 or earlier	519	26.9

140

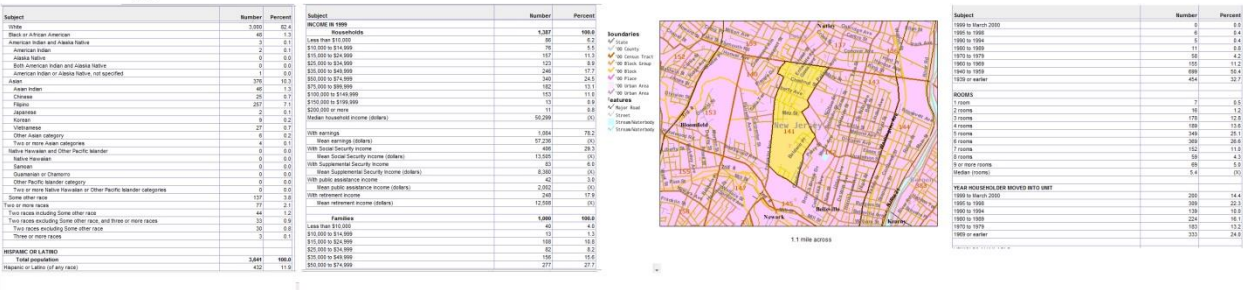
Subject	Number	Percent
White	2,987	76.6
Black or African American	86	2.2
American Indian and Alaska Native	3	0.1
American Indian	0	0.0
Alaska Native	0	0.0
Both American Indian and Alaska Native	0	0.0
American Indian or Alaska Native, not specified	3	0.1
Asian	629	16.1
Asian Indian	52	1.3
Chinese	29	0.7
Filipino	472	12.1
Japanese	2	0.1
Korean	2	0.1
Vietnamese	36	1.0
Other Asian category	21	0.5
Two or more Asian categories	13	0.3
Native Hawaiian and Other Pacific Islander	2	0.1
Native Hawaiian	0	0.0
Samoan	0	0.0
Guamanian or Chamorro	1	0.0
Other Pacific Islander category	0	0.0
Two or more Native Hawaiian or Other Pacific Islander categories	1	0.0
Some other race	113	2.9
Two or more races	79	2.0
Two races including Some other race	47	1.2
Two races excluding Some other race, and three or more races	32	0.8
Two races excluding Some other race	27	0.7
Three or more races	5	0.1
HISPANIC OR LATINO		
Total population	3,896	100.0
Hispanic or Latino (of any race)	389	10.0

Subject	Number	Percent
INCOME IN 1999		
Households	1,573	100.0
Less than $10,000	99	6.3
$10,000 to $14,999	47	3.0
$15,000 to $24,999	146	9.3
$25,000 to $34,999	176	11.2
$35,000 to $49,999	255	16.2
$50,000 to $74,999	307	19.5
$75,000 to $99,999	331	21.0
$100,000 to $149,999	184	11.7
$150,000 to $199,999	21	1.3
$200,000 or more	7	0.4
Median household income (dollars)	53,583	(X)
With earnings	1,235	78.5
Mean earnings (dollars)	52,696	(X)
With Social Security income	531	33.8
Mean Social Security income (dollars)	12,238	(X)
With Supplemental Security Income	44	2.8
Mean Supplemental Security Income (dollars)	8,632	(X)
With public assistance income	31	2.0
Mean public assistance income (dollars)	2,381	(X)
With retirement income	307	19.5
Mean retirement income (dollars)	11,476	(X)
Families	994	100.0
Less than $10,000	21	2.1
$10,000 to $14,999	15	1.5
$15,000 to $24,999	52	5.2
$25,000 to $34,999	90	9.1
$35,000 to $49,999	124	12.5
$50,000 to $74,999	215	21.6

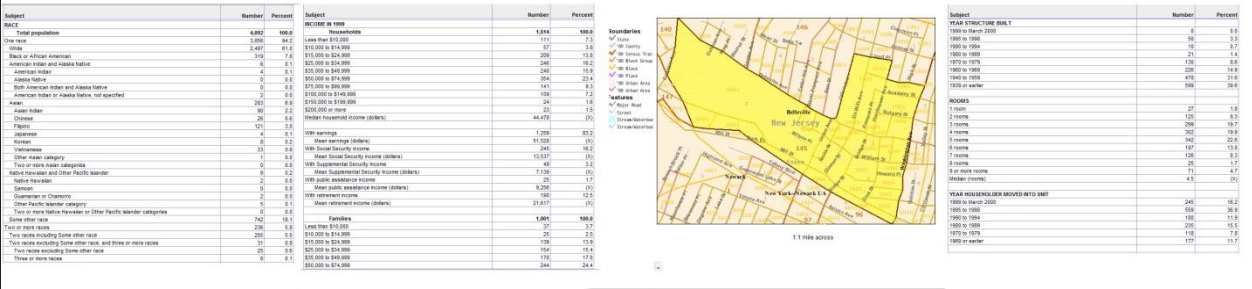


Subject	Number	Percent
YEAR STRUCTURE BUILT		
1999 to March 2000	0	0.0
1995 to 1998	5	0.3
1990 to 1994	14	0.9
1980 to 1989	76	5.0
1970 to 1979	262	17.2
1960 to 1969	186	11.9
1940 to 1959	814	51.7
1939 or earlier	273	17.3
ROOMS		
1 room	0	0.0
2 rooms	41	2.6
3 rooms	256	16.3
4 rooms	307	19.5
5 rooms	155	9.8
6 rooms	288	18.3
7 rooms	387	24.6
8 rooms	81	5.1
9 or more rooms	58	3.7
Median (rooms)	5.6	(X)
YEAR HOUSEHOLDER MOVED INTO UNIT		
1999 to March 2000	267	17.0
1995 to 1998	360	22.9
1990 to 1994	241	15.3
1980 to 1989	264	16.8
1970 to 1979	178	11.3
1969 or earlier	264	16.8

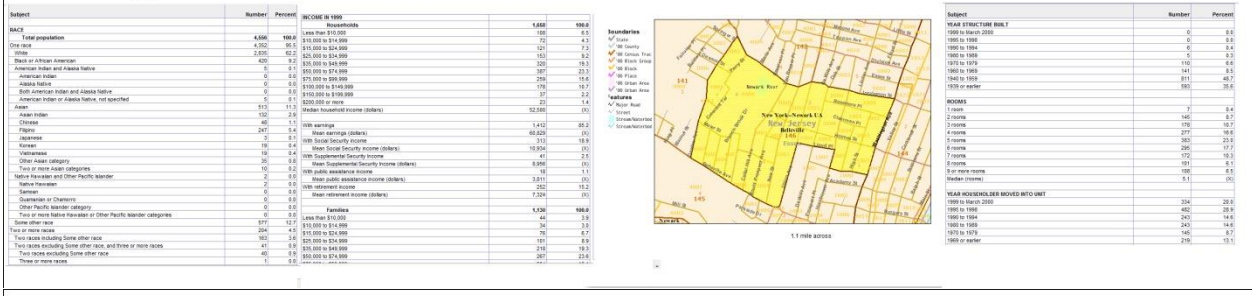
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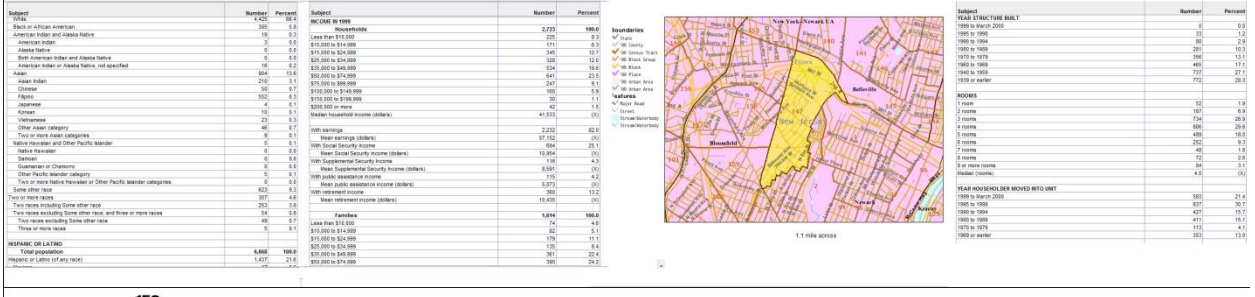
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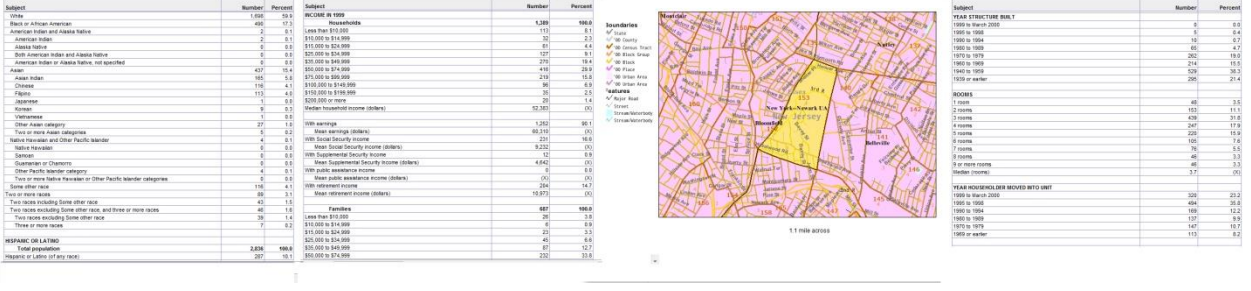
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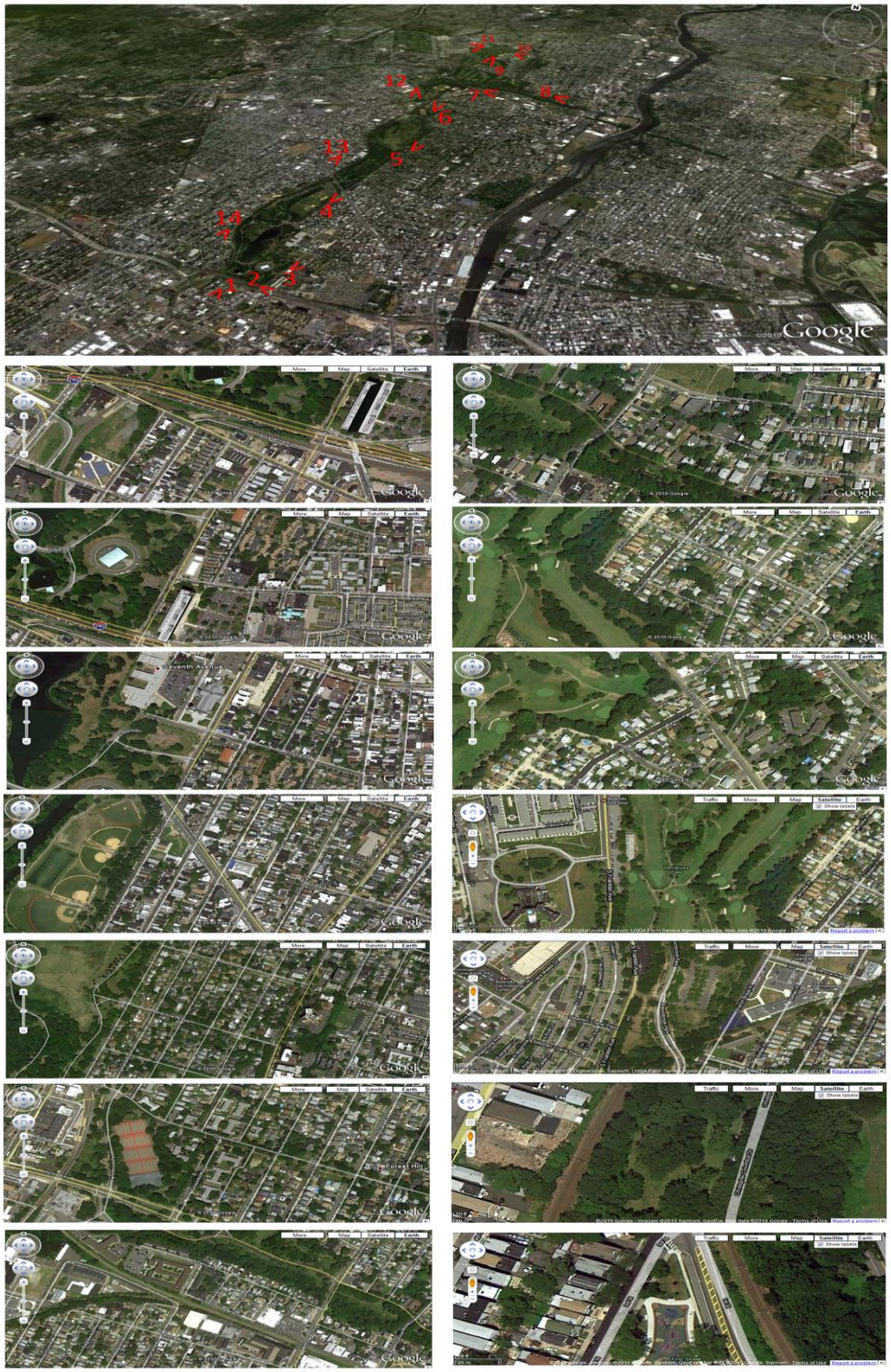
147



153



Appendix, Section B



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Planning Principles in Making New Cities in the 21th Century

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ABSTRACT

The population of metropolitan cities in different geographies of the world is increasing rapidly. One of the solutions to reduce this problem is to develop new cities. In this study, the new cities designed and built in the last decades are examined. Although many new city projects are developed and announced by governments only four of them (Putrajaya in Malaysia, Songdo and Sejong City in South Korea, Nanhui in China) are partially or fully implemented.

In the first stage of this research, the factors behind the planning of these cities, geographical location selection, city scales and functions are examined. In this sense the following objectives and concepts are depicted from project reports:

Adopting new technologies and value added from emerging economies,
Representing the urban image of the new political system,
Adopting to the climate change and mitigating disasters,
Creating an environmental sensitive city,
Generating a new district integrated to a new transport node,
Healthy city, smart city, green city, energy efficient city.

In the second stage, planning and design principles identified for for those four cities are investigated. Population, built up area, density, functions, transport modes, building layout, and urban form of planned cities are compared to find similarities and differences. New cities in the last decades are established for social, economic, technological, climatic and environmental reasons. Sustainability, adaptation to climate change, environmental sensitivity, reduction of carbon emissions, use of renewable energy, livability and symbolism, principles and objectives have been adopted in the planning and design of cities. On the other hand, large capital investment is necessary to achieve the planned development, that is if sufficient financial capital is not found, a planned city cannot be built. This fact is the main reason of delay in project implementation for various city projects in the world. It is observed that built up area provides a high quality of living conditions for dwellers and workers for planned new cities. Therefore, quality of space is a significant factor for attracting business investment and white collar workers. Research findings reveal that, new city development, principally motivated around green and smart city concepts, is regarded as an effective strategy in attracting international and domestic direct investments.

Keywords: new cities, sustainable cities, urban planning, urban design, planning principles

1. LITERATURE

Daffara[1] argues that "rethinking tomorrow's cities now, builds our capacity to act with foresight and create resilient and liveable places". Mayor et. Al. [2], Daffara[1] and Hajkowicz[3] argue that the following facts and megatrends of global change facing the planet and its cities address transformation of the cities and generating sustainable new settlements:

- Ecological risks,
- environmental problems,
- footprints (carbon and other pollutants),
- increasing pandemic risks, climate change,
- urbanization rate and urban population,
- clash of civilisations/cultures,
- aging world population,
- and increasing role of information and telecommunication technologies in economies and social life.

Botchie et.al [4] investigated and discussed how new forms of transport, communications and information technologies in the late period of 20th Century shape the cities. Researcher argue that these factors are forcing change in the production process, introduce high-tech industries, change the form of global economic organization, and land use. Emerging technologies and societal sensitivities brought emergence of 'designer cities' which is regarded as a current concept of new cities. New cities of the 21st Century are expected to be environmentally sensitive, open to social participation, and motivated around sustainable economic development [4].

Table 1. Urban Qualities of the Urban Future and New Cities [1]

Level of reality	City futures focus area	Phenomenology "I"	Ontology "It"	Ideology "We"	Epistemology "Its"
Physis	E^4 energy flows	Effective exchange	Economic (efficient) exchange	Equitable exchange	Ecological exchange
Physis and bios	C^4 city of synthesis (complexification)	Convenient urban form	Compact urban form	Complex urban form	Cybernetic urban form
Nous	'MUST' city governance	Self empowered leadership	Utilitarian	Multi-cultural leadership (Politics of difference)	Transformational leadership
Bios and nous	H^4 sustainability	Hospitable habitat	Healthy habitat	Humane habitat	Habitually fecund
Nous	City noosphere	Learning citizen	Creative citizens	Identifiable cultures	Conscious communities
Theos	S^4 spiritual city	Sacred personal places	Self-actualisation supported	Sacred public places	Suffer less place

2. NEW CITIES

In recent years, new cities have been built in many different parts of the world. There are many different reasons for the emergence of these new cities. However, when the examples are examined, there are some underlying issues. The global forces of urban change are outlined to provide the context and drivers for cities to act with greater foresight. These forces question the survival of civilisations, as cities are now the main site of habitation for the World's population [1]. While the world population is increasing rapidly, the capacity of some cities is insufficient and new cities are usually built as a new solution. In these stage, there are sixteen projects were examined from the world.

Table 2. New city projects from the world [5]

new cities

sehirler	etken	coğrafi yer secimi	kent olcegi(nufus-yuzolcumu)		kentin işlevi	temel alinan ilke
putrajaya-malaysia	reduce crowding capital	40 km to the south(former oil and rubber plantation)	88.300 inhabitants	49 km2	administrative capital	intelligent garden city
astana(nursultan)-kazakhstan	replaced the capital		1.029.556 inhabitants	810 km2	new capital	symbolism
songdo-south korea	technologic	an hour from Seoul			international business district	smart and eco-friendly city
naypyidaw-myanmar	replaced the capital		930.000 inhabitants	4.600 km2	new capital	symbolism?
king abdullah economic city-saudi arabia	economic	near the red sea	2.000.000 inhabitants	173 km2	financial district	
sejong city-south korea	replaced the capital	an hour from Seoul	281.120 inhabitants	465 km2	administrative capital	happy city
duqm-oman	economic	coastline	250.000 inhabitants		port town	industrial city
xiong'an new area-china	reduce crowding capital	100 km southwest of Beijing		100 km2	economic zone	livability
liuzhou forest city-china	climatic and environmental	banks of the liu river		140 ha	reduce co2 emission and environmental awareness	forest city
nanhui-china	economic	on the coast	600.000 inhabitants	277 km2	free trade zone	livability
gracefield island-nigeria	environmental	reclaimed land just off the coast of Lagos			technology and innovation center	eco-friendly and smart tech
neom-saudi arabia	environmental	near the Red Sea and the borders of Egypt, and Jordan		26.500 km2	environmental awareness and livability	smart city and renewable energy
forest city-malaysia	environmental	man made island	700.000 inhabitants	30 km2	environmental friendly and smart	forest city
colombo port city-sir lanka	economic	filled in land between the old city centre and the new industrial port	40.000 inhabitants	2.69 km2	international financial center	port city eco-friendly and smart tech
new cairo-egypt	reduce crowding capital		298.343 inhabitants	500 km2	new capital	smart
belmont-usa	economic	part of arizona desert		10.000 ha	technology and innovation center	smart city

As a result of the examined projects, four of them were investigated in detail cause of they were partially or fully implemented.

2.1. Putrajaya, Malaysia (1995)

The city of Putrajaya was established in 1995. It as Malaysia's new administrative center. The city was built to be "a laboratory for a new form of electronic government" using new technology [6]. It was also a solution to reduce crowding in Malaysia's capital of Kuala Lumpur. In the 1990s, Kuala Lumpur remained under the pressures of overpopulation, so the government decided to build Putrajaya and make it the country's new administrative center. The metropolis was built to be an intelligent garden city with a focus on sustainability. The city has green spaces and smart tech features. This is the largest integrated urban development project in the history of Malaysia, combining the development of government institutions, commercial, residential, public amenities and infrastructure [6].

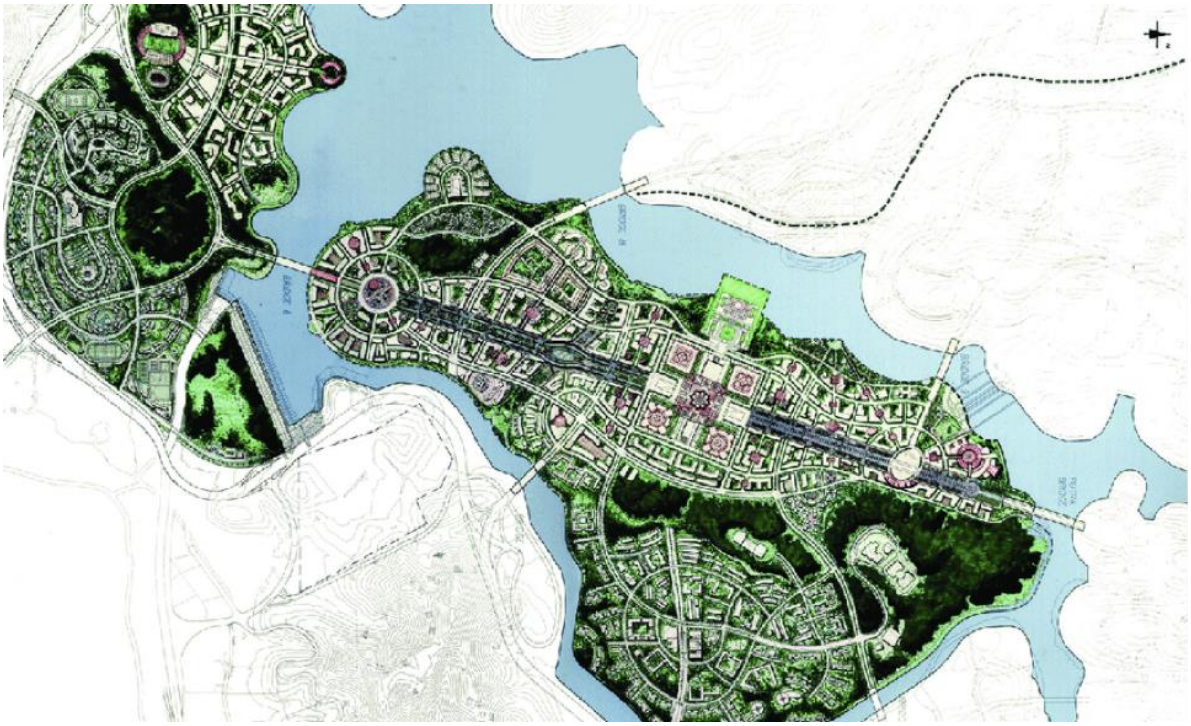


Figure 1. *General scheme of Putrajaya Garden City [7]*

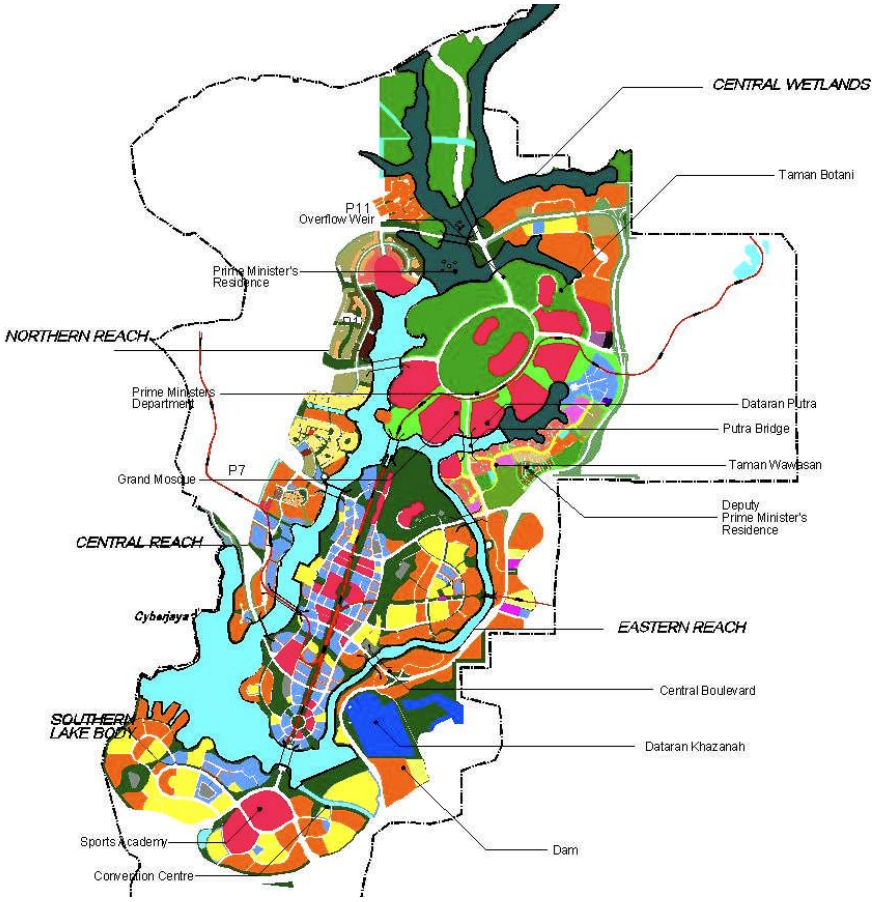


Figure 2. *Putrajaya Masterplan [8]*

Main features of Putrajaya Masterplan [8]:

- Large proportion of the city area is designated as green open space
- Waterbody (man-made lake) created within the city
- 38km of waterfront area created by the lake
- City is divided into twenty precincts. The core employment and commercial precincts located on Core Island
- Residential precincts planned based on the neighbourhood planning concept
- A 4.2km long Boulevard forms the central spine of the city

***Table 3**. Putrajaya New City Features*

city	factor	geographical location	city scale(population-area)		function of city	basic principle
putrajaya-malaysia	reduce crowding capital	40 km to the south(former oil and rubber plantation)	88.300 inhabitants	49 km2	administrative capital	intelligent garden city

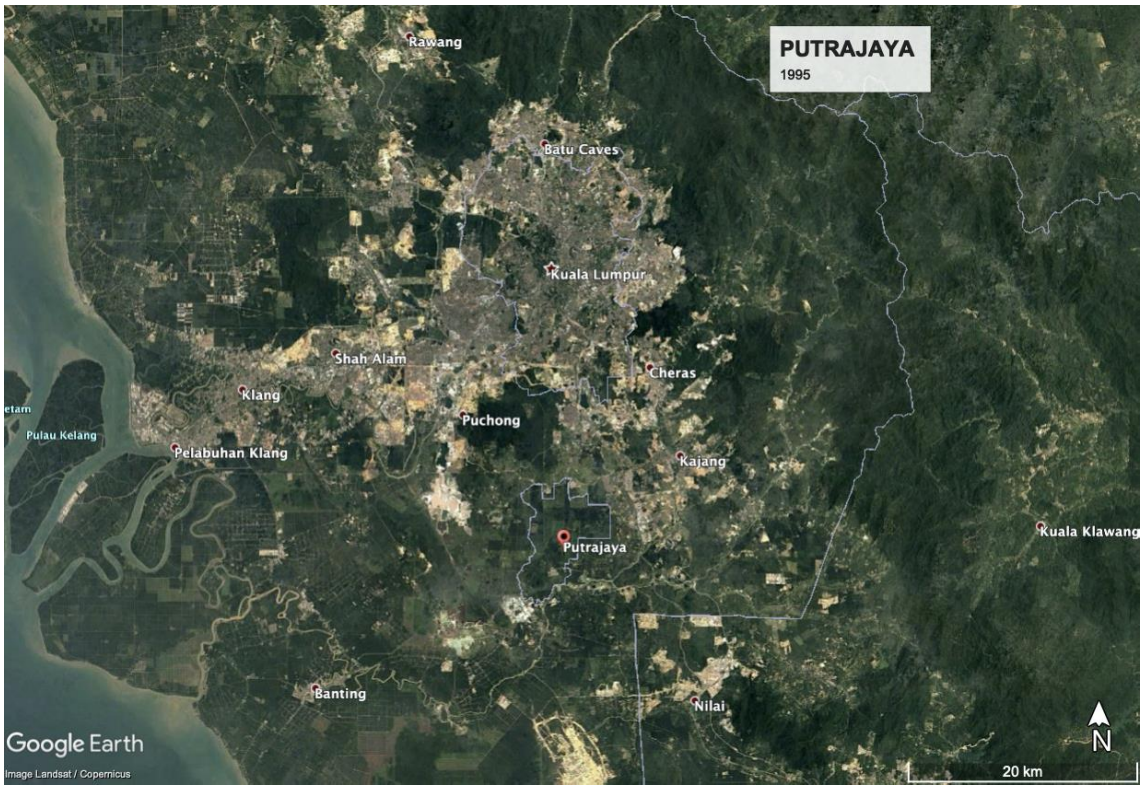


Figure 3. Google Earth view of Putrajaya in 1995

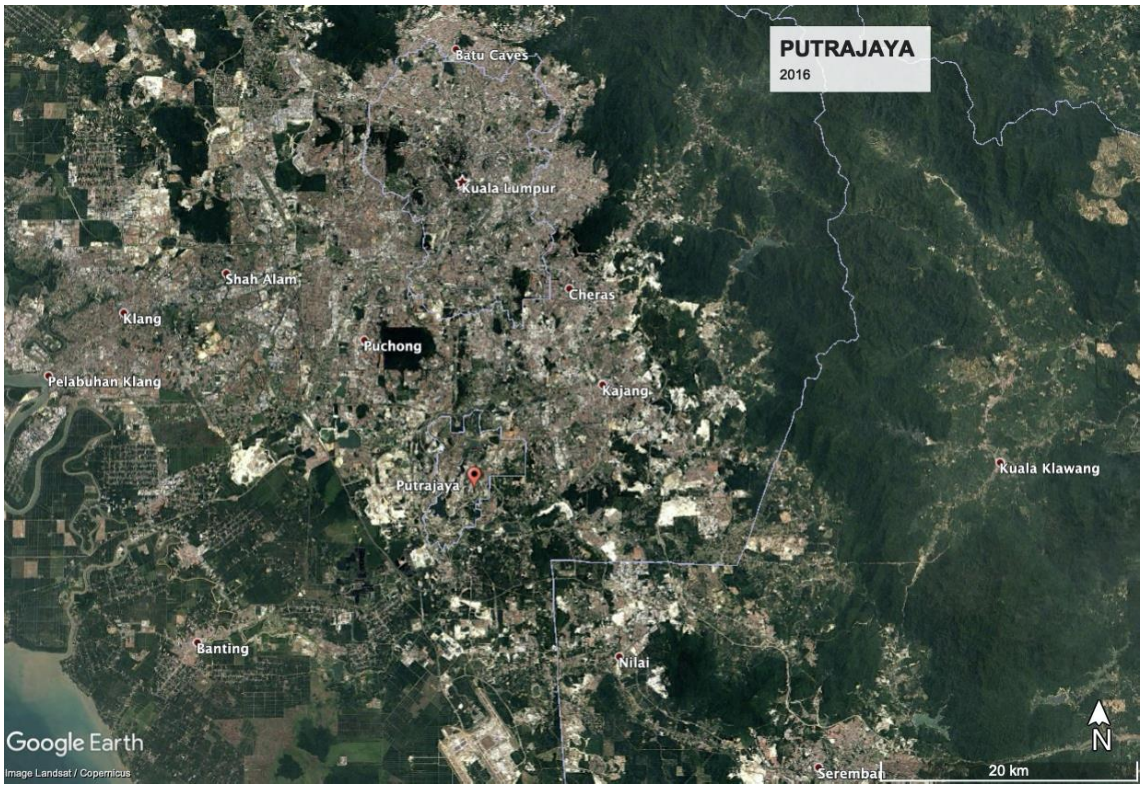


Figure 4. *Google Earth view of Putrajaya in 2016*

2.2. Songdo, South Korea (2022)

Songdo is a smart city built on reclaimed land. In the eco-friendly city, residents homes' have pneumatic tubes that send trash to a facility where it is sorted, making garbage trucks an idea of the past. Songdo city project is finally set to be finished in 2022[9]. As South Korea seeks to always be a leader in technology. Also this project has that environmental efficiency and this features. The officials claim that public transportation will be so well-planned and people will no need cars in their daily commute. If everything goes according to plan, this will greatly reduce greenhouse emissions [9].



Figure 5. Songdo city master plan [10]

The green infrastructure of the new city is to be enhanced by the provision of extra services. Its combine the information and communication technologies with digital networks to create harmony among the environment, society and technology. Their vision is construct a car-free world, 40 percent green space and dozens of kilometres of cycling routes. Construction began in 2003 and is slated to be completed by 2022.[10]

Table 4. Songdo New City Features

city	factor	geographical location	city scale(population-area)		function of city	basic principle
songdo-south korea	technologic	an hour from Seoul	61.500 inhabitants	22.660 units	international business district	smart and eco-friendly city

A look at Songdo IBD to date[11]:

- Over 20,000 residential units are occupied or under construction.
- 36,000 residents currently live in Songdo IBD (90,000 in Songdo City).
- Over 1,000 retail and hospitality businesses are open and operating.
- Over 1,600 domestic and global companies are currently located in Songdo City, with 60,000 employees.

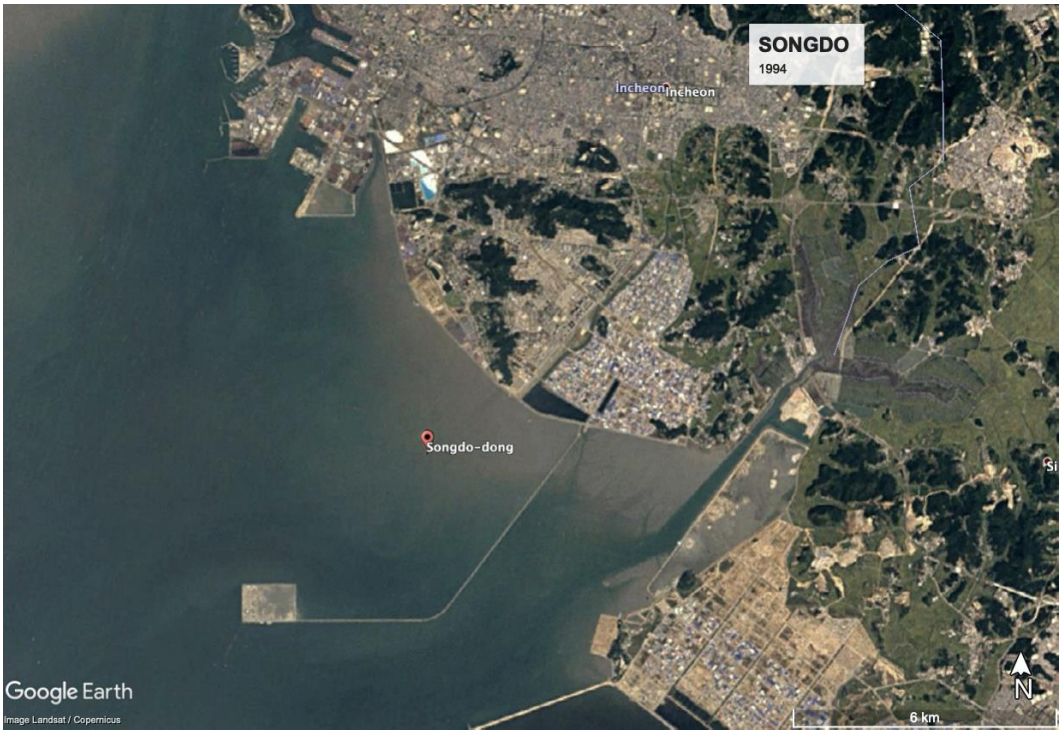


Figure 6.Google Earth view of Songdo in 1994



Figure 7. Google Earth view of Songdo in 2020

2.3. Sejong City, South Korea (2007)

Sejong City built in 2012 to replace Seoul as the country's administrative capital. The country hopes the new city, which houses some of the government's offices, will help mitigate overcrowding in Seoul, which is home to around 26 million people [12]. This city is an answer to overpopulation in Seoul. The metropolitan area of the capital is estimated to harbor half of the country's entire population. Some government buildings have been moved here for encourage the economic activities and the people to move new city [12].

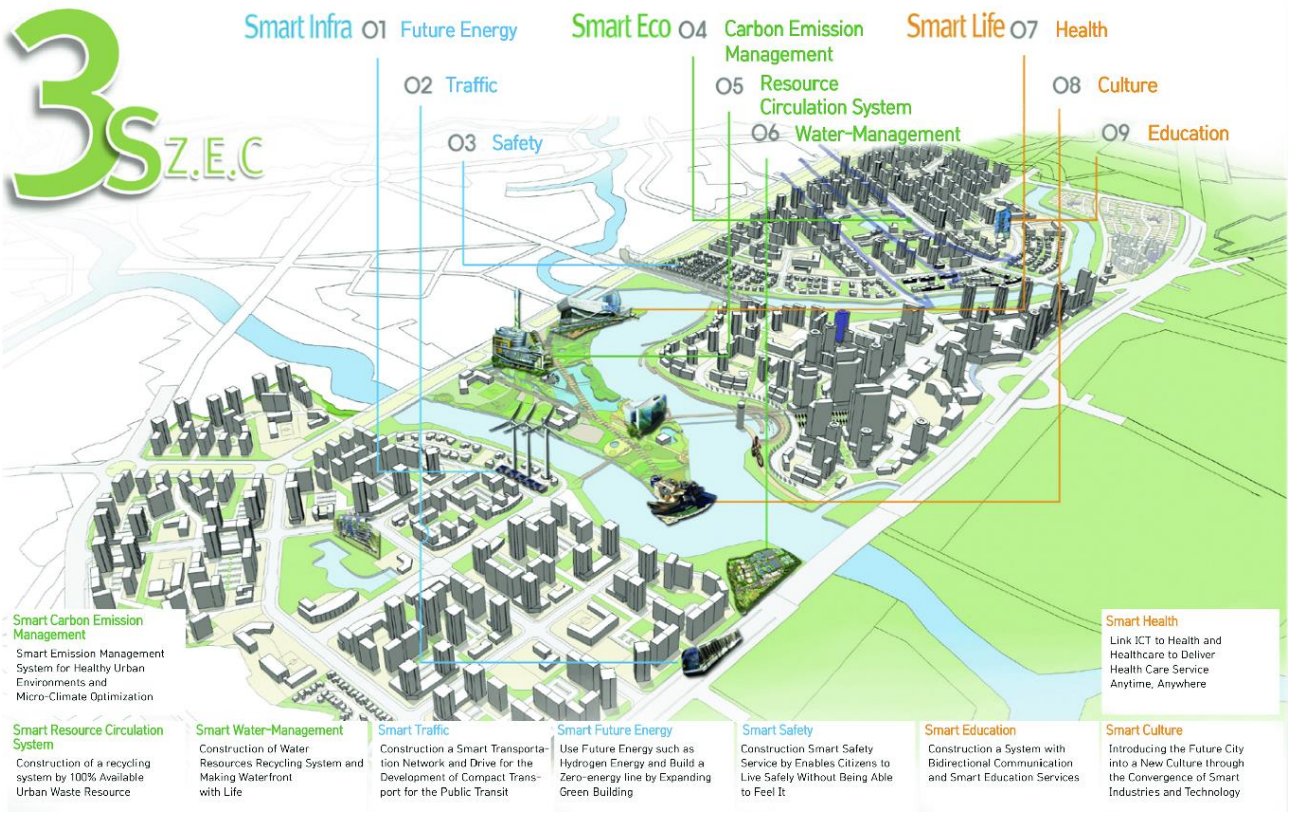


Figure 8. General scheme of Sejong City [13]

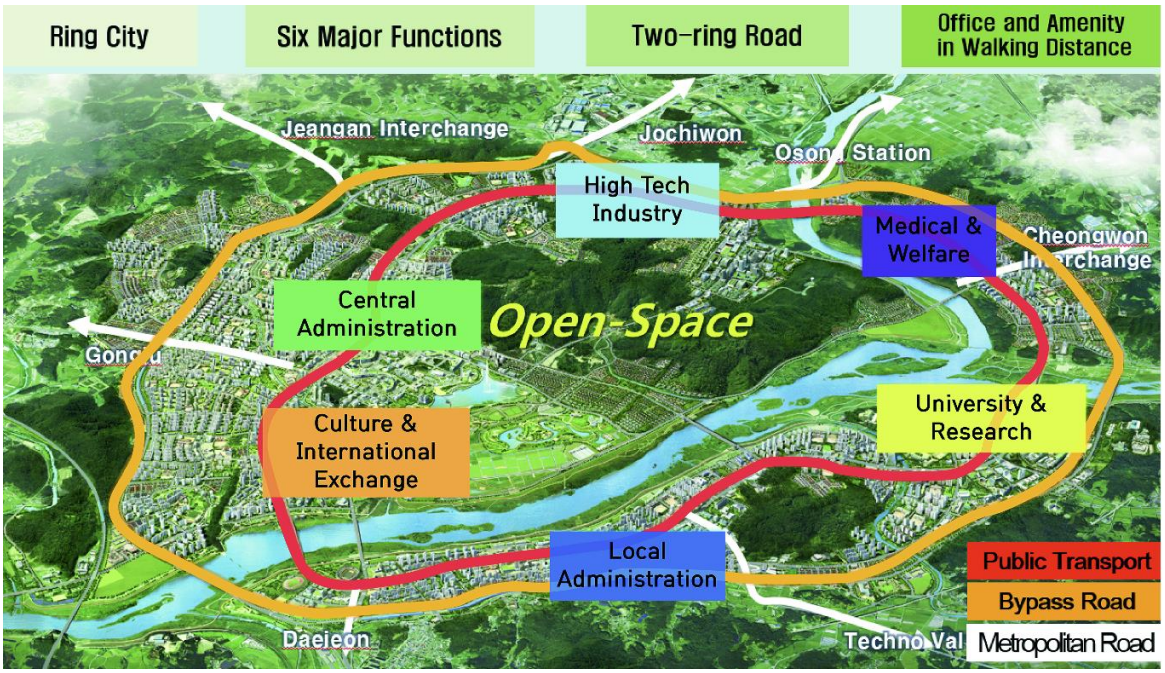


Figure 9. A Different Scheme of Sejong City [14]

In 2007 Balmori Associates won a competiton to prepare the plan for South Korea's new city[15]. Sejong City, ninety miles south of Seoul, are home to thirty six ministries and institution presently placed in or close to Seoul[15]. This project is still under construction . The master plan consists of endless linear park on a continuous roof change of integrity all the ministries. The government buildings aren't separate, closed structures. They form a continuity at the bottom and roof levels. This gesture suggests that transportation access to all or any and encourages communication among the ministries [15].



Figure 10. A view from the city[15]

Each of the six towns surrounding the Administrative City looks down on the park and the government buildings below it.[15]

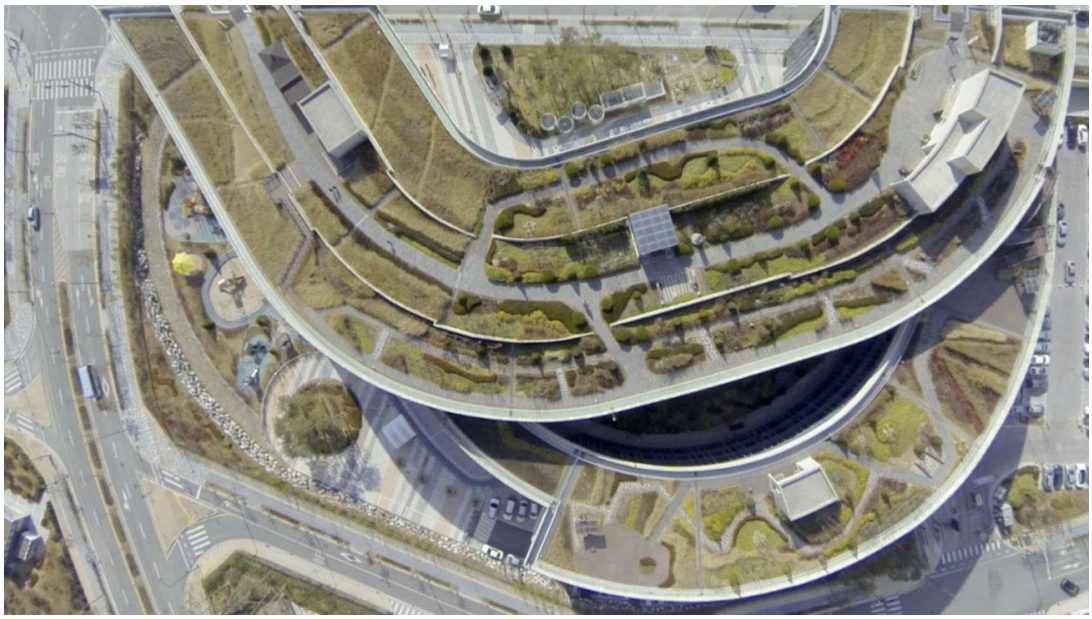


Figure 11. A view from the roof [15]

The creation of a new city is a chance to bring cultural concepts and beliefs along to celebrate the spirit of Korean Peninsula within the twenty first century. To achive this end, Balmori planned 3 interconnected urban strategies[15]:

1.FLAT CITY: The iconic plane – the physical and conceptual datum of aligned building rooftops – symbolizes the interconnected unity and democratic nature of the people and the government.

2.LINK CITY: Physical and visual linkages are created between the government and the people, the urban and the natural, the ground and the sky.

3.ZERO WASTE CITY: created a strategy for the model city development that is based on zero waste principles. All waste from one system becomes the food for another.

Table 5. Sejong New City Features

city	factor	geographical location	city scale(population-area)		function of city	basic principle
sejong city-south korea	replaced the capital	an hour from Seoul	281.120 inhabitants	465 km2	administrative capital	happy city



Figure 12. Google Earth view of Sejong in 2007



Figure 13. Google Earth view of Sejong in 2020

3.4. Nanhui, China (2020)

The city designed concerning thirty seven miles from Shanghai. The new city Nanhui is a component of the Shanghai Free-Trade Zone designed to revitalize a locality that has been somewhat neglected. As a part of the decide to encourage activity, several campuses are built here.They bring in an active student population which will hopefully keep or invest within the city once they need additional getting power. Construction is predicted to finish by 2020, with the entire price reaching about $4.5 billion[16].

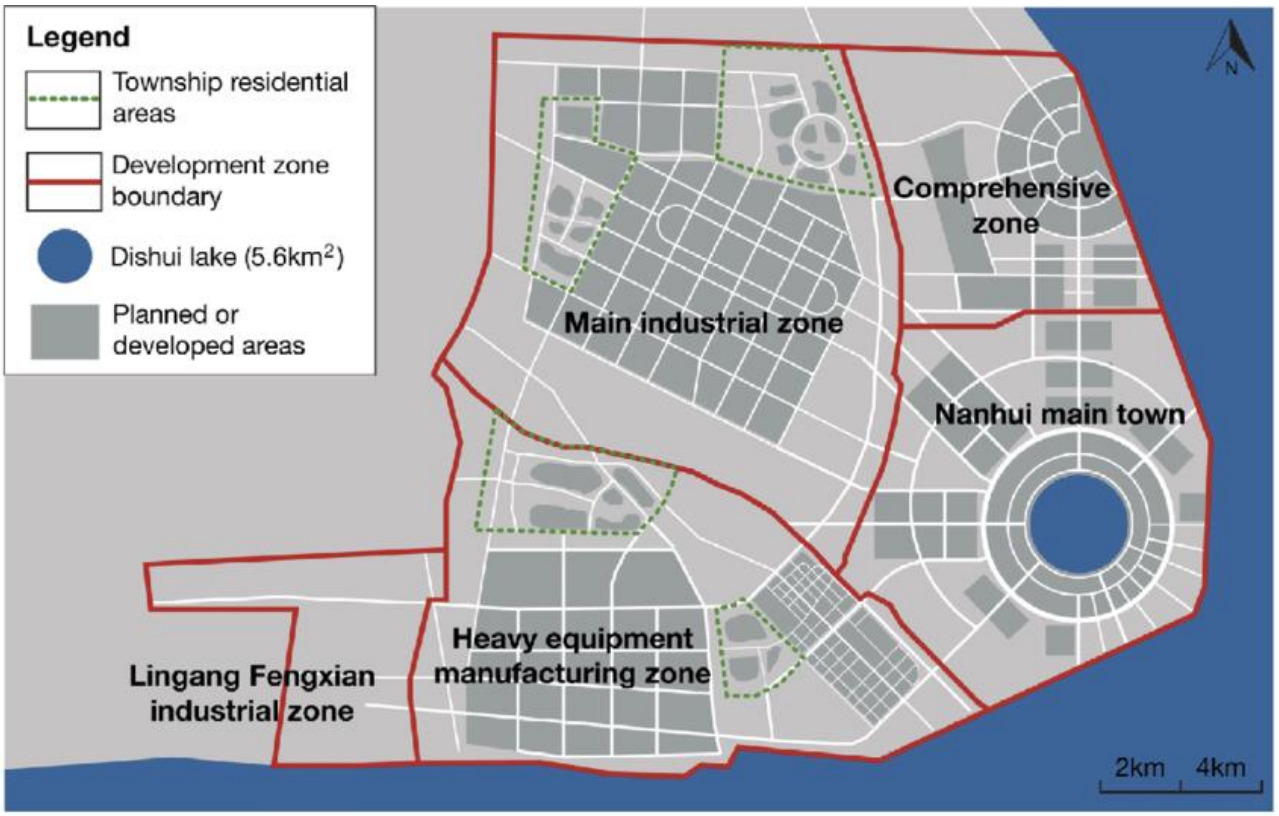


Figure 14. Nanhui City Plan[17]

Table 6. Nanhui New City Features

city	factor	geographical location	city scale(population-area)		function of city	basic principle
nanhui-china	economic	on the coast	600.000 inhabitants	277 km2	free trade zone	livability

The city is located on the tip of the peninsula between the Yangtze and the Qiantang rivers, on the Hangzhou Bay. It is 60 kilometers southeast of downtown Shanghai. A big part of the land was reclaimed from the sea and the city was slated to become a "mini-Hong Kong"[16]. Although property developments sold-out individuals are reluctant to move in. To help vitalize the city, eight university campuses have been designed on the side of Nanhui New City, it get additional more than 100,000 students.

The city area (nearly %80) is owned by private investors . It starts with the universities with about 100,000 students since 2016[16]. Nanhui becoming a green satellite city of Shanghai with the advantage of a strategic position for doing business. In this city project, another important point is the idea of creating an ecofriendly city. There are pedestrian areas instead of boulevards for cars and there are some cultural and recreational activities for everyone.



Figure 15. Scheme of Nanhui Main Town [18]

Instead of a high-density centre, Nanhui New City concept of ideals of the traditional European city and combines it with a "revolutionary" idea[18]. The focal point will be a circular lake. It is a diameter of 2.5 kilometer and an 8 kilometer lake promenade. The lake is a bathing beach in the heart of the city. Cultural buildings and leisure facilities are located on islands, which can be accessed by boat. They said, the design was inspired by the city of Alexandria, one of the Seven Wonders of the World and the quality of life provided by the close proximity to water draws its references from Hamburg [18].



Figure 16. Illustration of new city concept [18]

The whole city structure is based on the metaphor of an image of concentric ripples, formed by a drop falling into water. The city ring between the lakeside promenade and the green belt, the business district, forms the centre of city-life. A mix of offices, shops, arcades, pedestrian precincts and dense living space is located here [18].



Figure 17. Google Earth view of Nanhui in 2003



Figure 18. Google Earth view of Nanhui in 2020

3. FINDINGS

Following objectives and concepts are depicted from project reports:

- Adopting new technologies and value added from emerging economies,
- Representing the urban image of the new political system,
- Adopting to the climate change and mitigating disasters,
- Creating an environmental sensitive city,
- Generating a new district integrated to a new transport node,
- Healthy city, smart city, green city, energy efficient city.

The principles mentioned above are regarded as the motivation of new cities in the 21st Century. New cities in the last decades are established for social, economic, technological, climatic and environmental reasons. Sustainability, adaptation to climate change, environmental sensitivity, reduction of carbon emissions, use of renewable energy, livability and symbolism, principles and objectives have been adopted in the planning and design of cities.

4. CONCLUSION

Large capital investment is necessary to achieve the planned development, that is if sufficient financial capital is not found, a planned city cannot be built. This fact is the main reason of delay in project implementation for various city projects in the world. It is observed that built up area provides a high quality of living conditions for dwellers and workers for planned new cities. Therefore, quality of space is a significant factor for attracting business investment and white collar workers. Research findings reveal that, new city development, principally motivated around green and smart city concepts, is regarded as an effective strategy in attracting international and domestic direct investments.

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'Yedikule Bostans': A Serious Game For Cultural Heritage

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ABSTRACT

Serious games with their educational or skill development purposes besides entertainment, have been used in various fields such as architecture, landscape architecture, urban planning, cultural heritage, and learning of language and culture, easing the data absorption process of the specific topic for the user. The use of serious games in the cultural heritage or cultural landscape, as a subtopic, can have a role in its preservation in addition to the information transition ability. *Yedikule Bostans* is a serious game designed for cultural heritage, its importance, and maintenance ways. The case study of this article is the İstanbul's market gardens, existing plenty of them in İstanbul, which have remained since ancient times surviving despite the difficulties of urbanization. This research is focusing on the *Yedikule Bostanları* with their 1500-year history which are associated with the *Theodosian Walls*, registered in the list of historic areas of İstanbul in UNESCO. The serious game presented in this research with its immersive text-based time-traveling theme about these gardens aims to attract the public's attention to their perishing danger. Thanks to the abilities of the Twine software used in the game's development, we provide a charming journey to the users throughout the game to increase their awareness of the inherited farming culture and more comprehensively the cultural heritage and cultural landscape, meanwhile.

Keywords: Serious games, Cultural heritage, Yedikule Bostanları.

1. INTRODUCTION

Serious games term refers to the use of games for other purposes besides entertainment. Being audiovisual enables the educational aspect of the games, facilitating the data absorption action in memory (De Freitas & Liarokapis, 2011). The game-based learning approach is being trendy at a high pace via serious games, played aside from the spare time (Anderson et al., 2009; Becker, 2007; De Freitas & Liarokapis, 2011). These games can be used to engage the user in learning a specific topic or developing skills for various professions including landscape architecture and architecture (Örnek & Seçkin, 2016).

By considering the educational potentials of serious games, this study proposes a digital game about cultural heritage. This value, as tangible and intangible, respectively is inherited ancient objects or buildings, and skills, traditions, and knowledge from the preceding generations which is now in danger of perishing and its preservation is vital for the next generations (Marnerideset al., 2020). Furthermore, the cultural landscape, which according to UNESCO (2020), refers to the output of the interaction between human beings and the natural environment, should also be preserved due to the ability of it in terms of maintaining the biological diversity of that region and the development of its natural value. The cultural landscape approach also demonstrates the sustainable methods which should be used in a particular district according to its specifications (UNESCO, 2020).

The cultural heritage case of this article is the İstanbul's market gardens named as *bostan* in Turkish (Turan, 2015), existing plenty of them in İstanbul remained since ancient times surviving despite the difficulties of urbanization. However, the focus point of the research is the *Yedikule Bostanları* which are associated with the *Theodosian Walls,* referred to as *Kara Surları* in Turkish (Figure 1). According to Turan (2015), these gardens with their 1500-year history are currently in danger of perishing. Due to their tangled relation with the *Kara Surları*, which are registered in the list of historic areas of İstanbul in UNESCO, the culture of gardening continuing there, their place in the people's memory, and their integration with the everyday life of citizens for centuries (Turan, 2015), they can be referred to as İstanbul's Cultural Landscape and worth being protected and paid attention to.



Figure 1. Yedikule Bostanları and Theodosian Walls (Kanbak, 2016).

This research presents a serious game, which is designed with an immersive text-based narrative with the aim of cultural heritage maintenance and preservation. The objectives through which this aim is addressed are to increase public awareness and inform the users in terms of farming culture, inherited

from previous generations (Turan, 2015), with a non-linear story letting the player discover various endings by frequently playing as its initial outcome. Additionally, it imposes a more holistic attitude of protecting and reviving the surviving urban green infrastructure and urban productive landscape. In this research, we used Twine software (2020) to develop the game, which is an open-source platform enabling us to approach our goals throughout a charming storytelling journey without requiring almost any coding skills.

2. LITERATURE REVIEW

Regarding the previous works in serious games topic, there is a broad literature. *The Oregon Trail* which aims to demonstrate the difficulties of the pioneer life in the 19th on the Oregon Trail (Regalado, 2017) has been played by elementary schools since the mid-1980s for around twenty years (Slater, 2017). This cultural heritage game appears in the big majority of the studies on the serious game topic (Becker, 2007; Bigelow, 1997; Caftori & Paprzycki, 1997; Kane, 2020; Regalado, 2017; Slater, 2017). In the historical landscape topic*, The Fort Ross Virtual Warehouse* is a serious game that aims to transmit the cultural heritage of the region by immersing the player in a cultural virtual environment to promote the player's consciousness of the providing data (Lercari et al., 2015). This game was developed based on the agreement of the California State Parks and the University of California Merced to educate the visitors and the students about Fort Ross in March 2011 (Forte et al., 2012). A classic example of urban planning discipline is *SimCity* which allows players to design and develop a settlement by managing the city dynamics in terms of energy, waste, economy (Poplin, 2011). Furthermore, there are serious games developed to leverage the learning of language and culture. *Tactical Languages and Culture Training Systems* is a great sample of it teaching the players to communicate and speak in foreign languages as courses in the form of immersive gameplays using AI. This game engages the user in communications to learn the preferred language based on his/her own pace by making them speak to pass the stages of the game (Johnson & Valente, 2009).

Figuring out the existing literature, there is not a serious game regarding our case study, *Yedikule Bostanları.* The lack of attention to the *Yedikule Bostanları* and its cultural heritage and the lack of such a game with this topic drew us through the development of the *Yedikule Bostans* game.

3. RESEARCH

As a cultural heritage game, history review includes a prominent part of the study to gather the required data which the game aims to transmit to the user. For this regard, we conduct a wide literature review besides skimming the available news about the area in the newspapers or any other medium.

3.1 History

According to Kanbak (2016), from the Byzantine period until the second half of the twentieth century, the orchards which met the vegetable needs of Istanbul (Kart Aktaş & Yıldız Dönmez, 2018), spread throughout the city, both in the inner part of the city and on both sides of the Bosphorus. Indeed, each of these gardens in various locations differs according to the methods they apply, the variety of products they specialize in, and even the seasons they produce. For instance, *Yedikule Bostanları* were famous for their soft and greasy lettuce (Kaldjian, 2004).

Talking specifically about the history of *Yedikule Bostanları*, according to Aleksandar Shopov and Ayhan Han (2013), the most precise information is written in an ancient notebook from 1735. Due to that information, there are 344 gardens in the *Theodosian Walls*' vicinity nine of which are located in the *Yedikule* area with 52 farmers working on them. With the population increase towards the end of the 20th century, agricultural production areas expanded through the *Yedikule* walls, and these lands

turned into agricultural production sites. To be more explicit, from the end of the Ottoman Empire to the 1950s, that is, until the migration from the rural areas to the city, the gardens remained almost unchanged, while the change gradually emerged in the 1970s, it reached a serious level in the 1980s. However, while the housing supply that did not meet the population increase due to migration and political corruption in the early 1980s caused the emergence of new settlements in the periphery of the city, losses began to occur in agricultural lands (Kanbak, 2016; Kart Aktaş & Yıldız Dönmez, 2018).

Overall, while some of the *Yedikule Bostanları* were demolished in the 1960s, most of them faced the danger of extinction in the summer of 1999, 2004, and 2013 (Figure 2). The beginning of the inclusion of *Yedikule* Gardens in the building construction processes coincides with December 2011. Most of the *Yedikule Bostanları* were piled in rubble and unqualified soil within the scope of the park project between 5 and 17 July 2013, making them infertile. Hence, 27 decares of the 60 decares productive lands in the city walls were lost. Additionally, the excavations done along the historical *Theodosian Walls* during these interventions led to the destruction of the archaeological texture of the area. Then the project of the urban park was revised in a way that the 800 square meters of the gardens be protected but as hobby gardens. Finally, in 2016, the demolition of the *Yedikule Bostanları* turned into a hot topic again, and the gardeners' barracks started to be demolished by the municipal teams (Kanbak, 2016).



Figure 2. Map of Yedikule Bostanları in 1966;
The Red Parts show the Gardens' Current Situation (Aykan & Başyurt, 2019).

Nonetheless, there are some striking incidents in the *Yedikule*'s history which are the milestones generating the changes that occurred in this area from its existence since the *Theodosian Walls'* establishment in the 5th century by the *II. Theodosius* (Aykan & Başyurt, 2019). Firstly, the conquest of İstanbul in 1453 and the urbanization after it beyond the walls by the settlement of the people engaged with the agricultural activities to the *Yedikule* neighborhood led to the expansion of urban gardens along and beyond the walls generating the linear green area in the 17th century (Durusoy & Cihanger, 2016; Sarı, 2014). Then, the establishment of the *Vatan* and *Millet* streets in 1956-60 and the *Fevzipaşa* boulevard in 1958 expanding the urbanization toward the *Yedikule* area (İlter, & Pilehvarian, 2018) and the inscription of the historic areas of İstanbul by UNESCO as a world heritage site in 1985 (Aykan & Başyurt, 2019; Durusoy & Cihanger, 2016) which salvage these gardens in contrary with the other demolished gardens. However, the *Yedikule* farming culture and the gardens themselves should also be preserved the same as the walls according to Aykan and Başyurt (2019). On the other hand, *Yedikule Bostanları* have a prominent role today in İstanbul in the current pandemic

situation in which access to food and the production of the food by the city itself is a challenge due to the Covid-19 restrictions according to Aslihan Demirtaş and Yıldız Salman (İstanbul Hepimizin, 2020) and this fact make the protection of these gardens more important than ever.
Generally, the *Yedikule Bostanları* have a high production rate thanks to the land, seasonal characteristics, and effective use of natural resources, producing 15-20 kinds of vegetables in a year. Product diversity and flexibility are among the distinctive features of the orchards that reflect the characteristics of *Mediterranean* agriculture (Kaldjian, 2004). At the same time, in this type of agriculture where biodiversity is not lost, gardeners both reduce the risks of their products and maximize their products with more than one harvest and mixed cultivation ways. In this way, environmental and market risks have been minimized by continuously harvesting for months. The gardeners working on these orchards originated from various ethnicities and all inherited the gardening methods to their next-generation (Kanbak, 2016). Furthermore, the towers of the *Theodosian Walls* were used as storing places by the farmers for their agricultural tools (Durusoy & Cihanger, 2016) and the income of the gardeners provided a budget for the repair of the *Theodosian Walls*. In other words, gardeners provided support for the walls to survive (Kanbak, 2016). The skill of the gardeners has ensured that vegetable production is carried out at a low cost and the negative consequences of large-scale competition can be minimized. Different products are obtained in different seasons throughout the year. The gardens, wells, and water pools within the *Yedikule* area date back to very old times. Today's gardeners also produce with the same technique. The production model brought by the orchards and gardeners until today has been under the threat of urbanization due to the changing conditions (Kanbak, 2016).

3.2 Game Design

As mentioned before, the *Yedikule Bostans* game is designed with an immersive text-based narrative focusing on the cultural heritage gathered from the literature review, based on *Yedikule Bostanları* and *Kara Surları*. According to the main aim of the game, we made a broad mind mapping to fully transmit all the information we want, to a user, engagingly (Figure 3). However, according to the time limits the game is in its alpha version and we just devised its first stage.

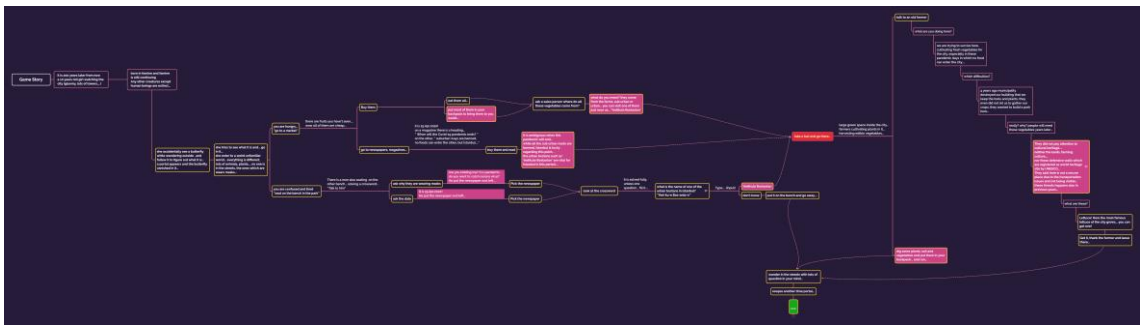


Figure 3. Mind Mapping for the First Stage of the Game

The game has a time-traveling theme, in which the first-character commutes among different periods via a time portal. In this journey, the player experiences a dystopian future world at first, then goes back through 1760 years ago, gathering various information about past events meanwhile. The character will try to change her world via the decisions she makes during her journey back home and the objects she brings with herself from the past. Figure 4 demonstrates the timeline in which the game occurs. At the beginning of the game, a 10-year-old girl leaving in 2220 will appear in a dystopian world, which is famine, and all the plant and animal species have been extinct. She is being transmitted to 2020 by a portal. In this period, the girl confronts various dilemmas in selecting different options to figure where and when she is and assemble valuable data and objects for the rest of her journey. Covid

pandemic, banned intercity paths, gardens' role, and farmers' difficulties are among the things that happen in this period. Afterward, she will travel to 1985, 1650, 1460, and 460, respectively, to understand how the initial gardens were and what are the reasons that caused their current state.

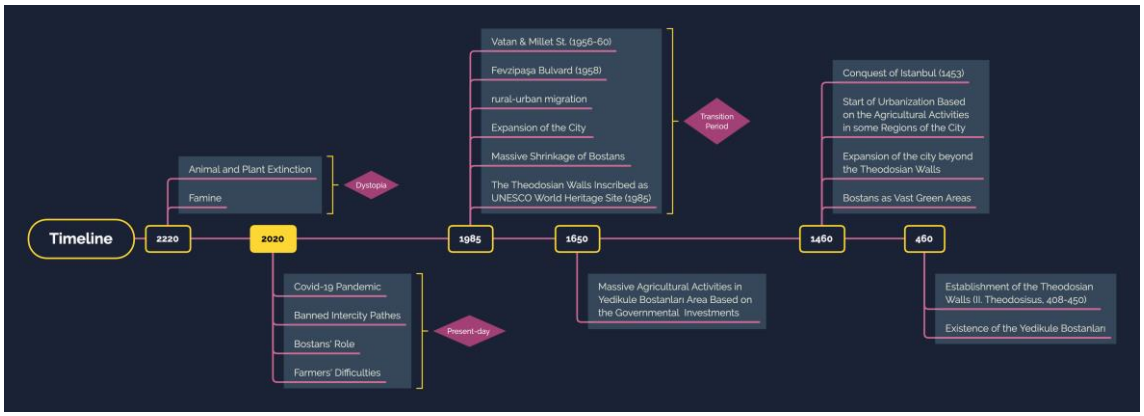


Figure 4. Timeline of the Game

In this research, we used Twine software to develop the game, which is an open-source platform enabling us to approach our goals throughout a charming storytelling journey without requiring almost any coding skills. Figure 5 depicts the platform and multiple choices just for the first traveling period. While, the Twine platform has the ability to publish and export the game as an HTML file, which enables us to play it in any browser, for now, the game is in its alpha version and available just locally. Furthermore, as an alpha version, only initial parts of the game are ready as videos and the rest of it is available in its text-based version.

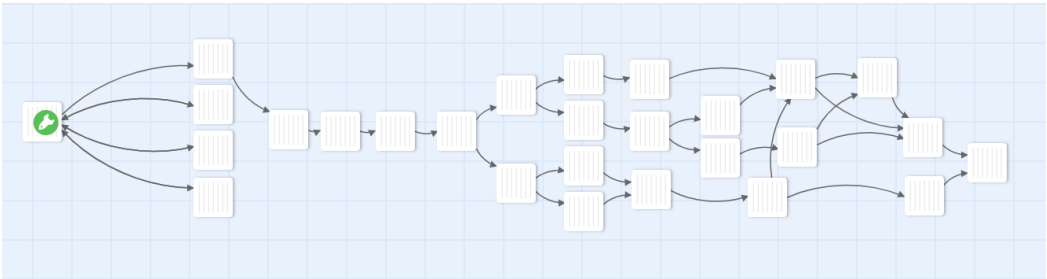


Figure 5. Twine Platform

However, despite the text-based nature of the Twine platform, which allowed us to expand our story and provide multiple choices for the user, influencing the outcome of the game, the player will face an attractive audio-visual interface (figure 6).



Figure 6. Gameplay Screen

As the game continues among challenging various selections for the player, the player may encounter some mini-games, fill in the blanks, finding hidden objects, etc. As shown in Figure 7, if the player enters a wrong answer, he/she will face a different scene than the right answer. After the player goes to the *Yedikule Bostanları*, which is the striking point of the game, there will be a conversation between her and a farmer, which will give lots of hints and information to her in order to use it in the rest of the game. Indeed, there are parts in the game in which the player can gain some objects, such as fruits, which the player is able to see on top of the screen, as achievements. Finally, the user after passing through all periods, as seen in the timeline, the character comes back to her era, facing varied outcomes based on her selections and gained objects.



Figure 7. Fill in the Blanks

4. CONCLUSION

To conclude the research, this paper aims to introduce the role of serious games in education and talking more detailed, about the cultural heritage topic. Considering this topic, in addition to its educational capacity, games could also cooperate in the cultural heritage preservation duty. In this regard, increasing public awareness according to the topic is the initial focus of the study. The case of this article is the *Yedikule Bostanları* which are gardens in İstanbul meeting the city's vegetable needs since 1500 years ago. These gardens which are associated with the *Theodosian Walls* are being destroyed and decreased in terms of area. *Yedikule Bostans* is a serious game that we designed to inform the players regarding the farming culture inherited from the previous generations. The game with its text-based nature, designed with the Twine platform, enables us to provide multiple choices for the user to experience different endings as a future era simulation in each playtime based on his/her selections during the game. In a more holistic view, the game tries to direct the public's attention towards the cultural heritage, urban green infrastructure, and urban productive landscape, their importance, and preservation ways. Overall, a serious game is a medium in which the professionals and the researchers could more take its advantage in any field of education. As mentioned before, due to the time limitations the game is in its alpha version. Hence, as a further study, the game has the potential of being expanded and published to be played in schools in order to raise the next generations' consideration of the topic.

5. ACKNOWLEDGEMENTS

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Extraterrestrial Urbanism: Vision, Progress, and Future Implications for City Planning and Architecture

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ABSTRACT

The blue sky, space, stars have always been an inquiry of wonder and/or fear in the process and development of human civilization. With the effort to make sense of what people are curious about and cannot know, in time astrology has led to astrophysics and contemporary space engineering and design technologies. On the other hand, cities and other built forms of environments have been witnessed and experienced only on earth surface and limited its development to physical parameters of our world. Parallel to the data processing and technical engineering solutions of the disciplines engaged in habitat planning and design, the satellites that compile visual and physical data following the given tasks in space, and after 2000, autonomous or controlled laboratory robots began to make the unknown known. And humanity is moving from a one-planet civilization to the construction of a multi-planet horizon.

In this context, this paper will examine the fields of extra-terrestrial urbanism and space architecture through 4 study topics;

In the first part, the International Space Station, which is the first and only volume adapted to human life in terms of space architecture, will be examined in terms of research technologies and architecture. Second, a general profile of the space missions of countries in the last century will be examined and prospective developments in terms of geography and space science disciplines will be evaluated. Third, the studies of visions and idea developed for environments that scripted the design and construction of research bases and cities on the Moon and Mars will be examined. Within the scope of this review, the expansions in terms of planning, architecture and design will be discussed. Fourth, the establishment and development of the Turkish Space Agency, suggestions for the development of satellite observations and data processing for Turkey's space research and technology development will be discussed. In the conclusion part of the paper, opinions and suggestions on what design academies can do on extra-terrestrial urbanism and space architecture, which is evidently emerging as a new generation of inquiry for spatial design disciplines will be speculated.

Keywords: Extraterrestrial Urbanization, Space Architecture, Mars Missions, Turkish Space Agency

1. INTRODUCTION

The blue sky, space, stars have always been an inquiry of wonder and/or fear in the process and development of human civilization. With the effort to make sense of what people are curious about and cannot know, in time astrology has led to astrophysics and contemporary space engineering and design technologies. On the other hand, cities and other built forms of environments have been witnessed and experienced only on earth surface and limited its development to physical parameters of our world. Parallel to the data processing and technical engineering solutions of the disciplines engaged in habitat planning and design, the satellites that compile visual and physical data following the given tasks in space, and after 2000, autonomous or controlled laboratory robots began to make the unknown known. And humanity is moving from a one-planet civilization to the construction of a multi-planet horizon.

In this context, this paper will examine the fields of extra-terrestrial urbanism and space architecture through 4 study topics; in the ***first*** part, the International Space Station, which is the first and only volume adapted to human life in terms of space architecture, will be examined in terms of research technologies and architecture, ***second***, a general profile of the space missions of countries in the last century will be examined and prospective developments in terms of geography and space science disciplines will be evaluated; ***third***, the studies of visions and idea developed for environments that scripted the design and construction of research bases and cities on the Moon and Mars will be examined. Within the scope of this review, the expansions in terms of planning, architecture and design will be discussed; ***fourth***, the establishment and development of the Turkish Space Agency, suggestions for the development of satellite observations and data processing for Turkey's space research and technology development will be discussed. In the conclusion part of the paper, opinions and suggestions on what design academies can do on extra-terrestrial urbanism and space architecture, which is evidently emerging as a new generation of inquiry for spatial design disciplines will be speculated.

The ISS (International Space Station), which is the first and only volume adapted to human life in terms of space architecture, will be examined in terms of research technologies and architecture. After that, the studies of visions and ideas developed for environments that scripted the design and construction of research bases and cities on the Moon and Mars will be examined. Within the scope of this review, the expansions in terms of planning, architecture and design will be discussed. Design Studio and Competition Cases for will be discussed parallel to the establishment and development of the Turkish Space Agency, suggestions for the development of satellite observations and data processing for Turkey's space research and technology development will be shared.

2. ISS-ARCHITECTURAL RELEVANCE

The role of 'design' in space architecture and the actual human experience, however, is not taken up, being supposedly of lesser value than the engineering feat of making an iconic object in orbit, which scrapes lightly over a lurking wraith – the need for human spaceflight at all. When design is mentioned, it's either as a "symbol of modernity", or as a neutralizing factor that mops up the oddities of human encounters within an extraordinary space. Lacking any critical engagement with the project, and untroubled by any poetic lyricism, descriptions sometimes read as brochure captions, or awe-filled museum voice-overs: 'The International Space Station is a very stylish design. We can concur that the way it sparkles in the sunlight from a distance resembles an enormous jewel. Up close, its intricate composition of precisely fabricated metal parts in a wide array of shapes and sizes takes the Machine Aesthetic of the Modern Movement in architecture to new heights. If we could visit it and touch it, we

would be awed and transfixed. The International Space Station exhibits all the characteristics of "firmitas, utilitas and venustas".

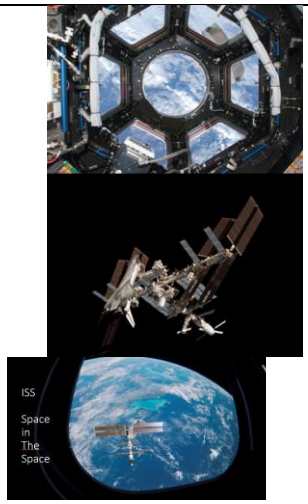
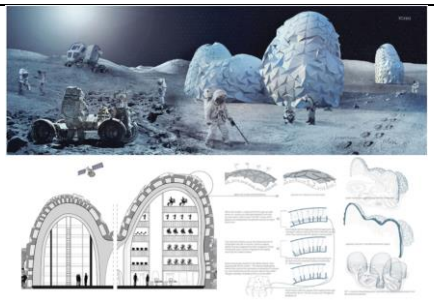
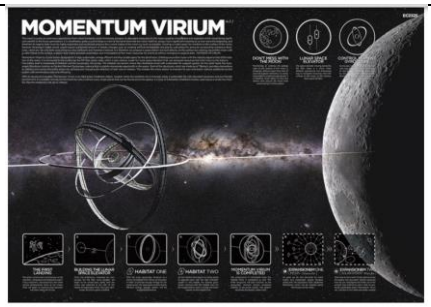
	→ Built by aerospace engineers and strung together by political grit, the ISS is a very different kind of construction to the iconic buildings that shape our contemporary city skylines. → Indeed, the ISS is 'space architecture' according to a semiotic technicality – simply because it is built in 'space'. → Today, the ISS fulfils only one of the functions it was intended to perform – a space laboratory.	This is an opportunity for lively debate, particularly with respect to the "role of designers in space colonisation", the human experience within the environments and the value of sending people into extra-terrestrial realms for increasingly lengthy periods, with a longer-term aim of space settlement.

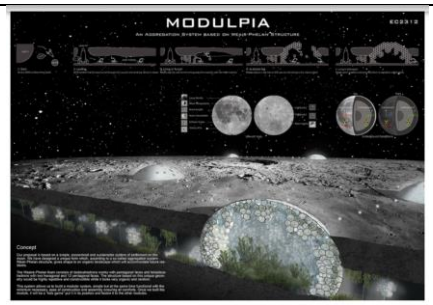
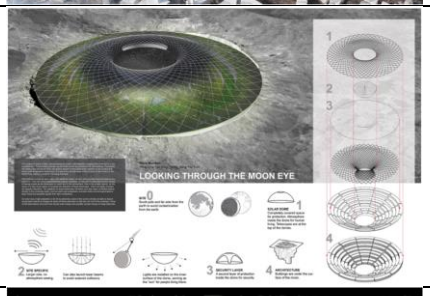
Figure 1. ISS images and general profile (url6)

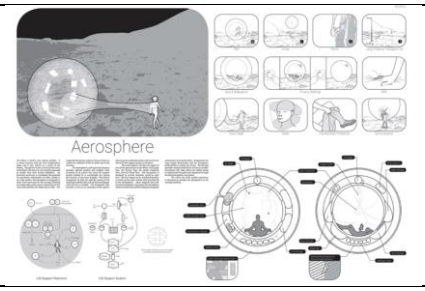
2.1 Moontopia Competition: Eleven Magazine

Nine space-age designs have been revealed as the winners of the Moontopia competition, which asked architects and designers to visualise life on the moon. Entrants to the Moontopia competition were asked to draw up plans for a self-sufficient lunar colony for living, working, researching and space tourism. One winner and eight runners up were selected from hundreds of proposals submitted to the competition, which was organised by architecture and design magazine Eleven, and ran from August to November 2016.

Table 1. Moontopia Competition Awardees and Concepts (compiled by the author (url1))

	**Test Lab by Monika Lipinska, Laura Nadine Olivier and Inci Lize Ogun**: The winning project involves the gradual colonisation of the moon through 3D printing and self-assembly. The carbon-fibre structures, based on origami, would be assembled by astronauts in the projects initial stages, with the chance for space tourism as the colony becomes more established.
	**Momentum Virium by Sergio Bianchi, Jonghak Kim, Simone Fracasso, Alejandro Jorge Velazco Ramirez:** The runner-up in the competition proposes a habitat that could be used to investigate and exploit the moon's resources without damaging them. Rather than building directly on the moon's surface, instead the habitat would be tethered to it by a cable and orbit around it.

	**Modulpia by Alessandro Giorgi, Cai Feng, Siyuan PanEsteban Analuiza:** Voted as the people's choice award through an online vote, Modulpia is a modular settlement designed for ease of construction and assembly. The settlement would be organised in phases, with a factory installed first, and followed by research laboratories and accommodation for researchers.
	**Platinum City by Sean Thomas Allen:** Given the first of six honourable mentions in the competition, this proposal provides homes for up to 3,000 "post-human moon citizens". The habit would support the first post-human industry of asteroid mining, as well as space tourism.
	**Upside Down by Ryan Tung Wai Yin, Ho Wing Tsit Teresina, Joshua Ho:** The second honourable mention went to Upside Down, a concept for interplanetary exploration and subsequent colonisation. Using the moon as a test site to gather experience and resources, inhabitants would then move to colonies on Mars.
	**Womb by Prapatsorn Sukkaset, Saran Chamroonkul** Honourable mention number three, Womb, imagines the moon as a place of contemplation and sanctuary from the materialistic planet Earth. Here, people live in bubbles rather than houses, and float from place to place.
	**Looking through the Moon Eye by Yiling Chu, Yao Ding, Yan-Fei Jiang, Hui Tian:** The fourth mention was handed out to a plan to build communities within the moon's craters. Protective covers would help to fend off asteroids, but also host observation telescopes.
	**Lunar Oasis by Edward Chew:** The fifth project, Lunar Oasis, is based on a hypothetical scenario that takes place 140 years after man's first landing on the moon in 2110. In this third wave of the moon's human colonisation, an oasis would created in response to people's wellbeing in relation to the built environment.

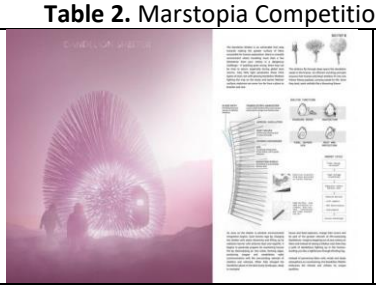
	**The Aerosphere by Stephanie Stiers:** The final award went to the smallest habitat submitted to the competition. The Aerosphere focuses on space tourism, facilitating short-term trips of one lunar day in a transparent sphere.

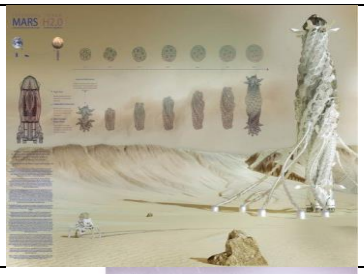
2.2 Marstopia Competition – Eleven Magazine

Marstopia challenged architects, designers and visionaries to engage with this hot topic, inviting them to conceptualize their visions of Marstopia and opening up the debate of Martian colonization to the creative fields. And the main question of the competition was; "Is living on Mars an inspiring Utopia or a questionable Dystopia?". This competition provided an international platform - open to all creative fields both professionals and/or students from around the World - for creative expression on the future of design and architecture beyond our planet. The winners of Marstopia were also invited by competition partner Mars City Design to attend an exclusive 10 day summer workshop in Los Angeles on Mars architecture including a mentorship programme to develop the design concept further with leading space agencies, VIP visits to space companies and JPL NASA, and a once in a lifetime opportunity to networking with professionals, pioneers and visionaries in the space industry.

The competition, which officially opened for registration on Saturday the 11th of November 2017, was scheduled to run for 4 months, closing on the 11th of March 2018 at 11:00am (UK Time). 'Marstopia', which is Eleven's 9th international competition till2017, launched challenges receiving global success. Previous competitions had been exhibited in Europe and the USA, published in multiple international magazines such as the Architecture Review, the AJ, Dezeen, Archdaily and Designboom, and have been featured in Bustler's 'Top-10 Best Competitions of the Year Awards' in both 2015 and 2016. The jury for the competition was comprised of; Marc Guberman (Team Leader of Mars Habitat Project and Partner – Fosters + Partners), Andrew Aldrin (Director – Buzz Aldrin Space Institute), Alberto Villanueva Galindo (Academic and Director – IDEA Architecture Office), Jessie Andjelic (Co-founder of SPECTACLE & Head of Mars Studio, University of Calgary), Vera Mulyani (CEO & Founder – Mars City DesignTM, Executive Director & Founder – Spaceport LA), Dmitry Zhuikov and Arina Agieieva (Founders - ZA Architects
- SEArch+ - First Place in NASA's 3D Printed Habitat Challenge for Mars), Monika Lipinska, Inci Lize Ogun & Laura Olivier (Winners - Eleven's Moontopia Competition), Andrea Verenini (Founder - Eleven Magazine), and Eloise Carr (Editor and Creative - Eleven Magazine)

Table 2. Marstopia Competition Awardees and Concepts (compiled by the author (url2))

	'Dandelion Shelter' by Karl-Johan Sørensen & Sebastian Aristotelis Frederiksen (Denmark) Inspired by Dandelions, this self-building 'fluffy' martian shelter is clad with a glowing Triboelectric Harvester which transforms electrostatic energy into power and traps Martian dust as a radiation shield

	'Mars H2.0' by Aleksandar Bursac & Ivan Djikanovic (Serbia) The project details a rocket ship which – upon landing – transforms itself into a vessel for habitation and a harvester of Martian water.
	'Desert Snowflake' by Robert Salazar, Anastasia Prosina & Svetlana Krinochkina (USA, Russia) This self-erecting, ultralight, deployable Geodesic Dome takes Buckminster Fuller's ideas into the new millennium. Desert Snowflake, the winner of the people's votes, is an ode to architectural origami form.

2.3 NASA - 3D-Printed Habitat Competition

The 3D-Printed Habitat Challenge is a competition to create sustainable shelters suitable for the Moon, Mars or beyond using resources available on-site in these locations. The multi-level 3D-Printed Habitat Challenge puts teams to the test in several areas of 3D-printing, including modeling software, material development and construction. In addition to aiding human space exploration, technologies sought from this competition could also lead to lower-cost housing solutions on Earth and other benefits.

Table 3. NASA 3D Challenge Competition Awardees and Concepts (compiled by the author (url3))

	Team SEArch+/Apis Cor won first place in the Phase 3: Level 4 software modeling stage of NASA's 3D-Printed Habitat Challenge. The unique shape of their habitat allows for continuous reinforcement of the structure. Light enters through trough-shaped ports on the sides and top.
	Team Zopherus won second place in the Phase 3: Level 4 software modeling stage of NASA's 3D-Printed Habitat Challenge. The team's design would be constructed by an autonomous roving printer that prints a structure and then moves on to the next site.
	The virtual design from team Mars Incubator won third place in the Phase 3: Level 4 software modeling stage of NASA's 3D-Printed Habitat Challenge. The team is a collection of engineers and artists.

2.4. Mars City Design - USA

Mars City Design was born from the vision of Vera Mulyani, who always dreamt of becoming an architect of Mars. Founded in Silicon Beach in Los Angeles, California, Mars City Design has become the action step to realizing not just the exploration of Mars, but making Mars the second home for humans.

Table 4. Mars City Design Motivations (compiled by the author (url4))

Vision	The vision for a better tomorrow. Mars City Design's vision is to create the blueprints for sustainable cities on Mars. Making Mars a second home is urgent, as practicing to thrive in the extreme environment like Mars will awaken the human awareness to live responsibly on Earth, a key to "becoming a multi-planetary species.
Mission	The mission for a responsible living on Earth. / Mars City Design selects, develops and builds Mars-architecture (Marschitecture) simulations on Earth, to provide a zero-harm living practice in response to climate change and extreme environment.
Commitment	The gate to the Mars projects Advancement / Together with global visionary leaders of multi-disciplinary Mars development contributors and experts of Earth preservation, Mars City Design is building the path for humans to thrive on Mars. Designing responsibly for Mars is practicing a mindful living for Earth

2.4. Techno-Space Entrepreneurialism: Elon Musk and SpaceX

Prominent entrepreneur and space-tech guru Elon Musk is the best known initiator for space fairing technologies encompassing field of sustainable energy, electric car, solar city initiatives and other multibillion dollar enterprises. We are need to underline the facts that, main motivations of his initiatives depict following motivations and main themes.

- His companies and vision aim mainly to capitalize and privatize space travel and technology by pushing forward first entry technology. In such a way, his ultimate goal is to overtake space technology monopoly from national agencies to private companies.
- He aims to overarch a mode of techno-space as a form of futuristic living. And the model he pursues underlines pragmatic and practical technology use.
- His models for first city on Mars gives no concrete evidence or approach on social and/or cultural context with which a city spirit is nurtured. He pushes up sleek and engineering based solutions in favour of whys of social sciences. We observe a SIM-CITY like mode of urban expansion.
- He usually refers to free enterprise direct democracy model for extra-terrestrial habitat, but upholds legitimate scepticism because of close ties with US government and Pentagon.
- Seeking models of terraforming and planetary engineering which might introduce new technologies for global ecosystem sustainability. But by suggesting nuking of Mars Polar ice caps, he portrays an unhinged approach by which there is high possibility of turning Mars into a never-to-be-habitable and devastated experimental lab zone.



Figure 2. An illustration of SpaceX's first city on Mars – strong SIM CITY approach



Figure 3. An illustration of SpaceX's planned StarShip rocket system to carry 100 people

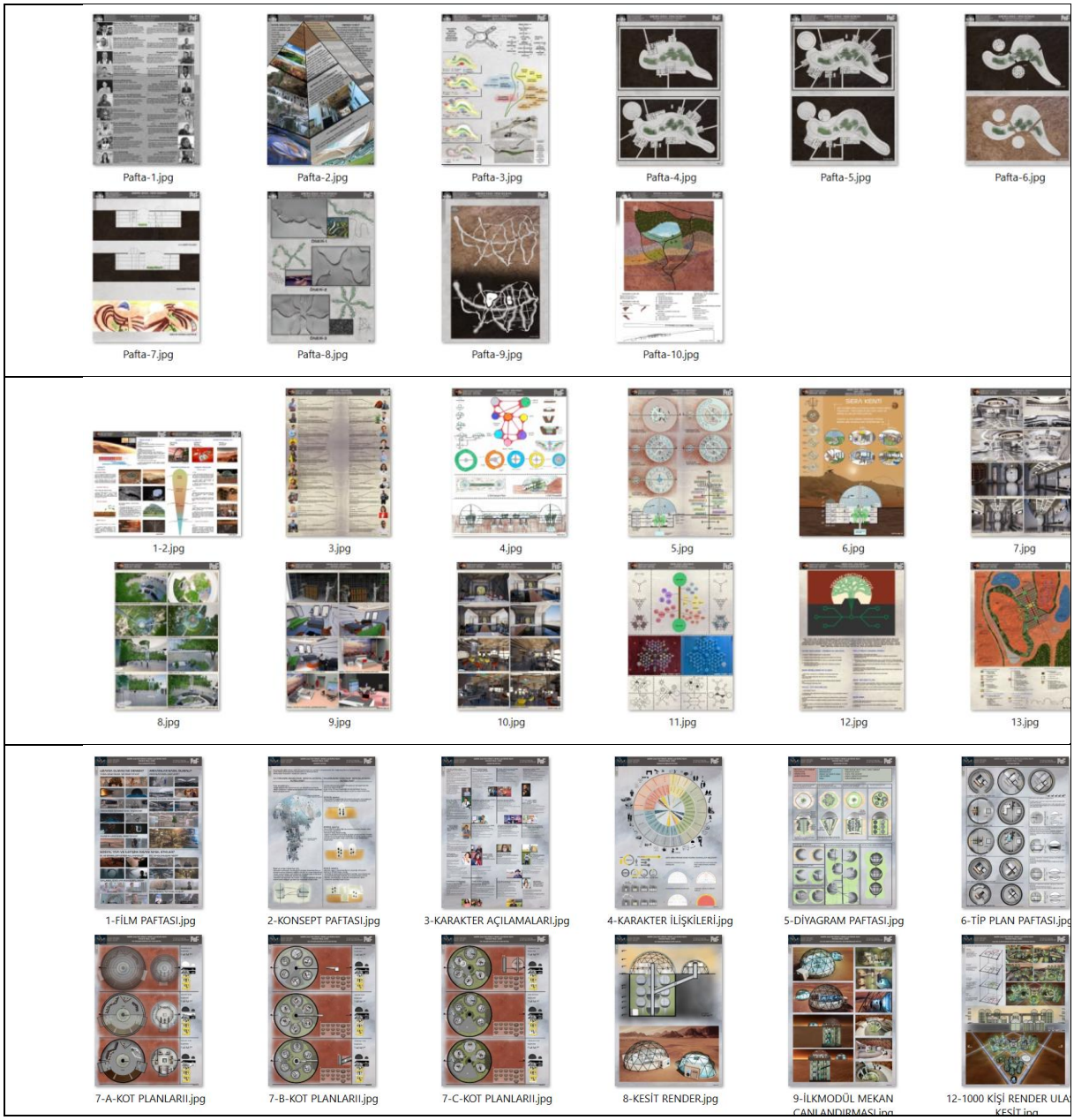
2.6. MARS 2100 Terra Nova Studio Project: Kocaeli University

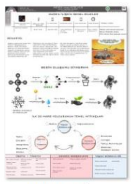
Feeding on the derivative effects of human philosophical and technological development and "Are we alone in the universe?" is preparing to rise to the level of "a multi-planet civilization" in pursuit of the question. In such a revolutionary quest, the redefinition of our lives and the places and places where all kinds of interactions take place have been brought to the agenda of design schools. In the process, man must not only travel great distances, but also redesign the entire living space of human beings and adapt to an ecosystem that is significantly alien to his biotic nature. In this context, the workshop searched for a sustainable settlement and habitat system titled "New Earth / Terra Nova", targeting the year 2100 on the planet Mars.In this context, the studio program designed by the author and ran with Dr. Büşra Özaydın Çat on 2017-2018 Fall semester of KOU, Department of Architecture pursued two contexts of design inquiry,

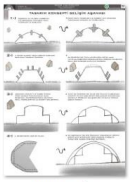
1. On the inductive design axis; closed volume underground and aboveground production-living-consumption-agriculture-eco balance and design spaces, greenhouse-type structures into which existing caves and underground tunnels are transformed will be investigated together with horizontal and vertical modular development possibilities, and
2. On the deductive design axis; by considering the horizontal and vertical dispersion-scatter-growth-development possibilities with geometric, organic and biomimetic approaches, in which terraforming / planetary engineering skills are interpreted with technological requirements and modular combination and flexibility approaches.

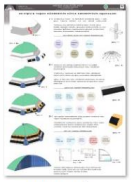
This workshop does not aim to solve all the problems of establishing a new life on Mars. Assuming that some problems will be solved by technological progress in the next 100 years, it has narrowed itself in the field of living space and spatial pattern formations.

Table 5. Mars 2100 Terra Nova Studio Projects




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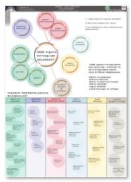

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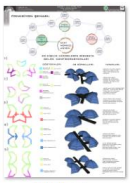

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PAFTA-4.jpg

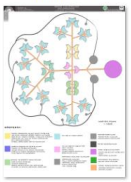

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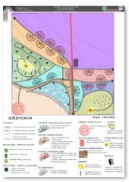

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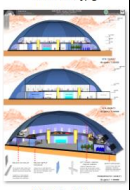

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PAFTA-13.jpg

DESIGN STAGES and METAPHORS: 1. CELL: The basic building block that works well together and is used to build texture / 2. TISSUE: Clustered units that are organized together, resistant to accidents and damages, formed in indoor and outdoor volumes, formed around functions. / 3.SKELETON: Forms of spatial continuity and overlapping layers of techno-spatial habitats.

2.6. MARS 2050 Habitat Competition-Turkey

Main theme and motivation of the competition was inviting student and professional participants to design the first living area / habitat in Mars. The project was managed between November 2019 and July 2020, with institutional sponsorship and cooperation by Bursa Technical University Rectorate and Bursa Metropolitan Municipality. The Ideas Competition focused issues of "extra-terrestrial urbanism and space architecture" to improve dialogue mediums within design and engineering schools and firms. The vision subject of the competition overlapped with the establishment on Turkey Space Agency on 13th of December 2018 with design schools focusing on extreme environments in celestial bodies investigating uses of resources and designing a living space

The competition was ran in 2 categories as "student" and "professional". It is designed by asking the following questions in both categories.

1. How can our sociological & philosophical & anthropological adventure affect the possibility of living on another planet?
2. How can existing and developing technologies regarding our ability to adapt to extreme natural conditions alien to human & living ecosystems on the planet Mars and to transform these conditions can be handled around the vision of "multi-planet civilization" in the planning, vision and design process?
3. How can the new generation current developments in establishing a sustainable life, producing suitable space, relevant engineering & architectural techniques be evaluated under Mars conditions?

An idea document covering 2 stages was expected from the competition participants.

1. MARS 2030 / FIRST CONTACT AND SURVIVAL UNIT DESIGN: Designing a "sealed spatial volume" which is protected and durable against extreme external conditions. For at least 20 marsonauts and at least 500 m3 / person. The architectural & engineering program, material, production technique, form, design theme, school, philosophy was free.
2. MARS 2050 / SETTLEMENT PLANNING AND DESIGN: initial settlement and design of human and other creatures' colony for at least 1000 marsonauts and 500 m3 / person. Selection of location and location, population of humans and other creatures, ecosystem construction and balance, external and internal conditions of the area, scenario was free.

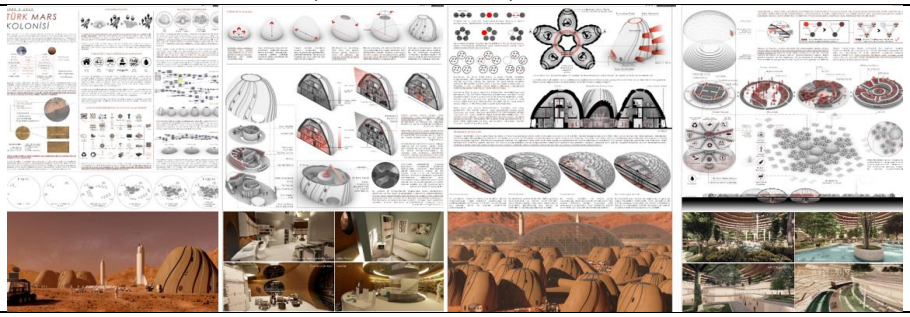
Table 6. Mars 2050 Habitat Competition Awardees and Concepts (compiled by the author (url6))



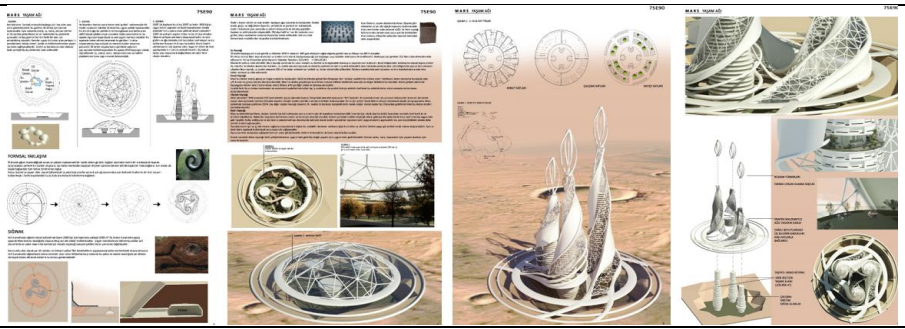
MARS 2050 HABITAT COMPETITON (NOVEMBER 2019-JUNE 2020), BTU AND BURSA METROPOLITAN MUNICIPALITY-CENTER FOR SCIENCE AND TECHNOLOGY COLLABORATION,
JURY AND PROJECT COORDINATOR: DR. ERSAN KOÇ



1st PRIZE – PROFESSIONAL:
Keremcan KIRILMAZ, İzmir Institute for Higher Technology, Faculty of Architecture, Dep.of. Arch, Erdem BATIRBEK, CMS



2nd PRIZE- PROFESSIONAL:
Ekin KILIÇ, İTÜ, Master Program for Arch.Informatics, Ceydanur KATMER, Sistema Techn. Structures



3rd PRIZE – PROFESSIONAL:
Merve ÇENGEL, OTS Project Management, Onur ERTAŞ, OTS Project Management

3. CONCLUSION

Why are we interested in design in and for space?

- ➔ Because the theory, education and practice of design is boundless… So is the Space… We need to strongly underline that, there is urgent need for expanding borders of design inquiry, education and practice for designing space in/for/by/within The Space.

What has been done so far in Turkey?

- ➔ Besides individuals and teams applying international competitions ad mediums, this paper is giving a brief summary of some studios and cases like; MARS 2100: Terra Nova Studio, BTÜ-Bursa BŞB BTM family and children workshops in Bursa Metropolitan Municipality Centre for Science and Technology, Mars2050 Habitat Competition. (Horizon, vision, excitement, self-confidence ... In our country ... in Turkish Language…now)

What are the conditions and motivations?

- ➔ We urgently need for higher levels of self-confidence for designing in/for The Space. Hopefully, such ideas will move from theory and models to practice and technologies. Science fiction is now becoming actual techno-spatial practices. The references to "Jetsons Millennium" or "Star Wars" are worth considering. Incremental and/or leaping steps to close up vision and technology gap is an urgent agenda. Hunter-gatherer man is looking for celestial bodies to collect for thyselves. As he/she discovered how to make walls out of stones in ancient times, now is time for pursuit of destroying the precious metals economy and replacing it with digital e-money such as bitcoin/etherium.

4. ACKNOWLEDGEMENTS

I sincerely thank "Bursa Technical University Rector Prof.Dr. Arif Karademir", "Bursa Metropolitan Municipality Mayor Alinur Aktaş" and all the jury members from BTU, KOU,İTU,İEU, and BUÜ for academic, institutional and financial support throughout Mars2050 Habitat Idea Competition process. And also I thank Kocaeli University Faculty of Architecture Dean Prof.Dr. Nezihi Köprübaşı for supporting Mars2100 Terra Nova Studio as a jury member.

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Gamification As a Motivation For Park Usage

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[2] İstanbul Technical University, maornek@itu.edu.tr

ABSTRACT

Game is a very old phenomenon and one of the factors that shape society and culture. In his book Homo Ludens, Johan Huizinga (1949) states that the game is actually older than the culture and games are indispensable for societies. According to Comenius (1592-1671), "*the game is a very important learning tool in the development of the child"* (Koçyiğit, Tuğluk & Kök, 2007*)*. In fact, terms such as gaming have been in our lives for a long time but Nick Pelling was defined "gamification" as a term in 2002. Gamification refers to adding game elements into non-game environments to engage and increase motivation for people to achieve their goals. This approach is a huge trend in various areas globally such as education, marketing, tourism and etc. The rising trend of gamification lays on increasing interaction levels by using game dynamics for non-game cases. For that reason, gamification is used when creating a new product or marketing a product such as corporations using for engagement and participation (Kavaliova et al., 2016). Gamification is also a form of learning; it is only slightly different from classical forms of learning. According to Ibáñez et al. (2014), employing gamification into learning activities dramatically improve the performance of test scores and the learning outcomes for undergraduate computer science students.

This research suggests using gamification to increase park visits and improve the experience of park users during their visits by employing the analog and digital methods. For that purpose, this research reviews the literature for case studies and applications on using gamification for engagement purposes in landscape architecture and related disciplines in terms of narration, role-playing, treasure hunting or geo-caching, immersion, loyalty, and awarding systems. As, this rese an outcome, this research aims to present a gamification concept by employing social media, which takes a critical role on engagement of public.

Keywords: Gamification, urban parks, user engagement.

1. INTRODUCTION

Merriam-Webster dictionary defines the word gamification - "the process of adding games or game-like elements to something (such as a task) to encourage participation". Terms such as gaming have been in our lives for a long time but Nick Pelling was defined gamification as a term in 2002 (Marczewski, 2013).
Gamification as a motivation for park usage is the topic of this research. This research reviews the literature for case studies and applications on using gamification for engagement purposes in landscape architecture and related disciplines. Apart from case studies; some implementations that we want to show about gamification for this research to make a clear idea about examples. One example is for elderly people to make them more active the other one is for children. Finally, the results of the gamification concepts about parks are shown as a final part of the research. Gamification concept for increasing park usage defining our main research paper. For this research, we describe the gamification concept which includes two parts. One part is about the analog process the other part is about the digital process.

2. GAMIFICATION

Terms such as gaming have been in our lives for a long time but Nick Pelling was defined gamification as a term in 2002 (Marczewski, 2013). Gamification refers to adding game elements into non-game environments to engage and increase motivation for people to achieve their goals. This approach is a huge trend in various areas globally such as education, marketing, tourism, etc. Our main research problem is to make parks more attractive and fun places for people. Nowadays people, especially children are lazy and they focus most of the time on technology. For this reason, we need to motivate them with different needs. Gamification is a key point in this research. We can motivate children with gamification elements to make them more active in life.

2.1 Gamification Usage

Gamification is used in various areas such as education, marketing, business, computer sciences, learning are some examples.

2.1.1 Gamification on Education

Gamification is also a form of learning; it is only slightly different from classical forms of learning. According to Ibáñez et al. (2014), for undergraduate computer science students, the use of gamification in learning tasks significantly increases the efficiency of test scores and learning results. The research assessed the learning efficacy and interaction appeal of a gamified learning experience aimed at learning the language of C-programming.
Khan academy and GamiCAD from Autodesk are other examples. The content on Khan Academy is designed to be engaging for students. Because Khan Academy empowers students to make choices about their learning. It helps to get students motivated.
GamiCAD, a gamified in-product, interactive tutorial system for first time AutoCAD users. GamiCAD provides real-time feedback to users.

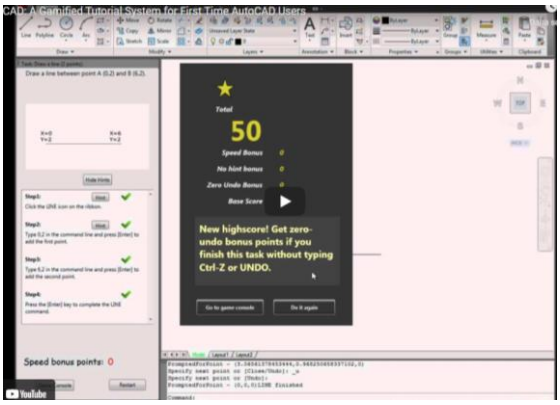


Figure 1. Gamicad screen

2.1.2 Gamification on Tourism

There are a variety of options for people to visit. That's why engagement and loyalty are the key points also in tourism. There are different methods to digitally engage visitors with the use of their digital devices.



Figure 2. STAM Museum Ghent

Interactive Museum games are one of the best examples of the gamification process. The game interacts with visitors and also they can learn about the arts.
There are some serious games which are examples of tourism also. Roma Nova is an immersive serious game in 3d designed to teach key notions of the history of Rome.

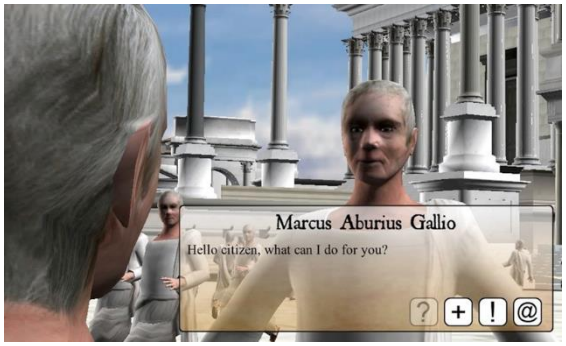


Figure 3. Roma Nova game scene

2.1.3 Gamification on Marketing

Gamification is to increase interaction levels by using game dynamics outside the game. This is why gamification is used when creating a new product or marketing a product. Gamification is also used by companies for engagement and participation (Kavaliova, Virjee, Maehle & Kleppe et al., 2016). Gamification is an important key factor for user loyalty as well.
Starbucks, foursquare, and yemeksepeti are using gamification for their companies. For engaging customers and loyalty and motivation as well.
Starbucks has some stars of levels depending on customer's loyalty. For example, customers register for a reward system with the application My Reward every time they interact with the application they would gain some "stars". With this process, they get some benefits. An extra cup of coffee as an example.



Figure 4. Starbucks card

3. CASE STUDIES

In this research paper; four case studies are offered about gamification to make a clear idea. Save the park project, the Swiss National park project, Greenify, and Pokemon Go are examples of case studies. With these case studies, gamification and its components will be examined for demonstration.

3.1 Save the Park



Figure 5. Save the park game scene

It is a project for preserving national parks in the United States. The game was developed by Schell Games. The game highlights four national park volunteers who must complete a range of volunteer tasks to help preserve and conserve the parks. These characters were developed to represent different concerns/passions that would make people want to volunteer. In Save the Park; players learn about the national parks through the game. The game is a perfect chance to engage younger generations in sustainability and green ideas as well.
The game's target audience is teens, adults, and families. With the save the park project; the new generation and park lovers will be encouraged to take any action in preserving natural parks and nature.

3.2 Gamification mobile application concept for national parks: A case study in the Swiss National Park

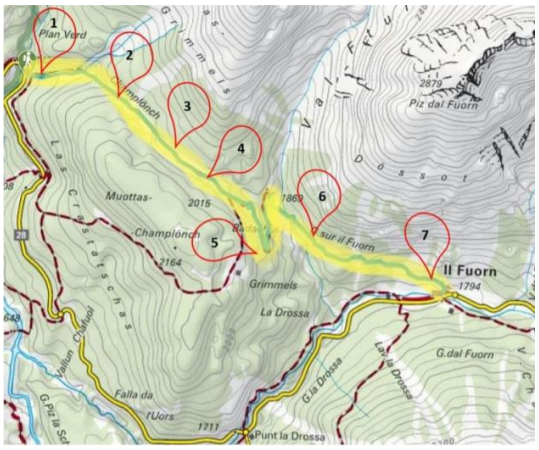


Figure 6. Gamification path scene

The objective of the gamification application is to engage more people with nature by attracting them to the Swiss National Park. The goal of the research is to develop a gamification model for a mobile application that national parks might use (Sprecher, 2018). Therefore the research aims to establish a general definition that can be used as the basis for the development of a national gamification application for national parks and from there to establish a particular idea of gamification for the Swiss National Park. The concept case study is the Swiss National Park. The research problem is making suitable gamification concepts for mobile applications in the context of national parks.

In terms of national parks, in the process, the visitors or players of the gamification app have to overcome different tasks to receive points or badges. After the mission is completed successfully, the player will obtain feedback on their mobile apps in the form of points or rewards. Seeing achievement by the actions becomes an inspiration for the participants and they pursue their actions with the national gamification app.

The players have to go to the Swiss National Park for some tasks because there are some hints and QR codes that they have to scan. By the reason for these tasks, people are engaged with nature. They will be more familiar with plants or trees by their actions. There are points players get after complete tasks. It also motivates players to the game process.

The gamification application is to participate in more people with nature by attracting them to the Swiss National Park. This is done by giving them tasks that they can fulfill to move forward in the game and gather points. The gamification concept shows the lists for an adult version but no children version. To sum up; this game is a real-time adventure game that focuses on the experience of nature. At the same time, this concept is educational because users can learn about nature and the Swiss National Park.

3.3 Greenify: Fostering Sustainable Communities via Gamification



Figure 7. Greenify app scene

Games Research Lab created Greenify, an online social platform linking gamification elements, designed to promote developing sustainable communities via individual actions and user-created tasks communities of peers. Greenify addresses a Healthy climate and environment, social well-being, and economic security. The Greenify system tests users to create and complete tasks in their local communities. These actions are personally related, real-life actions that are broken down into five areas: energy, food, consumption, household, and transportation. For instance Oh! Organic Challenge is a food task that challenges users to consume organic food for a week. Right after successful completion of missions, users receive badges and points, improve their in-game avatars, and enlarge their ranking on the leaderboards. Through gamification elements, greenify promotes the identity of users as eco-friendly members within a sustainable and thriving community by promoting desired behaviors through badges, heightened status, and systems of social reward.

3.4 Mobile Applications Encourage the Use of Open and Green Spaces: Sample of Pokemon Go



Figure 8. Pokemon Go in Taksim

Pokémon go has probably been one of the most popular examples of inspiring young people to become passive in terms of activity, to spend time in parks, and to make these practices routine. Pokémon Go, released on July 6, 2016, is a virtual reality game that invites people to take daily walks and explore parks and squares. To progress in the game, players need to walk around the city, especially city parks and squares. The most obvious result of this work is that people can walk, move, and exercise with augmented reality applications, and the vast majority of participants stated that they had regular and long walks after they started playing the game, and began to discover other things. Besides, thanks to the game, users become aware of the sculptures and art objects around them. For example, in the pokemon go game; the statue at the entrance to the Ankara opera and ballet building is said to belong to the world-famous soprano Leyla Gencer. As it is constantly shared in such spatial representations, it appears to have made a great contribution to uninformed players. Owing to the game users have

become informed of the sculptures and art objects around them. At the same time while playing they also have a chance to examine the environment. Also, users spend more time outdoors and socialize with each other, and being active outside helps to fight obesity.

4. GAMIFICATION IMPLEMENTATION

There are two implementations that we would like to demonstrate to give this research a good picture of examples. With these implementations, we can see two different age groups. One example is for elderly people to make them more active in their life the other one is for children. According to us looking at different age examples is important for understanding gamification ideas.

4.1 Mobile Walking Game and Group-Walking Program to Enhance Going Out for Older Adults

Japan has the world's largest share of older people, so "tojikomori", which refers to shut up in a room or house has been a major societal problem (Kawasaki, H., Maeda, A., Nakamura, M. & Takahashi, M., 2016).

The study indicated that in an urban setting, "tojikomori" is about no practice patterns and no involvement in group events. Moreover, older men who have little interest in the region in which they live are vulnerable to being "tojikomori". Accordingly, to improve physically healthy behavior and allow one to become acquainted with an environment, the researcher developed a walking game. The walking game is a mobile game intended to encourage the elderly to explore a town and contribute to the discovery of favorite places they want to visit again.

Games and gamification techniques have positive motivations for people's health and behaviors.
We are seeing these consequences in this analysis as well. Researchers add a group walking program to make communication through this app. Elderly people can use this application for communication besides walking features.

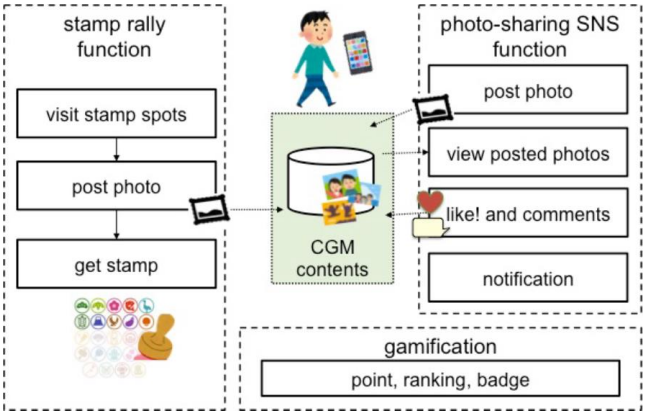


Figure 9. Application design architecture

The application has two functions: (1) an electronic version of a stamp rally and (2) a photo social networking site for sharing local information by uploading photographs. The photos also can be used by the development of the city of Mitaka, Tokyo. There are different motivations for these activities to happen. Users think getting stamps is fun or getting points and badges to go higher in the ranking are some examples. With these outcomes, we can comprehend that gamification elements have positive effects on motivating users.

Gamification components are used in this application to trigger people to be more involved in life. Results of the application illustrate the purpose of the application is well known.

Users have an enjoyable and productive way to increase their performance. To evaluate, this application has health benefits, game elements, and social contributions to the users.

4.2 Beat the Street Game

In our research work; we recommend using gamification to increase park visits and improve the experience of park users during their visits by employing analog and digital methods. For this achievement; Beat the Street is analyzed as in the main case study.

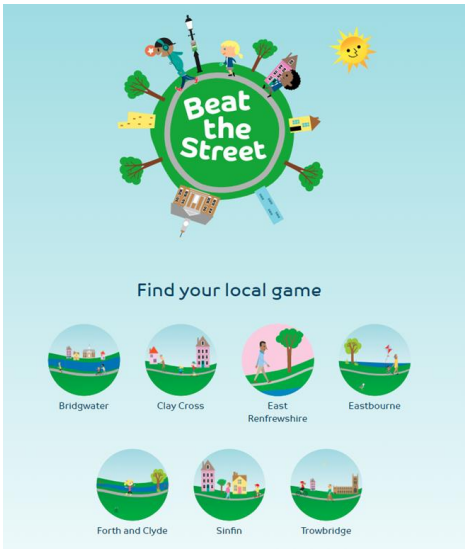


Figure 10. Beat the street game

Intelligent Health, a company committed to creating active communities in the UK and worldwide, has developed Beat the Street. The game made central Southwark a giant game.

Children under the age of 11 are playing with a Beat the Street fob that they are going to get from their school. Anyone 12 and over, play with the Beat the Street Card. Build your account online, and connect your fob to your account once you have collected your card or fob. In the game, each player requires his or her account (Beatthestreet, 2020). The game aims to earn as many points as possible. Alone with your family or with friends by running, walking, or cycling between Beat Boxes. Here are the definitions of the Beat Box game below:

- **Beat Box Device** - Contactless card and fob reader connected around your area to street furniture.
- **Card** - Contactless Adult Cards to hover against Beat Boxes to score points. To enter a team, the card needs to be registered online.
- **Fob** - Contactless keyring for children under the age of 11 to swipe against Beat Boxes to score points.
- **Lucky Box**- Draws will take place in the game, where a reward will be awarded to a Beat Box from a registered player.
- **Cheating** - Driving between Beat Boxes, swiping multiple cards and fobs per person (this applies to one person swiping multiple cards and fobs), or using someone else's card or fobs constitutes cheating (Beatthestreet, 2020)

How to play

Players need to find the Beat Boxes on the map closest to them. After finding the Beat Box devices they need to hover in front of the Beat Box with their card or fob before it beeps and flashes.
In an hour, players can walk, bike, run or scoot to another Beat Box. With their card and fob, swipe the Beat Box device until it beeps and flashes to score 10 points. After getting points, they continue their journey and gain more points for each additional Beat Box device that they swipe. In this game, users can play the game in collaboration by spending time with each other. There are leader boards for school & community teams. The highest average and highest points prizes are available.

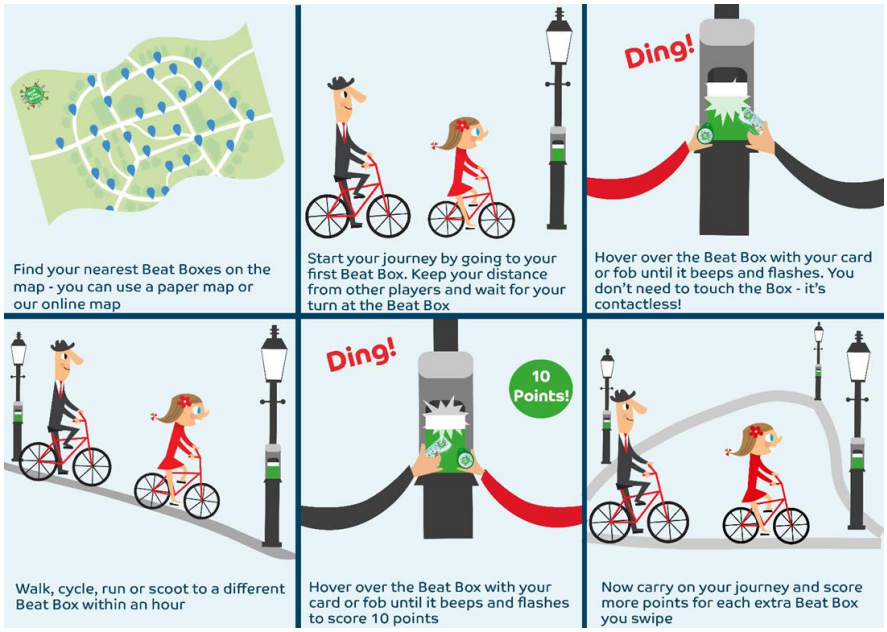


Figure 11. Step by step how to play

5. GAMIFICATION AS A MOTIVATION FOR PARK USAGE

In this research study, we are concentrating on gamification as a motivation for park usage. This research examines applications and case studies in gamification. A different implementation of gamification is looked for with a clear glance. As an example of making children more active "Beat the Street" is a good and successful implementation for our approach.
We can use a related example of this implementation in our research. With gamification elements; 10 to 12 years old children learn about the environment at the same time as their surroundings. In specific, we choose to prioritize children to engage with because the gamification process has a beneficial impact on actions.
Environmental psychologists have researched the efficacy of pro-environmental motivational approaches, many of which correlate with gamification methods, including target setting, social comparisons, simulation, and incentives (McKenzie-Mohr 2011).

5.1 Gamification Concept

By the time users are getting lazy and they focus most of the time on technology. For this reason, we need to motivate them with different needs. Gamification is a crucial feature of this research. Children can be motivated by gamification elements to make them more active in life. Our main research

problem is to make parks for them more attractive and fun places. Digital or analog gamification processes are used to motivate them. The paper aims to develop a gamification concept that could be used by parks. Our main target is children (10-12 years old).

In our gamification concept; we would like to use gamification elements to make users more often go to parks. With badges, levels, and points system children can be motivated.

With a special system integration to IstanbulKart; children can go to parks and gain points for this activity. Just by adding a box to the lighting poles for reading cards; children finish their journey.
The first objective of the research is to make parks for children in more alluring places. Users can finish the paths, which will be shared by a map, with alone, family, or a group of friends. Communication and family activities could be possible with this concept.

In the beginning; some chosen parks could be case studies. With this process along with positive health effects, park usage will increase. Apart from the park usage effect; just adding a digital section to the process for making children recognize various plants could be a plus. With this section, users will learn about nature while spending time in parks.

All this process makes playing, walking, and learning possible at the same time.

6. CONCLUSION

In conclusion; Gamification is an important motivation factor in this research issue. The intention of the research is to increase park usage at the same time raising aware children with plants. With both analog and digital components, a gamification process can be created. With a gamification rewards system, users will want to use parks frequently. Users' loyalty is also a plus for this concept.

With this gamification process; promoting a degree of competitiveness within the game is a simple way, through the concept, for motivated players to aspire to achieve greater results. Playing with a group of friends encourages users to go to higher levels they would want to get points as many as possible with competition effect.

Adding social media effect to the gamification concept would help to the recognition of the parks. Like the San-Poki application that we looked at as an implementation of elderly people; users sharing pictures about places that they have visited. To them, this section is a sense of responsibility toward town development. In the research; in order to expose the impact of the walking game on the social network formulation, the researcher asked the participants, "Is the San-Poki application a cause to make new friends?"21 out of 30 (70 percent) participants replied Yes" because it became a popular topic among strangers and taught each other how to use it (Kawasaki, H., Maeda, A., Nakamura, M. & Takahashi, M., 2016). Social media effect not only helps to the recognition of parks but at the same time getting likes on the platform or making new friends can be motivation for users.
Park gamification is a wonderful resource consisting of game components in a non-gaming environment. After all, gamification for park usage could increase player engagement and enhance the visitors' natural experience. The digital section of the process helps users to learn more about plants and the environment.

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8. FIGURE LIST

Figure 1. Gamicad screen
Figure 2. STAM Museum Ghent
Figure 3. Roma Nova game scene
Figure 4. Starbucks card
Figure 5. Save the park game scene
Figure 6. Gamification path scene
Figure 7. Greenify app scene
Figure 8. Pokemon Go in Taksim
Figure 9. Application design architecture
Figure 10. Beat the street game
Figure 11. Step by step how to play

Future Planning Approach: Low Carbon Cities and Urban Tree Management

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ABSTRACT

Low-carbon cities have been formed by terms such as carbon neutral city, zero-carbon city as a result of the discourse of decarbonizing the cities, the concept of urban sustainability, policies and initiatives. One of the prominent issues in the planning of these cities is urban green spaces and the amount of carbon captured in these areas. Trees are of great importance in capturing carbon. In this context, the study aims to provide suggestions on "Urban Tree Management", which offers technological solutions in data collection, monitoring and analysis for measuring carbon flows in cities, ensuring adaptation to the effects of climate change, and supporting sustainable urban development.

Keywords: Low-carbon cities, Urban tree management

1. INTRODUCTION

About half of the world's population live in cities. It is expected that this rate will reach %60 by 2030, and two thirds of the total population will live in cities by 2050. In parallel with the increase in the urban population, it is predicted that the amount of urban area will increase even more than the population increase (11). It is stated that the share of cities is more than %70 in the global carbon emission resulting from the increase in the population and the amount of urban area. On the other hand, the fact that cities cover approximately %3 of the world's land area (23) causes them to be seen as important action areas for climate change mitigation and adaptation (20).

The concept of sustainability, which emerged to fundamentally solve the problems experienced today in the urbanization of the future, is accepted all over the world. With this concept, it is developed new urban development strategies as eco city, slow city, compact city, archaeological city, symbio city, ideal city, comprehensible city, livable city, low carbon city, digital city, smart city that will help cities to evolve into a more sustainable model in the future, which approaches the city system more holistic in the combating climate change and the urban heat island effect (13).

One of these strategies, "Low-carbon cities" was formed in line with concepts such as carbon neutral city, zero-carbon city, low-carbon regions resulting from the discourse of decarbonization of cities, the concept of urban sustainability, policies and initiatives (2). Accordingly, many cities around the world try to adapt their development policy to the low-carbon economy in order to reduce energy consumption and CO_2 emissions and aim to create a low-carbon city (4). It is reported that approximately 1,050 cities in the United States, 40 cities in India and more than 100 cities in China have set low-carbon development goals and are making efforts to reduce carbon emissions. This is evidence that low carbon cities are becoming a new urban development target (21). However, research is ongoing on how to measure and validate low carbon levels so that cities can be identified as low-carbon cities in the future (22).

Some issues such as natural environmental protection, protection of biological diversity, creation of green living environments and establishment of a green city system, preserving existing carbon sink resources and ecosystems and creating new ones, raising awareness of energy conservation, development of compact and flexible urban spatial structure, use of environmentally friendly transport plans come to the fore in low-carbon urban planning (1,9,17).

China, one of the countries with the highest carbon emissions worldwide, can be given as an example of low-carbon urban development (12). The Chinese government has started to implement the low-carbon urban development strategies of the future as a solution to climate change, carbon emission and environmental problems in 8 cities where they have determined as a pilot. Pilot cities are aimed to be pioneering models for other cities in China to develop low-carbon urban development in the future (16).

Another example targeting low carbon urban development is the city of Masdar, created in Abu Dhabi, United Arab Emirates. This city, which is thought to be completed in 2025, is one of the leading exemplary cities in the world in terms of being a new model for the design and governance of sustainable cities with zero carbon emissions (7).

2. LOW CARBON CITY AND URBAN TREE MANAGEMENT

While there are many criteria and indicators for carbon reduction targets in planning low-carbon cities, the urban environment criterion consists of sub-criteria such as the amount and distribution of green space in cities (10).

Urban green spaces (UGS) function as 'lungs of cities' and 'carbon stock' reservoirs. Vegetation in and around urban areas captures and stores large amounts of carbon (14). Since factors such as land distribution, the configuration and distribution of green areas, the presence, type and distribution of vegetation differ according to the cities self-structure, the amount, density and distribution of carbon retained in the urban area also vary. In this respect, the monitoring of these areas that have carbon sink potential in cities is a very important issue in terms of sustainability.

It has been stated that the amount of carbon retention of trees is higher than that of shrubs and groundcovers in researches on urban green areas and the amount of carbon retained in these areas (3,14,20). In this respect, taking an inventory of trees is a very important issue in terms of measuring the carbon amount.

Traditionally, knowledge and research on urban tree structures are often expensive, labor-intensive and time-consuming processes. However, researches such as the identification, classification and mapping of urban tree characteristics are studies that use non-uniform and multifunctional approaches and may face difficulties due to lack of information.

According to web of science data, it is understood that 170 studies have been conducted on urban green areas, carbon storage or mapping and trees since 2016. Information on some of these studies, which are related to the subject and scope of the study, are as follows;
Speak et al. (2020) have benefited from the data they obtained from LIDAR and I-Tree in their research in creating an inventory of trees in urban areas and measuring the amount of carbon retained. In this context, they stated that they used criteria such as crown height, crown width, dead tree biomass, land type, tree density according to area use, but they did not evaluate data on tree care, irrigation, soil. As a result of the research, they stated that there is a tendency for underestimation in LiDAR-based tree height estimates and that there may be standard errors of up to %40 in urban tree carbon storage models such as i-Tree. In addition, they stated that in future studies, using urban developed biomass equations, it can be better calculated estimates of carbon sequestration in urban areas.
Fu et al. (2019) stated in their research that the carbon holding capacity of vegetation in urban green areas is highest in leaves compared to branches, roots and stems. They also emphasized that vegetation can vary depending on the species, the characteristics of the trees and the amount and conditions of permeable surfaces for soil respiration. They underlined that the ability of trees to retain carbon is not only related to tree species, but also to the planting density and age of the tree species.

As a result, they emphasized that
-determining the carbon holding capacity of different plant species throughout their life cycle and
-determining the best combination of carbon holding capacity created with trees, shrubs and groundcovers should be investigated in the future.
Lindén et al. (2020) determined in their research that the amount of carbon in urban green areas varies according to the size of the green area, tree density and size, and soil characteristics. In the study, they stated that methodological differences make direct comparisons difficult, but that carbon amounts differ between cities depending on the climate, the history and structure of urbanization and the composition of the city's species.

García-Sánchez et al. (2019) stated that different from other studies, plant height, leaf morphology and structure, stomatal density and size changed the amount of carbon retention.

When the above and other studies within the scope of this study are examined, it is understood that there are many interrelated criteria in the calculation of the carbon capture amount of urban trees. Again, according to the data obtained from these studies, it is possible to group the criteria as in the example given in **Table 1**. However, it is thought that while the criteria in **Table 1** may be sufficient to calculate the carbon retention amount of trees according to current conditions, different criteria will be needed for new conditions that will arise with the formation of low-carbon cities in the future and the grouping and criteria in the Table may change. In addition, it can be predicted that the analysis process will be a difficult process as a large number of data will be needed in the analysis of all these criteria.

Table 1. Criteria used to calculate the carbon capture amount of city trees

Criteria for the self-structure of the tree	**Criteria for the physical environment in which the tree is located**	**Biological environment criteria**
Species	Urban climate	Urban fauna
Height	The size of the green area	-------
Size	Green area density	-------
Density	Location	
Albedo ratio	--------	
Leaf area index		
.....		

When all these resources are evaluated, it is understood that there is a need for "Urban Tree Management", which provides technological solutions in data collection, monitoring and analysis for measuring carbon flows in cities, ensuring adaptation to the effects of climate change, and supporting sustainable urban development. This proposed management includes calculating and mapping the amount of carbon released from trees, making and monitoring tree inventories, tracking tree care, detecting problems and developing solutions.

Integration of technology is important for obtaining, monitoring and analyzing data about trees within the scope of urban tree management. "Lisbon city urban tree database" can be given as an example for the storage of data. This database is a public website that stores the properties of trees in Lisbon city such as scientific name, geographical location, height and age (19). Neto and Sarmento (2019), who conducted research using this database, determined that they prepared the carbon storage amount and carbon storage density map of each tree in the Lisbon urban area with ArcMap software offered by ESRI (Environmental Systems Research Institute). As a result of the research, they emphasized the importance of developing the database in terms of obtaining up-to-date data such as the age of the trees and enabling comparison between European cities.

When the studies on urban tree management and low-carbon cities are examined, it is understood that simulation models such as NASA-CASA, Geographic information technologies (GIS), cloud computing and satellite images are used as data analysis methods as in the Lisbon research example. Choudhury et al. (2020) carried out the carbon storage map of trees with the Object-Oriented Image Analysis (OBIA) approach. As a result of the study, they stated that they faced difficulties in obtaining data due to reasons such as classification and distribution of tree species in urban areas, heterogeneity of urban surface cover, presence of dense areas of trees and buildings (3). Matasov et al. (2020) used wireless and multi-parameter network monitoring devices working with Internet of Things (IoT)

technology in monitoring city tree ecosystem services. As a result of the study, they stated that monitoring such dynamic systems requires technological solutions that provide easy data collection, processing and use at affordable costs, otherwise research will lead to high costs (18). Harris et al. (2020) emphasized that it is important to determine the key components that can effectively represent the urban system in the modeling process in order to quantitatively model the future scenarios of complex systems such as those in low-carbon cities (8).

3. CONCLUSION

The results obtained within the scope of the study are stated below;

- Changes in the space, time and self-structure of trees in urban green areas cause changes in the amount and density of carbon that the trees will store.
- In this context, it is important to reveal the basic information about the characteristics of tree species to be used in low-carbon cities that are resistant to urban heat island effects in urban planning actions and strategies in terms of sustainability in the future.
- Considering the research results of Neto and Sarmento (2019), it is understood that supporting urban tree databases with new technologies such as sensors or drones is important both in terms of obtaining up-to-date, fast and reliable data and integrating low-carbon cities with technologies. In addition, it is considered that integrating these databases into urban information systems is necessary for urban tree management and sustainability.
- Analysis of the data for determining the carbon storage amount of city trees is very costly under today's conditions, and it is understood that there are still difficulties due to reasons such as the distribution and classification of trees in the urban area, the urban surface cover heterogeneity, and the shadow areas of buildings.

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