# ACADEMIC STUDIES IN ARCHITECTURE, PLANNING AND DESIGN - II

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PROF. DR. SEÇİL ŞATIR

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**e-mail:** gecekitapligi@gmail.com

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# Chapter 1

## IN SUSTAINABLE URBAN TARGET ECOLOGICAL PLANNING AND APPROACHES

*Aslı KORKUT[1] , Tuğba KİPER[2] , Tuğba ÜSTÜN TOPAL[3]*

1 Prof. Dr.,Tekirdağ Namık Kemal University, Faculty of Fine Arts Design and Architecture, Landscape Architecture Department, aslikorkut@nku.edu.tr
2 Prof. Dr., Tekirdağ Namık Kemal University, Faculty of Fine Arts Design and Architecture, Landscape Architecture Department, tkiper@nku.edu.tr
3 Res. Assist., Tekirdağ Namık Kemal University, Faculty of Fine Arts Design and Architecture, Landscape Architecture Department, tustun@nku.edu.tr

## INTRODUCTION

From prehistoric times to the present day, human beings have lived in places where can supply their housing and social needs. In the early periods, these places which were original and various nature examples, have changed their qualities and forms with settled life. By their nature, non-stationary human communities have formed living spaces that are constantly changing by shaping their areas in line with their desires and needs. With time changing needs and developing technology, urban and urbanization phenomena which are complex living areas have emerged. Cities are defined as centers where housing, socio-cultural activities such as recreation, resting, traveling and socio-economic needs are supplied for societies. Cities has been attraction and civilization center for people throughout history, due to their possibilities and equipment.

Cities, which are the centre of innovation and creativity in the world, offer opportunities for employment and education, on the other hand have an uncontrolled urbanization process. To benefit from the opportunities and o possibilities of the city, uncontrolled migration from rural areas to cities causes urban areas to become increasingly difficult to live. Due to technological facilities, modern and fast living conditions, urban people have been in for excessive consumption and the unlimited use of existing natural resources. The race to overcome nature and consume the natural resources unconsciously, disrupted the harmonious balance of nature itself and caused serious environmental problems, especially in urban areas.

With the understanding of the fact that natural resources are non-renewable sources, many countries in the world have been forced to do joint work and produce solutions. Nowadays, the most widely used concept is sustainability which of concepts emerged from handling environmental problems on a global scale and with discussions in the international political platform. With the concept of sustainability in the context of city and environment, it is understood that conservation of ecosystems and transfer of natural resources to future generations within the protection-utilization balance. Nowadays, there is sustainability in the basis of all works aimed at protecting nature.

In this study, it is especially emphasized that the importance of ecological planning in achieving the goal of sustainable city on the basis the concepts of urban, urbanization, sustainability and sustainable urbanization. The historical development of ecological planning and ecological planning methods are explained and ecological planning approaches for urban environmental problems are analyzed.

## URBAN AND URBANIZATION

The city and urbanization, which started with the establishment of settled life, represent the process of deep-rooted structuring that has a global character and diversity in our age. In the historical process, the most established cultures and civilizations of history have emerged in the cities that have continuously developed in line with the needs of the people.

It is very difficult to try to explain the concept of city with single definition, which is a multidimensional and undefined area. Cities are residential areas, where population is dense, social and cultural diversity and technical facilities are high, non-agricultural production gain importance. The cities, which gain the character according to people's aims in maintaining their existence, living together with their inhabitants and changing over time, are defined by many different criteria and dimensions (Hasol 2010, Kuban 2010, Bulut and Atabeyoğlu 2010, Keleş 2016 ).

With changing needs and expectations in the process, urbanization has emerged. Keleş (1998 and 2008) defines urbanization as a demographic description of the number of cities and the increase in the population of people living in cities. However, urbanization is not only a movement of population, it is a process of population accumulation which leads to increasing number of organization and specialization in society parallel to economic development, and city-specific changes in human relations. The reasons for urbanization in general are given in Table 1.

**Table 1:** *Reasons of urbanization (prepared by using Çelik 2017*, *Alpaslan and Tüter 2016)*

| | |
|---|---|
| Economic reasons | Migration from rural areas to urban areas is one of the primary reasons for not providing the desired income from production and business lines the lack of future security. |
| Technological reasons | Urban areas are the first areas where all inventions are applied. Especially, all the inventions that emerged with the industrial revolution had a significant impact on the acceleration of urbanization. |
| Political reasons | Attractive decisions taken by managers attract people to urban areas. For example, urbanization accelerates and investments in the region are increasing in a capital city and its surroundings. |
| Socio-psychological reasons | The diversity of socio-cultural opportunities in the city and the services and facilities provided are the reasons for attracting people to urban areas. |
| Wars | People want to live in areas where they feel safe. That is why wars are one of the major reasons that cause urban migration. |

Based on the definition of the city and the information in Table 1, urbanization is a phenomenon that covers the process of where non-agricultural production branches gain importance, socialization, division of labor, and most importantly, people from different regions come together to create new cultures.

## THE CONCEPT OF SUSTAINABILITY AND SUSTAINABLE URBANIZATION

The concept of sustainability was first discussed at the Human Environment Conference in Stockholm in 1972. This concept was officially used in 1987 in the Brundtland Report (Our Common Future) published by the World Commission on Environment and Development (WCED). Sustainability is the use of existing resources by taking into consideration the needs of future generations and ensuring their continuity by transferring them to the future (Edwards 2007). When the domestic and foreign literature is examined, many definitions related to sustainability are found. Daily and Ehrlich (1992 and 1996) describe sustainability as a number of methods and conditions that include ensuring to preserve heritage indefinitely considering to future generations, without reduced value, loss or interruption of current generation's valuable qualities of natural heritage. Choucri (1998) mentions that sustainability can be achieved when ecological balance, economic performance, institutional capacity and sustainable management style can be provided.

Sustainability is a concept that needs to be considered as a whole in the interrelated environmental, social and economic dimensions (Table 2).

**Table 2:** *Environmental, social and economic sustainability (prepared by using Sev 2009)*

| | |
|---|---|
| Environmental Sustainability | Ecosystem integrity |
| | Ecological artificial environment |
| | Reduction and control of waste |
| | Elimination of products containing toxic raw materials |
| | Use of recycled materials |
| Social Sustainability | Cultural identity |
| | Life quality |
| | Human health and safety |
| | Stability, justice and easy accessibility |
| | Social inclusion of the disabled |
| Economic Sustainability | Healthy growth and development |
| | Low cost / high efficiency |
| | Rational resource and energy use |
| | Continuous cycle |

The concept of sustainability is focused on preventing the environmental problems arising in line with economic and technological developments and protecting the ecosystem (Tosun 2009). Sustainable development apporoach is the basis of sustainable urbanization. It is aimed to provide with sustainable development quality of life, quality of social life and economic capability. In this respect, sustainable development is integrated with the concept of urban development (Karakurt Tosun 2009).

Sustainable development is an environmentalist worldview, aiming at ensuring economic development by considering the use of environmental values and natural resources by future generations (Keleş 1998, Girginer 2006).

Sustainable development and sustainable planning is a planning approach developed against the consumption and loss of the environment as a resource. According to Atabay (2003), the relation between sustainable development and ecological and social development and environmental-sensitive planning is given in Figure 1.

“Sustainable cities are cities in which socio-economic interests are accord with environmental and energy concerns in order to ensure change in continuity” (Eke 2000). Sustainable city is a habitat in which a positive relationship between economy and ecology is established in order to increase sustainable social development. The basis of this approach is based on the conservation and sustainability of natural resources. These approaches now reveal the fact that sustainable urban development is based on ecological basis (MACED 2001, Korkut et al. 2017).

Sustainable urbanization approach integrates the aim of preserving and improving natural resources with the aim of social and economic development. This understanding includes all environmental (built environment / natural environment), social and economic factors, which are interrelated and balanced, affects urban development. In addition, this understanding requires that the form of development be decided through participatory processes (Karakurt Tosun 2009). In the World Environment Convention signed in the Environment and Development Conference held on June 3-14, 1992 in Rio, the topics such as adequate housing for all, improving human settlements management, sustainable land use planning and management have formed the objectives of sustainable urbanization (Tekeli 1996).

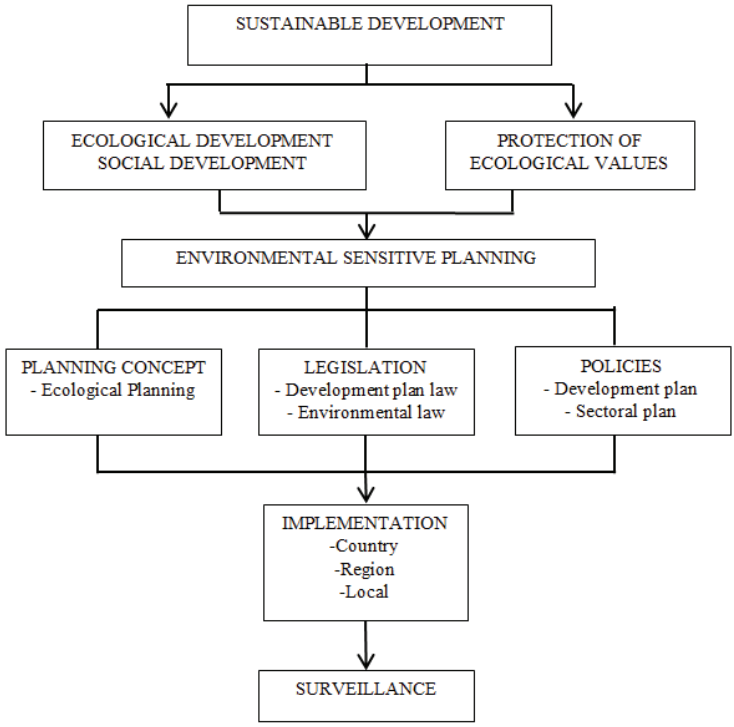


**Figure 1.** *Relationship between sustainable development and planning (Atabay 2003).*

## ECOLOGICAL PLANNING

Ecological based approaches in sustainable development correspond to the concept of environmentally sensitive planning. In this respect, the concept of ecological planning is seen as the ecological dimension of sustainable development. Ecological planning is a planning approach that is the basis of landscape planning, which contains all the ecological concerns and provides protection when using natural resources. According to Ayaşlıgil (1997), landscape planning provides the optimum development and security of structural and visual diversity as well as the ecological-biological diversity of landscape spaces. It creates and secures an ecologically-structural and visually optimum land pattern by keeping the implementation's damages to each other at the lowest level (Tozar and Ayaşlıgil 2008). With the planning, the negative effects of the environmental conditions are minimized and the quality of the space is increased (Çetinkaya and Uzun 2014).

Ecological planning is a planning process in which the most appropriate places in the balance of protection-use are determined by evaluating all natural and artificial socio-cultural factors and

their relation, based on ecology while giving land-use decisions for physical planning in pristine areas. It is a priority planning action used to prevent environmental problems and protect resources. In ecological planning, the use in the field is given according to the regeneration potential of renewable resources and non-renewable resources according to substitution principle. However, ecological planning is a planning approach that encourages the reduction of natural resource consumption, recycling of waste, conservation of biodiversity, and the use of local materials and renewable, clean energy resources. Human beings have a dynamic role in the center of ecology, planning and sustainability as a central component of landscape (Köseoğlu 1982, Koç 1994 ,Cranz and Boland, 2003, Makhzoumi and Pungetti 2005, Atıl, Gülgün ve Yörük 2005, Tozar 2006, Çelik 2013).

According to Koç (1994), some basic features of the ecological planning approach are given below:

- The ecological approach includes not only parts, but also the whole system.
- It accepts the dynamic structure and nature of the ecosystem.
- The relationships between the components of the ecosystem (air, water, soil, living organisms, etc.) are important.
- It includes the concepts of the capacity of the land, flexibility and sustainability.
- It uses a extensive definition of the environment (natural, physical, economic, social and cultural environments, etc.).
- It is based on natural geographical boundaries rather than administrative boundaries (basins, thresholds, etc.).
- It includes all local, regional, national and international working levels.
- It emphasizes the importance of other species than humans and future generations.
- It is based on an “ethic” that is consistent with natural, social and economic systems, measured in terms of quality, welfare, integrity and human dignity in the process.

The participation of landscape planning in ecological planning studies can be handled in three different scopes (Figure 2) (Uzun 2006).

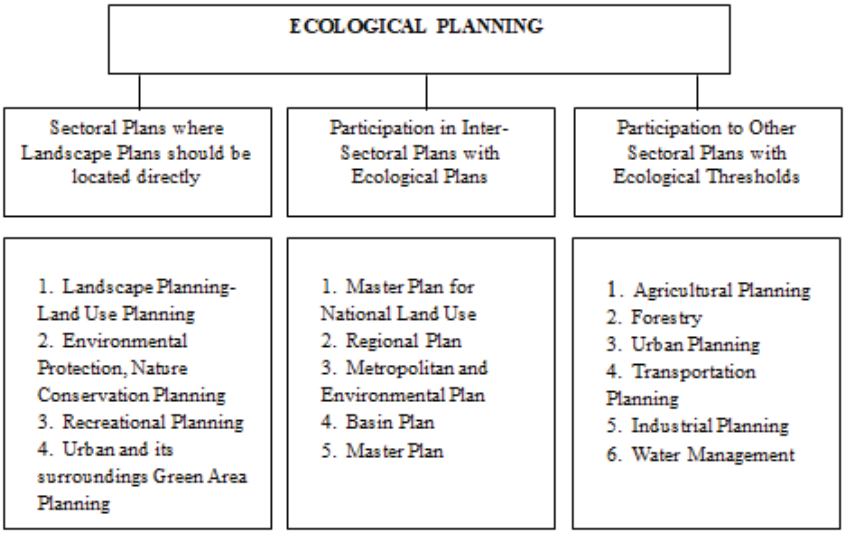


**Figure 2:** *The scope of ecological planning (Uzun 2006).*

## Development of Ecological Planning in the Historical Process

The historical development of ecological planning is examined under five (5) periods, including the Awareness Period, the Development Period, the Merger Period, the Acceptance Period and the Diversity Period. The main methods which are developed and applied by the important names contributing to the ecological planning that emerged in these periods are summarized in Table 3.

**Table 3.** *The development of ecological planning in the historical process (prepared by using Erol 2005; Tozar and Ayaşlıgil 2008).*

| | IMPORTANT NAMES | YEAR | PROJECT / METHOD | INSTRUCTIONS |
|---|---|---|---|---|
| AWARENESS PERIOD | George Catlin | 1796-1872 | | The emergence of the first ideas, basic concepts related to ecological planning |
| | Ralph Woldo Emerson | 1803-1882 | | |
| | Henry David Thoreau | 1817-1862 | | |
| | Frederich Law Olmsted | 1864 | Yosemite Valley Project | With this project, which is the first example in terms of ecological planning, it has been argued that physical planning alone will not be sustainable without management strategies. |
| | | 1891 | Plans developed for marshes and waterways in Boston | They are the first metropolitan park systems planned within the framework of hydrological and ecological features. |
| DEVELOPMENT PERIOD | | 1865 | Yosemite, California, Michigan, New York State Parks | The period of the state parks developed |
| | Warren Manning | 1912 | Boston Billerica Town Plan | The 'Overlay Technique' was used for the first time. |
| | Patrick Geddes | 1915 | Regional Surveillance Method (Geddes Model) | "Human-work-space" relationship is based. |
| | | 1920 | | The emergence of the idea of evaluation main characters of the landscape from an ecological and aesthetic perspective |

| | | | | |
|---|---|---|---|---|
| MERGERS PERIOD | Tansley | 1935 | | Implementation of ecological ideas in planning and use of the term ecosystem for the first time |
| | Raymond Lindeman | 1960 | | Research on the nutrient cycle in terrestrial ecosystem |
| | Benton MacKaye | | | Defending planning based on human ecology |
| | Lewis Mumford | 1938 | | It is aimed that ensure the harmony of the three important components of the region to be planned and to preserve the balances in ecosystems. These 3 important components: 1. Interaction between geography, climate, soil, vegetation, agriculture and technology, 2. Adaptation of the components of the region, 3. Physical boundaries. |
| | Biyolog William Vogt | 1948 | | Investigation of natural resource consumption, calculation of nature carrying capacity and demographic structure |
| | Trywhitt | 1950 | | Overlay technique is used on transparent paper where maps showing terrain characteristics are overlapped. |

| | | | | |
|---|---|---|---|---|
| ACCEPTANCE PERIOD | Angus Hills<br><br>Philip Lewis | 1961<br><br>1969 | Methods that provide balance between human uses and nature conservation have been studied. | Reports on the negative consequences of human activities at the global level have been prepared. |
| | McHarg | 1970 | There have been important developments in ecological planning. | A method known as “Suitability Analysis”, which integrates ecology into planning and design, thanks to “Design with Nature” (Overlay method- the basis of GIS ). |
| DIVERSITY PERIOD | Carl Steinitz<br>McHarg<br><br>Roberts and Tood | 1970<br>1980 | The basis of Geodesign<br><br>Plans for Texas Woodlands | Different approaches have been introduced. Planners have been provided to evaluate ecological principles more easily and accurately in land suitability studies. |

## Ecological Planning Methods

Ecological planning methods and techniques have been developed for the conservation and sustainable use of nature as a solution to problems such as depletion of natural resources due to insensible use, reduction of species and biodiversity, loss of habitats and increased pollution. In ecological planning, methods are not independent of each other. The methods have been developed in relation to each other by showing similarities in terms of contents and techniques. Although the differences between them are uncertain in the practice phase, it is theoretically important. In this respect, ecological planning methods are examined in two main groups: Landscape Suitability Approach I-(LSA I) and Landscape Suitability Approach II –(LSA II) (Tozar 2006).

Landscape Suitability Approaches-I (LSA-I) includes five (5) methods: Gestalt Method, Capability System, Physiographic-Unit Method, Resource-Pattem Method and Suitability Method. Landscape Suitabili-

ty Approach-II (LSA-II) includes five (5) methods: Landscape-Unit and Landscape-Classification Method, Landscape-Resource Survev Method, Allocation-Evaluation Method, Strategic Suitability Method and Golany Method. Ecological planning methods and evaluation techniques according to LSA-I and LSA-2 are given in Table 4.

**Table 4.** *Ecological planning methods and evaluation techniques according to Tozar 2005 [Landscape Suitability Approach I-II (LSA I-II)] (Tozar 2006, Tozar and Ayaşlıgil 2008)*

| | Method Name Developer and Country | Aim | Evaluation Factors | Evaluation Techniques |
|---|---|---|---|---|
| Landscape Suitability Approach-I (LSA-I) | **Gestalt Method** A. Hills, Canada | To determine land capabilities that support land uses | Visual features | Land use decisions are given based on satellite and aerial photos and observations. |
| | **Capability System** NRCS, A.B.D. | To determine the degree of suitability of the land according to land capability classes | Soil structure | Land capability classification is made according to productivity and restrictive properties of soil. |
| | **Physiographic-Unit Method** A. Hills, Canada | To determine the suitability, ability and feasibility of the land in terms of factors | Ecological and socio-economic | The area is divided into physiographic units according to their biological efficiency. |
| | **Resource-Pattem Method** P.Lewis, A.B.D. | To determine the parts of nature with rare features, to ensure the ecological and cultural integrity of the landscape | Recreational resources | Their natural, cultural and visual characteristics and their location and distribution are mapped and defined as absolute protection areas. |
| | **Suitability Method** McHarg, A.B.D. | To determine the most suitable ecological locations, to ensure the sustainability of natural resources | Ecological factors | Each ecological factor is mapped. Suitable / unsuitable regions are determined.by overlaying prepared maps. |

| | | | | |
|---|---|---|---|---|
| Landscape Suitability Approach-II (LSA-II) | **Landscape-Unit and Landscape-Classification Method** A.B.D. | Determining the character of the planning area by analyzing the habitat factors and the relations between them | Abiotic, biotic, socio-cultural factors | A single factor is created by analyzing multiple habitat factors and defining ecological units. |
| | **Landscape-Resource Survey Method** A.B.D. | Aims at the sustainability of ecological balance and productivity | Ecological and socio-economic factors | Supply: The ecological characteristics of the landscape supporting the use of land. Demand: Factors determining suitability. |
| | **Allocation-Evaluation Method** A.B.D. | Determining the suitable areas in terms of ecological characteristics for certain functions | Ecological and socio-economic factors | Possible environmental impacts of land uses are evaluated. |
| | **Strategic Suitability Method** A.B.D. | To ensure the balance between the uses that will ensure the sustainability of the natural balance and the demands of the society | Ecological and socio-economic factors | The most appropriate alternative is chosen. It is a method used in macro scale plans. It is recyclable. |
| | **Golany Method** G.Golany, A.B.D. | Site selection for a new city | Ecological and socio-economic factors | Each unit divided into small and equal square cells is scored according to the specified criteria (Ecological celling method: Virginia Roanoke Valley project) |

There are ten basic principles that complement each other in order to implement ecological landscape planning approaches. These principles (Kışlalıoğlu and Berkes 2010): The principle of integrity of nature, the principle of nature limitation, the principle of self-control of nature, the principle of nature's diversity, the principle of non-destruction in nature, the principle of no free benefit, the principle of nature's backlash, the principle of nature has found the most appropriate solution, the principle of cultural evolution and respect for traditional ecology, the principle of going with nature.

The Sustainable Sites Initiative, which was initiated by ASLA (American Society of Landscape Architecture) in 2005, the points to be taken into consideration has been explained under five main titles in order to support sustainable landscapes. These are hydrology, soil, vegetation, materials, human health and well-being. Title of hydrology includes conservation and restructuring of hydrological functions, rainwater management and design, ensuring the least water use. Title of soil includes, the conservation of healthy soils, the improvement of the soils that have lost their properties. Title of vegetation includes conservation of natural habitats, use of local species, energy consumption, planting and planning for reduce fire damage. Title of materials includes using existing materials, taking into account the life cycle of materials, reaching zero waste level and reducing air pollution. Title of human health and well-being includes making the settlements to be user-friendly, keeping the natural structure, culture and history alive, social interaction and physical activity (URL1).

## ECOLOGICAL APPROACHES FOR URBAN SUSTAINABILITY

According to McHarg (1992), sustainable development goals can be achieved if nature and natural processes are integrated into planning and designing. However, it should be taken into consideration that this process can be performed more slowly because of the natural areas in the cities are less. In this context, design with the nature approach in areas that have not lost their natural characteristics in urban areas is gaining importance. From this point of view, ecological basic principles regarding the sustainability of urban areas can be compiled from McHarg (1992), Tuncer (1994), Jeantet (1995), Korkut et al.(2017): conserving the existing landscape character, using topographic data in the most efficient way, repairing and evaluating the deteriorated landscape, making necessary maintenance and repair of the structure and infrastructure systems, minimizing consumption of natural resources and developing,, using the microclimatic data in the most efficient way, using the local resources, water, energy and material efficient design, recycling of waste, using renewable energy sources, permaculture, green roof and green wall implementations, creating of alternative green areas.

Nowadays, when problems are increasing, different planning approaches and principles have been developed in urban areas in order to re-integrate with nature and create sustainable living spaces. The main planning approaches developed for urban sustainability are compiled from Kurtaslan and Yazgan (2005), Aksoy and Samur (2012), Sınmaz (2013), Onur Erdoğan and Demiroğlu (2016) and summarized below.

- **New Urbanism:** The new urbanization movement is a design-oriented approach, which was developed in the early 1990s to provide an alternative solution to sub-urban expansion. In 'Congress for the New Urbanism (CNU)', a guide is provided to planners and society to create sustainable structures, neighborhoods and regions that will adapt to human and natural ecology. Planning and design principles of the new urbanism movement: Local architecture and landscape design, energy efficient materials in structures, renewable energy production, efficient water use, compact building island and defined settlement form, mixed land usage and walkable street texture, wide variety of housing typologies, comfortable public spaces on the human scale, development of the settlement in the residential area and reuse of worn areas.

- **Smart Growth:** Smart growth has been introduced to prevent urban spread. In this regard, at least 100 laws regarding smart growth have been defined in 27 states in USA. Planning and design principles of this movement: compact structure design, development of different housing alternatives, creation of walkable neighborhoods, various transportation alternatives, mixed use of land, strong sense of belonging in the settlement, fair and cost effective development decisions, outdoor space, agricultural area, natural beauty and the protection of critical environmental areas, the development of the existing settlement area, the cooperation between the community and the practitioners.

- **Sustainable Cities:** A sustainable city is a concept that cannot be defined precisely by many authorities and does not have indefinite boundaries. In order to ensure sustainable change, it can be defined as the city where socio-economic interests are adapted environmental and energy concerns. Planning and design principles of sustainable cities: ensuring long-term economic and social security, conservation and restoration of biodiversity and natural ecosystems, recognition of the cultural characteristics of cities, empowering people in the process of sustainable development, establishment of cooperation networks for sustainable future, use of sustainable technologies, transparent management.

- **Ecological City / Ecocity:** Ecocity is healthy human settlements with self-sustaining flexible structure and modeled as a function of natural ecosystems. The first attempts for Ecocity came to exist after the United Nations Earth Summit in Rio de Janeiro in 1992. Planning and design principles of ecological cities: clean air, reliable food and water supports, healthy housing and workplaces, cost effective eco-engineering solutions for the recycling of all wastes, production and use of renewable energy, development of efficient transportation systems, infrastructure integration compatible with the natural qualities of settlements development of ecological awareness.

- **Green Cities:** Green cities are places that provide fresh air-water, resist natural disasters, and encourage ecological behavior, such as public transport. Some initiatives and projects carried out under the theme of green cities put forward the conservation of buildings and energy. Planning and design principles of green cities: integration of renewable energy tools with city and building, use of materials to provide energy efficiency and development of ventilation systems, implementation of green building control systems, increasing ecological awareness, development of green workforce.

- **Low Carbon Cities:** Many cities around the world aim to create low-carbon cities by reducing energy consumption and $CO^2$ emissions. Various programs and initiatives often put forward ecological awareness and construction technologies for low carbon emissions. Planning and design principles of low-carbon cities: increasing awareness of energy conservation, development of structure and material technology for energy conservation, compact and flexible urban spatial structure, environment-friendly transportation plan, determination of boundaries based on ecological thresholds, efficient land use with urban renewal and density control, the creation of green living environments and the green city system.

- **Liveable Cities:** The livable city is a city that is environmentally sensitive, has strong social and economic functions, provides access to pedestrian and non-motorized, provides access to services for the elderly, disabled and children, provides a healthy living space for future generations. Therefore, the livable city is also a sustainable city. Planning and design principles: high communication and interaction possibilities, aesthetics, functional, clean and secure public and urban space, human scale, comfortable urban areas for elderly, children, disabled people, sustainability of ethnic and cultural diversity, management structure that provides participation opportunities, sustainable transportation models, conservation of natural resources and support of energy efficiency, economic housing opportunities, independent urban of motorized vehicles, support of local economy.

- **Slow Cities:** The slow urban movement offers an alternative approach to sustainable urban development in the face of trends in globalization and standardization. The slow city approach includes more than 50 commitments. Settlements below 50000 can participate. The basic principles of the group are constructed on environmental policies, infrastructure policies, urban texture quality, local production and awareness. Planning and design principles: energy efficiency, waste management and use of alternative energy systems, noise, light, electromagnetic pollution prevention, protection of historical and cultural values, promoting pedestrian,

cycling and public transport, designing a comfortable settlement for the elderly, children and the disabled, supporting the local economy, equipping the city with fiber optic and wireless system, creating a quality and aesthetic physical environment with natural and artificial design elements.

- **Ecological parks:** It is necessary that the functions and actions that should be in an ecological park should be directed towards recycling, to ensure efficiency with natural energy sources, animal and plant species should create an ecosystem in this area. Protection of air, environment, natural resources, biodiversity, special protected areas and species is among the most essential goals of eco park. Principal planning and designing principles: sustainable material use, reducing greenhouse gas and taking measures for the use of zero carbon, using natural energy and water resources, recycling of waste and generating energy, creating organic gardens and agricultural areas, creating a living space for various plant species, ensuring the continuity of life.

- **Greenbelt:** It is a systematic open space integrity planned, implemented and managed for ecological and recreational purposes. Planning principles: ecological / integrative planning approach, formation of the green belt's natural systems form and boundaries, to establish continuity of open areas from urban to rural, handling the relationship between resources and land uses in the balance of protection-use.

- **Green wedge:** It is mostly formed of green tissue depending on the existence of linear natural environments such as streams and valleys. In this system, open spaces are designed in connection with each other. Planning and designing principles: the connections of open spaces are provided with walking tracks, bridges, bicycle paths, valleys, linear parks, aqueducts etc. other "green ways". In the formation of this system, the green ways play an important role that connect the green areas inside and outside the city and based on the vehicle or vehicle-pedestrian association.

## EVALUATION AND CONCLUSION

Today, more than half of the population live in big cities around the world, and it is estimated that this ratio to reach 66% in 2050. Increasing urbanization has caused more energy and resource consumption, more environmental pollution, and destruction of nature and natural assets. In this case, as Beck (2013) mentioned, as the human impact on the planet grows, and as the built environment rise to prominence, the landscapes we design and manage will play an increasingly important role.

Nowadays, unconscious uses of natural resources as if never to be exhausted, has brought with them life areas that are becoming increasingly difficult to maintain. The ecological problems, which occur in cities have

dense habitats, have distanced the cities from being sustainable. In this context, ecological planning concept is gaining importance. As Ndubisi (2014) emphasizes that planning is a promising direction to balance human use with environmental concerns. It is the application of knowledge of ecological relations in decision making about the sustained use of the landscape, when accommodating human needs. With the understanding of the globalization of problems by influencing environmental ecosystems, new concepts and ecological planning approaches have emerged which bring an ecological perspective in cities. Sustainable City, Eco-City, Green City, Eco-Tech City, and Cittaslow Cities are the most important ones. On the basis of these methods and approaches, they are played roles: using of topographic structure and microclimatic data in the most effective way, being at the center of human beings, limiting the use of motor vehicles, spreading of pedestrian and bicycle use, minimizing the consumption of natural resources, producing energy from natural sources, collecting and recycling of waste, using local materials and plants, creating ecological awareness with the use of efficient water, energy and materials.

The planning approaches developed for the solution of urban problems and sustainability are the approaches that will contribute to the sustainable development of the cities by targeting the conservation and sustainable use of natural and cultural values. According to Ahmedi and Toghyani (2011); the target of sustainable urban development process is to achieve the status of "sustainability" in urban communities and also to create or to strengthen the sustainability's characteristics of economic, social, cultural and environmental city. As Tratsela et al.(2012) mentioned that in order to achieve sustainable development, aims should be set and achieved in a large scale. Eco-based design and planning approaches are important for achieving sustainability. These approaches will also make significant contribution to people living in urban areas to live in physically, spiritually, socially healthy. At the same time, in order to implement these approaches, the inclusion of society in the planning process and creating awareness for the sustainable urban phenomenon are important issues that should not be ignored.

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# Chapter 2

# CURTAIN WALL SYSTEMS AND MATERIALS USED IN CURTAIN WALL SYSTEMS

*Uğur ÖZCAN[1] , Didem NAİBOĞLU[2]*

1 Dr. Öğr. Üyesi, Fatih Sultan Mehmet Vakıf Üniversitesi, Mimarlık ve Tasarım Fakültesi, uozcan@fsm.edu.tr
2 Fatih Sultan Mehmet Vakıf Üniversitesi, Lisansüstü Eğitim Enstitüsü, didem.naiboglu@gmail.com

## INTRODUCTION

Curtain walls,with the emergence of the industrial revolution, these systems can be said to have emerged as new construction systems as the result of the development of structural elements such as steel, glass, and concrete.Curtain wall systems defined as building components that are installed independently from the elements of the structures to which they are attached, connecting its load and the loads on it to the main structural system with fasteners and protecting the building from external influences.

These systems, which generally consist of horizontal and vertical profiles, are anchored to the structural elements of the building and fulfill all the features of an exterior wallin the same way, continuously, spontaneously or in combination with the structure, creating a cover that does not contribute to the main structure such as loading and stabilizing, they are qualified as all of the filled building elements between them.

Curtain wall systems are usually constructed using aluminum and glass materials except for a few different building elements. Aluminum material is a highly preferred material in these systems as it is easily shaped, resistant to natural events, robust, and economical. Curtain walls are widely used today on the facades of high-rise buildings for reasons such as aesthetic appearance, ease of installation, high production standard, heat ,and water impermeability.

### Historical Development of Curtain Wall Systems

The first known curtain wall is a two-story bank curtain wall built in Philadelphia in 1830. The first aluminum building element is a small square pyramid built on the Washington monument in 1884. Two years later, after this, aluminum gradually became an economically used material in the structure with Charles Martin Hall obtaining aluminum through electrolysis in 1886. The first comprehensive application in aluminum structure is the Empire State Building, which was built in New York in 1929 (Gür, 2001).

The intensive use of glass material in structures is first seen in 1851 at the Crystal Palace, designed for an industrial fair by Joseph Paxton, who was engaged in the greenhouse. 300,000 glass was used in the structure and carried by cast-iron rods. Crystal Palace’s importance in architecture lies not only in the use of cast iron elements in its construction but also in the expert use of glass. Glass panels of sizes of 7.3 x 1.25 were used in the structure. As the use of the combination of glass and iron increased, large glass facades had been developed. (Tortu, 2006).

Some developments in the late 19th century have been seen as a direct result of the developments in the construction area of the structural

elements of these curtain walls. Increased use of frame systems led to the abandonment of heavy concrete structures. Thus, the definition of a new building shell has emerged.

The 6-story Boley Clothing Company building, built-in 1908, one of the first U.S. buildings, was one of the structures built with acurtain wall system, using glass and iron building materials. In these early periods of curtain wall, metals such as bronze and copper were not used as material, but metals such as bronze and copper were used as building elements.

As the first applications of the curtain wall system in Europe, Fagus Shoe Production House, built-in Alfeld in 1911, the Production House, which took part in the Werkbund Exhibition in Cologne, Germany in 1914, and Bauhaus Design School in Dessau, Germany in 1926, are the buildings built with these systems.

Since the first examples of curtain walls do not have insulated and processed glass and appropriate profiles, they have not been able to fully meet the comfort conditions expected of them. The technology developed in aluminum and glass production has enabled the combined use of these two materials on the facades, while the building weight decreased, and the possibility of floor upgrading has increased. In the 1930s, the curtain wall system, which found a use area in high structures, exploded in the 1950s, becoming a symbol of tall structures in a sense and found widespread use on the facades of modern buildings. An essential factor in this development is that the increased aluminum production capacity during World War II was introduced to the market inexpensively after the war (Şenkal Sezer, 2003).

The 20th century was a period of significant changes in facade architecture and technological innovations. Increased interest in prefabrication and light materials in the construction sector, reduced construction time, and many new materials were found and developed. Towards the end of the 20th century, with the presence of the tempering method of the aluminum material that does not rust and can be processed easily, it was appeared to us as an important development to use it on glass facades more reliably.

The curtain wall systems seen in the curtain wall designs of high-rise buildings, which are very much in today's architecture, are frequently preferred systems due to their advantages such as fast and easy manufacturing. In shaping these systems on the building curtain wall, it will be possible to say that environmental conditions are evaluated, and physical environments are created depending on the functions.

## COMPONENTS FORMING CURTAIN WALL COMPONENTS

To choose the most suitable material in the curtain wall system and to use it in the best way, it is necessary to examine these systems in terms of building physics. The structural system in terms of functional material of curtain wall systems, It is possible to separate it as a glazing and parapet component (Tortu, 2006).

### Structural Systems

Curtain wall systems are systems made of aluminum or steel, which attach anchoring elements to the appropriate points to connect to the structure and transfer the load of the curtain wall from the connection points to the structural system of the building.

Since expansions will occur in the curtain wall as a result of thermal changes, expansion intervals should be left when applying the curtain wall.

In the structural system, to prevent condensation in the insulated area behind the parapet, ventilation ducts should be opened so that there is no water leakage in the area. Plastic wicks should be used to prevent condensation that may occur due to temperature differences between the structural profile and the fixation profile (Tortu, 2006).

### Glazing Unit (Transparent Area)

The parts that provide light and image in the building are called transparent areas. These parts are passed through glass partitions and units on the curtain wall. These units are generally used on the curtain wall with composite applications in order to provide comfort in the building.

### Parapet Component

In the parapet component, it is aimed to make the glass elements more resistant to external effects compared to other materials used in curtain wall systems, to provide homogeneity and ease of maintenance in the created image.

However, the glass, beam, and parapet concrete used in the parapet component must be opaque in order to hide the insulation material. Aluminum is also used as a material in the parapet component. (Tortu, 2006).

## TYPES OF CURTAIN WALLS

Different application methods are observed in the mechanical properties and weights of curtain wall systems, in the formation of the materials used on the facades and in detecting the systems of structural elements of

these facades.

Depending on the weight of the curtain walls, there are two types of classification made.

These:

• “Light Fronts” if less than 100 kg / m2,

• If they are more than 100 kg / m2, they are called “Heavy Fronts.” Accordingly, facades with concrete-based material in curtain wall systems are “Heavy Curtain Walls”; The facades consisting of metal, wood, and plastic materials are called “Light Curtain Walls” (Göçer, 1997).

## Light Curtain Wall Systems

### Framed Lightweight Panel Facades

In framed light panel systems, this frame system is created from the opaque and transparent components of the elements that create this system. This system is separated from light curtain wall systems due to the way the building is fixed to the structural system.

### Framed Light Curtain Systems

The curtain wall components in the framed light curtain wall system, are determined by point connections to the beam and floor foreheads, which are the horizontal structural system components of the building. Such curtain walls are separated from framed light panel facades in that they have vertical continuity and a point fixation in connection with building bearing systems (Göçer, 1977).

### Concrete Based (Heavy) Curtain Wall Systems

The heavy suspended curtain wall is a curtain wall system consisting of concrete based panels. In the concrete-based curtain wall system, the panels are transferred with metal fasteners on the interior walls and floors, which are points where static and dynamic loads are connected to the building. These elements in the curtain wall thus constitute the “heavy curtain wall system.”

## CLASSIFICATION OF CURTAIN WALL SYSTEMS ACCORDING TO APPLICATION AND CONNECTION SYSTEMS

The way the curtain wall systems applied in high-rise buildings are identified to the structural frame elements, and the shaping of the elements are divided into four different groups. These are suspended panel systems,

metal-framed curtain wall, infill wall, and column parapet coated curtain wall systems. Curtain wall systems are divided into three as stick systems, half panel systems, and panel systems in terms of their applications.

**Stick Systems**

In these systems, structural grids are usually placed with vertical mullion in certain axle spacings left on the curtain wall of the building. Vertical mullion is placed first, then horizontal mullion, then panels, if any, and finally glass (Köksoy, 2001).

The common feature of these systems is that the combinations of the mullions of the structural grids can be mounted on the building as separate processes in the workplace environment. However, these systems are not very suitable for high-rise buildings. Since stick systems are built in the construction area, the increasing wind speed will make the assembly difficult.

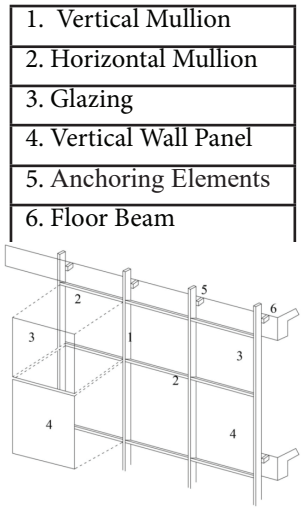


**Figure 8.***Schematic representation of the stick system (Tortu, 2006).*

**Semi-Panel Systems**

Panels, based on stories prepared as horizontal strips, they are like large panels throughout the story. It is brought to the construction site as disassembled and mounted on the construction site. Glasses are installed inside or outside at the construction site (Şahin&Tülübaş Göküç, 2018). These types of systems are economical, like stick systems, and at the same time, they are compatible with movements occurring in the building, like panel systems. The advantage of this system is that water leaks that may occur on the curtain wall can be prevented if appropriate detail conditions are provided since it consists of panels that continue on the floor.

| |
|---|
| 1. Glazing |
| 2. Vertical Mullion |
| 3. Anchoring Elements |
| 4. Floor Beam |

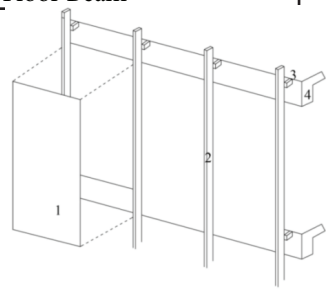


**Figure 9.**Semi-Panel System Facade Detail (Ağdemir, 2017).

**Panel Systems**

The Grill system is not available on the panel systems. Panels in metal frames are created at the factory with parapets. Glass elements can also be added before or after assembly. All of these panels are attached to the building with their frame. Combinations of panels can be made from different parts of the flooring or column beam combinations.

These systems are closed systems. It is also resistant to external influences, such as leakage and expansion. Since it is mounted as a pre-frame, it is fast to install and weather conditions do not affect the mounting speed much. Therefore, it can be said that it is quite suitable for use on the curtain wall of high-rise buildings.

| |
|---|
| 1. Glass And Parapet Facade Cladding Element |
| 2. Glass And Parapet Facade Cladding Element |
| 3. Replaced Coating Element |
| 4. New Coating Element To Be Installed |
| 5. Anchoring Elements |
| 6. Floor Beam |

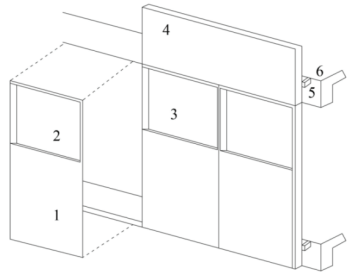


*Figure 10. Panel System Scheme (Ağdemir, 2017).*

**Prefabricated Metal Panel Systems**

In prefabricated metal panel systems, the concept is similar to panel systems. The most important difference in these systems is that these panels cannot be pre-installed in the structural system and are homogeneously composed of metal panels. The facade panels of this system are all formed in the factory.

Window openings are cut and removed from the metal layer with mold. It is easier to make window details. Panels;

• Metal,

• Rigid-lined novent,

• Ventilate,

panels can be classified into three groups. Panel thickness is at least 100 mm (Köksoy, 2001).

**Column-Cover Parapet Systems**

Column-cover parapet systems aim to cover columns on the exterior and to close the sections between the coated columns with parapets. The glass layout can be installed later by pre-construction or by adding a separate frame. Unlike the other four systems, it has been found that the structural system was created by bringing it to the forefront and preferred more than other grid systems.

**MATERIALS USED IN CURTAIN WALL SYSTEMS**

The curtain wall system components are being manufactured by assembling the parts which are either ready-made or custom-made at the factory and assembled at the construction site.

Although these ready-made facade elements are usually made up of concrete and metal materials, it has been seen that wood and plastic-based materials are used in some applications and designs.

**Concrete Based Curtain Wall Components**

Various types of concrete are used in concrete based curtain wall elements. These :

• Normal Concrete,

• Lightweight Concrete,

• It can be listed as aerated concrete.

Thanks to the possibilities brought by the formwork in concrete based curtain walls, the desired shape can be given to concrete. In addition, the use of formwork allows the concrete to be acquired the desired form and be shaped the surface texture of the concrete according to the formwork

surface. The formation of the desired texture on the surface of the concrete can also be achieved with the aggregate inside of the concrete. Concrete material has been a structural element with low thermal impermeability as a structural feature. Therefore, thermal insulation must be done well in cement-based curtain wall systems.

Static and dynamic loads are transferred to the structural interior walls and floors of the building with the help of metal fasteners. Heavy suspension facade elements must be at least 6 cm in wall thickness to maintain their stability in the face of their weight and wind load. Also, the distance between the equipment bars used on the element's on-site should be in the form of a steel grille, not less than 10 cm (Senkal Sezer, 2003).

**Metal-Based Façade Components**

It is observed that Metal-based facades be used by manufacturers to manufacture and apply a specific facade system by order or on standard type components. Aluminum, steel, and steel alloys are used in these components.

Metal materials are used as profile components (stick-shaped) that form the structure of the curtain wall systems or as a surface coating (sheet-shaped) on filling boards that are a component of the outer shell elements. The metal facade components used in the form of rods should be installed in heat barriers to prevent the formation of heat bridges (Göçer, 1997).

**Wood-Based Curtain Wall Components**

These lightweight panel systems consisting of wooden building materials are placed and determined in the structural system of the structure. Wood panels, wall elements are composed of panels of single or double-walled wood origin. Construction of wood panels (frame) component ranges is selected according to the plate sizes used (Göçer, 1997). Wood panels, thermal insulation is made by placing between two plates. Wood material that is sensitive to water and fire should be protected against them.

**Plastic-Based Curtain Wall Components**

Plastic curtain wall components are lightweight materials and have a wide range of uses. In addition, it can be easily formatted as desired and has many kinds of colors. Plastic materials are used as filler components for the frame components that form the element construction in the curtain wall systems. Due to their high thermal expansion properties, they are connected to joints that can enable expansion to other curtain wall components.

The assembly of plastic curtain wall components is done with the help of corrosion-protected mild steel profiles and galvanized screws. They are

easy to assemble and have a workability feature due to the lightness of the plastic sheets. They are connected to joints that can expand to other facade components due to their high thermal expansion property (Göçer, 1997).

## CURTAIN WALL FACADE APPLICATION EXAMPLES

SEAGRAM BUILDING, New York, 1958

The Seagram Building was designed by Mies Van Der Rohe and Philip Johnson, pioneers of modern architecture, with 38 floorsand 160 m high in 1959 in New York City. In the Seagram building, which has an essential place in the development of modern American architecture, a kind of crossing is used to increase the strength of the steel rigid frame system made against the horizontal loads.

Seagram Building, which is one of the best examples of curtain wall systems, has been designed with a stick system, and bronze profiles on the curtain wall of the building are designed as structural. Parapet region, which is one of the components of the curtain wall system, was designed by creating a metal alloy using more copper in bronze color.

**Figure 11.** *Seagram Building curtain wall view (URL 1.)*

**Figure 12.***Seagram Building curtain wall system view (URL 2.)*

## HONG KONG BANK, 1985

Norman Foster designed the Hong Kong bank building as the general management building in 1985. The planned building constructed by hanging four towers into the Vierandeel Tower and placing a crane in the middle of the towers to pile prefabricated elements on top of each other.

In the building's curtain wall system, aluminum materials and facade panels were used, and these facade panels were mounted to the steel frame by using supporting laths along with the panels. In addition, coatings with a thickness of 12 mm against corrosion of structural steel elements were made. In accordance with the design of the architect of the building, the two facades of the building were built as glass. In addition, two layers of varnishing have been applied to the curtain wall in order to avoid excessive heat loss due to the sun breakers on the curtain wall of the building. The bonding of glass elements to the frame elements in the curtain wall system was designed and applied as a structural silicone curtain wall.

**Figure 13.** *Hong Kong Bank building curtain wall view (URL 3.)*

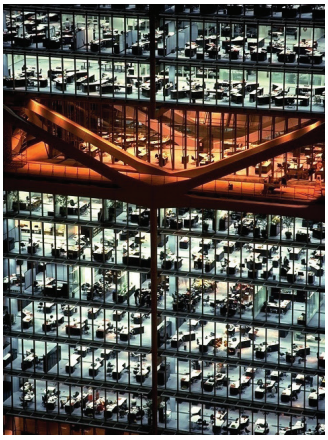

**Figure 14**. *Hong Kong Bank building curtain wall view (URL 4.)*

## I. LEVENT PLAZA, 2000

Levent Plaza consists of 4 blocks, as A, B, C, D blocks. Block A has a rectangular form with dimensions of 54x15.3 m. The structural system of the 53 m high block consists of a reinforced concrete frame and core. The core is formed as a reinforced concrete curtain. The dimensions of the columns in the core are placed with 70x50 cm and 6 m axis spacing. Curtain walls were created with a thickness of 30-20 cm (Köksoy, E., 2001).

The curtain wall system of the building is designed as a stick system. The curtain wall system is connected to the main structural structure of the structure with anchorage elements with vertical mullion elements. Then horizontal mullion, one of the curtain wall joints of the building, was added. Besides, the first opaque panels were installed on the parapet areas of the curtain wall, and then on top of the glassware. The insulation was made by wrapping it in vertical and parapet areas with aluminum foils.

**Figure 15.** *I. Levent Plaza A block building curtain wall view (URL 5.)*

## CONCLUSION

The new technological developments, construction techniques, and new materials that have evolved with the period known as the Industrial Revolution, aka the Industrial Revolution, have affected the building and construction systems to a great extent. Facades, apart from the aesthetic design of the buildings, function as a building element that protects the interior from external influences. Curtain walls have been seen as design-

ers' preferred systems because they provide significant advantages. The reasons such as low load on the structural system of the structure, being economical, and ease of assembly have had significant effects on the increase in the use of these systems.

When we analyze the early years of the multi-story buildings, the impacts of Gothic influence can be seen on the facades. Mies Van Der Rohe's high-rise building designs have taken on a new dimension. After 1950, new different solutions and designs started to show themselves. These approaches were to express the structural system of the building on the front.

Curtain wall systems examined within the scope of this research including; stick systems, semi-panel systems, panel systems, prefabricated metal panel systems, and column-cover parapet systems,and the materials used in these systems; concrete-based curtain wall, metal-based curtain wall, wooden-based curtain wall, and plastic-based curtain wall. These materials, which can be used in the curtain wall system, are shaped by the designer according to particular design fictions.

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# Chapter 3

## STRUCTURAL AND ARCHITECTURAL A STUDY ON VISUAL EFFECTS OF TRANSFORMATION IN BUILDINGS: EKINCILER STREET

*Iclal ALUCLU[1] , Sule ELHAKAN[2]*

1 Doc., Dicle University Architecture Faculty Architecture Department; ialuclu@gmail.com
2 Architecture, elhakans@gmail.com

## 1 INTRODUCTION

The role of the buildings located on a street or in a neighborhood changes over time. This issue was well and deeply investigated in Rincon and Rahmi (2002). The authors tried to identify interventions to the historic buildings and found out how changes in the appearance, the condition, and the role of the buildings had affected the urban landscape in the neighborhood [1]. The new role of the buildings causes the fact that transforming residential areas into commercial areas. Sometimes oppositely, commercial areas are transformed into residential areas. Mostly this situation occurs due to the change (rise/decrease) in the commercial value of the street. Such transformations can be classified into following three categories: 1) changes in only a flat, 2) Changes in whole apartment, 3) Changes in Whole Street, district, or quarters (Figure 1 and 2). Faye and Eric (2012), states that the values of price elasticities of the characteristics often give unexpected results in regard to the theory of centrality and the expectations of regeneration programs. City planners can thus evaluate the consequences of their decisions on housing values [2].

The transformations accountable in the first two categories produce problems as described in the following paragraphs. So such local transformation can be mentioned as problem producers. On the other hand the transformations mentioned in the last categories (3dh category) can be divided into two subcategories: a) unplanned (random) transformations and b) planned according to a new general plan of the city, which called as "Urban Regeneration" [3-9]. Tyler et al. (2013) presents the findings of research that has sought to value the benefits of urban regeneration policies [4]. Zebracki and Levi (2012) presents comparative case studies on current artists-accompanied urban regeneration initiated by housing corporations in Utrecht and Rotterdam and the authors state that urban regeneration in Dutch cities is increasingly accompanied by the cultural sector in general and by artists in particular [5]. Blessi et al., (2012) investigates the relationships between investments in cultural resources/activities and urban regeneration processes. In this respect, the authors criticize how culture can be considered a determinant to the accumulation of human and social capital [6]. It examines the transformation of the Saint Michel district located in metropolitan Montreal. The Saint Michel area is experiencing a radical change in its social, economic and environmental profile due to its transition from the industrial-led development model to the post-industrial model in which investments in cultural and creative activities/industries - particularly the headquarters of Cirque du Soleil and TOHU - La Cite des Arts du Cirque - are supplying new opportunities for the local area in a metropolitan dimension. What impacts does such clustering have on the social and human capital of the vast majority of the populations that live within this area?

Faye and Eric (2012), states that public squares are becoming the targets of regeneration programs in many cities and then the authors indicated that the impact of characteristics may vary according to the degree of centrality, the type of square and the regeneration policy implemented [2].

Yu and Lee (2012) pointed that the success of an urban regeneration project depends on how successfully conflicts among stakeholders are mediated and a "middle ground" is found. In this respect, performing an adequate assessment of conflict-risk in advance is essential to effective project management. The authors propose a conflict-risk assessment model based on Fuzzy-Failure Mode and Effect Analysis (Fuzzy-FMEA) for an urban regeneration project. To validate the effectiveness and suitability of the proposed conflict-risk assessment model, they applied the proposed conflict-risk assessment model to 34 conflict types in South Korea using survey results from 84 people currently participating in urban regeneration projects [8].

The unplanned transformations also can be mentioned as problem producers. However, urban regeneration is a concept to solve the problems depends on such bad transformations. Rogers et al. (2012) says that making cities more sustainable is a top priority - for national governments, for cities and for the people who live, work and visit urban areas and adds that the past decade has seen a concerted UK effort to develop, apply and assess sustainability solutions for the present and near future; however, little has been done to test urban regeneration solutions beyond that [9].

The changes in the role of such buildings bring with structural and architectural transformations in them according to their new functions. These transformations cause visual and non-visual impacts on buildings and streets as well as many problems in cities. "The landscape of rural America has been profoundly influenced by social, cultural, and economic changes" says Flad (1997) [3].

Another factor impacts the regeneration is the healing environment. Huisman et al. (2012) reports a large review on the impacts of physical environmental factors on healing environment users' health [10]. Due to the health tourism, such environments have effects also on the urban regeneration. So they bring together with them new functional, social, and health concepts. For example, it is possible to transform a building previously used as residence, to hostel, hotel, health center, or any commercial area.

The functional changes made on streets and related to such changes, physical or operational *changes made* in buildings and flats, especially the transforming residential areas into commercial areas cause many problems in cities. Environmental and visual pollutions, structural risks in the building body, unpleased residents, dense population, and functional

problems in the commercial facilities carried on in the offices transformed from houses are only a few problems faced due to such transformations. One of the most important structural risk is the removing of masonary walls which may cause increase in axial load of the nearest columns. Since compression strength of concrete in Turkey is very low (smaller than 10 MPa) [11]. increase in axial load of the column may easily cause collapse of the nearest columns. On the other hand, such changes cause decreases in the number and the total area of child-parks and car parks, increases in traffic load, difficulties in water supply, drainage, electricity, natural gas, and any other system requirements. Today, many people faced such problems in cities, which have dramatic changes and transformations in Turkey (i.e. Istanbul, Ankara, Izmir, Adana, Bursa, G. Antep, and Diyarbakir) just like cities in developed countries [12,13]. However, these problems are not serious in cities have slow change and transformation period. Sometimes oppositely, commercial areas are transformed into residential areas. Mostly this situation occurs due to the change (rise/decrease) in the commercial value of the street.

In this work, these problems were investigated by the light of a comprehensive questionnaire supported by visual items and detail study made on such transformed buildings on the Ekinciler Street in Diyarbakir-Turkey. Consequently, the results were discussed and some recommendations and analyses were presented. This study claims to be an easy guide for city planners. And this study claims to be an easy guide for who interests in urban regeneration as well as for municipalities.

## 2 DESCRIPTION OF DIYARBAKIR

Diyarbakır, a province at Southeastern Region of Turkey, is one of the oldest civilization place and has important trade background. It consists of two parts; the old city which is enclosed by a city wall and called as “Sur içi” and new settlement areas which have showed a rapid development due to dense immigration and insufficient capacity of the old city. Especially after 1950s, the new part has been shaped by cooperatives which made up high buildings then trade activities naturally moved in. These activities mostly take place on a street called Ekinciler and all old buildings around it replaced by new ones. Recently, many buildings in the street have been transformed into shops or offices for commercial purposes. This new situation has created many problems such as unpleasant for the residents, deteriorations of buildings with functional and physical changes and visual pollution. Diyarbakir is located in Southeastern region of Turkey and many civilizations, some are Hurri-Mithani, Hittites, Assyrians, Arami, Bit-Zamani Kingdom, Meds, Persians, Macedonians, Seleukos, Romans, Ilkhanide, and the Akkoyun Seljuks have lived there throughout history.

The city composed of two parts; 1) the old city is surrounded by a wall which is 12 m. high and 5.5 km. long and 2) the new city *cover the residential and commercial areas extended to* the outside of the city wall. The old city has a rich historical heritage which contains many fortress, mosques, churches, tombs, palaces, inns, official and educational buildings, caravanserai, and museums [14].

Diyarbakır, which is established on a historical trade-way, is one of the most crowded city and industrial centre of the Southeastern Region of Turkey. It has populations of approximately 1.5 million, continental climate, and important geographical conditions [15].

## 3 METOD

### 3.1.Spatial analysis method

With this method, spatial changes have been detected in the process of changing the residence in the workplace. This change is reflected in the front line is determined by this method. The work was carried out in 26 apartments selected on Ekinciler Street. The use of spaces in the apartments was examined one by one, the commercial areas were determined numerically and paintings were created.

As mentioned earlier when performing space analysis; considering that commercial centers prefer more front and ground floors; Functional aging, renovations and visual contamination began in these sections of the structures and this change progressed in the upper floors in the upper time, so the facades of the structures began to work in mind.

In selected apartments, a limited number of houses were carried out due to the fact that the owners did not allow it and were not in the venue. The works began by removing sketches of the houses, and sketches were increased at the rate at which the function of the apartment was changed. A total of 92 locations have been sketched.

The study, which has been going on for three years, included sketches and information showing spatial transformation in the created table, as well as photographs taken over time. Thus, even over a 3-year period, the changes can be determined how much.

Then the work continued in the same way with 3-year periods and it has been reached to this day. By today, almost no more housing on Ekinciler Street.

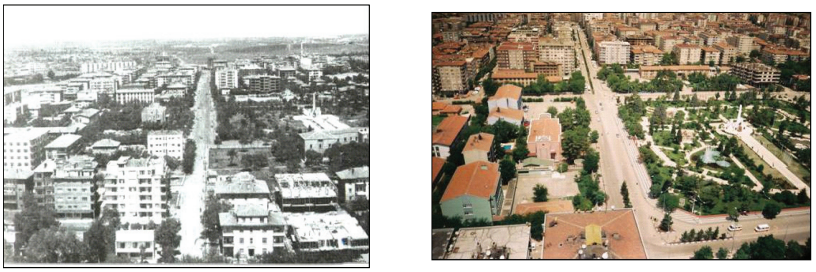
### 3.2.The historical background of the study area

Since 1950s, the new city has extensively been established by various house-building cooperatives at the outside of the city wall as illustrated in Figures 1a. Initially, there were not any commercial areas in the new city and the outside of the city wall was used only for housing. The buildings *were two or three*-floored with large gardens. A few years after 1950, commercial activities also moved to these new settlement areas as well as housing. Later (after decades), the small old houses have been replaced by high apartments with commercial facilities (Figure 1b).

(a) (b)

*Figure 1. The past and present of the outside of the city wall: a) 1960 [4], b) 2006*

This situation could be clearly seen in the Ekinciler Street, which is the most important street of the new settlement area for decades. A historical development of the street was given in Figure 2. Figure 2 shows also that there are not any significant differences in construction between 1970's and 2004's in the street except only a few buildings such as Tansel Apartment have more than five flats.



(a) (b)

*Figure 2. Two views of the Ekinciler street: a) 1970, b) 2004*

Tansel apartment demolished and instead, a new and commercially functional building namely Kalender Business Center has been built in 2005 (Figure 3a, b).

(a) (b)

*Figure 3. (a) Tansel Apartment (2003) was demolished and instead, Kalender Business Center was built in 2005 (b).*

Similarly, many buildings were demolished and the news were built or functionally converted. Figure 3 shows such buildings at only Ekinciler Street in Diyarbakir.

It can be clearly seen from the figure; the buildings have no billboards in 2003 except on their ground floor. However, the number of advertising panels has increased from year to year to cover almost all the building as seen in the figure.

This is due to transforming the buildings from residence to commercial spaces. However, such transformations made in buildings have showed a rapid development after 1970s. (Figure 4).

The reason of this condition is fixed and explained by a questionnaire conducted at the street. The question to the owners is “why the flats on this street were being *transformed from housing* to commercial spaces/ offices?” The answers: 1) high income (29%), 2) the need for commercial areas (29%), and 3) the street became a great commercial center of the city (42%) [5]. In addition, Figures 4 shows the changes and transformation in the buildings only in last six years in the street. Approximately 50% of the commercial facilities have been open in the last year and 94% of the owners do not want to move elsewhere [5].


*Figure 4. a) Tansel Apartment, 2003 b) Tansel Apartment (Kalender Business Center), 2005, c) Kalender Business Center, 2009, d) Güldamlası and Külüm Apartments, 2003 e) Güldamlası and Külüm Apartments, 2006 and f) Güldamlası and Külüm Apartments, 2009, g) Laleli Apartments, 2003 h) Laleli Apartments, 2006, i) Laleli Apartment, 2009, j) Işık 1 Apartments, 2003 k) Işık 1 Apartments, 2006 and l) Işık 1 Apartment, 2009.*

## 4 THE QUESTIONNAIRE WAS CONDUCTED IN THIS STUDY

### 4.1. Evaluation of the questionnaire made for the residences

The number of the residence taken under consideration: 70.

Q.1. Are you the owner or the renter? 29% (20) renter and 71% (50)

Q.2. How long do you live in this house? 0% (0) less than 1 year, 36% (25) 1-5 years, 7% (5) 6-10 years, and 57% (40) more than 10 years

Q.3. If you have opportunity would you like to move to another house? 71 (50) yes, %29 (20) No

Q.4. what are the non enjoyable conditions of the environment? Herein the question gives opportunity to the people to give more than one answers. 1) the street is too crowded and the apartments are too high, 10% (25); 2) neglected environment 22% (55), 3) insufficient green area 14% (35), 4) unsuitable for children, 10% (25); 5) the relations among the neighbors is not good, 6% (4); 6) noise pollution 24% (17); 7) bed landscape, 4% (3); and 8) change in user profile 10% (7) (Figure A1).

Q.5. what are the non enjoyable conditions of your residence? Herein the people joined to the questionnaire gives more than one answer as seen in Figure A2. 1) the residence is too small, 21% (25); 2) the plan is not appropriate, 42% (50); 3) the flat is not appropriate, 8% (10); 4) the side is not appropriate, 4% (5); 5) the external view is not enjoyable (or bad), 8% (10); and 6) it has structural problems such as humidity, noise pollution (insulation), rundown, and the building is too old, 17% (20) (Figure A2).

Q.6. what are the enjoyable conditions of your residence? 1) Centrally placed, 79% (55); 2) useful, 14% (10); and 3) other 5% (7) (Figure A3)

Q.7. Dou you have intimacy among the neighbors? 1) Yes, 57% (40) and 2) no 40% (43) (Figure A4).

Q.8. Do you feel confident? 1) Yes, 93% (65) and 2) no, 7% (5) (Figure A5).

Q.9. Have you ever changed the walls in your residence? 1) Yes, 36% (25) and 2) no, 64% (45) (Figure A6).

Q.10. Why you have changed? 1) due to security, 11% (5); 2) wind and the sun, 0% (0); 3) To extend the place in residence, 56% (25); and 4) the rooms were not functional, 33% (15) (Figure A7).

Q.11. Have you made reparation in structural components of the building (walls, floor, roof, etc.) for the last 5 years? 1) Yes, 36% (25) and 2) no, 64% (45) (Figure A8).

Q.12. what kind of reparation have you made in your residence for the last 5 years? 1) painting, 72% (50), 2) installment, 14% (10), and 3) not yet 14% (10) (Figure A9).

Q.13. Do you have any problem with business in the building? 1) Yes, 64% (45) and 2) no, 36% (25) (Figure A10).

Q.14. Why the residences in the building are converted to workplaces? 1) Due to the income, 29% (20); 2) the building is located in a commercial street, 29% (20); 3) close to banks, 0% (0); and 4) the building is located in the city center, 42% (30) (Figure A11).

Q.15. Do you think that placing residences and offices all together in the same building causes problems in shared space in the building? 1) Yes, 71% (50) and 2) no, 29% (20) (Figure A12).

Q.16. Why? (Asked to the users who gave "Yes" answer to the previous question) 1) Due to cleanliness, 30% (15); 2) due to the intensity at the entrance, 40% (20); 3) due to the common expenses (energy, lift-elevator, etc.), 30% (15); and 4) other, 0% (0) (Figure A13).

Q.17. If you move from this apartment you will rent your flat to a family or a business? 1) to a family, 50% (35); and 2) to a business, 50% (35) (Figure A14).

Q.18. Why (Asked to who give the answer of "to a family" to the previous question)? "Other family will not let me to rent to a business", 29% (10); "I would like to keep the same sort of user", 29% (10); and "the worker will damage the flat, 42% (15) (Figure A15).

Q19. How do you solve the car parking problem? Was asked to 58 people: 1) We use the street as car park, 17% (10); 2) we use the garden, 34% (20); 3) we use car park, 26% (15); 4) we use the street behind the apartment, 17% (10); and 5) we have no car, 5% (3) (Figure A16).

Q.20. Asked to the residents: "do you have children?" "no" 14% (10); "yes" 86% (60). "Where do your children play?" asked to the people who have child: 1) on the street, 21% (15); 2) at the garden, 44% (30); 3) at home, 21% (15); and 4) playpen, 0% (0) (Figure A17).

Q.21. Asked to the people who join to the questionnaire: "What do you think about the street to be closed to the traffic?" 1) will cause the chaos in the city traffic, 14% (10); 2) there is no need, 29% (20); 3) it is essentially needed, 50% (35); and 4) no comment, 7% (5) (Figure A18).

4.2. Evaluation of the questionnaire made for the workplaces

48 of the people join to the questionnaire. 9 of them were the owner; the others were renters.

Q.22. Asked to the people join to the questionnaire: “are you the owner or the renter?” 1) owner, 19% (9) and 2) renter, 81% (39) (Figure A19).

Q.23. How many years have you used this workplace? 1) Less than 1 year, 37,5% (18); 2)1-5 years, 37,5% (18); 3) 6-10 years, 18,75% (9) and 4) more than 10 years, 6,25% (3) (Figure A20).

Q.24. Would you like to move from this apartment? 1) Yes, 5% (3) and 2) no, 94% (45) (Figure A21).

Q.25. what are the disliked aspects of your workplace’s environment? For this question, an opportunity was given to the people joined to the survey to give more than one answer 1) the environment is cramped and multi-storey, 12% (18); 2) the environment is neglected (bedraggled, dirty), 6% (9); 3) insufficient greenbelt, 25% (39); 4) the environment is not appropriate for kids, 8% (12); 5) there is no good relationship among the neighbors, 8% (12); 6) parking problem, 16% (24); 7) noise pollution, 23% (36); and 8) ugly view or no landscape, 4% (6) (Figure A22).

Q.26. what are the disliked aspects of your workplace? For this question, an opportunity was given to the people joined to the survey to give more than one answer 1) it is too small, 23% (15); 2) bad arrangement, 14% (9); 3) the floor is not suitable, 5% (3); 4) direction is not good, 18% (12); 5) it is not esthetic, 14% (9); and 6) structural problems (i.e. old, moisture, leakage, 16% (24) (Figure A23).

Q.27. what are the enjoyable aspects of your workplace? 1) It is at the centre of the city, 94% (45); 2) it is usable, 6% (3); 3) other reasons, 0% (0) (Figure A24).

It should be noted that nobody said that “it is large” or “it is esthetic”. This means that the owners or the renters prefer their work place since it is at the centre of the city.

Q.28. Dou you believe that the district of your workplace is confident? 1) Yes, 75% (36) and 2) no, 25% (12) (Figure A25).

Q.29. Have you made any modification at the walls? 1) Yes, 69% (33) and 2) no, 31% (15) (Figure A26).

Q.30. Have you made any change at facade of the apartment due to need? 1) Yes, 38% (18) and 2) no, 62% (30) (Figure A27).

Q.31. Why you have made changes? (asked to the people who give “yes” answer to the Q.30). 1) due to security, 33%, (10); 2) solar, wind, 0% (0); 3) due to shortage in storage capacity, 17% (5); and 4) due to unsuitability of the workplace, 50% (15) (Figure A28).

Q.32. “does the hangout allow easy movement for the customers? 1)

yes, 75% (36) and 2) no, 25% (12) (Figure A29).

Q.33. Do you have any difficulty in the service to the customer (in communication, transportation, etc.)? 1) Yes, 75% (36) and 2) no, 25% (12) (Figure A30).

Q.34. Asked to the owner of workplaces: Why the residences are converted to the offices? 1) the rent of an offices is higher than that of a residence, 19% (9); 2) here is a commercial area, 25% (12); 3) close to the banks, 6% (3); and 4) here is the centre of the city, 50% (24) (Figure A31).

Q.35. Asked to the people at the workplaces: How do you solve the parking problem? 1) we use the street, 31% (15); 2) we use the courtyard, 6% (3); 3) we use the car park, 13% (12); 4) we use the back street, 44% (21); and 5) we have no car, 6% (3) (Figure A32).

Q.36. what do you think if the street is blocked off to traffic? 1) Will cause traffic chaos in the city, 19% (9); 2) there is no need to block off, 44% (21); 3) it must be blocked off, 31% (15); and 4) no comment, 6% (3) (Figure A33).

## 5. RESULTS

The whole buildings in the Ekinciler Street have been built formerly as residences. After 1970s, the transformations into commercial facilities have been started. This situation leads to the following problems:

1. Some functional changes resulted with structural changes like made in the flats like removing of some walls, opening new doors and windows, stairs, or opening any holes. The questionnaire indicated 62% of the owners have made changes on outside walls and 69 % of them have made changes on inside walls due to the security (33%), opening new areas (17%), and other functional needs (50%). These structural changes could create great risks for the construction of the buildings.

2. It can be easily understood from the signboards in the Figures 1-4 as well as from the questionnaire which are represented by the figures given in Appendix that, many buildings or flats have been transformed completely or partially into the commercial facilities such as business offices, shops, private schools and their classrooms. However, the buildings were designed originally for residences so these structurally changes create high risks.

3. Functional transformations in the street have caused to environmental and visual pollutions as can be seen in Figures 1-4.

4. The questionnaire was conducted in this study revealed the following conclusions;

- 64% of families live there are unhappy due to these functional transformations.

- 71% of the families have problems like crowded population at the entrance of the building (40%), high living cost (30%) and dirty environment (30%).

- Most of the families have parking problem and use the main street (14%), garden (30%), and other streets far from their houses (14%). Only 21% of the families use their own parking places.

- Insufficient children park and play areas creates unhealthy environment for children live there. They are playing on the main street (21%), at home (21%), at the garden (44%) or at the playground (0%).

- The owners of the commercial facilities are also unhappy due to they are small (23%), not functional (14%), structural problems (26%), high floor (5%), wrong direction (18%), car park (15%), noise pollution (23%), lack of green areas (24%) and visual problem (14%).

5. 71% of the families would like to move from the street to any other settlement areas where there are no commercial activities.

At the present day, visual pollution has become very important in ekinciler street which is one of the most important streets of the city (figure5,6,7,8).

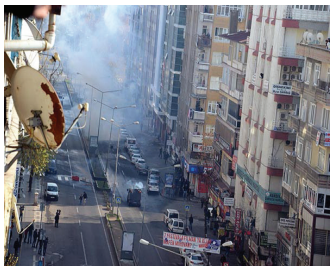


*Figure 5. Ekinciler street 2015*

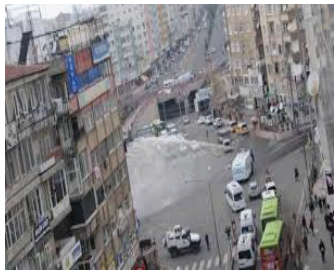


*Figure 6. Ekinciler street 2015*

*Figure 7. Ekinciler street 2018*

*Figure 8. Ekinciler street 2019*

## 6.CONCLUSIONS

Transformation from settlement areas to commercial facilities leads to serious urbanization problems as well as social and structural problems. These areas should be differentiated from each other during city planning and any necessary transformations should be done for suitable cases. The housing areas in the plan should also be conserved. Partial transformations always create problems therefore; complete transformations of the areas must be taking into consideration. In case of compulsory transformations, modifications on some flats or building elements are not sufficient. Transformations decisions should contain some rules in order to avoid problems like visual, environmental, noise, social and etc.

The leading role of the public in improving the built environment quality and the importance of sample public projects are significant; public authorities need to act as information platforms and sharing networks, coordinate between different parties, play a leading role with standards and sample projects that respond to human needs, and direct resources to areas that are really needed;

• The quality of buildings and built environment cannot be assessed by economic parameters; the criteria related to qualification in the purchase of architecture and construction services must also be used;

• In city-related decisions, it is appropriate for politicians and governments to engage in dialogue with different professional groups and society;

• The planning of the city needs to emerge from an interaction between private sector actors, public and political actors, architects, planners and designers, and therefore a common urban culture must be developed among all these parties;

• Mechanisms, such as public-private partnerships, which aim to privatize the public spheres of the city and which prevent the occupational fields from entering the planning process sufficiently, should be avoided from the mechanisms that result in a decline in the quality of the resultant product; instead there is a need to develop mechanisms that produce positive results for the public good and the city.

The main objective of all these opinions is to increase the quality of life by increasing the quality of architectural and urban environment. At this point, the architectural environmental quality in both urban and rural areas will be possible with the conscious, sensitive and active participation of all relevant actors**.**

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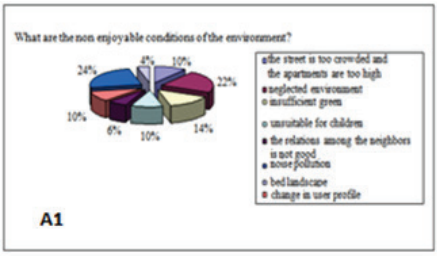
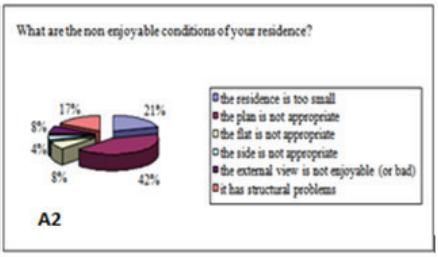
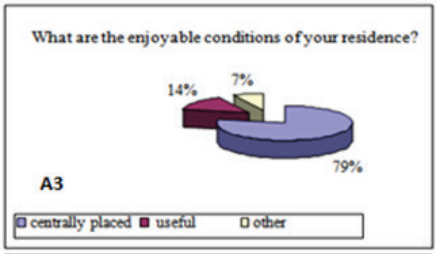
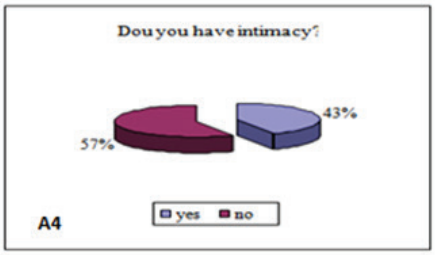
## APENDIX

A 1 – A33 the graphical representation of the questionnaire (for questions 4 - 36)

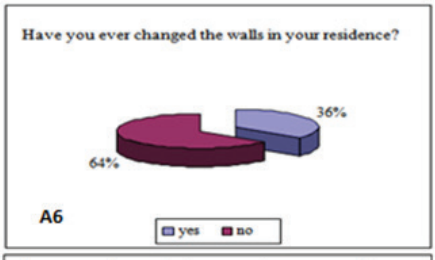


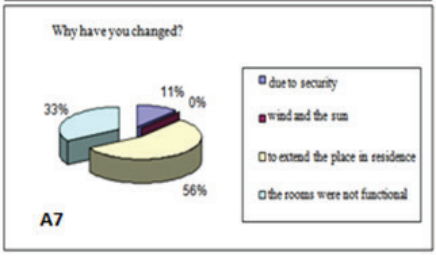



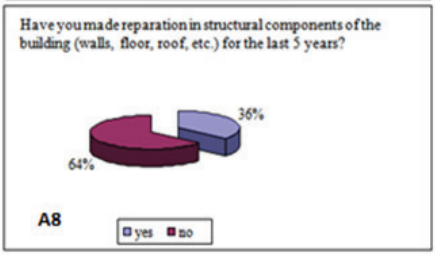



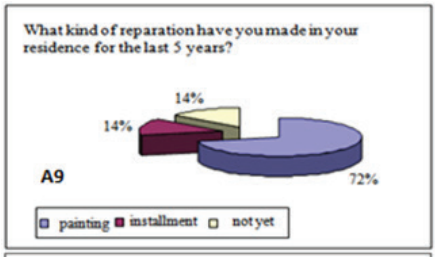



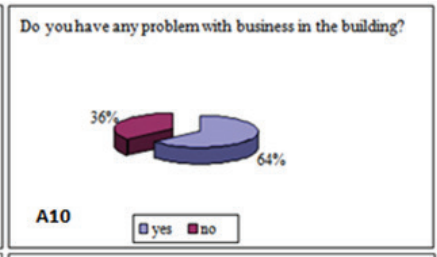


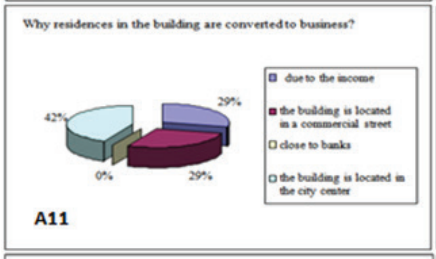


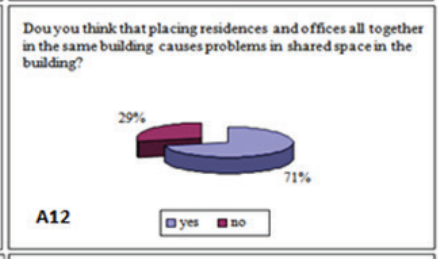



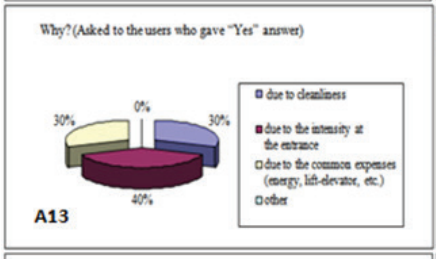



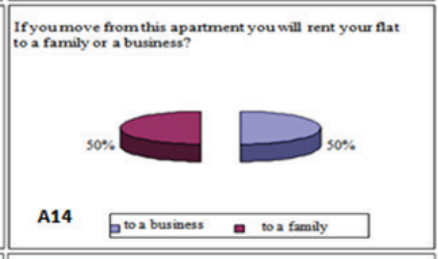

What kind of reparation have you made in your residence for the last 5 years?
14%
14%
72%
painting
installment
not yet
A9

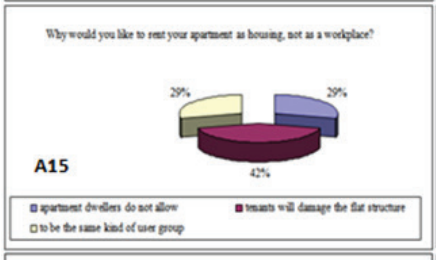

Do you have any problem with business in the building?
36%
64%
yes
no
A10

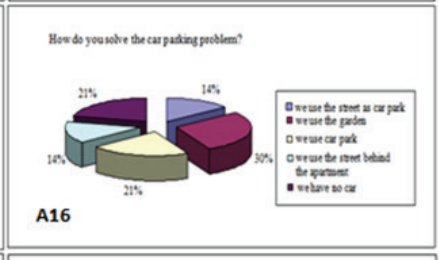

Why residences in the building are converted to business?
42%
29%
0%
29%
due to the income
the building is located in a commercial street
close to banks
the building is located in the city center
A11

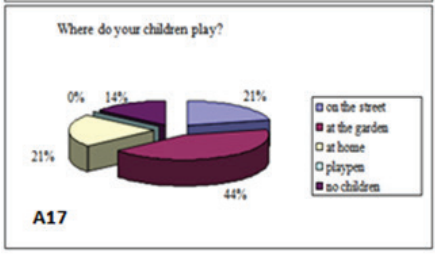

Dou you think that placing residences and offices all together in the same building causes problems in shared space in the building?
29%
71%
yes
no
A12

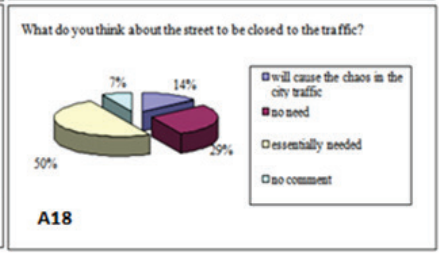

Why? (Asked to the users who gave "Yes" answer)
30%
0%
30%
40%
due to cleanliness
due to the intensity at the entrance
due to the common expenses (energy, lift-elevator, etc.)
other
A13

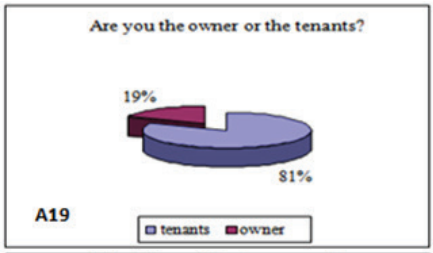

If you move from this apartment you will rent your flat to a family or a business?
50%
50%
to a business
to a family
A14

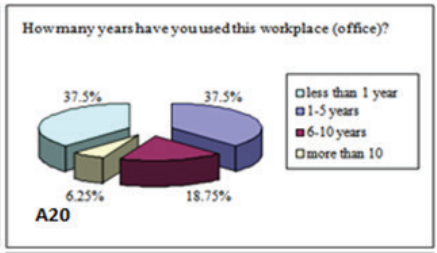

Why would you like to rent your apartment as housing, not as a workplace?
29%
29%
42%
apartment dwellers do not allow
tenants will damage the flat structure
to be the same kind of user group
A15


How do you solve the car parking problem?
21%
14%
14%
30%
21%
we use the street as car park
we use the garden
we use car park
we use the street behind the apartment
we have no car
A16

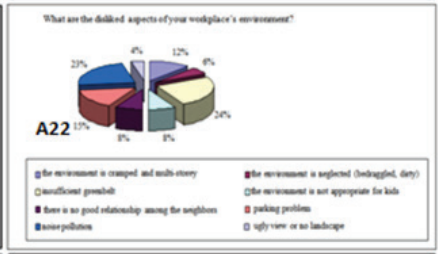

Where do your children play?
0%
14%
21%
21%
44%
on the street
at the garden
at home
playpen
no children
A17

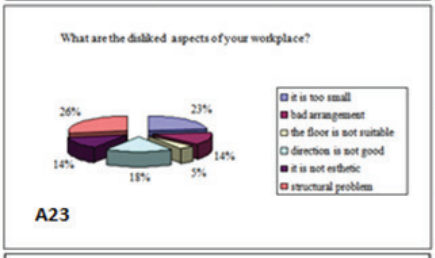

What do you think about the street to be closed to the traffic?
7%
14%
50%
29%
will cause the chaos in the city traffic
no need
essentially needed
no comment
A18

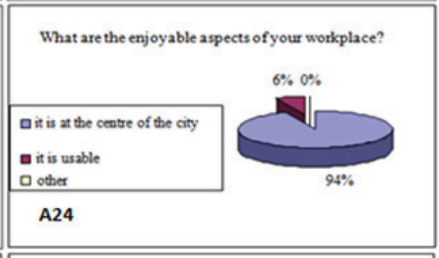

Are you the owner or the tenants?
19%
81%
A19
tenants
owner


How many years have you used this workplace (office)?
37.5%
37.5%
6.25%
18.75%
less than 1 year
1-5 years
6-10 years
more than 10
A20

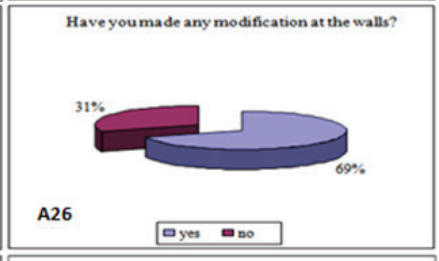

Would you like to move from this street (Ekinciler) if you had such opportunity?
6%
94%
A21
yes
no

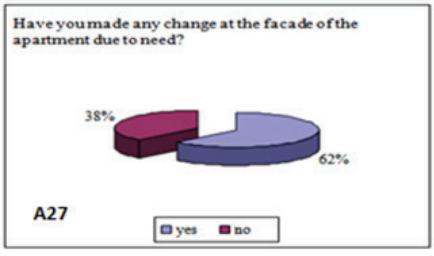

What are the disliked aspects of your workplace's environment?
A22

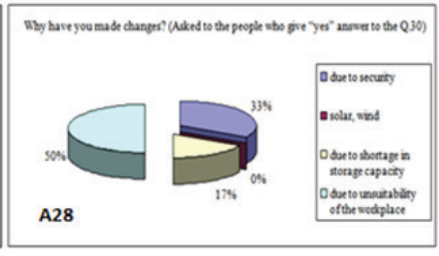

What are the disliked aspects of your workplace?
26%
23%
14%
14%
18%
5%
it is too small
bad arrangement
the floor is not suitable
direction is not good
it is not esthetic
structural problems
A23

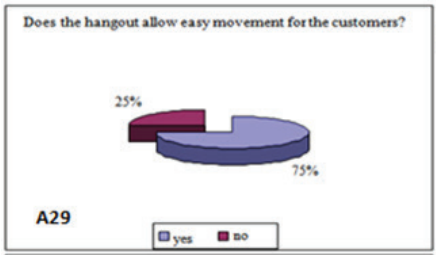

What are the enjoyable aspects of your workplace?
6%
0%
94%
it is at the centre of the city
it is usable
other
A24

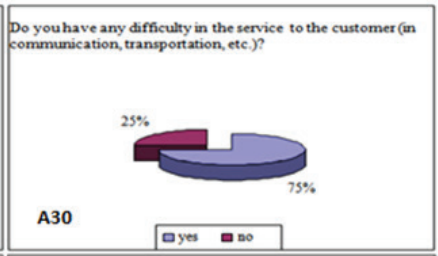

Do you think of your workplace is safe?
25%
75%
A25
yes
no

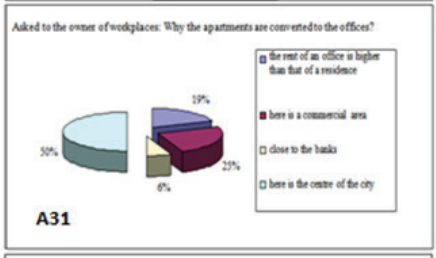

Have you made any modification at the walls?
31%
69%
A26
yes
no

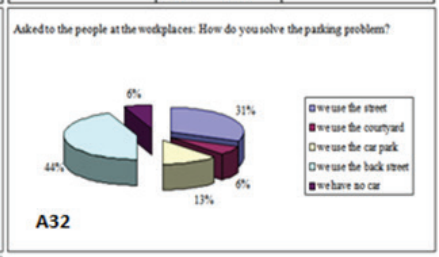

Have you made any change at the facade of the apartment due to need?
38%
62%
A27
yes
no

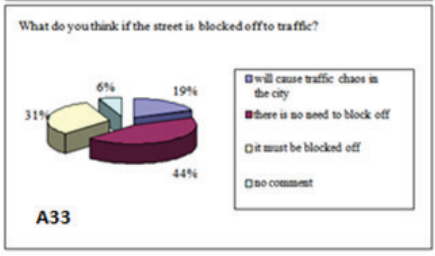

Why have you made changes? (Asked to the people who give "yes" answer to the Q.30)
50%
33%
0%
17%
due to security
solar, wind
due to shortage in storage capacity
due to unsuitability of the workplace
A28


Does the hangout allow easy movement for the customers?
25%
75%
A29
yes
no


Do you have any difficulty in the service to the customer (in communication, transportation, etc.)?
25%
75%
A30
yes
no


Asked to the owner of workplaces: Why the apartments are converted to the offices?
19%
50%
25%
6%
the rent of an office is higher than that of a residence
here is a commercial area
close to the banks
here is the centre of the city
A31


Asked to the people at the workplaces: How do you solve the parking problem?
6%
31%
44%
13%
6%
we use the street
we use the courtyard
we use the car park
we use the back street
we have no car
A32


What do you think if the street is blocked off to traffic?
6%
19%
31%
44%
will cause traffic chaos in the city
there is no need to block off
it must be blocked off
no comment
A33

# Chapter 4

# INTEGRATED WATERSHED MANAGEMENT APPROACH IN CONTRIBUTION TO SUSTAINABLE DEVELOPMENT

*Sahar POUYA[1] , Handan TÜRKOĞLU[2]*

1 Ph.D Candidate of Urban and Regional Planning ,Department of Urban and Regional Planning, Faculty of Architecture, Istanbul Technical University, Pouya@itu.edu.tr
2 Profossor. Dr. Department of Urban and Regional Planning, Faculty of Architecture, Istanbul Technical University, turkoglu@itu.edu.tr.

## 1. Introduction

Water Basin includes groundwater and the surface water in rivers, aquifers, and lakes/reservoirs that collectively account for approximately one-third of the total available freshwater in the world. Each water basin covers a group of watersheds and smaller watershed called sub-watersheds. They contain vast areas from several hundred to thousands of square miles including agriculture, forest, suburban, and urban areas. Livestock and people are the indispensable part of a watershed and their functions influence the productive situation of watersheds and vice versa. There are also many economic benefits related to watersheds including, creation of water-related recreation opportunities, minimization the vulnerability to floods, fires, and other natural disasters, contribution to water supply for human needs, agricultural and industrial uses, mitigation the effect of climate change by holding huge amounts of carbon, and regulating flows during droughts and storm events (EPA, 2012). Therefore, the watershed is not only the hydrological unit but a social, ecological, and political entity that plays a significant role in providing social, and economic security, and life-related services to rural people (Wani et al., 2008).

However, watersheds are under various threats posed by humans through changing land uses, water pollution, environmental degradation, and intervention in the hydrological cycle of rivers by changing the bed streams and the riverine landscape, etc. (EPA, 2012). Thousands of years ago, efforts to control rivers were initiated, and the concept of river basins as units for planning and managing water emerged in the late 19th and early 20th centuries (Molle et. al, 2006). With increasing development, population pressure, environmental degradation, and water shortage and pollution, the watershed management approaches has become a difficult task, especially according to the resilience and administration (Peña-Guzmán et al., 2017).

Following the Earth Summit of the United Nations Conference on Environment and Development (in 1992, Rio de Janeiro, Brazil), new ideas of watershed management approaches were thought by national and international agencies. Barrow (1998) stated that river basin planning is the process of water allocation between different stakeholders and human needs and environmental objectives. According to Brooks et al. (2013), basin management organizes the land and other resources on a basin for providing the desired services and products without adversely affecting soil and water resources. With understanding water importance, Sustainable Water Resource Management (SWRM) has become one of the most significant Sustainable Development Goals (UN, 2014). Previous approaches towards SWRM have highlighted on creating various indicators that including multidimensional economic social, and environmental aspects (Singh et al.,

2009). The SWRM is not an easy task, as it deals with the water supply system, water distribution, water consumption, and discharges, different actions of upstream and downstream, surface and underground water, and so on (Kharrazi et al., 2016). Furthermore, as a multi-dimensional process, it is interconnected with socio-economic, ecological, and governance and built environment, which has been caused it much more complicated. In this way, it felt to need a holistic and optimal solution involving socio-economic and environmental dimensions in the management approach (Garcia et al., 2016).

"Integrated Water Resource Management" as a sustainable approach to water management has been introduced to the world since the late 19th century. This new paradigm has been different in various aspects from traditional water management especially in terms of administration. In the past, water-related sectors, including wastewater treatment, water supply, solid waste management, stormwater drainage, and sanitation have been planned as isolated sectors under a central administration. Fragmented water resources management has posed the water resources degradation in many watersheds as it has failed to distinguish between different water qualities for various uses (Bahri, 2012). All domestic water is treated to drinking water standards, and water was used only once and disposed with a large amount of energy and materials. Furtheremore, lack of appropriate infrastructure and high transaction costs in the centralized management of water basins worsen the problems (Dinar et al., 2007). With population growth, it became expensive to aggregate water services over vast areas and to transport water over a long distance by pumping energy. Besides, the whole system was vulnerable to hazards, such as draughts and salt loads.Therefore, due to these problems, the conventional water management became outdated, and a new paradigm of "integrated water management" has emerged at both levels of urban and basin water management.

IWRM could achieve significant attention in watersheds management. Following the report of the global water partnership (GWP) and the Japan Water Forum presented in the fourth world conference on water in 2006, many countries have planned to obtain IWRM as a global index. Also, in 2006, the UN secretary asked all of the states to provide the progress report on the development of IWRM in 2008. In this research, IWRM's contribution to sustaining water resources is analyzed. So, management projects and implementation techniques in which the IWRM approach is applied are evaluated in terms of Sustainability Framework. At first, trying to provide a clear framework for sustainable planning of watershed management, it identifies the primary factors and sub-factors of sustainability in the watershed management and planning process. Second, it evaluates the IWRM's regulations and strategies based on the defined framework of

watershed sustainability. Therefore, it attains a comprehensive about how the IWRM acts and contributes to the sustainability of watersheds in general. It also provides some suggestions for better sustainable management and planning in the watershed.

## 2. Sustainable Development and Water

Foundation of the sustainable development was laid in the Brundtland Report in 1987 and the 992 Rio Declaration on Environment and Development. It was defined as a "development that meets the needs of the present without compromising the ability of future generations to meet their own needs". From an anthropocentric point of view, sustainability has been summarized as "improving the life quality of humans while living within the carrying capacity of supporting ecosystems" (van Leeuwen & et al., 2012). One of the most popular sustainability principles is the "triple bottom line approach," which includes environmental, economic, and social aspects of sustainability. In city development, two indicators of assets and governance are also added to those three indicators. The water is central to the sustainability concept, as the water basins and water systems that provide water, sanitation, and drainage systems are essential for Today's growing population. Most of the river basins are suffering from the mismanaged governmental institution, inadequate knowledge about the fundamentals of the riverine ecosystems, and its dynamics (Mencio et al., 2010). So, governance and technical dimensions should be considered in their management process.

### 2.1 Sustainability Aspects

There are various categorizations of indicators for water sustainability, which address both large water resources such as lakes and urban water systems. Loucks and Gladwell (1999) provide guidelines for water sustainability, including the importance of water infrastructure, environmental quality, economics and finance, institutions and society, human health and welfare, as well as planning and technology. Mays (2006) introduced seven requirements to ensure the sustainability of water resource systems, which are basic water needs to maintain human health and ecosystem health, a minimum standard of water quality, long-term renewability of water resources, accessible information on water sources for all sectors, institutional plans to resolve water conflict, and participatory water-related decision making. In this research, we classified the watershed sustainability into five main groups, including ecological, economic, social, physical, and governance areas (Figure 1) which are explained in the following text.

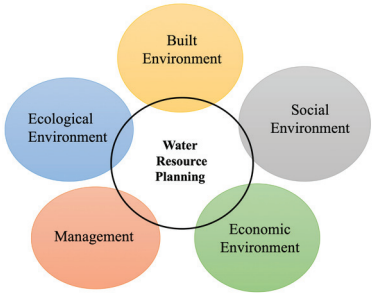



*Figure 1. Primary dimentions of sustainable watershed planning and management*

- **Natural Environment and Sustainability**

It is the maintenance of the water-related factors and functions that contribute to the environmental quality on a long-term basis. The present use of the water resources should be managed in a way that sustains the vital life-support systems, thereby not compromising use by future generations of the same source. For maintaining the ecological integrity of aquatic ecosystems, it requires understanding the chemical, biological, and physical condition of water bodies, as well as vital watershed functions and attributes (hydrology, geomorphology, and natural disturbance pattern) (EPA, 2012).

- **Social Environment and Sustainability**

Population growth and socio-economic development continuously increase water demands and, thus, extreme water pressure and water shortage risks (Zhou et al., 2017). Therefore, accessibility to drinkable water is one of the primary social dimensions of water sustainability. The fundamental right for all people to have access to water of adequate quantity and quality for the sustenance of human wellbeing must be universally recognized (Shen et al., 2011). This area consists of regulations that support social changes and better living conditions. It is a process for creating places that promote wellbeing, by understanding what people need from the sites.

- **Economic Environment and Sustainability**

Economic sustainability means to keep the resources both human and material resources to generate long-term sustainable values through optimal use, recycling, and recovery. Sustainable development is mainly mentioned as the requirement to sustain a permanent income for humankind, obtained from non-declining capital stocks. Permanent stocks of man-made, natural, human, and social capital are considered as essential and often adequate criteria for sustainable development. It also means long-term costs for the use of resources and maintaining human sources and technology in a long-time are included in economic calculations. This dimension

intends to maximize the economic benefits obtained from the entire basin and ensure that these benefits and costs are equitably distributed in the planning and management on a basin scale. Through the planning, it must identify equitable budget and risk-sharing policies and improve approaches to risk/cost management.

- **Built Environment and Sustainability**

The built or physical environment conclude living space, buildings, infrastructural elements like waste management, transportation, and other utility systems for serving the building areas, that are produced or developed by people. There are various environmental problems from cooling and heating buildings, new buildings construction, and people transportation between buildings. Examples of those environmental issues are deterioration of water and air quality as a result of the pollutants released from construction sites. Sustainability of built environment means to maintain human sources and technology in a long-time (Yang et al., 2016). This area includes the requirements for using the relevant physical sciences and technology in the water basin management plans to correlate the competing interests of various types of land use.

- **Governance and Sustainability**

Governance on water-related efforts means to sustain continuous governance over a long time of water basin planning. A good governance level or management is necessary especially when the resources are too limited to provide the minimum requirement of the people. It is dealing with the government and the governance functions of other social actors. In general, sustainable governance is concerned with planning and managing social changes through democratic interactions and specific reforms. One main challenge with governance is corporate governance that can create an environment of confidence where the stakeholders, government, public, and service providers corporate and allow various users and policymakers are involved at all levels (Durham, 2002). There is also a need for integrating institutional aspects towards the sustainability of the water basin (Belay et al., 2010). Corporative management contributes that all state and public stakeholders communicate in the decision-making process to enhance the people awareness on the main problems like water shortage and resources management; to improve the understanding of the regional water cycle, and to develop knowledge of water alternative resources (Thomasa & Durham, 2003)

There is a set of general criteria, principles, and indicators to develop a flexible and adaptable water sustainability framework. By utilizing the sustainability indicators, the local and regional water sectors can enhance their water sustainability through an evaluation of the current condition.

### 2.2 Evaluation of Water System Sustainability

There are various methods and tools to assess the sustainability of water systems which are used by water managers and urban planners at a variety of scales. Spatial variations, socio-political characteristics, and data availability are factors in determining the evaluation methods (Russo et. al, 2014). In general, there are three primary evaluation methods for Sustainable Water Management in the cities.

#### 2.2.1 Indicators and indices

The water index and indicators should quantify and simplify the data and information for evaluating environmental values. The indicator method provides simple numerical data which makes it possible for the cases to be compared. Some of the important indices which address water in sustainable development are: Water Poverty Index (2002) to evaluate the water availability and the people's capacity to access water (Lawrence & et al, 2002); the Canadian Water Sustainability Index (2007) to measure community well-being in terms of the water resources, ecosystems services, and the community ability in water stewards (Morin, 2006); the Environmental Performance Index to mitigate the environmental crisis to human health, and to fortify ecosystem vitality and natural resource management by providing an analytic basis in environmental policymaking; the Watershed Sustainability Index (2007) to create an integrated assessment of the current situation of watershed management; City Blueprint Index as water management indicators as a basic sustainability assessment of urban water cycle services to quickly understand how advanced a city is and to compare its condition with other cities.

#### 2.2.2 Product-related Assessment

Product-related assessments can provide data on energy, water, and land needs for a specific product or a supply chain. Awareness of environmental protection and the negative impacts related to both consumed and manufactured productions on the environment has led to developing tools to evaluate these impacts. Here, two methods of Life Cycle Assessments, Water Footprint are explained.

- Life Cycle Assessments

Life cycle assessment is an evaluation of the inputs, outputs, and the potential environmental impacts of a product chain throughout its life cycle (ISO, 14040). The life cycle is a series of consecutive stages of a production system, from natural resources (raw materials) to final production and disposal (ISO, 14040). Four phases in this assessment are a) the goal and scope definition, b) the inventory analysis, c) the impact assessment, and d) the interpretation phase. It defines a product system through stages

of unit processes that have a system boundary with defined input and output flow as elementary flows. This method as one of several environmental management methods that might not be a suitable technique for all situations and cases.

- Water Footprint

A footprint family is a group of indicators that relate using the pattern of the consumers and demand of production to the natural resources. The concept of 'water footprint' introduced by Hoekstra and Hung in 2002 is the total used water by an individual, household, business, sector, city, or country for various purposes from domestic use to agriculture, and production. It estimates both the amount of direct and virtual (indirect) water consumption (Hoekstra et al, 2011). In the water footprint, water is considered in three forms of blue water, rainwater, greywater (Hoekstra et al, 2011). The blue water footprint refers to the use or consumption of freshwater resources including surface and groundwater. The green water footprint refers to the use of rainwater, which does not recharge in runoff or the groundwater. The grey water footprint is the amount of fresh water that is needed for dilution of pollution load so that the water quality remains above the water quality standard. Water footprint methodologies are being useful and applied in several cases of regional and global levels. However, its experiences at the urban level are limited due to the lack of local data (Paterson et al., 2015).

### 2.2.3 System-Based Tool

One of the System-Based tools is "Emergy", which is defined as the available energy used directly or indirectly in a production. This theory emphasizes that all functions of the current systems in the world (ecological, economic, and social) are generated through energy transformation. For example, to generate phosphate fertilizer, it requires more energy investment than generating wind energy, as phosphate needed fossil fuel in mining and phosphate formulation. Similarly, phosphate fertilizer has higher "energy quality" (Ma et al, 2015). Therefore, water quantity is not the only matter, but also the energy quality of water is an important issue. This applies to water systems with elements such as drinking water, surface/groundwater, wastewater, stormwater, water basins, and their related infrastructures. The energy values for drinking water are high due to the high energy requirement of electricity, and wastewater treatment comes from raw materials such as soil, organic matter, fertilizers in food, and from modern agricultural techniques (Ma et al, 2015).

### 2.2.4 Integrated assessment

Integrated sustainability assessment is used to assess urban water decision making. Integrated Assessment is defined as the scientific principle

that integrates knowledge on a problem and makes it available for decision-making processes**.** The development of Integrated Assessment models needs an adaptive process that incorporates both scientific knowledge and stakeholder in model development. As a part of an integrated assessment, models must be produced to act for the requirement of other disciplinary components that contributed to the assessment (**Croke, 2007).** The Multi-criteria decision model is an integrative process utilized in the assessment of urban water sustainability with a central concentration on stakeholder participation. It assesses urban water cycle sustainability through weighting techniques that gather stakeholders' perspectives and preferences.

## 3. Integrated Water Resource Management

### 3.1 Theory Framework

The concept of Integrated Water Resource Management (IWRM) was described in Agenda 21, through the International Conference on Water and the Environment in Dublin (1992). Dublin-Rio Principle emphasizes that blue water is limited while, it is necessary for sustaining life, environment, and economic development. Thus, the social, economic, environmental, and technical dimensions should be considered in the management of water resources. The Global Water Partnership (GWP, 2000) defines IWRM as "a process which promotes the coordinated management and development of land, water, and related resources (human-environment relations), to improve the economic and social welfare equitably without compromising the resistance of critical ecosystems. The new paradigm at the basin scale highlights the decentralization of watershed management to the lowest level, the stakeholder participation, cross-agency coordination, and the protection of the ecosystems (Agyenim, 2011). It provides several tools and strategies that should be planned for a watershed to improve the status of both the surface water and groundwater (Safavi et al, 2015). Main Integrated management goals in Watershed planning are:

- Soil protection and control of erosion, landslide, flood;
- Water production at the desired quantity and quality;
- Improvement of the socio-economic situation of the basin;
- Achieving forestry objectives;
- Conservation of wildlife and biodiversity production;
- Land use objectives and organizing the use of land;
- Preserving cultural resources;
- Land and water management integration;

- Sustainable irrigation for agriculture;
- Best development of natural resources, watersheds, infrastructure, agriculture, social services, etc
- Recreational goals;
- Reclamation of the degraded land natural resources in a conservative approach;
- Development of methods in the use and control of natural resources with the advancement of civilization and technological developments;
- Water ecosystem conservation, their enhancement, and sustainable water use.

### 3.2 Integration Aspects

Adopting an Integrated Water Resource Management (IWRM) which considers all relevant technical, social, economic and environmental factors need to consider integration at relevant scales and water sectors, at relevant disciples, at administrative levels, and in the environmental systems. According to Grigg, 2008, we consider seven main categories which are;

- Integration across policy sectors: The inherent interdependencies of the nature and economic and social sectors in IWRM are established by the governments through primary policy sectors such as environment, natural resources, agriculture, public health, transportation, energy, and emergency management (Grigg, 2008).
- Integration across water sectors: It is integration among water sub-sectors such as water quality, water supply, irrigation, environmental water and flood control, hydropower, navigation, and recreation. This integration can expand to contain all aspects of water use, water quantity and quality management in upstream and downstream, surface and groundwater integration, freshwater and coastal zone management (Kidd & Shaw, 2007).
- Integration of geographic units and the surrounding environment: It involves basin management and management between basins. The water supply of a basin may be wastewater from another basin (Grigg, 2008).
- Integration across government units: It includes integration of vertical levels such as the national, regional, and local levels and horizontal dimension such as government units at the same level.
- Integration among management functions: It needs alignment among experts, planners, finance staff, engineers, and other members of the organization.

- Integration among organizational levels and administrative tools: It is integration across phases of management like policy, design, planning, construction, implementation, treatment, recycling, and so on.

- Human sectors and disciplines integration: Disciplines and professions should be included in water resources management as an interdisciplinary process. This integration is both cross-sectoral integrations for between spatial planning and water management on both sides and inter-agency integration among public, private and voluntary sector interest in water management (Kidd & Shaw, 2007).

## 4. Results

### 4.1. Determination a sustainability structure for water resource management

This work provides general planning and management factors that should be considered as primary aspects of water resource sustainability. However, the management or planning priorities decisions should be based on the existing water resources problems and their specific characteristics. Considering five main areas in the sustainability of water resources or watershed, this article provides 17 sub-factors which should be applied in any planning and management program of the water bodies (Figure 2). These sub-factors are clarified in Tables 1, 2, 3, and 4 in terms of the main scopes and the strategies and techniques suggested in the management of a water basin or any water resources


*Figure 2. Main planning factors and sub-factors involving in water resource sustainability*

*Table 1. Clarification of the Natural Environment, its sub-criteria, and explanations under each determined sub-criteria.*

| Sustaibility | Sub-factors | Purpose | Some of the main planning strategies and management techniques |
|---|---|---|---|
| **Natural Environment** | Water resources | -to improve the water quality and quantity;<br>-to study pressures over the water resources;<br>-to prevent excessive destruction of the water resources. | -Intelligent water Allocation to various sectors<br>-Incorporation supply and demand management.<br>-Planning alternative water resources and the use of various water sources (rainwater, stormwater, runoff)<br>-Putting relevant standards for the discharges of wastewater<br>-Restoring damaged lakes and marine ecosystems<br>-Limiting some activities such as mining, fishing, agriculture to increase water quality |
| | Other natural sources (Land, forest, air, so on) | -to protect other natural resources such as air, soil, forest;<br>-to integrated land and water management;<br>-to achieve forestry objectives. | -Technically controlling sediment solution and steep slopes to prevent erosion;<br>-Controlling and monitoring of air pollution and greenhouse emission;<br>-Conserving the forest areas from human construction, agriculture, and other land uses;<br>-Assessing risks to forest biodiversity and taking action to prevent the spread of invasive alien species. |
| | Ecosystem and biodiversity | -to conserve the various ecosystem functions, biological diversity with sustainable use of them | -Spatial analyzing related to the ecosystem services of the water, forest and other natural ecosystems<br>-Keeping use-conservation balance in the water basins based on ecosystem functions<br>-Constructing artificial wetlands to improve diversity and ecosystem function<br>-Recognizing animal food resources and protect their food needs<br>-Providing the migration and movement chance for the species. |
| | Ecological health | -to prevent environmental pollution and manage solid and liquid waste in the water basin | -Increasing the number of treatment plants and sewerage systems over the reservoir;<br>-Determining the wastewater treatment methods for domestic wastewater;<br>-Rehabilitating all irregular landfills in the basin;<br>-Separating the stormwater collection system from the wastewater systems;<br>-Using the leak-proof septic to transfer the rubble and construction material in the protected areas of the basin |
| | Climate change and natural hazard | -to control, monitor, and anticipate the possible inherent risk and future climate change like the landslides, flooding, overflowing extreme weather, and droughts, temperature, rainfall, and sea-level change. | -To establish a framework for the assessment and management of flood and overflowing.<br>-To plant for flood and landslide control, and overflowing management.<br>-To plant the water-resistant's species for doughtiness management.<br>T-o restore wetland areas along rivers for natural flood control.<br>-To measure and register the climatic factors of temperature, rainfall, sea level in the area. |

*Table 2. Clarification of the Built Environment, its sub-criteria, and explanations under each determined sub-criteria.*

| Sustainability | Sub-factors | Purpose | Some of the main planning strategies and management techniques |
|---|---|---|---|
| Built Environment | Infrastructure and utilities | - To supply service utilities and sanitation infrastructure;<br>-to reduce water losses in the existing infrastructure;<br>-to reduce operational cost and technological development;<br>-to maximize their efficiency in terms of sustainability principles | -To repair the current infrastructure with an adequate, cost-effective utility to match the needs of the population residing in the area;<br>-to prepare the emergency action plan for faults, accidents, etc. of any wastewater infrastructure facility in the basin;<br>-to implement the infrastructure alternatives such as green infrastructure for run- of management;<br>-to decentralize the infrastructure system and integrate drinking water, wastewater, and stormwater system. |
| | Transportation and logistics | -To manage the transportation by environment-friendly techniques;<br>-to provide efficient access to goods and services for all inhabitants | -Emergency plan for transport of dangerous materials of the roads to keep from leakage in surface and groundwater.<br>-Construction of footpath, cadastre way, forest path etc. to walk and cycle in the protected areas.<br>-Limiting construction of new roads in the protected area. |
| | Land uses and density | -To minimize environmental impacts of the construction on the water systems,<br>-to sustain agricultural land;<br>-to increase energy and material efficiency, and more recycling rate;<br>-to increase the community well-fare economy, and employment in the water basins. | -To goods storage and organized industrial zones in drinking water basins.<br>-to preserve open space, farmland, natural beauty, and critical environmental areas. |
| | Cultural landscape and historical heritage | -to protect cultural values and heritage sites;<br>-to preserve traditional architecture existent in the area. | -Conservation of Treasury lands;<br>-Managing the characteristics of rural settlement a the existing traditional texture;<br>-Discussing the spiritual values with indigenous peoples to a better understanding of their relation to water;<br>-Analyzing each site's heritage features and requirements for their drainage.<br>-Providing the rehabilitation plan of the damaged cultural heritage |

*Table 3. Clarification of the Economic Environment, its sub-criteria, and explanations under each determined sub-criteria.*

| Sustainability | Sub-factors | Purpose | Some of the main planning strategies and management techniques |
|---|---|---|---|
| Economic Environment | Agriculture, husbandry, and aquaculture | -To improve the financial situation of the rural community by agriculture and aquaculture and farming as well as following the environmental protection objectives. | -To compose the liquid and solid wastes resulting from livestock activities as agricultural fertilizers;<br>-To provide technical supports to the farmers on irrigation systems and ways of water reduction use;<br>-To use advanced techniques of rainwater harvesting and supplementary irrigation;<br>-To not allowing fishery in the protected lake, drinking water basins and the creeks feeding the reservoir;<br>-To control erosion and run-off on agricultural and forestry practices -To encourage organic farming throughout the basin |
| | Industrial production and mining | • - to minimize negative construction impacts on river systems during exploration and industry,<br>• -to provide jobs and benefits to the community resided on water basin;<br>• -ensure that the fiscal regime is stable over time. | -Initiating recycling efforts to nature simultaneously with mining;<br>-Not permitting solution mining and industrial solid waste storage and disposal centers in the basin;<br>-Rehabilitating the mine after closure to prevent the enormous environmental effect;<br>-Treating wastewater from existing and new industrial facilities following the relevant legislation;<br>-Complying the individual industries with the discharge standards by using advanced treatment methods; |
| | Tourism and ecotourism development | To improve the resident's livelihood;<br>to enhance recreational chances | -Using natural and water features to attract tourism;<br>-Analyzing the tourism and ecotourism opportunities and its environmental impacts;<br>-Examining the tourism development effects on life quality and social conditions;<br>-Considering necessary disinfection procedures for the vehicles brought from outside to the dam lake;<br>-Forbidding the use of fuel-powered vehicles into the lake or drinking water resources |
| | Energy generation from water (hydraulic energy), nutrient, and recycled wast | -Energy generation from water (hydraulic energy), nutrient, and recycled wast;<br>• -To help keeping electricity bills as low as possible while providing reliable energy services that meet customers' needs. | -Managing the water reservoirs with ample storage for the optimization energy.<br>-Using dams, lake, and so on to produce hydrological energy in the basin<br>-Establishing a solar and wind power plant by the relevant regulatory procedures |

*Table 4. Clarification of the Social Environment, Institutional Environment, their sub-criteria, and explanations of each sub-criteria.*

| Sustaibility | Sub-factors | Purpose | Some of the main planning strategies and management techniques |
|---|---|---|---|
| Social Environment | Social Rights and values | -To ensure that all people have access to essential goods, services, food, and water;<br>-To give the right to peiople to make any decisions on the water basin | o -Informing people about improvement efforts and problems in the basin.<br>o -Providing the public participation from the first step of management programs |
| | Public health | -To give the people settled in the area access to safe and clean water. | -Increasing the investment of sanitation facilities on a local level;<br>-protecting the areas surrounding potable water resources by materials such as wire or fence. |
| | Behavior and attitudes | -Analyzing the population behavior, consumption pattern, and pollution trends through planning;<br>-Study the social challenges of the inhabitants, the current users' needs, and expectations of the water basin. | -Conducting practical training and awareness-raising activities by the administrations;<br>-Achieving the residents' preference, needs, and perception through organized interviews, questionnaire, and meetings by the local administration;<br>-Studyig behavioral changes for the efficient use of water and the reuse of used waters. |

| | | | |
|---|---|---|---|
| **Governance (Institutional Environment** | Institutional structure | -To increase policy coherence, the effectiveness of legislation, institutional integration and flexibility in adapting to change;<br>-to identifies clear roles and responsibilities. | -Applying the measurability of the water basin policies;<br>-Openly working of the institutions with accessible and understandable language;<br>-Decentralizing of responsibility and authority to the local administration and the users;<br>-Preparing work programs with time table by the related institutions and organizations. |
| | Participation | -Organiing stakeholder participation in the decision- making process. | -Sharing benefits, income distribution and costs for all parties<br>-Availability of information and documents to the public by consultation and communication channels<br>-Broad participation throughout the policy chain from conception to implementation |
| | Finance | -To provide the regulations on finance dimension provid for increased capacity, employment, and water-related investment in the management plans. | -To provide a mix of public and private benefits through the stakes in water infrastructure such as dam production;<br>-The investments in monitoring water resources storage, extraction, quality, flood protection, and water transfers;<br>- To provide Governmental funding and budget on the education of the farmers resided in the water basin;<br>-To define fund for waste recycling and pollution treatment technologies |
| | Management | -To monitor actions, management tools, and planning approaches | -Identifying the leading indicators and index for evaluation of the activities;<br>-Determining goals, objectives, limitations, and management challenges ;<br>-Using methods and tools leading to integrated management of water ecosystems;<br>-Determining the responsibility of the local administration and institutions on contamination of groundwater and surface water. |

### 4.2 Evaluationg the main achievements of Integrated Water Resource Management (IWRM)

Over the last decades, the IWRM approach has been followed and implemented all around the world. For providing an appropriate integrated management plan, the evaluation of the water basins, goals, and the identification of the problems, a set of data collection networks, environmental assessment, and data communication should be created. According to the various studies and projects, some main functions and achievements through the IWRM are identified which are:

- Decentralization: Decentralization in watershed management means the devolution of authority from the center to the lowest sector and admission of responsibility by local communities (Dinar et al, 2007). The lowest level refers to the water users' and stakeholders' involvement in basin management.

- Stakeholders' Participation: The stakeholder's participation at the watershed level concerns all water-related functions such as planning, watershed assessment, implementation techniques and strategy, water quality maintenance, water allocation methods, monitoring, basin guideline, flood control and monitoring. There are various ways for the public involvement in water resources management such as public hearings, comment and notice procedures, and use of advisory committees.

- Governmental Budget: The government and public authorities are responsible for the large scale of water such a river that includes maintaining and monitoring the quality and quantity of groundwater, river, and lakes rivers (Thomasa and Durham, 2003). Sharing the budget and cost of the decentralization process needs for the existence of a large number of organizations, and a large length of time within a river basin. Dinar et al. (2007), emphasize that the success of water basin management is associated with the combination of three main financial sources: central government support, basin revenues remaining in the basin, and financial responsibility on the part of water users.

- Water and Land Use Allocation: Land use changes the watershed and groundwater cycle (Du et al, 2018). Assessment of the land-uses in a watershed will contribute to the local stakeholders with appropriate decision making on protection and management strategies. Water allocation is also a necessary process when the natural sources and water availability is limited and fails to meet the needs of all water users. It means sharing water between various regions and competing water users. The national water allocation plan and a local assessment of water availability determine the amount of utilizable water in the watershed. The watershed allocation plan should also assess the water required for environmental flows.

- Inter-basin water transfer projects: Water resources are distributed unevenly in diverse spatial and temporal scales in the world. Inter-basin water transfer has been one of the effective engineering projects and methods that will ensure the water accessibility to water -scared places. China, plenty of water transfer projects have been implemented that involved reservoir establishment, complicated water diversion works, long tunnels construction, and massive water pumping. As the impacts of inter-basin water transfer projects on the water-supplying basin and their socio-economic systems are large, the intelligent water allocation strategies are critical to mitigate these negative effects before and after project implementation (Zhou et al., 2017).

- Climate Adaptation: Researchers who work on watershed planning and management are facing issues on how to determine policy based on a future climate change and how to evaluate its environmental effect. The effects of climatic change on water resources are hard to precipitate, while with population pressure, increased demand for waste and pollution, it could be very extreme in single water resources (Teclaff, 1991). A warming trend could change precipitation and streamflow regimes, and cause floods or drought. It will damage the watershed forests having impacts on the entire river basin by soil erosion, changing the number of downstream flows, the overall reduction in water quantity. Climate change will influence the river basin ecosystems and its interrelated elements and systems. Commissions already place in many watersheds, will have the function of managing watershed ecosystems in a different environment and adapting to new conditions and (Teclaff, 1991).

- Flood risk management: Flood risk management acts as a tool to improve water sanitation and health. For flood management, a wide range of flood control techniques and measures including structural measures like bridges and dikes, and also non-structural measures such as early warning systems and land use planning are needed (Räsänen et al, 2017).

- Adequate wastewater management: Integrated water resources call for collecting and treating wastewater before discharging into nature, watershed restoration, and wastewater recycling (Zhou et al., 2017).

- Water Quality Monitoring: There is a need for well-equipped and carefully managed monitoring networks for pollution analysis. Research of Diamantini et al (2018) identifies the importance of statistical analyses of physical and chemical quality of water basin (such as pH, water turbidity and temperature, electrical conductivity, biological oxygen, and chemical oxygen demand, dissolved oxygen, general nitrogen, phosphates, phosphorus, and chloride) considering temporal and special trends of pollution changes in the river basin. The control and monitor of physio-chemical

characteristics (monthly, seasonal or annual) as well as topographical and erosion evaluation of water have been used as indicators of environmental degradation in the watersheds (Tarlé Pissarra et al., 2008).

- Water Footprint Accounting: The grey and blue water footprint analyses are not only water use indicators, but they can also provide data of water utilization that are useful in decision-making. Water accounting through water footprint is also necessary for water demand management in domestic and agricultural sectors, for controlling water extractions from sources, and analyzing water transfer from other basins. Furthermore, in regions with water scarcity or in a contaminated area, WF accounting can provide beneficial data.

- Supply and Demand Management Incorporation: Integrated Water Resource Management aims to incorporate supply and demand management. Water availability in watersheds alters between dry and wet seasons, however, the human water demand differs based on construction rate, population growth, agriculture patterns, etc. When watersheds become urbanized, proper supply and demand planning will be necessary.

- Sustainable Farming: Sustainable farming pinpoints the crop diversification by utilization of advanced technologies, the use of the acceptable variety of seeds, and the application of stabilized fertilizer (Wani and Garg,2014). It refers to carrying out appropriate changes in the existent cropping patterns towards a more balanced agriculture system to increase cropping capacity and mitigate the risk of crop failure.

- Sustainable Irrigation: It is one of the main objectives of IWRM at the basin scale in irrigation management and planning (Billib et al, 2009). Causapé *et al*. (2004a) highlight that the three important factors determine the quality of irrigation containing irrigation system, soil characteristics, and crop water requirements. Some vital suggestions for enhancement of irrigation are raising the efficiency of flood irrigation, applying the pressurized systems in the previous soils, and reusing the drainage water for irrigation. There is a suggestion for conjunctive management of surface and groundwater for irrigation to develop the sustainable use of the watersheds and protect the water of high quality in the primary reservoir.

Various initiations and techniques have been identified through the watershed management projects in the leading countries. As Table 5 shows, the IWRM strategies and purposed techniques contribute to the water resource or watershed resistance in various aspects. However, its techniques mainly address the management and governance dimensions, while in the area of the built environment and social dimension, it has limited strategies.

*Table 5. The IWRM strategies in the sustainability framework of a water resource.*

| **Sustainability Dimensions** | Sustainability Sub-Factors | Techniques and Strategies of **IWRM** |
|---|---|---|
| Natural Environment | Water Resources | • Water Allocation |
| | Environmental Problems | • Flood Risk Management<br>• Climate Adaptation |
| | Ecological Health | • Adequate Wastewater Management<br>• Water Quality Monitoring |
| Economic Environment | Agriculture | • Sustainable Farming<br>• Sustainable Irrigation |
| Social Environment | Social Rights | • Public Participation |
| Built Environment | Infrastructure | • Inter-Basin Water Transfer Projects |
| | Land Use and Density | • Land Use Allocation |
| Management (Governance) | Institutional Structure | • Governmental Budget<br>• Payment for Ecosystem Services<br>• Alternative Water Resources |
| | Management | • Water Footprint Accounting |
| | | • Decentralization of the Basin Management |
| | | • Supply and Demand Management Incorporation |
| | Participation | • Stakeholders Participation |

Implementation of Integrated water management has been discussed in various researches in the world. Even though there are noticeable achievements in some projects of integrated watershed management, the concept is still unclear and complex in so many aspects. There is no compromise on the basic issues of the IWRM approach such as what dimensions should be integrated, and how by whom it will be possible. The IWRM application should be flexible for today's development, understandable and available to the public, integrate diverse viewpoints, and concentrate on efficient solutions. There is no experience in conducting the IWRM for macro-scale policies and projects. Lack of systematic data collection is another issue that affects the performance of the IWRM process especially in developing countries. Furthermore, as many actions should be divided among various agencies including private companies, government agencies, and

nongovernment organizations, it needs to connect to a statutory basis. But, it is disconnected from the municipality plans especially land use plans. Thus, due to the low legal basis, in action, the results have low efficiency.

## 5. Conclusion

Water resources have been critically important due to water scarcity and population growth in the world, and their management planning has become challenging among researches. However, this process is not transparent to many water managers, and the related institutions because of the complexity and interconnectivity of the management aspects. The main step seems to mitigate this complexity by determining a brilliant structure of planning elements and management issues. Sustainable Development determines five main dimensions of the water resource management that includes the ecological, social, economic, land use and infrastructure, and governance dimensions in which various sub-factors are included. All aspects have an essential role in sustainable water resource management, which means integrations of various sectors and disciplines in the process. However, the priority of planning techniques and policies should be determined based on the specific environmental issues, residents' needs, social and economic situation, and other characteristics of each water body.

The Integrated Water Resource Management following the sustainability principles highlights the integration of various dimensions, sectors, disciplines, and scales in the management planning approach. It has been associated with successful results and practical strategies for managing water resources, however, it needs much more effort to clarify the proposed concepts through implicated projects and practical programs to be functionally effective in the area of watershed management.

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# Chapter 5

## IS IT POSSIBLE TO RE-DESIGN LIVABLE URBAN STREETS?

*Çılga RESULOĞLU*[1]

1 Dr. Öğr. Üyesi, Atılım Üniversitesi, Güzel Sanatlar Tasarım Mimarlık Fakültesi, İç mimarlık ve Çevre Tasarımı Bölümü, cilga.resuloglu@atilim.edu.tr

## INTRODUCTION

The design of urban spaces for pedestrians, particularly urban streets, should accomplish people's demands and should propose certain utilities. Meaningful relations between mobile users and environment can be generated through the appropriate design elements and strategies. Streets are both physical environments and social settings, thus, physical configuration of the street has a direct influence on the socialization process. In fact, the spirit of the street comes from the urban public places where social activities happen. Therefore, the liveliness of streets depends on the network of spatial configuration and interaction among people.

Every urban street is a unique and evolving organism and every city has streets across a comprehensive continuum of contexts. Designing for lively streets requires meticulous consideration of many demands and facilities throughout the day. Urban streets invigorate social, cultural and economic life by offering physical activities. They can be our front yards and living rooms, our parks or nightlife destinations and our essential circulatory system and they should provide for users-from different ages and socio-economic and socio-cultural statues- walking, cycling, driving, making deliveries, public transportation, selling goods or simply just stopping to take a breath. Thus, streets are urban places for everyone and the vessels of a city. That's why cities cannot be imagined without streets.

The design of the street affects the quality of public life which is one the significant concerns of livable urban streets. Nowadays, streets have been converted into unlivable environments, however, by understanding appropriate design considerations for urban streets, urban designers can have a chance to maximize the quality of life and to generate livable streets. Burton and Mitchell (2006) in their famous book *Inclusive Urban Design – Streets for Life* indicate six key design characteristics for streets such as familiarity, legibility, distinctiveness, accessibility, comfort and safety. In this study, these six principles are highlighted by examining the entailment of the each one and is discussed if it is possible to re-design livable urban streets by maintaining these six interconnected design features.

This study is structured by the content analysis method which is the technique of collecting and analyzing text context. (Creswell, 2009) Content analysis method is a well-established sociological research technique and it is a flexible tool. (Zaleckis, et. al., 2019) It does not only concern the sociological but also spatial aspects, in other words, content analysis reinforces social dimension in spatial analysis of urban forms. (Porta et. al., 2006) Burton and Mitchell's (2006) text constitutes the backbone of the study, because it is considered that the six design characteristics examined in their work creates a ground to make recommendations for livable urban

streets and give an opportunity for urban designers to discuss physical attributes of livable urban streets in accordance with urban life.

**Familiarity**

The design of street features is effective to determine users' familiarity in the urban place. Liveable street design involves familiar identification on the street environment. Burton and Mitchell (2006: 51) define familiarity "[t]o the extent to which streets are recognizable, [e]asily understood. [F]amiliar streets are hierarchical and long established with forms, open spaces, buildings and features in designs familiar to people." They (2006: 63) also mention the features of familiar streets are as follows:

- Streets, open spaces and buildings are long established,
- Any change is small scale and incremental,
- New developments incorporate local forms, styles, colors and materials,
- There is hierarchy of street types, including main streets, side streets, lanes and footpaths,
- Places and buildings are in designs familiar to or easily understood by (older) people,
- Architectural features and street furniture are in designs familiar to or easily understood by (older) people.

According to these definitions and features to obtain familiarity in order to increase users' comfort is very critical, particularly, when walking. The sensors, signals and information technology is significant as way finding elements on the streets. To understand the proximity of the destination, way finding elements should be located near main destinations such as transit stops, parks, public facilities, and markets where the pedestrian capacity is high. (Tibbalds, 2007) For instance, by using sensor-activated lighting, energy loss and safer spaces can be obtained for pedestrians at night and by using multi-user signal coordination daily needs can be adopted during peak hours. The amenities such as Wi-Fi access points, real time transit information and mobile applications aid in making streets more efficient as well as sustain familiarity.

The character of the public place, even a city, can be enhanced by well-known streets. The visual language of the signs including graphic standards and maps help to inform users as wells as to increase the identity of streets. They should also be convenient to the all users eye and height. Rubenstein (1992: 67) states that "signs are part of the overall graphic design for a city. They convey messages that are essential to the function,

safety, and security of a mall. A symbol or logo can be very important in giving identity to a (pedestrian) mall. The logo can be useful for public relations purposes". Thus, signs are one of the crucial concerns of the streets while defining familiarity.

Moreover, as well as way finding elements, the edges and the facades of the buildings define familiarity of urban streets. Clear design of the facades including lighting devices, architectural details, entrance spacing, landscaping, different heights of the buildings make streets more walkable and familiar. The multifaceted and the human scaled streets provide cosy walk. "The street in addition to being a physical element in the city is also a social fact. It can be analysed in terms of who owns, uses and controls it." (Moughtin, 2003) Thus, diverse uses have a crucial effect on the atmosphere of the street while creating familiarity. Diversity for urban street includes not only social gatherings, cultural activities or commercial uses but also incorporating appropriate designed green spaces wherever possible. (Relph, 2007) If the atmosphere of a street magnetizes users that means pleasant and lively pedestrian environment is obtained by the effective use of design principles, because successful streets can encourage face to face interactions to support public life which creates familiarity. Furthermore, they encourage users' activities which help to provide a lively urban environment.

**Legibility**

Visualizing a mental image of a street as users drive, ride or walk along creates legibility. According to Burton and Mitchell (2006: 64), "legibility refers to the extent to which streets help [p]eople to understand where they are and to identify which way they need to go." They (2006: 77) claim that the legible streets for life should consist of the followings:

- A hierarchy of street types,
- Blocks laid out on an irregular grid based on an adapted perimeter block pattern, […]
- Well-connected streets,
- Gently winding streets with open ended bends and corners greater than 90°,[…]
- Forked, staggered and T-junctions rather than cross-roads,
- Places and buildings with clearly visible, obvious and unambiguous functions and entrances,
- Low walls, fences and hedges and open fencing separating private and public space,

- Minimal signs giving simple, essential and unambiguous information at decision points, […]
- Locational signs for primary services positioned perpendicular to the wall,
- Signs with large, realistic graphics and symbols in clear color contrast to the background, generally with dark lettering on a light background,
- Signs with non-glare lighting and non-reflective coverings,
- Street furniture and other latent cues positioned at decision points where visual access ends.

Thus, legibility can be achieved by the combination of these features such as street layout, street shape and size, mental maps, sings, landmarks and environmental factors. Lynch (1960:3,) explained legibility as a feature that is easily identifiable and simply grouped into an over-all pattern. It is one of the most integrative characteristics of urban streets which constitutes the experience of users and it has blurred lines with familiarity. For instance, just like familiarity, distribution of signs and information technology (i.e. navigation facilities) which are located across the multiple planes of a street to enhance legibility for all street users. The consistent pedestrian signage in a clear visual language should also be universally understood. Legibility can enhance and support the current and planned streets at multiple scales. A legible street has a power to traverse diverse urban environments, from low-density neighbourhoods to dense urban centres. (Gehl, 2007)

Green corridors and building edges play significant role while defining the legibility of urban streets. (Jackson, 1984) Green corridors underpin the character and identity of the street. Landscaping which identified throughout the street leads to legibility of the street. Even a favourite tree can help to remind the place either its visual quality or smell. Selecting native species to best suit local climates for sustainability is also essential. Building frontage design is one of the other critical elements in terms of shaping the overall users experience on a street. Particularly, the design of the ground floor (land use) has a direct outcome on the character of the street which determines the legibility of the street. Thus, the level of pedestrian engagement increases by the proper design of the ground floor of a street such as frequent entrances, visual variation and textures. They all contribute to shape street environment as a legible public place. Therefore, sense of place identity and continuity should be supplied to make urban streets more legible.

**Distinctiveness**

Local features give a street its own distinctive identity. Burton and Mitchell (2006: 78) associates distinctiveness "[t]o the extent to which streets give a clear image of where they are, what their uses are and where they lead. Distinctive streets reflect the local character of the area and have the variety of uses, built form, features, colors and materials that give the streets and buildings their own identity […]." In addition, they (2006: 78) depict the characteristics of distinctive streets are as follows:

- Local character,
- Varied urban and building form,
- Small, informal, welcoming and understandable local open spaces with varied activities and features,
- A variety of open spaces, such as squares, [a]llotments and parks,
- Streets, places, buildings and architectural features in a variety of local styles, colours and materials,
- A variety of historic, civic and distinctive buildings and structures,
- A variety of places of interest and activity,
- A variety of aesthetic and practical features, such as trees and street furniture.

Yet, as well as physical attributes, it is naively obvious that users' experiences of places compose the individuality and uniqueness of urban streets. The identity of the place (*genius loci*) is very related with the notion of distinctiveness of the place. (Wagner, 1972) Distinctiveness of the urban places can be spawned by making them memorable and recognizable. This quality gives a sense of place to the entire street and its environment. The success of a street depends on its identity which includes some criteria such as linkages, uses and activities.

Landscape architecture, street vendors, kiosks, street furniture, sidewalk cafes and amenities can generate distinctiveness as spatial elements. (Cerver, 1995) Soft and hard landscape architecture contributes to character of urban streets. With the correct use of plants, more social relations can be established. For instance, canopy of trees encourages street activity such as walking, cycling or any other recreational facilities.

As well as landscape design, different types of commercial activities provide amenities and improve the character of urban streets, from sidewalk cafés to market stands. Push carts, market stalls and kiosks can be designed in various shapes and sizes and features of a certain streetscape. Street furniture and movable chairs and tables offer flexibility. (Talen,

2002) Thus, commercial uses provide vitality and activity within the street and make streets more livable and attractive to for all users with its' distinctive characteristics.

**Accessibility**

Accessibility of a street is determined by its visual and physical connections to the surroundings. Burton and Mitchell (2006: 92) examines accessibility "[t]o the extent to which streets enable (older) people to reach, enter, use and walk around places they need or wish to visit. [A]ccessible streets have local services and facilities, are connected to each other, have wide, flat footways and ground level signal controlled pedestrian crossings." They (2006: 102-103) depict design characteristics of accessible streets are as follows:

- A mix of land uses, […]
- Obvious and easy to recognize entrances to places and buildings,
- Entrances at ground level whenever possible with flush thresholds,
- Public seating 100 m. to 125 m.,
- Well connected streets with clear views along them and simple junctions,
- 2 m. wide flat footways,
- Gentle slopes rather than one or two small steps where slight level changes are unavoidable,
- A choice of steps and a ramp with a maximum gradient 1 in 20 where greater level changes are unavoidable, […]
- Pedestrian crossings and public toilets at ground level, […].

All streets should be universally accessible and should accommodate different walking speeds for all users including people with disabilities, the elderly and children. Accessible streets are mostly convenient to public transport. Good accessibility by public transit, by bicycle and by private automobile should be provided for the presence of users on the sidewalks. Sidewalks are fundamentals of streets because they ease walking and socializing.

Urban streets should struggle for better pedestrian access to create healthy urban life. Talen (2002) mentions that enhancing pedestrian access to goods and services is a main aim of walkable, pedestrian-oriented urban environments. Thus, if the accessibility in an urban environment is aimed streets should become more walkable. Renewal of urban streets is a necessary circumstance to make pedestrian environment more livable and usable.

Lynch (1990) explains accessibility is the competence to reach people, activities and places which represents the quantity and diversity of the elements that can be reached (e.g. ease of communication and transportation). Hence, it should be easy to go to the street, reach the activities and a street should also take users where they actually want to go. Not only reaching a street but also understanding a street layout makes street more accessible. To sum up, width of sidewalks, clear paths, spacing, pedestrian crossings, ramps, sidewalk furniture and facilities determine the level of the accessibility of urban streets.

**Comfort**

Comfortable urban streets are welcoming and have an image. Success and livability of a street is arbitrated its comfort level. Burton and Mitchell (2006: 104) examines comfort "[t]o the extent to which streets enable people to visit places of their choice without physical and mental discomposure and to enjoy being out of the house." Furthermore, they (2006:114) mention design features of comfortable streets are as follows:

- A calm, welcoming feel,
- Familiar buildings and features in designs (older) people recognise,
- Small, quiet well-defined open spaces, free from motorised traffic and with seating, lighting, toilets and shelter,
- Quiet side roads as alternative routes away from crowds and traffic,
- Some pedestrianised areas to offer protection form traffic,
- Acoustic barriers, such as planting and fencing, to reduce background noise,
- Relatively short, gently winding and well-connected streets,
- Enclosed bus shelters with seating and transparent walls or large clear windows, […]
- Sturdy public seating [w]ith arm and back rests and in materials that do not conduct heat or cold,
- Ground level conventional public toilets in view of buildings and pedestrians.

Safety, cleanliness, width and hierarchy of sidewalks, maintenance and the convenience of street furniture are the components of comfortable urban streets. Streets should allow space for amenities such as commercial activities or various outdoor uses and also should involve landscaping

where necessary. To offer comfort, everyday opportunities for users such as places to rest should be considered. For instance, seating should propose a mix of shaded and unshaded seats. A variety of seating arrangements can help users to socialize. Moreover, providing proper containers for waste establishes a clean and enjoyable urban street. (Moughtin, et. al.,1995)

Streets as public places can offer physical and psychological shelter which can generate comfort. (Madanipour, 2003) Canopies designed whether by trees or by structures add shelter and character to the street enhancing the level of comfort. They protect from weather during snow, rain or heat as well as generate privacy. (Madanipour, 2003) Overhead protection and vertical partitions should be used to create shelter from weather. Transparency of vertical partitions is crucial to provide safety and visibility for waiting passengers. Sidewalk space should allow space for people in wheelchairs.

As well as canopies and shelters, detectable surfaces provide comfort. For instance, a distinctive texture envisioned an identical meaning in notifying users to the approach of conflict zones. Tactile paving at curb ramps or transitions between pedestrian and vehicular is also significant. Moreover, fixed stands for streets vendor can enhance the comfort level of the street. (Hebbert, 2007)

**Safety**

Acceptable speeds, noise levels, and volumes of traffic are the fundamentals of safety of urban streets. Burton and Mitchell (2006: 115) examines safety "[t]o the extent to which streets enable to use, enjoy and move around the outside environment without fear of tripping or falling, being run-over or being attacked. Safe streets have buildings facing onto them, separate bicycle lanes and wide, well-lit, plain, smooth footways." They (2006: 128) also highlight design features of safe streets are as follows:

- A mix of uses,
- Buildings, doors and windows facing the street,
- Clearly marked bicycle lanes separate from footways,
- Pedestrians separated from traffic by trees, on-road parking or bicycle lanes crossing, […]
- Wide, well-maintained, clean footways,
- Flat, smooth, non-slip paving, […]
- Street lighting adequate for people […].

Streets must be safe for all users at different times of the day and should be "well-lit, provide accessible slopes and gradients, be free of obstructions, and offer eyes on the street for natural surveillance and crime prevention." (Marcus, et. al., 1998) In order to create inviting and livable streets, particularly at night, well-lit spaces become more important. For preventing crime and pedestrian safety, pedestrian-scaled lighting along urban streets should be used in order to restrain dark spots.

Increasing visibility for drivers by adding curb extensions is useful for safety because curbs discourage vehicles from entering pedestrian areas. They should also incorporate ramps. Curbs should be located at pedestrian crossings to aid safe access. In addition, to augment safety, crossings should always be marked and visible, short and direct crossings at intersections should be provided. Besides, protected areas for pedestrians should be deliberated waiting to cross. (Steinma and Heines, 2004) Thus, streets should be designed for slower traffic speeds and should include sidewalks, furniture and lighting so as to encourage a safe experience.

## CONCLUSION

Understanding of self and environment is extended by urban streets as public spaces. Therefore, people can feel a new and more direct relation of self to the world on urban streets. Urban streets as public spaces have always been the major components of the city and play decisive roles for expressing the characteristics of urban spaces. They construct the city form and improve linkage between indoor and outdoor (public) spaces and they content users' needs and propose certain functions. Users of all ages experience streets in diverse ways and have many different needs. Meaningful relations between mobile users and street environment can be created through the design elements and strategies. Spatial configuration of the street has a direct influence on the socialization process. Urban streets are both physical environments and social settings. Thus, liveliness of urban streets depends on the network of spatial configuration, interaction and communication among users. For this algorithm, design characteristics of urban streets should be defined.

Refining the physical setting of urban streets, the quality of public life should be improved. Neither the influence of a place can be considered without reference to social conditions nor can the quality of life be deduced only from social conditions without allusion to the spatial environment. (Lynch, 1990) As a result, urban streets should not be considered as places which offer only shopping. Indeed, they are more multifaceted formations. They should provide multiple mobility options for users. Their attractiveness comes from the variety of activities. The types of users and the total volume of users on urban streets depend on many variables such as the

time of day, the size and the layout of a street and the urban context, however the diverse activities that urban streets accommodate and facilitate can form the accessibility and livability of the city.

Six design characteristics-familiarity, legibility, distinctiveness, accessibility, comfort and safety-that Burton and Mitchell (2006) mentions for livable streets, help to provide high-quality, attractive and durable streets as well as to reinforce the identity of the city and to enhance users experience. Creating urban streets within the framework of six design characteristics supports opportunities for variety of activities and access for everyone where users can gather, meet and socialize. Thus, urban streets can turn into more livable public places. To sum up, recommendations in this study can form guidance for urban designers and these recommendations can also be tested for further studies if they are beneficial or not.

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# Chapter 6

## MEANING IN GOTHIC CATHEDRAL: READING THE SYMBOLISM IN GOTHIC ARCHITECTURE THROUGH CHARTRES CATHEDRAL

*Elif DEVRİM TOPSAKAL*[1]

1 Öğretim Görevlisi, İstanbul Ticaret Üniversitesi, Güzel Sanatlar Tasarım Mimarlık Fakültesi, İç mimarlık ve Çevre Tasarımı Bölümü, cilga.resuloglu@atilim.edu.tr

Otto von Simson states in the preface of his book, "The Gothic Cathedral" that the Middle Ages were spoken as an epoch of faith and that faith and doctrine have left their imprint upon all aspects of medieval thought,[11] especially affecting architecture. Since faith played such a big role in that period, the role of churches and cathedrals were important. A look into the symbolism found in and on Chartres Cathedral, through ornamentation and biblical references, since the Cathedral is believed to be the "house of God", not as a term used at the time period in Europe, but as a fearful reality. The cathedral was the threshold to heaven.[2]

I examined Chartres Cathedral [Fig.1], as it contains details from the Early Gothic period as well as the High Gothic, since cathedral construction, like most monuments of that size would, expanded over a long time. Chartres Cathedral is still unique, considering its original structure, portals, towers and even its stained-glass windows which are mostly intact and represents the medieval thought as it should be, and it is here that we find the most elaborate display of iconography.[3] But before I can continue to read Chartres Cathedral and its hidden messages, I should discuss a little bit about what Gothic is, and why it was exactly what the medieval world needed and represented, by starting with the School of Chartres.

**The School of Chartres**

"A considered arrangement of symmetries and repetitions, a law of numbers, a kind of music of symbols silently coordinate these vast encyclopedias of stone."

- Henri Focillon**, Art of the West**, 1963.[4]

In 990 a scholar named Fulbert arrived at Chartres and established a school which would eventually be one of Europe's leading scholastic institutions for the next couple of centuries, thus turning the town of Chartres into an important seat of learning. The school not only concentrated on secular subjects and trying to discover the unknowns of the universe, but it also gave its students a thorough knowledge of other sciences. Around 1140s, Thierry of Chartres wrote the "Eptateuchon", a treatise describing the secular subjects taught in two cycles, one right after the other, called *trivium* and *quadrivium*, which together, made up seven liberal arts that are depicted on one of Chartres' portals. "The *trivium* consisted of rhetoric, grammar and dialectics, or the art of oral and written expression. The quadrivium was devoted to arithmetic, geometry, music and astronomy. These subjects were taught as a basis for the more complex ones of theology, law

1 Simson, Preface: V.
2 Simson, Introduction: XV.
3 Prache, 122.
4 Ball, 100.

and medicine.".[5] As one can see from the range of subjects, the cathedral school was where pupils got their education of literature, philosophies, sciences and art, both Christian and non-Christian. Theresearch showed that the "theoretical principles governing the construction of the Gothic cathedrals were geometry and clarity... The building express a conviction that the glory of God's universe is expressed as a system of eternal order. "This belief was highly popular during the twelfth century and at the School of Chartres itself.[6]

Geometry represents the order of the universe, especially in medieval times, and it is not a coincidence that God was depicted in a miniature dating the 13th century as an architect [7], God shapes the universe with the aid of a compass which gives geometrical representations a new meaning. "The Lord, the architect of the universe, made of these churches his dwelling place, and this dwelling place was also that of the Church marching towards the Heavenly city of Jerusalem. An ideal vision - the imagination of the Middle Ages, the imagination of Chartres.".[8] [Fig. 2]

Otto von Simson has written about geometry being the basis of art for Gothic builders[9], and that by submitting to geometry the medieval architect might have been imitating the work of his divine master. Professor de Bruyne asks, "Must not the ideal church be constructed according to the laws of the universe?".[10] Besides the need to imitate the order of the universe, and try to create the Heavenly Jerusalem on earth, there must have been a practical reason as well. Just as us architects do today, they must have used geometry and a systems of proportions used to turn small-scale drawings and models into the incredibly large monuments that we still see in our contemporary lives, in almost all European city centers.[11] The medieval thought dictated that the true path to God was through knowledge, and Augustine wrote in his Soliloquies: "I desire to have knowledge of God and the soul"; knowledge of the realm of God being the only knowledge worth having. "Of nothing else? No, of nothing else whatsoever."[12] Philip Ball wrote in his book "Universe of Stone" that, Boethius proposes the Pythagorean idea in "Consolation of Philosophy" and "On Arithmetic" that the universe is based on numbers: "God the Creator of the massive structure of the world considered this first discipline as the exemplar of his own thought and established all things in accord with it; though numbers of an assigned order all things exhibiting the logic of their maker found

5 Prache, 22.
6 Ball, 104.
7 "*God as an architect of the World*", folio I verso, Paris, ca: 1220-1230.
8 Prache, 13.
9 Simson, 13.
10 Simson, 33.
11 Simson, 18.
12 Ball, 80.

concord.”.[13]

Numbers in Christianity have significant meanings; such as the number two that symbolizes the spiritual realm and the mundane world, the “in” realm and the “out” realm as it were. Three is a much more commonly known number, representing the Trinity: The Father, the Son Jesus Christ and the Holy Spirit. Seven, usually attributed to the seven days of the week, and the number of planets, nine representing the Virgin, and twelve is the number of Apostles, the zodiac signs and the months of a complete year.[14] These numbers will come back to us under The Labyrinth title.

**The Gothic Chartres**

“Beneath the vaults of Chartres, Napoleon Bonaparte said, the atheist would feel uneasy.”[15]

Churches, and cathedral are unique in a sense: they are part of an architectural history that is still visibly intact and in use today. Most of the cities and towns in Europe, and even in a smaller number, in USA are constructed around a church or cathedral. Not only they are there for religious purposes, they are still used as centers, even a gathering point. The contemporary world we live in “came into existence as a revolt against the intellectual order of the Middle Ages.”[16], yet the Gothic Cathedral, the expression of that intellectual order, is still in use today. They were not just constructed under the order of the clergy; they were created by an entire community coming together. When one thinks of cathedrals, many imagine a Gothic monument. “Once created, Gothic became the conservative ‘language’ of Christian architecture throughout the Western world.” [17] Cathedrals were an expression of pride, of prestige, power and every town desired one.

The generally accepted eras of Gothic architecture is divided into three: Early Gothic, High Gothic and Late Gothic. Abbot Suger’s design of the choir of St. Denis which was built in 1144 has an historical significance as it is considered to be the first Gothic church ever built. [Fig.3] Chartres Cathedral’s (1134 -) completion, as in many other cathedrals, extended to centuries and it started as an Early Gothic example and its rebuilding after the fire made it an example of High Gothic as well. In 1550, Giorgio Vasari, first used Gothic as a derogatory term to describe late Medieval art and architecture, which he attributed to the Goths and regarded as “monstrous and barbarous”.[18] Even Molière wrote: ...Le fade goût des monuments go-

13 Ball, 87.
14 Ball, 63.
15 Ball, 24.
16 Simson, Introduction: XIV.
17 Simson, Introduction: XX.
18 Sankovitch, 29.

thiques, Ces monstres odieux des siècle ignorants, Que de la barbarie ont vomis les torrents... ["The besotted taste of Gothic monuments, these odious monsters of ignorant centuries, which the torrents of barbary spewed forth."].[19] Even though these criticisms came from a Renaissance and/or later periods kind of viewpoints, the gothic style managed to survive many centuries and was called by the men of the thirteenth and fourteenth century referred to the Gothic cathedrals as *opus modernum* (modern work).[20]

Many architectural features that are associated with Gothic architecture had already been developed and used in Romanesque buildings which included ribbed vaults, buttresses, rose windows, spires and richly carved door tympana. Yet architecturally speaking, the pointed arch is considered to be the new technology brought by the Gothic era, initiating the idea of the walls to be less important to sustain the weight of the vault as it was in the Romanesque period. As a general rule, the façades were decorated with reliefs and buttresses and counterforts were used on the outside to support the weight of the vault. Apses were enlarged, if one compares it with earlier monuments. A typical characteristic of Gothic means the placement of a rose window covered with stained glass on the façade. The reason why Vasari and Molière called Gothic architecture monstrous and barbarous could be reasoned with the use of gargoyles that served as waterspouts and decoratively to protect the building from evil forces.

Victor Hugo stated that Gothic cathedrals were "the greatest works of architecture". These works must be regarded as a legacy left by a nation, as the accumulations of centuries.[21] Cathedrals are testaments of the skills of the medieval engineers. According to Simson, two aspects of Gothic architecture are unique, unlike anything seen before: the relationship between structure and appearance and the use of light. The precedent styles in architectural history are Romanesque and Byzantine architecture, their structure is a necessary but invisible means to an artistic end, yet in Gothic architecture "ornamentation is entirely subordinated to the pattern produced by the structural members, the vault ribs and supporting shafts, the aesthetic system is determined by these.".[22] Gothic architecture is known for being light in a more metaphorical way: the builders found a way to eliminate the "massiveness" of walls and replace them by stained-glass windows or creating open spaces, a free continuity.[Fig.4-5] The Gothic cathedral can be defined as seeking to unify volumes and to create openness and light. They go higher and higher, and create open spaces much more than its precedents, where the solidity of the walls are emphasized.[23] Prache called

19 Kimbell, 275.
20 Gardner.
21 Ball, Introduction: 2.
22 Simson, 5.
23 Prache, 61.

them "skeletons of stone", only what is structural and absolutely necessary is used.[24] Since the walls were becoming unnecessary, the famous stained-glass windows started to take their places on exterior walls, creating walls that looks like paintings, shining their colours inside, and creating mysterious and "out of this world" ambiances.

Verticality and the impression of climbing higher and higher were amongst the characteristics of Gothic architecture, an ambition that can be interpreted as going beyond human limitations, and the need to reach the divine realm. In the Christian cosmology and how it was affected by Islamic cosmology of the same era, in which God, the Divine is outside the other realms. In Sedlmayr's opinion, one of the Gothic cathedrals characteristics was that all parts of the building "have to hover, to be in suspension": "not raised on human ground, but coming down from Heaven.". The portal figures, the towers, the façades and flying buttresses, and all the other details; everything needs to be in a state of suspension: has to be "Heavenly Jerusalem on a visit to earth.".[25] It is this liberation from gravity, the illusion of massive stone transforming into air that makes the Gothic Cathedral quite unique: the need to go up to heaven by defying gravity and heaven coming down to earth. P. Ball described this phenomenon by painting a picture in our minds; "As you enter Chartres Cathedral from the west, what strikes you first is the sheer scale. Your eye is drawn in two directions: forward to the sacred altar and up into the lofty shadows - towards the cross of Jesus and to god in heaven. And you realize that the worship of God can move men to conquer stone and transform it into something without apparent weight or bulk.".[26]

As stated before, two striking features of the Gothic style and one of them was the use of light, or the relation of light to the material substance of the walls. For the medieval era, light was the source of all visual beauty, and that God himself was light, the light of the world, the light of truth.[27] The stained-glass windows that Simson called "transparent walls"[28] created an atmosphere that one could feel to be heavenly, and not just in Gothic art but in others as well: The Sagrada Familia [Fig.6] would be an example of that. The Gothic walls, penetrated by these colourful openings, seems porous. Even though Gothic cathedrals can hardly be described as being luminous or bright, nonetheless, no inner space seems to be left in the dark or undefined by light. The famous Abbot Suger called the colored light, "Lux Nova" meaning new light which can be interpreted as the light coming from the glass windows or as God himself. Peter of Roissy wrote, at the beginning of the thirteenth century: "The paintings on the windows are

24 Prache, 47.
25 Schlink, 280.
26 Ball, 23.
27 Prache, 61.
28 Simson, 4.

divine writings, for they throw the light of the True Sun, that is to say the light of God, into the interior of the churches, that is into the hearts of the faithful, by filling them with light.".[29]

**Heaven on Earth**

"And I saw a new heaven and a new earth: for the first heaven and the first earth were passed away; and there was no more sea. And I John saw the holy city, new Jerusalem, coming down from God out of heaven, prepared as a bride adorned for her husband.".

- Revelation XXI I-II [30]

As it was written before, the Cathedral was designed as an image, and that it was meant to be understood as one, an image of heaven, a symbol of a paradise, a promise of salvation: Christ promised His followers that if they led a life of virtue and sought knowledge, they will enter the Kingdom of God. "Both the heavenly city of Jerusalem and the church of Christ are thus evoked through architectural images.".[31]

Heavenly Jerusalem; [Fig.7] a city with walls and twelve gates: the four sides representing the four directions and the twelve gates representing the "completeness". This example of decoration is not the only one of course, since the idea of a heavenly city inspired multiple images. Many drew their inspiration from the Book of Revelation or from Ezeikel's Vision of the Temple and even from the description of Solomon's Temple in the Book of Kings.[32]

According to Simson, the medieval man looked at the world very differently from us today and made comparisons between them. For us the symbol is an image in the physical reality with a poetical underlining, yet for the medieval man the physical world had no reality except as a symbol. The medieval man conceived the symbolic instinct as the only source for understanding the world, whereas we tend to suppress this instinct.[33] But in order to understand a church, a cathedral, in order to depict a monument such as the Chartres Cathedral, one must try to understand the medieval man and put oneself in their mindsets.

**The Royal Portal**

"... for the sculptures of Chartres, God was the only audience they thought they would ever have, and He was the only one they needed."

-Philip Ball

29 Prache, 62.
30 Lutan, 156.
31 Prache, 69.
32 Prache, 12.
33 Simson, Introduction: XVI.

According to P. Ball, there are around 1800 images and scenes depicted in Chartres Cathedral, yet most of them are out of view of the worshipper of the twelfth century. The west portal of Chartres, came to be known as the Royal Portal, [Fig.8] has three portals, each adorned by a tympanum depicting a scene out of Jesus Christ's life. Prache wrote that before Gothic architecture, or specifically, before Saint Denis, there had never been a building with three carved doors on the exterior.[34] Because the Royal Portal is considered to be the entrance to the Temple of Solomon, it reminds us of the manuscript with the twelve gates. Even though the image is incomplete, Chartres is surrounded on three sides with portals containing three doors each. The number three is, as I stated before, associated with the Holy Trinity: The Father, the Son and the Holy Spirit.

The two sources on the subject of Chartres Cathedral Portals in this article, each looked at different sides of the Cathedral: A. Prache described the Royal Portal (west) while S. Luthon described the southern portal. Lutan's article "The Heavenly Jerusalem: from Architectural Canopies to Urban Landscape in the Southern Portals of Chartres Cathedral" is incredibly educational and detailed where she assumes that the representations of the Heavenly Jerusalem on the architectural canopies at the Cathedral followed the long established tradition of emblematic images of the Holy City. The north portal [Fig.8] or right portal depicts the Incarnation or the coming of the Messiah on earth. The infant Christ is sitting on Mary's lap, the Queen of Heavens, and to whom the cathedral was dedicated to. She is sitting on a throne at the summit, a reverence to Our Lady. The arch moldings consisting of women and men mostly writing on their desks, are the pre-mentioned Liberal Arts and the scholars who illustrated the disciplines, the core of medieval learning and human knowledge.[35] [Fig.9] Geometry is denoted by Euclid, rhetoric by Cicero, while Aristotle stands for dialectic. Boethius represents arithmetic, and Ptolemy astronomy. Bent over a writing desk on his knees, Pythagoras is accompanied by a woman playing an array of bells, depicting music, while grammar is embodied by a figure who is either Donatus or Priscian.[36]

The left tympanum [Fig.10], or the south portal depicts Christ's Ascension into Heaven. The time passing while men waits for their Lord the Savior is represented on the voussoirs by a symbolic calendar composed of the signs of the zodiac.[37] The number twelve, here again plays a role, and the Labours of the Months which are symbols of cosmic and earthly worlds are represented. The largest portal's tympanum is a representation of Christ at the second coming, thus we have the entrance of Christ (right portal),

34 Prache, 30.
35 Prache, 28.
36 Ball, 103.
37 Prache, 39.

Christ leaving temporal existence (left portal) and the second coming in the middle. Jesus is seated on a throne [Fig.11], accompanied by angels and supporting a halo over his head. “He holds the Book of the Scriptures in His left hand and makes the sign of the blessing with his right.”. He is surrounded by a mandorla, signifying His radiance and light. Around Him are the four Living Creatures, the figures from one of Ezeikel’s Vision. The jambs [Fig.12] of the doors are also significant, symbolizing not only the verticality that is one of Gothic architecture’s important trades but also personages from the Old Testament: Kings and Queens, patriarchs and prophets, thus the name Royal Portal. [38]

**The Chartres Labyrinth**

The famous labyrinth [Fig.13] set into the nave floor of Chartres Cathedral is one of the symbols that may bare many answers and meanings, lasting since its creation in the thirteenth century. The labyrinth that can be observedtoday was made of a plaque that was melted down around 1790s for the Napoleonic wars[39], yet the shape, the path of stone is still intact. Even though it is an enigmatic piece of decoration and symbol, the Chartres labyrinth is not unique, in the sense that motifs similar to this one were found in other Gothic churches and cathedrals such as Reims, Amiens, Arras in France, Ely in England and last but not least in Köln, Germany and many more. Most of them were destroyed between the seventeenth and nineteenth centuries.[40] The Chartres labyrinth measures around twelve meters across and is round with eleven concentric rings [Fig.14] split into four parts and the center consists of six petals. Nevertheless, not all labyrinths were and/or are circular: some were square like at Reims and Amiens, some octagonal as in Arras and Köln Cathedrals. In Lucca Cathedral in Italy[41] has a labyrinth [Fig.15] that is as old as the Chartres labyrinth, that has an inscription that reads: “This is the Labyrinth built by the Cretan Daedolus. No one who enters has ever found the exit, except Theseus, and he also would have failed had Ariadne, from pure love, not helped him with her thread.”.[42] According to Ball, a copper plaque once sat at the center at Chartres that also depicted the Theseus, Ariadne and the Minotaur and Anne Prache in “Chartres Cathedral: Image of the heavenly Jerusalem” assumes therefore that the labyrinth perpetuated the memory of the first maze, the Minoan Crete and its architect Dedalos.

38 Prache, 36.
39 Ball, 138.
40 Ball, 136.
41 In Italian: Duomo di Lucca or Cathedrale di San Martino, a Roman Catholic church that started construction in 1070 according to the official website; https://www.museocattedralelucca.it/cattedrale-lucca/
42 Ball, 138. The Latin writing is stated in the image and on the labyrinth itself as: “HIC QUEM CRETICUS EDIT. DAEDALUS EST LABERINTHUS. DE QUO NULLUS VADERE. QUIVIT QUI FUIT INTUS. NI THESEUS GRATIS ADRIANE. STAMINE JUTUS“

The labyrinth that many have researched and that is larger than the rose windows and the sculptured doors of the Cathedral should not be confused with a maze.[43] A labyrinth consists of a single path that guides you towards a final point, whereas a maze, has multiple paths with dead ends in order to confuse you. Labyrinths have been around for five thousand years and they are considered by many to be a pagan motif so the questions remain: Why did the Middle Age men used a pagan motif in a Christian world and why so often does it appear? The answer may be in the names given to the labyrinth throughout Europe in the twelfth and thirteenth centuries: "Chemin de Jérusalem", "Iherusalem", and "City of God".[44]

As stated before, the Chartres School was known for its Platonic scholarship, and their path to the Divine was a Gnostic one, a path to God was one of knowledge. The Sufis wrote: "Beware, for love alone without knowledge, remains unfocused, unaimed, undirected. The consequence of such a love is pointless, leading to a confused state of perpetual "Hallelujah" comparable to the village idiot's perpetual good humour. Through the medicine of knowledge joy is anchored so that love is directed to the Subject of all love."[45] The Heavenly Jerusalem is described and depicted as having four walls and four gates, representing the four cardinal directions. Paradise also is described with four walls through which four river streams, and the life of Jesus Christ had four stages: Conception, birth, crucifixion and resurrection.[46] The four armed cross, the symbol of Christ and the four directions are all linked in this sense; the cross being the universal sign of light. Jung wrote about the act of combining the cross with the circle - in this case the Chartres labyrinth's motif - representing "the synthesis of the four elements which are forever tending to fall apart.". He goes on to write; "The squaring of the circle is one of the many archetypal motifs which form the basic pattern of our dreams and fantasies. It could even be called the archetype of wholeness. Because of this significance the 'quarternity of one' is a schema for all images of God.".[47]

The symbolism of the Chartres labyrinth lies in its pattern and design; the eleven concentric rings symbolizing the path to salvation, to the heavens, to the Heavenly Jerusalem. The path to God was a path of wisdom and the trade route of the twelfth and thirteenth centuries created a communication link between the Arabic east and the Christian west, that led to an exchange of Sufi teachings and the Gnostic Christians, whom all believed that "to find the Way we need wisdom".[48] Only the pure, and knowledge-

43 James, 467.
44 James, 467.
45 James, 469-471.
46 James, 470.
47 C.G.Jung, 387.
48 James, 478.

able could reach the center, as in the Garden of Eden and Theseus that had to overcome the obstacles and face his moment of truth. The center rose, the final destination, the Holy City was given many meanings according to John James in "The Great Labyrinth at Chartres"; "...the Lamb describes in Revelation as being the center of the Heavenly Jerusalem", "Dante's Christ resides with the great Rose in the center of Paradise", and most importantly the "seat and birthplace of God.".[49] The eleven rings and the rose center gives us the number twelve; the number of "completeness": the twelve months of a complete year, the twelve apostles, and the twelve zodiac signs. We learned in our course that up to the fifteenth century, the direct relation between cosmos, religion and environment was related to astronomy since the medieval religious universe was directly related to science and observation of the environment. James wrote that twelve has been the number of completeness since the Sumerians, that it is closed and perfect in itself. [50]

It is not unorthodox that this pagan symbol found itself a place among the Christian belief system; men guided by knowledge and wisdom, must walk a difficult path, the path of a labyrinth in order to find the center, the light, the Heavenly Jerusalem.

Churches and cathedrals, in the Middle Ages were not only secular sanctuaries but also were very much a part of the daily lives of men and women of the epoch. And it is not surprising that they are decorates and carved with symbols that had major effect on the medieval thought. These magnificent monuments were considered to be the images of the world beyond, of the heavenly Jerusalem, and in each detail the symbols of the Christian Cathedral, having survived the test of time, is an almost endless book of symbols that is, still today, baffling scholars. During my research, which is just a very small amount on the tip of the iceberg, I came across biblical iconographies, philosophy, geometrics, mathematics, art and there is still so much to read about these "barbarous" monuments that are intact and in use today and not the romantic ruins of the past.

49 James, 471.
50 James, 478.

*Fig.1: The Chartres Cathedral at night.*

*Fig.2: "God as an Architect of the world".*

*Fig.3: Saint Denis choir by Abbot Suger.*

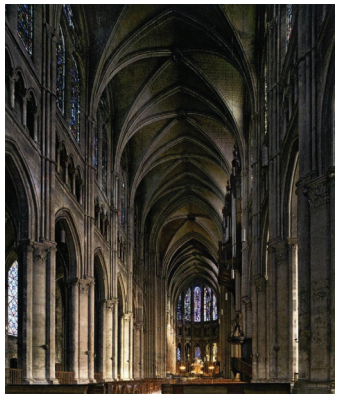

*Fig.4: Interior of Chartres Cathedral.*

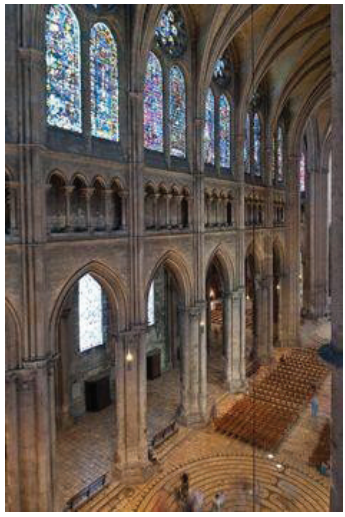

*Fig.5: Interior of Chartres Cathedral.*

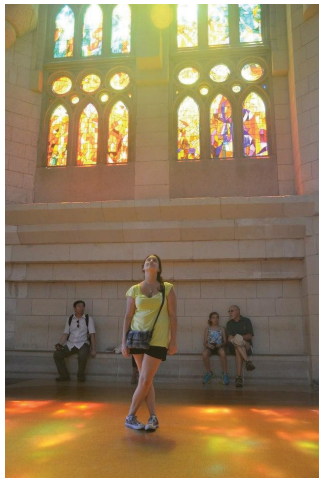

*Fig.6: Sagrada Familia.*

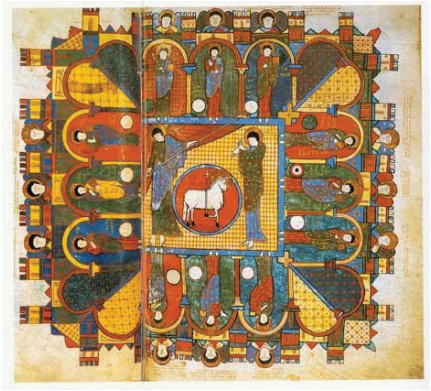

*Fig.7: Manuscript of Heavenly Jerusalem.*

*Fig.8: Royal Portal, Incarnation.*

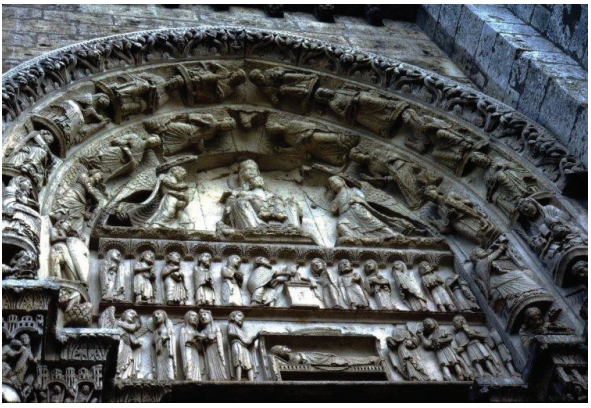

*Fig.9: The 7 Liberal Arts on the portal.*

*Fig.10: Royal Portal, Christ's Ascension.*

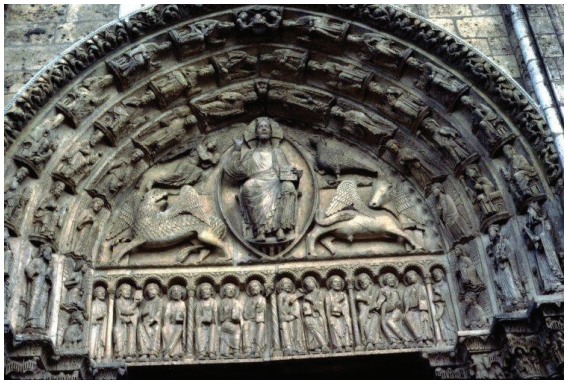

*Fig.11: Central Portal: The Second Coming.*

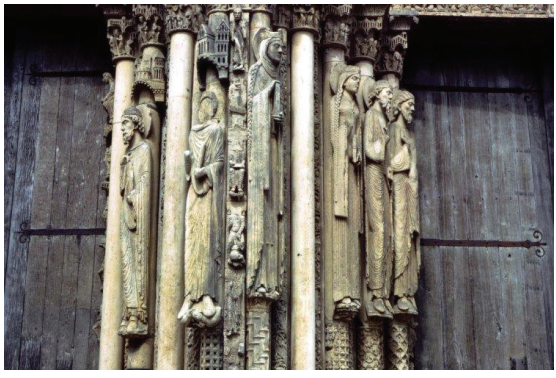

*Fig.12: Jamb-figures.*

*Fig.13: The Labyrinth.*

Chartres Cathedral: The Labyrinth in the Floor of the Nave

*Fig.14: The eleven concentric rings.*

*Fig.15: Lucca Duomo Labyrinth.*

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# Chapter 7

# THE EFFECT OF THE HISTORICAL HEVSEL GARDENS ON THE URBAN IDENTITY OF DİYARBAKIR

*Gülcay ERCAN OĞUZTÜRK[1], Müberra PULATKAN[2]*

1 Öğretim Görevlisi, Dicle Üniversitesi Diyarbakır Teknik Bilimler Meslek Yüksek Okulu,
2 Doç.Dr. , Karadeniz Teknik Üniversitesi Orman Fakültesi Peyzaj Mimarlığı Bölümü, muberra@ktu.edu.tr

## INTRODUCTION

Population growth and individual requirements caused an increase in new structures and change in urban centers. Such change resulted with shifts in urban identity and led to the formation of similar cities. In order to prevent such similar developments in the urban context, it is essential to identify the structures that constitute the texture and to emphasize the components that reflect the originality of a city.

The structure and nature of the cities are often reflected in urban life through settlements and the urban landscape, which defines the urban panorama. The vistas, silhouettes and landscape of cities framed from certain perspectives are the essential elements that form the image of a city. Cities have unique features such as purpose of establishment, dense built environment, rich historical texture, geographical locations etc. Such features are usually translated into unique structures and result with acquired identities such as historical, industrial, touristic, commercial cities etc. Furthermore, cities might have different qualities in terms of green texture. Hence, urban landscape should be evaluated not only based on its green texture, the abovementioned features that reflect urban characteristics and identity should also be prioritized. The quality of urban landscape does not solely depend on the ratio between the constructed environment and the green textures, rather depends on their balanced and harmonious distribution based on the identity of the city (Karagüler and Korgavuş, 2014).

The Turkish province Diyarbakır, which has a traditional urban identity in terms of the cultures of the civilizations in Mesopotamia and Anatolia, is a city which accommodated diverse cultures and beliefs. This historical city still maintains the archeological history and cultural anthropology of several civilizations such as the Hittite, Assyrian, Persian, Roman, Byzantine Ottoman and the Turkish Republic. The urban and cultural identity of Diyarbakır, revealed through its traditional urban structure, faced social, political and cultural difficulties during the last 25 to 30 years. Spatial patterns (mosques, churches, baths, monumental buildings, city walls, traditional houses, etc.), which constitute the historical urban settlement (Sur içi - Inner City Walls) of Diyarbakır, represent the sustained and shared collaboration among diverse cultures (Sami, 2017).

Diyarbakir is surrounded with Adıyaman, Batman, Malatya, Bingöl, Elazığ, Muş, Mardin and Urfa provinces, is located to the north of Mesopotamia and has a history of 7,500 years. The old names of the city were "Amidi, Amida, Âmid, Kara-Amid, Diyarbekr, Diyarbekir" and received its current name in 1937 due to Atatürk's visit to the city after the establishment of the Turkish Republic. Diyarbakır, considered as the focal point of important civilizations throughout the history, accommodated successive

yet diverse civilizations. The history of Diyarbakır extends between the Hurrians in 3000 BC and the Ottomans. In recent years, Diyarbakır became a touristic destination and attracted significant tourist attention due to its historical and cultural values (Serçek and Hassan, 2016). The ethnic structure, cultural and historical heritage values of Diyarbakır had a considerable influence on the development of the tourism opportunities in the city. The most prominent historical heritage in the city is the City Walls, which is a structure with a top view that resembles the shape of a turbot, and surrounds the city (Çelik, 2008).

Diyarbakır Fortress was founded on the steep slopes on Dicle River side of the plateau, between Karacadağ and the Dicle River. The fortress which was constructed in two parts (the outer and the inner castle) survived to date, carrying the effects of several civilizations and various additions (reliefs, inscriptions, and carvings) by these civilizations. Diyarbakır Fortress is a defense structure which accommodates universal cultural values such as Arabic, Latin, Armenian and Helen inscriptions. Diyarbakir Fortress also includes the Hevsel Gardens, which survived since the Assyrians, supplied the food requirements of the city and is an important natural site for Diyarbakır (Çağlar, 2018) (Figure 1).

*Figure 1: The city of Diyarbakır, Dicle River and the Hevsel Gardens*

Hevsel Gardens, which were located by the Diyarbakır City Walls, the longest city walls after the Great Wall in China, in 3000 BC, has significant heritage value due to its historical and cultural values. Hevsel Gardens are also significant due to the values of the original resource produced in the area for thousands of years. Hevsel Gardens, which should be preserved as a cultural heritage and should be sustained for future generations, are also important in terms of their intended use, structural changes in the historical process, cultural characteristics of different civilizations, various legends, and written and oral historical sources. The value of Hevsel Gardens increased due to the prominence of garden culture in the location and it was also used as a recreational place (URL-1).

Technically, the City Walls, which has 82 bastions in various forms

(square, round, polygon) (URL-1) has a length of 5500 m, an average height between 11 and 12 m and a width between 3 and 5 m. The most known bastions are the Ben-u-Sen Bastion, Keçi Bastion, Yedi Kardes Bastion and the Nur Bastion (Tezgel, 2013). The thickness of the bastions varied in the east-west and north-south directions, and such variations were explained by the fact that the fortress was built upon a land which topographically had natural defense qualities (Dalkılıç and Nabikoğlu, 2013).

Several bastions were destroyed with the reason to let airflow in the city and the bastions such as Dağ Kapı and Mardin Kapı bear the traces of destruction. In order to prevent the destruction of the castle and fortifications with significant cultural value Prof. Dr. Albert Louis Gabriel filed a request to the Ministry of Education of the era and due to his intervention the destruction was stopped before further consequences (Çelik, 2008).

Hevsel Gardens, merged with the Dicle River, made Diyarbakır the source of oxygen and food (Figure 2). The gardens supplied the city with the fruits and vegetables for years. Furthermore, 180 species, which existed in the gardens as one of the most fertile lands in the region, contributed to biodiversity. It is assumed that humans in Mesopotamia took a step towards civilization earlier than others, since Ergani Çayönü is one of the first agricultural spots of the world and is located a few kilometers away from the city. Hevsel Gardens are located in the southeast of the city. The historical investigation on Hevsel Gardens revealed that the gardens were known as “Hoser” until 1960s. The meaning of the word “Hoser”, with its origins in Kurdish, referred to “the region with dense trees.” Later, the gardens also appeared with the names “Efsel” and “Gardens of Eden.” The currently used name is Bexçeyan Hevsele (Hevsel Gardens). In 2015, the name “Hevsel” was registered by the United Nations Educational, Scientific and Cultural Organization (UNESCO). The gardens were taken under the protection of UNESCO, along with the City Walls of Diyarbakır, which is the largest inhabited castle structure in the world, thus their significance increased (Tanrıkulu, 2016).

*Figure 2: Dicle River and Hevsel Gardens (Akdemir et al., 2015)*

Dicle River received several names during history. As a province, it was either called “Idigna” or “Idignou” the Semites called it “Idigla”. Later, it was translated from “İdiklat” to “Tıklat” “Hiddegel” in Hebrew and “Tiygr” or “Tigra” which means “arrow” in Persian. Although it is mentioned as “Tigris” in Ancient Greek, the name “Dicla” was first used by the Arabs. The Dicle River has a length of 1900 km and was formed by two streams, the Maden stream formed by the Caspian Lake and the Bırkleyn stream formed by the cave of Zulkarneyn, which combined in the Dicle district of Diyarbakır. 523 km of the 1900 km river length is within the borders of Turkey and the remaining 1377 km length is in Syria and Iraq. The area between the Euphrates and Dicle Rivers is called the Mesopotamia. The experience, cultural and historical heritage in Mesopotamia shed light on the formation of the new age. The pioneering events in the region were quite remarkable. It is known that first settlement and infrastructure works were completed, first seed was planted, first writing was used, and the first epitaphs were kept in the region. The fertility of the Dicle and Euphrates Rivers increased the popularity of Mesopotamia and several civilizations were founded and reigned in the region. The Dicle River was also a highly popular transportation route for many years. Transportation was provided by “Kelek” which was composed of four “Meşk” stitched and inflated animal skins, combined and covered by a lightweight material. Such method led to commercial freight transportation between Cizre, Mosul, Hasankeyf, Baghdad, Basra and Diyarbakir. The “Kelek” method lost its significance during the second quarter of the Turkish Republic, due to the decrease in water flow and the constructed bridges (Tanrıkulu, 2016).

## MATERIAL and METHOD

The present study focused on the Diyarbakır province due to its unique and historical urban structure (Figure 3) and investigated the effects of Hevsel Gardens, a highly significant historical heritage in the city, on the urban identity. Historical buildings, Dicle River, the riverbank, and agricultural areas were examined as case studies in order to evaluate the contribution of Hevsel Gardens to the urban identity in Diyarbakır.

Hevsel Gardens, located in the southeast of Diyarbakır, has an approximate area of 31 hectares and consists of alluvial and clay-loam soil accumulated by the Dicle River. Several names, such as Esfel, Efsel, Hefsel were used to refer to Hevsel through the course of the history, both in oral and written sources (Abakay, 2013). According to Evliya Çelebi, Hevsel is a garden full of roses, an orchard full of purple basil and vineyards, and extended on both sides of the great river. The site is also a recreation and entertainment area where residents of Diyarbakır take the Şattul-Arab chapter for five or six months annually (Van Bruinessen and Boeschoten, 2003).

*Figure 3: The province of Diyarbakır and the location of the study area*

The present study, which was conducted to determine the effects of Hevsel Gardens on the urban identity of Diyarbakır, reviewed the literature to define the urban identity concept, gather knowledge on Hevsel Gardens and the historical structures. Photographs taken at the case study area and on-site observations were used as auxiliary material to reveal the contribution of Hevsel gardens in creating the urban identity.

## FINDINGS

Land use characteristics in Hevsel Gardens were determined by literature review and observations focusing on the on the historical buildings, Dicle River, the riverbank, and agricultural areas to identify the effect of Hevsel gardens on the urban identity of Diyarbakır.

### Land Use Characteristics of the Hevsel Gardens

Four land use characteristics, Agricultural Areas, Riverbank Areas, Historical Buildings and Recreational Areas were evaluated to determine the value of Hevsel Gardens.

#### 1. Agricultural Areas

Different tributaries and the gardens located on the bank of the Dicle River allowed fertile areas in the south and east of Diyarbakır (Figure 4). Melon and watermelon, named after the city of Diyarbakır, and various fruits and vegetables are grown in these fertile areas. In spring, these areas turn into rose and violet gardens. The areas between the Rum Kapı (Greek Gate) and Dağ Kapı (Mountain Gate) developed a reputation as the entertainment places of the urban residents (Tezgel, 2013).

Various plant species are cultivated in Hevsel Gardens;

- Fruit trees (Apple, berry, almond, walnut, apricot, fig, plum, cherry, sandstone peach, cherry etc.)

- Poplar trees
- Vegetables (lettuce, watermelon, zucchini, tomato, cabbage, tomato, corn, melon, cucumber, eggplant, pepper, parsley, onion, garlic, okra, bean, rucola, spinach, dill, purslane etc.)
- Cotton

*Figure 4: A view from the Hevsel Gardens*

Furthermore, pigeon fertilizers are highly effective in growing various kinds of crops in Hevsel Gardens, especially the unique Diyarbakır watermelon, which reaches massive dimensions. The importance of Diyarbakır Pigeons was also emphasized in the city's castle. The pigeon figures on the Nur Bastion and the 22nd bastion indicate that such culture dates back to old periods (Akdemir et al., 2015).

The vineyards, figs and rose saplings of the Hevsel Gardens are well-known. In the 19th century Diyarbakır Yearbooks mentioned 24 rose species. Given that rose symbolizes the Prophet in the Islamic World, the rose species that grows in Diyarbakır is called the "Mohammedi" (Tezgel, 2013). The Ottoman Documents indicating the type and quantity of products grown in Hevsel Gardens are available in the archives (Figure 5).

*Figure 5: Ottoman Document indicating the type and quantity of products grown in Hevsel Gardens (Tezgel, 2013)*

Hevsel Gardens, which supplied the food requirement of the city, also has mulberry groves as the borders between the agricultural lands, and these groves were also used for breeding silkworm, creating a significant and tradable raw material for the city. Although it is unclear exactly when sericulture was first practiced in Diyarbakır, which became a trade center due to the emergence of the Silk Road, however, the production was known to continue since 18th century. Sericulture developed in the city since silk was an important and popular property for trade. The suitability of the climate and mulberry trees in the city, especially in Hevsel Gardens, contributed to the development of sericulture (Akdemir et al., 2015).

**2. Riverbank Areas**

The riverbank is a naturally protected area with an altitude of 650 m from the average sea level and 60-100 m from the Dicle Valley. Along with its uses for transportation and service water, the Dicle River provided for the vegetable and fruit demand of the city with its fertile soils such as the alluvium-based valley and the Hevsel Gardens and visually offered a natural landscape to the city (Figure 6). Spring water in the city were sufficient to meet the needs of the city during every period. Diyarbakır had adequate facilities to accommodate people through its spring waters and abundant, fertile agricultural areas, in which the alluvium were accumulated by the Dicle River and which emerged due to the withdrawal of water during dry the seasons (Akdemir et al., 2015).

*Figure 6: A view of the Hevsel Gardens (Tezgel, 2013)*

### 3. Historical Buildings

Hevsel Gardens are located by the City Walls of Diyarbakır, which were assumed to date back to 3000 BC. The walls have a length of 5500 m, an average height between 11 and 12 m and a width between 3 and 5 m. The City Walls of Diyarbakır are the longest after the Great Wall of China. The walls have 82 bastions in round, polygon, and square forms. The City Walls of Diyarbakır and the Hevsel Gardens complement each other (Figure 7). It is possible to observe the effects of Hevsel on the stones of the City Walls. The art of stone decoration included stylistic and natural representations of animal and vegetable figures. Various flower patterns were engraved on the stones. These flower patterns indicated the first examples of art (Tezgel, 2013).

*Figure 7: Historical City Walls and the Hevsel Gardens (URL-3)*

### 4. Recreational Areas

In *Seyahatname* (The Travel Book) Evliya Çelebi emphasized that Hevsel Gardens was not only a site where agricultural activity took place, but it was also a public space where people had fun, relaxed, and spent

pleasant time. Hevsel Gardens were not only important production areas, there existed archives and information that revealed the vitality of the gardens in the emergence and survival of traditions, culture, everyday life and, significantly, the intangible cultural heritage of the city of Diyarbakır (Çağlar, 2018).

Hevsel gardens are highly significant due their natural values as well as the cultural values. The gardens, occupied by migratory birds for nutrition and resting during the migration period, also accommodate wild bird species. It is one of the rare places where wild birds live in an urban center. It accommodates a total of 180 bird species. In history, the gardens were also mentioned as the area where sultans came to listen bird sounds, rest and to have picnic. Birds have a unique place in the architecture of Diyarbakır. Bird figures were engraved on the walls of certain historical buildings in the City Wall. Hevsel Gardens were also considered to guide the migratory birds along the Dicle River (Tezgel, 2013).

Hevsel Gardens, important example of the garden culture, were publicly open as a civil garden since the past to the present (Figure 8). The gardens also had historical and cultural value besides their funciton as a garden for almost 8000 years. The value of the landscape provided by the Hevsel Gardens was a crucial factor for the continuing life of the city and its residents (URL-2).

*Figure 8: Recreation area in the Hevsel Gardens*

## CONCLUSION

Cities have an identity based on their natural and historical structures. Increasing population and structures leads to a change or loss of urban identity. The present study, which was conducted in Diyarbakır province in Turkey, examined the effects of the historical Hevsel Gardens on the urban identity of Diyarbakır. The city of Diyarbakır has important values due to

its history, historical buildings, and Hevsel Gardens. The requirements to protect and utilize historical buildings are of utmost importance in shaping the lives of the urban population. However, it is possible to observe that the historical buildings were not attributed an acceptable value once the general structure of the city was examined. Lack of maintenance can be observed as a significant problem. Posters and information boards fixed on City Walls damage their historical value and create visual pollution. These interventions also reduce the visual value of the Hevsel Gardens, which were limited by the City Walls. Unplanned, irregular, and unmaintained seating areas at the City Walls disrupt the view of the Hevsel Gardens.

The historical and cultural values of Diyarbakır, inherent since its establishment and throughout its development, survived to present day and are principal factors for forming the urban identity of Diyarbakır. However, the lack of public acknowledgement and accurate planning of such values result with undervalued heritage sites. Hevsel Gardens is considered as one of the most valuable historical and cultural heritage sites.

It is essential to acknowledge the importance and necessity to preserve the historical values in urban centers. Furthermore, the currently developing urban textures in the city should be planned in a way that does not disturb the historical values. The implementation of appropriate planning and restoration interventions could lead to restoring the unique urban identity of Diyarbakır through the balance and harmony of the urban landscape created by the historical buildings and the green texture of the Hevsel Gardens.

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