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Ecological urban space

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Abstract. Interventions in the urban environment at the local and global level, have led the urban designer to use ecological principles in urban space design and economy with resources and energies, to minimize the negative impact on the urban environment and to explore how the signature of the urban space elements should harmonized and formed, to suit the local character. The problem of the research is the lack of a clear perception of the common characteristics of the urban ecological environment. Thus, the goal of the research is to reveal the characteristics of urban ecological environments and ecological design principles, which gain it these qualities. Therefore there is an imposition of a number of ecological characteristics, necessary to achieve the ecological structure of the urban environment. So that the research methodology represented in, the theoretical presentation of the urban ecology concept and the extraction of the theoretical framework were at several levels. Which in turn contain a set of concepts and indicators related to urban ecological characteristics, on which the elected examples were measured and that led to reach the conclusions.

1. Introduction

Due to the increase of urban areas because of the increasing urban settlements, the necessity to understand the relationship between the concept of ecology and the built environment has emerged. The ecological urban environment and saving the environment is one of the most vital issues that humanity must address today. Therefore, the urban environment, whether at the level of space or sector is the main research base, where the idea came to study how the urban environment works ecologically. For the purpose of the need to find a solution to the problem of how the ecological urban space works, the research addressed the assumption of the existence, of a number of ecological principles necessary to achieve the ecological structure of the urban environment. The research dealt with the gradual levels for testing the hypothesis, which is consist of many studies that dealt with the concept of ecology and the concept of the urban environment as an ecosystem to reach the definition of the ecological city concept. Hence the design of the research was included multiple studies, global and regional examples to test the hypothesis of the research and from which reached the conclusions of the research.

2. The concept of ecology

Ecology is the science that studies the relationship of organic systems with the environment, a word with Greek roots consisting of (Oikos) which means the house (Logos), means the surrounding area, and includes the identification of the laws of nature and their interrelationship with the environment [1]. It is the scientific study of the patterns of natural relationships of plants, animals, humans and their surroundings [2]. Also defined as the science that deals with the relationships between living



organisms and the physical environment, or the environment in which they exchange materials and energy, forming an ecosystem, or studying the harmful effects of modern civilization on the environment, with the view of avoiding or preventing those effects through protection. The ecological is the study of the relationship of plants and animals with their natural and vital environment. The ecosystem is the functional relationship between society and its environment. In addition, Characterized by ecological unity within nature, this formed because of the convergence of organisms with the natural environment. Eco-zone defined as a specific geographic spatial space (maybe the mountain range, plateau, coastal, desert and other).The correlation between the natural and the built environment and its effects resulting from the inputs and outputs of the urban environment is one of the characteristics of the ecosystem [3]. The ecology is the study of biology in its natural habitat and defined in 1869 as the science of studying the relationship of biology to its outer environment, a relationship that includes all the conditions of survival. [4]

Ecology has included several principles: *Solidarity* which means Every element in nature needs the other, for example, the plant needs soil to grow, the soil needs water, water needs the atmosphere, the atmosphere needs the plant... etc. Each member is in a continuous, interactive, interrelated relationship with its surroundings, (other members around it do not grow any species or organism indefinitely within the ecosystem). Limitation or limitation is the natural balance in the environment, where the increase is determined According to the standards necessary for life and balance by humans and other beings. The principle of, *unity and cohesion linked* which means that neighborhoods have subordinate ties to survive and sustain life, where there are complex relationships between them [5]. Ecological science more closely related, to the analytical system of architecture and urban planning than to civil society. While these linkages are indirect, they significantly influenced by the surrounding people and their actions, and call for the consumption and investment of such resources to serve their needs. Thus, the essential fundamentals are energy, primary resources, as well as the ability for major innovation and development, which is the basis for environmental science. To say that the field of manufacturing or the purpose of achieving such designs determined by the designer himself, but he often wants to Consumption and investment of available raw materials nearby, to reduce the loss ratio and give a functional character to those resources [6].

Ecology included several concepts, including:

Biodiversity: change at the levels of living organisms that include terrestrial and aquatic ecosystems and include differences within species themselves and between ecosystems.

Ecological resilience: refers to the viability of the ecosystem by reference to its original composition, form and function.

Eco-engineering means Integration of structures, design elements and materials into traditional engineering structures to protect and conserve biodiversity or other ecological functions.

Green space: such as park, sports fields, river edges, public squares, parks and cycling routes as well as safe streets linking different elements as well as spaces around buildings, parking spaces and rainwater canals.

Connectivity: Structures in outer space that allow the flow of living and non-living components and can be the size and scale of the ecosystem (such as nutrients, hydrological and energy flows between ecosystems), at the species / population level (as the movement of organisms) and at the genetic level (such as characteristic movement) Genetic among individuals.

Green infrastructure: an adaptive term used to describe multiple tools and techniques that use natural systems and systems designed to simulate natural systems for sustainable environments and human habitats. The objectives of green infrastructure focus on three objectives: the role of ecosystem services, green engineering, green spaces and linking infrastructure Green usually used as a way to integrate urban ecology into the built environment.

The term blue infrastructure: describes the tools and techniques related to the element of water and includes blue places such as water and artificial rivers. [7]

3. The foundations of ecological formation

Studies indicated that ecological spaces are prepared to be livable with three main components. Namely the structure of spaces that includes space patterns, the organization of elements of outer spaces, as well as the function of spaces, associated with the movement of organisms, water, wind and energy, as well as interested in changes in outer spaces and related to the dynamics of space patterns and function over time has been divided Elements of ecological spaces to (patch) , (edge), (path) and (matrix) which means : [8]

Patch: which mean the area of the natural land with knowledgeable boundaries that vary according to their size, number, location, shape and nature of the surrounding boundaries. In order to achieve their ecological value, they depend on a set of features and their relations with other elements. When one patch divided into two parts, it creates a new edge suitable for living. The proliferating organisms on the edge environment, but at the same time, it reduces the number of objects in the interior environment of the patch. If the patch is small, it does not provide biodiversity. Small patches can merge with large patches because of the close distance between them. The interconnection between ecological patches provides multiple options for organisms in choosing the right environment, thus eliminating its natural environment as in Figure 1.

Another study pointed out, that one of the important principles in ecology is the larger the area of habitats, the greater the diversity of species, and the multiple relations between them. Thus, serve more biodiversity. This means the more areas of habitat lost, the more of species are lost too. Therefore, the conservation of environments is a process of conservation of biodiversity, the large islands support different types of organisms in contrast to small islands, and their support related to the proximity and distance of the colonies. The sooner they supported more types of organisms and ecological processes [7] Figure 2.

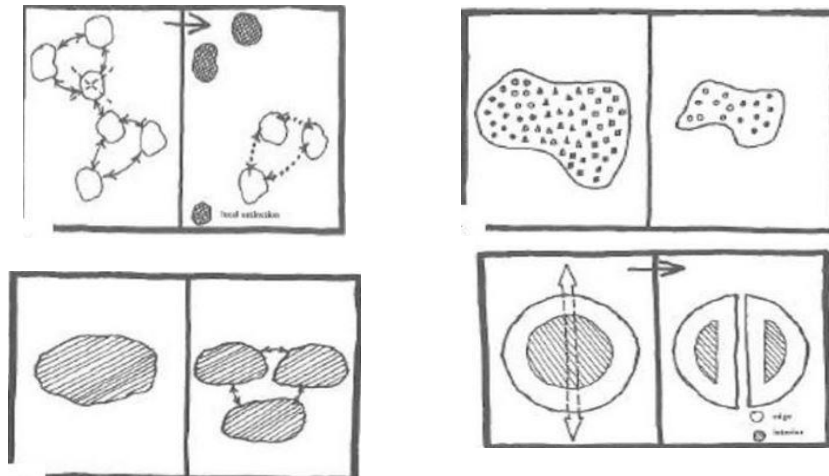


Figure 1. Forms of corridors, patches and source edges.[8]

Edge: it is the area that interval between the area and the surrounding environment and varies according to the components of the edge; they are either green plants or water or industrial boundaries resulting from human intervention in the identification of the patch. Increasing abnormal interactions on the natural edge reduces natural communication, and human interventions tend to modify irregular natural edges and thus weaken their diversity because a straight edge helps pass along them, while irregular edges provide levels that are Environment for diversity and increased communication as in Figure 3 [8].

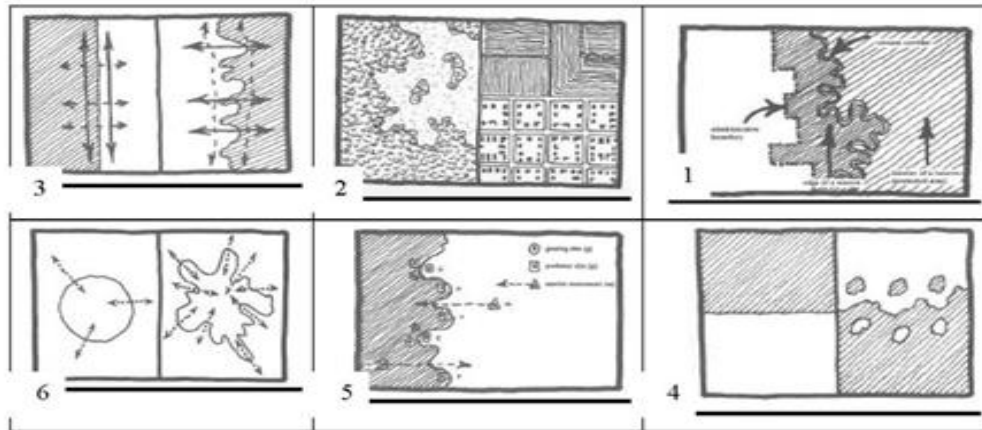


Figure 2. Forms of corridors, patches and edges.[8]

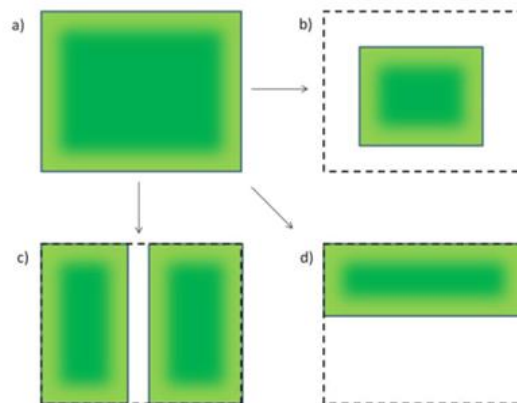


Figure 3. The forms of corridors, patches and edges [8]

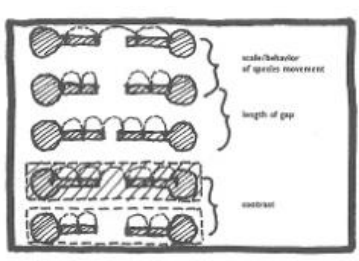


Figure 4. corridors shape

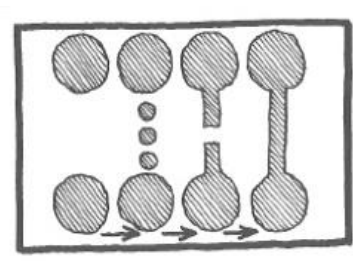


Figure 5. corridors loss

Matrix: It is the network of relationships between the patch, the corridor and the edge in the outer ecological spaces. matrix vary according to their forms, geometry, the density of the corridors, patches in it and where they reflect the patterns of patches and corridors within them. also illustrates the network relationship between patches and space relations, within the matrix and the degree of

complexity of these relationships shows the complexity of the network. The intersection areas between passages and patches considered the richest part of the matrix due to the overlap and convergence of multiple species [8].

3.1. Application of ecology in urban networks

Planning aims to preserve the biodiversity of cities by maintaining the proportion of patches and diversity in them, the introduction of industrial structures and infrastructure and the preservation of the size of habitats and avoid loss with each future development. Spatial planning of matrix, understanding of space uses, and monitoring of active distances and edges. The environmental monitoring distance is about 10 hectares, with a 200-meter partitioned patch area. Within these practices, include natural regeneration after stopping harmful practices, removing the causes of degradation and the active inputs that caused the degradation as well as reconstruction in order to restore life to their habitats. Artificial or plant type, change with the aim of changing species. [7] As an example, the Sydney Green City Network is a major strategy and project plans, whose aim is to provide connectivity and diversity in the green network of green spaces. Provide the Increasing access to open space, promoting good health and human activity. Creating new high quality public areas, making the urban environment greener by enhancing green spaces, restoring natural green habitats and pathways, improving access to sports and recreational fields, providing future tools in open space design. as well as the network will provide social and environmental benefits, through the national parks surrounding the city Public as well as planting DOCUMENTS streets that permeate the Green Grid. [7]

Studies have also indicated that ecology helps the urban natural environment as an integrated, multidisciplinary approach in linking spatial patterns to the city's environmental processes. Creating the natural matrix of the city and continues to exist in the urban fabric. in the form of spots and pathways where the ecological structures of landscapes directly affect their individual elements ,functions and the city. Whole in terms of city size, type, shape, orientation, composition, distribution, links, spatial distribution, nodes, intersections, hierarchies of hierarchies on the structure and thus the function of the city [9]

Concepts introduced such as patches, pathways and matrix as key elements in the landscape environment to describe spatial patterns in the landscape and rural landscapes. [10] Where spatial patterns consisting of linear landscape elements, introduced the concept of communication in the landscape environment. Thus, networks defined as patterns of connected landscaping elements, which are important in the environmental performance of landscapes. Spots in the urban landscape formed, because of turbulent human activities. Which include pathways - natural or compact - pathways consisting of a river or canal, and linear pathways Such as borders, roads, paths, parks, and strip lanes with their ranges like green belts.

The structure of ecological urban networks defined, by the spatial relationships between the distinctive elements that make up the landscape. Large heterogeneity, smaller spots, de-fragmentation and diminishing biodiversity reduce the quality of the urban landscape, between context, urban and natural processes. The transformation of spots and corridors in the city matrix directly affects the environmental function of the city. Some considerations mentioned to improve the structural and functional spots and corridors in the urban context. Which been considered in the environmental flows within the network and the protection of large patches with high environmental values amid the urban environment. In addition, the importance of small patches integration, to improve the performance of environmental networks. Create new patches to facilitate the penetration of Environmental corridors in urban fabric. So that creating convergent patches to increase their environmental relevance and functions. Connecting lanes for higher environmental performance as well as selecting branching pathways, where the interlocking structural pattern of both branching natural lanes and circuit lanes, directly affects their environmental functions. [11] We conclude from the foregoing the existence of the basic elements to describe the patterns of ecological spatial networks or matrix, patches, corridors and edges, all of which are formed among themselves to form a homogeneous structure and

biodiversity fully supports the ecosystem and strengthens the linkages between the natural and urban built environment.

4. Ecosystem concept

Ecosystem means the content of a piece of land, with different size of living and non-living elements as well as the interactions and overlapping processes between them and their surrounds. The key element of any ecosystem is the existence of knowledge boundaries of its lands and its inclusion on living and non-living elements. This concept emphasizes on the physical meaning, of the total system, which does not include the living community. However, the total community of the physical elements that makes it up or which called the surrounding biological environment. [12] The ecosystem (each) is not an element and is indivisible, where individual behaviors affect the characteristics of the group. ie there is no independent influence of elements and the functioning of the system as a whole depends on how it interferes with its environment and with other systems. [13]

The term ecosystem is inseparable from the theory of systems because it represents an ecosystem that includes living organisms and is more comprehensive to ensure a complete community environment where humans are effective in them. Dynamic energy flows are the core of the ecosystem's processes [4].The channels of energy flow between man and his environment, presented in a model that demonstrates the importance of the term ecosystem. The industrial urban fuel systems have emerged as energy-consuming areas which Introduced by ecologist Eugene. [14] This energy-consumed areas derived, from the natural ecosystem of the old natural ecosystem such as agriculture and fossil fuels. The cycle of production and consumption of food and fuel produces residues that harm the natural ecosystem.

Several other concepts linked to the concept of the ecosystem: Ecosystem functions, which mean the preparation of processes that arise because of species interactions, such as water filtration processes and food recycling processes. Ecosystem services are divided into provisioning services (food, water, natural resource productivity) and regulated services (eg water and air filtration, climate regulation) Food) and supporting services (food recycling operations, and the provision of habitat) and cultural services (cultural, educational and aesthetic benefits). [7]

It is clear that the concept of eco-urban environment is a multi-level environmentally, socially and economically. Studies have confirmed the link between ecology and cities. The concept of ecosystem services and the emphasis on continuity in the spatial and temporal dimensions have emerged. The importance of urban ecology and the concept of ecological cities come to know the characteristics and principles of the urban ecological environment is clearly a focus of the problematic research point marked by the following:

Research Problem is Lack of clear perception about the common characteristics of the urban ecological environment. Thus, the aim of the research is to uncover the characteristics, of urban ecological environments and the eco-design principles that these qualities gain.

Research hypothesis is the existence of a number of ecological characteristics necessary to achieve the ecological structure of the urban environment. To achieve the goal of the research and to test the hypothesis, the research designed as follows: - Building a knowledge framework from the previous literature. Build a theoretical framework on the concept of an urban ecological environment, and defining a general concept of it as an integrated ecosystem and defining its concepts. After that, present the measurement method, analyzing examples, extracting conclusions and recommendations.

5. Theoretical construction

It includes studies that address the concept of eco-urban environment and urban ecological space, as an essential part of the formation of eco-cities and for determining the area in which the characteristics related to the urban ecological environment.

5.1 The concept of urban ecology and eco-cities

The origins of urban ecology date back to the fifth century BC, When Hippocrates examined the impact of natural atmospheres of water and natural environments, on the health of human societies. Vitruvius also described the planning of streets and orientation of buildings, in harmony with natural seasons. Streets, squares, and buildings with the prevailing ecosystem, and the waste of resources, reduce the productivity of the natural land within the ecological range. Berti stressed that urban ecology is a science resulting from the integration of several disciplines. Because of the exchange of interest, the hope of these disciplines has become unclear and overlapping in understanding the ecological structure. Urban ecology defined as “the study of the ways in which human and ecological systems evolve together in areas of continuous urbanization” [12].

In urban design, ecology has focused on the characteristics of urban design for humans in cities and minimizing environmental impact on urban areas. Therefore, the term urban ecology means the relationship between the spatial patterns of the urban environment and the ecological process. Although there are many concepts related to the term, today they fall under two categories: the first is ecology in cities where the city or urban area considered as an ecosystem and the other where it focuses on non-human organisms in urban environments. Recently, the concept of sustainability of cities has emerged as cities considered as social ecosystems. Urban ecology provides an understanding of the cumulative effects of changes in the environment to match the nature of ecological requirements and values in terms of distinguishing the prevalence of crowded urban centers and transport systems as shown in Figure 6. [7]

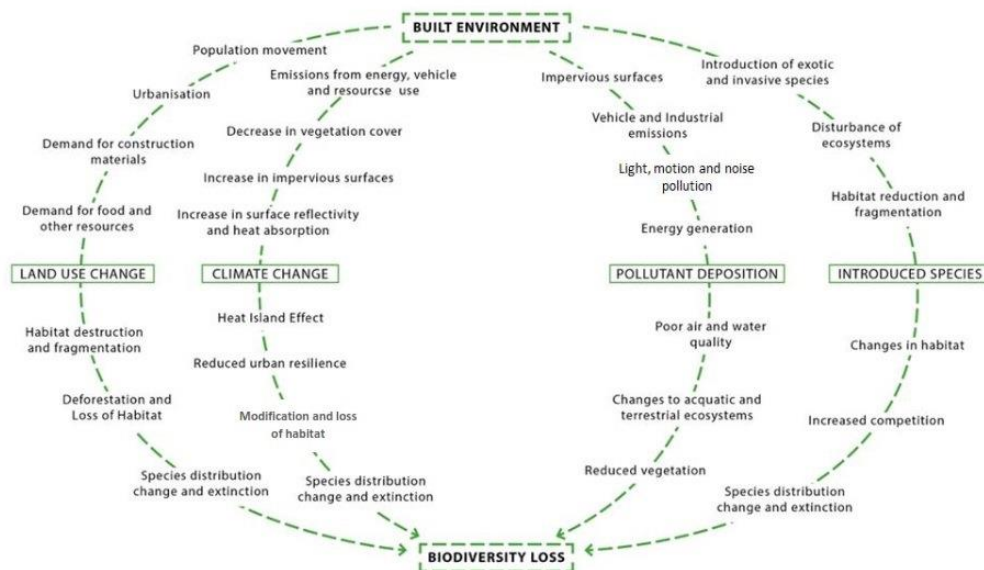


Figure 6. A diagram illustrating the impacts of the environment based on the loss of source biodiversity [7].

Urban ecology represents the basic principles of the field of urban ecology. It applies the ecological objectives of remote and natural ecosystems to emphasize the nature of green spots in urban areas. There are many questions, including how urban design affects the ecology of other organisms in urban habitats and thus considers the city as an ecosystem. It is gray and green where green is a natural habitat, and gray is the built environment. Also greening the city is a way to allow diversity and urban services ecosystem providing urban housing ecological services such as local climate and pollution

regulation. Improve public health, aesthetic external spaces that help to improve the working and productive environments. [15]

5.2. *Eco City concept*

The concept of eco-city first found in the UNESCO MAB program. Launched in 1971 and has since evolved along with social and technological development. The eco-city is a human settlement based on the sustainability of society, economy, and population. The ecological city is a symbiotic structure, where nature, city and the people form an organic whole. Forming symbiotic structures with harmony with the city, people and nature should follow the human ecological theory (ecological). Where it aims to change the mechanism of economic and technological rationality of human beings, and the combination of logical and value judgments. Through the establishment of ethics based on environment, life and environmental humanity, Takes into account the interests of non-human and all natural environment. It attaches the highest priority to the common long-term interests of humankind, retaining the central role of humanity.

Environmental development considers ecological cities are reasonably structured, functionally stable and complex ecosystems. That integrates society, economy and nature. Material, energy and information flows can use efficiently. Human settlements with reasonable spatial structures, flexible infrastructure, environmental buildings and urban landscapes, with urban and rural areas promote green development. [16]The term eco-city also referred to as Eco-City, a place where humans can be found in harmony with nature, i.e. “eco-friendly city” [17].According to international building standards, they have been defined as human settlements, with a self-sustaining, resilient and resilient human infrastructure without consuming more (renewable) resources than they produce. Without producing, more waste than they can absorb, and without being toxic to themselves or neighboring ecosystems. [18]

5.3. *Characteristics of the ecological urban environment*

5.3.1. *Previous studies*

Studies reported that the concept of eco-city addressed several topics which they [18]

- Urban model and achieve the concept of ecological city by looking at the urban shape and proximity and density of the fabric
- The possibility of mobility and the creation of an environmental transport system to reduce the environmental footprint
- Biodiversity where it requires minimal impact on the ecosystem, in addition to encouraging people to live close to nature.
- Environmental industry and the distribution of industries in a way that depends on each other as the formulation of the industrial ecosystem Increases the use of recycled materials in production and waste from industry is used by one another as a supplier and vice versa
- Classify the city as an environmentally friendly city based on economic stability.- Social sustainability by creating a stable economy and focusing on environmental issues.

Studies have pointed to a set of characteristics of the ecological city, where ecological cities are complex ecosystems with a high degree of harmony unite society, economy, culture and nature. Form internal materials, energy and information flow, coordinated and integrated network of interrelated elements of these characteristics. Human cities are representing the core values of humanity, in terms of caring for human needs. Respecting personal choice, emphasizing public services, and working for a livable environment with a humane approach promote inclusive human development.

It also pointed out that the concept of a circular economy used as an economic model, which complements sustainable development in terms of efficient use and recycling of resources, commitment to reduction, reuse and recovery. It integrates cleaner production methods with comprehensive reuse of wastes and the absorptive capacity of natural ecosystems. In circular economy calculations drives production, Rely on trading in natural ecosystems. Advanced technology is integrated into systems, so that knowledge replaces the introduction of material whenever and

wherever possible, to achieve harmony between the economy, society and ecosystems. The use of the concept of clean production, an emerging area focused on industrial production patterns. The development of clean production is a basic model for companies to achieve environmentally friendly production, to include reducing Waste disposal or comprehensive reuse of wastes. As well as a clean production model, that in turn prevents pollution in an attempt to avoid damaging the environment in all aspects from raw materials to final products. That requires Clean Production Extraction of clean raw materials, environmentally friendly energy sources, and innovative production techniques. So that products do not harm human health or ecosystems Green manufacturing, also known as environmentally conscious manufacturing. (ECM) is Contemporary manufacturing system that includes a comprehensive study of resource use and environmental impact. ECM to minimize the environmental impact of the product, remove the potential damage of the product to human health, maximize the efficiency of the supplier's life cycle, extended design, manufacturing, packaging, transportation, use, and disposal processes [18].

Based on Agenda 21, the requirements for building viable environments and building eco-cities should include: (a) adequate and diverse residential buildings for all urban dwellers. (b) Improved infrastructure includes water supply, electricity, heating, sanitation. (C) Provide sustainable energy and transport systems, to enable people to live and travel easily. (d) Provide diverse spaces for recreational, cultural and sports activities, to foster a sense of belonging and increase leisure opportunities. (e) Promote sustainable planning, land use and Environmental management for inculcating order, reason and energy in spatial arrangements throughout the city. Where the city becomes a place, where people interact only when certain elements and images meet their basic needs, and livable spaces. For healthy urban environments through blending cultures, and institutional innovation generated by bringing people together. [19]

The American environmental scientist Richard Register also made ten recommendations for building environmental communities in 1990. Included environmental awareness among the public, Renewable resources with their more effective use, establishment of management departments for eco-city construction and improvement of the existing eco-city management system, ecological reconstruction of cities and creation of diverse areas of population, Promoting the ecological restoration of old cities and unused land in cities. Also establishing a reliable public transport system; Abolishing car purchase subsidies; and developing policies that encourage individuals and companies to participate in the creation of eco-cities. [20]

5.4. Principles of Urban Ecological Design

The Carmona study pointed to several sustainable ecological principles across different spatial scales that may be buildings, urban spaces or sectors since urban design worked across the scale of a single building, block / street, neighborhood, town / village, city as well as regional standards [21]:

- Urban management and careful and continuous supervision of the built environment and achieving sustainable quality by setting clear and measurable goals for every aspect of sustainability with economic, social and environmental integration.
- Efficient use of resources and attention to the use of both energy and resources in the fabric of the built environment by preventing unsustainable spatial patterns of construction and its effects on energy consumption and the use of more sustainable building materials and design and access to solar energy and air and more efficient infrastructure
- Biodiversity and freedom of choice in mobility and urban facilities as well as mixing uses and removing barriers by linking the different spaces and networks that make up the public domain- taking into account human needs where sustainable environments must meet physiological needs (warmth and shelter), safety, security, belonging (belonging and acceptance) and needs for self-realization (expression and fulfillment) and also create a comfortable environment on a human scale and visually interesting, providing a safe and crime-free human communication, Mobility (clarity)-Flexibility and adaptability of urban forms and infrastructure by creating long-term development patterns and adopting more energy

-efficient building techniques- Reduce pollution and reduce the impact of development on the surrounding environment and treatment of pollution through reduction and investment in public transport and ventilation against fumes and design filtration by trees

- Focus on the spatial scale to reduce travel, energy use, land grabbing and increase the vitality and viability of existing centers.

- Various levels of Vital support at design and conservation biodiversity.

- Self-sufficiency and self-sufficient lifestyles in the future

Studies indicated that eco-design considerations based on network matrix variables are not limited to engineering design, but deal with the overall ecosystem in an attempt to minimize the negative impacts on the environment through technology, pollution identification, energy use and recycling. The matrix is a design program and an organizational structure through which to study the foundations of ecological planning and to reach an ecological law according to the problems and their solutions. The strategic choices of the structure of the matrix can analyzed to determine the suitability of ecological planning and its adaptation. Leah does not separate ecological design from the traditional design process, but the process of adding decisions related to the environment and the ecosystem as it represents the matrix design readings of all the problems of the ecological balance within the principles of design represented Palate [3]:

- The ecological design emphasizes the importance of diversity as the components of the natural environment change during urban development in a direct relationship with the environment.

- Give importance to manufactured ecosystems where technology introduced in order to create a convergence between the built and natural environment and what produced in the so-called controlled environment, through industrial control where this system improves environmental performance.

- Ecosystems Conservation made by repaired and restored built environment, to convergence with the natural environment using alternative techniques.

- Making coexistence between human and natural systems, because nature has a self-ecological control that taken advantage of architecturally.

- Create an industrial control system by simple mechanical methods within the ecosystem determinants. The sustainable green design integrates with the artificial ecosystems that exist in nature by means of autonomous systems or by combining the artificial environment with the ecosystems of the neighboring context.

- The ecological design takes into account the phenomenon of degradation or disturbance (entropy) in natural systems and the need to recognize this process in systems and reduce in the urban environment.

It been concluded from the above, that ecological design is the interdependence of multiple factors as it is not considered ecological design if one of these factors is absent. As the matrix after construction does not give the amount of outputs going to the environment, while at the same time affected the physical environment. The urban environment outputs as the urban ecology and design have included multiple levels. These included the level of the urban formal model, the level of mobility within the urban environments, the level of integration between the natural environments, the built environment and the level of the environmental industry. As well as the socio-economic levels, To be achieved depending on the local ecosystem characteristics and requirements have concepts of these levels, and the theoretical framework indicators, as a summary of what has been reported and launched studies in this area as in Table 1.

Table 1. Theoretical framework, concepts and indicators, Source (researcher)

Levels	Concepts related to it	Indicators
urban Form level	Density of fabric	The blocks are close together Achieve harmony Format items Express human values Use the human scale Create diverse activities Integrate environments Supporting institutional innovation Prevent the use of unsustainable spatial patterns
	Integrated network elements Human environments	
	Miscellaneous spaces Sustainable planning	
Level of mobility within the urban environment	Retinal matrix	Network organizational structure Long-term development patterns Efficient building techniques Easy movement Public transport Remove pedestrian barriers Connecting spaces and networks
	Adaptability and flexibility	
	Environmental transport system	
Level of integration of the natural environment with the built environment	Biodiversity	Reduce patches losses vital environment Use of technology
	Controlled environments	
	Live Systems	Restoration of the built environment Take advantage of the ecological endogenous nature Distribution of industries Industrial control Reduce distances between industries Waste disposal methods Effective use of materials Recycling and reuse Reduce consumption Commitment to environmental limitations and recovery Use industrial production pattern and reduce waste Use a basic corporate model Use of alternative energy sources Use innovative production and reduce pollution
Environmental industry level	Industrial ecosystem	
	Circular economy	
	Clean production or environmentally friendly production (green manufacturing)	
Social level	Environmental Management	Meeting humanitarian needs Increase environmental awareness
Economic level	economic stability	Fixed economy Provide a self-contained lifestyle

6. Examples Analysis and Practical Study

The paragraph includes the identification of the most important levels and topics to be analyzed within the scope as well as the selection of samples (examples) to be analyzed and the application of levels of exploration of urban ecological characteristics and the extent to which these levels in the examples through

6.1. Determine the levels of exploration of ecological characteristics used in the measurement:

In this section, the levels derived from the theoretical framework will be measured, which will be measured in the selected models, namely the urban level, the level of mobility within the urban environment, the level of integrating the natural environment with the built environment, the level of environmental industry, the economic level, and the social level. To know the extent of which the existence of the characteristics beside their levels, through comparative analysis and test case studies. By selecting, the property achieved in the model and not to mark on the property, which not realized. Then extract the results for each model, and extract the common characteristics. Thus, test the hypothesis of the presence or absence of common urban ecological characteristics, despite the dominance of the local ecosystem.

6.2. Election of examples, method of analysis and results

Four urban models selected at the level of urban sectors that varied between global models and regional models, all of which characterized as ecological environments that already exist for the purpose of analysis according to their characteristics within the levels chosen above.

6.2.1. Msheireb Downtown Doha / Doha / Qatar

Located in the center of Qatar's 35-hectare area near Hamad International Airport, the project occupies an intermediate position between two main roads leading to the Qatari capital. To the north-west of Musheireb, Doha Corniche stretches just east of Musheireb extending the 'Grand Hamad Street' and the Financial District. One of the favorite destinations for shoppers and tourists in Doha [22], the traditional Souq Waqif is one of the most eco-friendly areas in the world. Figure (7) - (9).

Downtown Doha is one of the most sustainable areas in the world due to the LEED-certified smart neighborhoods. The new Doha Central Station (Musheireb) is an exchange point in the center of the network, where people move around the city, which greatly reduces the use of the car in the city and the streets tend to pick up cool breezes from the bay and shade most of the pedestrian roads from the scorching sun. All buildings to shade each other light color to reduce the cooling requirements were abundant solar energy that captured by photovoltaic solar panels and solar hot water panels on rooftops to generate electricity and water heating indoor use. The installation of efficient irrigation systems and the cultivation of many native species adapted to survive in dry conditions reduce natural irrigation requirements. There are varieties of uses and integration with the new Doha Metro, which presents safe and comfortable public world that, encourages both cycling and walking. The placement of vehicles and underground service vehicles across many basements ensures a comfortable pedestrian atmosphere, and the ideas involved emphasize social integration through urban design - focusing on extended families, kinship ties, social activity, local economy, collective identity, and increased environmental awareness. After extensive research on key concepts such as durability, functionality and aesthetics including materials, designs, layouts and decorations in all aspects of Qatari architecture it aims to restore the uniqueness of the built environment in Qatar and the strong social ties that have been T day defines the Qatari society [23].

The idea of the project is to combine the aesthetics of ancient Qatari architecture with modern technological concepts through the following seven principles [24]:

The Principle of continuity

The principle of harmony of all parts

The principle of the exploitation of spaces and the re-conversion

The principle of privacy of houses

The principle of activating the role of roads

The principle of keeping up with the climate

The principle of the new architectural language

The project was based on the following principles, according to several analytical studies where solving urban problems and applying several new urbanization principles are necessary for sustainability. Which include [25]:- Communication (pedestrian paths / walkability) which described as paths and canals that connect the area for easy movement. Also, can be visually effective, and allows people to feel the center of the old city structure, developed into a network of shaded sidewalks with seven meters wide corridors. So the proximity between Buildings are a key feature in providing shaded space, due to increases in building height and this creates an unpolluted environment. To encourages people to walk away from the intense heat, and noise generated by cars. Also mixed use where the project consists of more than 100 buildings of cultural and residential spaces, offerings and commercial real estate, entertainment and retail areas. The largest share is for commercial use, as well as a mix of modern and traditional. As the building system consists of standardized facades made of marble has been applied strategies. Traditional restoration of traditional historical buildings made in order to preservation against external factors that seek to destroy them.

The Msheireb project included various open spaces, distributed throughout the area and considered one of the largest open spaces in the project. Designed to host occasional events and includes shaded areas, cafes and outdoor furniture to meet the needs of people. Promote social participation- Intelligent transportation and parking strategy, where the Msheireb project focuses on generating intelligent transportation within neighborhoods, by tram system and the main metro station. To support low traffic the main railway station used by residents, employees, passengers and shoppers. Design plans handled by traditional ecosystems, managed and controlled using LEED guidelines, which include standards and measurements to support the assessment of sustainability measurements within the project.

We conclude that to achieve sustainable neighborhoods, emphasis placed on communication between pedestrians and cycling trails in the neighborhood, to enhance the mobility on the ground levels of buildings. Provide smart public transport options. The establishment of social spaces reflects the sense of belonging, and participation, Different public transport options connected with the surrounding context in different areas, within the neighborhoods provided. Therefore, there are nine tram stations, and retail stores designed to be Ground level of the project, to enhance communication and reduce the use of cars within the neighborhood for linking cycling and pedestrian roads. The design of underground parking creates multi-use facilities where different activities held by identifying different areas within the project.



Figure 7. The shading Techniques



Figure 8. Horizontal Chart of the Msheireb Ecosystem Sector Msheireb Properties



Figure 9. Aerial perspective showing the solidity and density of building blocks www.msheireb.com



Figure 10. Perspective showing shaded open squares [26]

6.2.2. The ecological city in the Chinese capital Beijing City / Beijing / china – Changxindian

The ecological city is located in the southwest of the Chinese capital Beijing on the west bank of the Yonding River in the Fengtai district, three kilometers from the old city and an area of about five hundred hectares. With the capital city of Beijing, the area contains four urban areas and also an ecological field overlooking the river's edge. arup.com/projects/changxindian-low-carbon-community) A set of concepts related to the ecological area studied were developed [27].

Environmental construction includes Density, which included about 600 dwellings per hectare, Green environment when the greening rate is about 50 percent and about 40 m per person. The use of local plants is by 80%, Open space 100 percentage with easy access to open space and to all residents with a distance of not more than 400 m. Easy access to the neighborhood center with a distance of 400 m.

Resource economics includes energy saving- Use of renewable energy- Reduce carbon emissions- Clean water consumption

Community protection includes: - Restoration of old areas- Easy access- Affordable housing.



Figure 11. Blocks and buildings in the ecological sector [28]



Figure 12. site plan of Changxindian ecological city showing its ecological source [27]

6.2.3. MianYang City, a city of Chinese science and technology- China

Located In the northwest of Sichuan Province, China is 7.2 km from the city center [29], Based on traditional communities, and the application of the low-carbon city concept. The reorganization of the spatial structure of communities, also land use planning, to achieve a pattern of functional mixing. The use of compact, high-density land, and the two general centers, The Residential Area E. Kologi, the scientific and educational housing area, the central residential area, mixed commercial and residential area, public service area, The southern industrial area, north and south public center. The overall community planning structure for housing, commercial, leisure, work, and other multi-functional makes it easy to access with complete urban functions as shown in Figure 13. [30]

The ecological principles that adopted are the use of a low-carbon green traffic system, the reliance of people on car travel based on the traditional main, secondary and secondary road system. At the same time, it regulates the slow non-motor system - penetrates deeply inside the block, affects coverage, improves distance and travel distance of people, and can improve the effectiveness of the road on both sides of the façade. Based on the TOD model and green transport guidelines, as well as adopting by planning community green space. Linking design and nature based on the node in the Green Belt and the waterfront of wetlands. It extends to various levels including roofing, walling, roofing, greening, and greening. The use of ecological services improves the proportion of carbon, and creates public spaces and waterfront construction through water, soil, plants and animals. Reshaping the “beach” and focusing on water and vegetation. Several ecological services used, including waste treatment and classification, in terms of recycling such as stone. Other wastes that reprocessed to form stone veneer and stone floors. Coordinate the aquatic environment, use rain to irrigate green spaces, and use low-carbon construction technology such as full use of solar energy, clean water, clean rechargeable energy, renewable, recycling, ventilation systems and the use of energy-saving technology in the roof. Focusing on the consideration of the physical and aesthetic exterior design encourages the use of energy-saving lamps, appliances energy saving, Encourages the use of low-carbon paving materials. [31] the most important ecological properties extracted as follows:

Table 2. shows the ecological characteristics derived from the MianYang City ecological source model [31]

Ecological characteristics	design strategy	The method used to reduce carbon
Integrated multifunctional and mixed land areas	Mixing land use and using a variety of intertwined spaces	Full-employment space and reduced planning space
Energy Technologies	Of biomass, solar energy, hydro access, implementation of	Building energy conservation measures, construction and

	renewable energy use by 20%	installation of solar panels, together with the construction of Riverside plant
Short and low carbon transport routes	100% of the resident population of open public space no more than 500 meters, 100% of the resident population of bus lanes only and bus stations less than 500 meters	Encrypted bus, bike and hiking stations with on-site organizing system, set aside the BRT transit canter, to be suitable for traveling in the direction of the intersection bus
Ecological structures	The roof uses natural grass for plants and plants, uses recycled original materials, and a green roof / solar panels in the building	Increase green space, use of local building materials and increase the use of solar energy efficiency
trash disposal	100% waste rating. Use of rainwater	Preparation of garbage collection facilities and rainwater harvesting systems
Carbon leak	There are more than 50% of the green area per capita a public green area of 40 square meters and 80% of the plants of local species in the area	Multi-level green, groundwater leakage
Social control	Encourage residents to participate in the planning and implementation process for return	Public participation in building a low-carbon, self-governing society



Figure 13. Perspective showing the river's ecological edge and vegetation with buildings [32]

We conclude from the model that it promotes natural convergence of society and environmental sustainability by creating public spaces and building waterfront through water, soil, plants and animals, reshaping the 'beach' and focusing on water, vegetation and the environment and introducing natural environmental elements in the middle of everyday life to create a variety of living space Low carbon.

6.2.4 Ecological sector of the city of Helsinki - Eco Viikki Distract

The eco-sector built between 1999 and 2004. It is located about 8 km from the center of the Finnish capital, Helsinki, near a wide area of open farmland surrounding a nature reserve. The main criterion for the design and planning of the city is to provide the optimum size of an effective community for at least 15,000 inhabitants. Natural (reduce Fossil fuels, use of multipurpose space (and health), indoor climate, moisture risk control, noise, wind-free and sunny characteristics of the site, alternative land

plans (and biodiversity as shown in Figure 13), plant and habitat types and storm water (nutrition) Plants, Soil) Climate Change, Energy Efficiency, Water Management, Sustainable Consumption, Waste Management [33].

The ecological principles used relate to the design of the urban ecological sector at several levels, Included the level of preparation of the environmental impact report, of the Vikki city development model. The measurement of the effects of such a project considered the first natural environment of its kind in Finland. The preparation of ecological environmental information included the region's natural characteristics, climate change, air quality and biodiversity. These reports have succeeded in removing urbanism, from the most sensitive areas in the region. Giving design and planning decisions that emphasize construction along with the existing main roads. As well as the provision of ecological alternatives to deal With the surrounding landscapes, building constructions, congestion treatment, energy and water use, waste treatment and environmental standards, The use of renewable energy and the use of raw materials in a balanced manner. Reduce the pressure on natural structures, operation and diversity of local ecosystems such as soil, air, water, plant life, animals, etc. Levels of pollution, noise and waste, as well as the level of green anchor structures added to the site. Which is the most influential in the structure of this ecological neighborhood, where a model was presented where the overlap of construction with the Nature, through the so-called Green Fingers as in Figure14. These elements formed an important characteristic, of the ecological sector overlap. Between natural areas and built, to be the basic structure of the sector within the linkages of the surrounding green nature. The provision agricultural land had distinctive characteristics which they Individual population, contribution, food production by a certain percentage besides its social importance [12]. Ecological treatments alleviate wind gusts by planting a dense vegetation area along the southern edge (with the main wind direction) of the residential area in order to ensure that this treatment continues to repel the wind during the winter as well as the formation of the existing water channel in a similar way. Natural water flows to form a green edge, for filtering water leachate as well as rehabilitation of sustainable buildings, by guiding the building blocks within the eco-neighborhood, the way, which the blocks designed, is to increase solar exposure. [34]We conclude from the study of the adoption model of the components of green anchor. That structures on a certain basis, namely communicative using elements of green fingers, and green belt in a way that penetrates the site and participate in natural ecological processes. Provide accessibility through the signature of green structures, in the built environment.



Figure 14. Perspective showing building blocks [34].



Figure 15. A horizontal diagram showing the green fingers and vegetation belt

6.2.5. Results

The results showed that there are several ecological characteristics, to achieve harmony with the coordination of elements and human values, in the ground level of the sector and in general. Thus achieving the index of environment integrates and institutes support, at a medium level. In addition, the level of mobility based on the model of environmental transport system has been achieved level of public transportation as well as linking areas and networks with all models. The use of technology achieved using green and smart technologies in the project. As well as achieving the property of restoring old buildings, those characterized by restored old buildings, as shown in as table A1.

7. Conclusions

The main conclusions summarized as follows: Confirming the hypothesis of research by confirming the existence of vegetative ecological characteristics. The presence of common ecological characteristics at the urban formal level, represented by achieves harmony and coordination of elements. The existence of common urban characteristics between ecological models, and the reason for their recurrence, is due to the importance and necessity of the ecological property itself. Regardless of the local ecological characteristics, that contributes to the change of some ecological indicators accordingly. The existence of these common characteristics between models utilized in terms of being essential characteristics, and attributes to achieve the urban ecological environment. The overlap of properties levels observed due to the holistic character and ecosystem integrity. This applies to the urban ecosystem. In addition, ecological design considered as a process of interdependence, of multiple factors. It is not considered ecological design if one of these factors is absent, because of the lack of the external knowledge data affecting the environment. This emerges from the matrix, the existence of the basic elements of ecological spatial patterns and their formation, such as networks or matrices, patches, corridors and edges. Which they form among themselves, create a homogeneous structure and biodiversity. That fully supports the ecosystem, and strengthens the interdependence between the natural environment and the urban built environment. In addition, the need for ecological characteristics is to achieve the sustainability and vitality of environments and urban spaces.

8. Recommendations

Going towards the study of ecological formalities and taking them into account in the design of urban environments, Establishing ecological urban spaces that adopt ecological principles and foundations

Urban and ecological characteristics can be investigated at multiple levels and scales both at the level of skyscrapers as vertical ecological communities.

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Appendices

Table I. The characteristics of the theoretical framework achieved in the elected models. (Researcher)

Levels	Concepts related to it	Indicators	Indicators				Extent check	
			Sample 1	Sample 2	Sample 3	Sample 4		
urban level	Form	Density of fabric	●			●	Low	
			The blocks are close together	●	●	●	●	high
		Achieve harmony	●	●	●	●	high	
		Integrated network elements	●	●	●	●	high	
		Human environments	Express human values	●	●	●	●	high
			Use the human scale	●	●	●	●	high
		Miscellaneous spaces	Create diverse activities	●	●	●	●	high
		Sustainable planning	Integrate environments	●	●			Low
			Supporting institutional innovation	●	●	●		Average
			Prevent the use of unsustainable spatial patterns	●	●	●		Average
	Retinal matrix	Network organization structure		●	●		Low	
	Adaptability	Long-term		●	●	●	Average	

	and flexibility	development patterns					
		Efficient building techniques	●	●			Low
Level of mobility within the urban environment	Environmental transport system	Easy movement		●	●	●	Average
		Public transport	●	●			
		Remove pedestrian barriers	●	●	●	●	high
		Connecting spaces and networks	●	●			Low
Level of integration of the natural environment with the built environment	Biodiversity	Reduce patches losses vital environment	●	●	●	●	high
		Use of technology		●	●	●	Average
	Controlled environments Live Systems	Restoration of the built environment	●	●	●	●	high
		Take advantage of the ecological endogenous nature	●			●	Low
Environmental industry level	Industrial ecosystem	Distribution of industries	●	●		●	Average
		Industrial control		●	●		Low
		Reduce distances between industries		●	●		Low
		Waste disposal methods	●	●	●	●	high
	Circular economy	Effective use of materials		●		●	Low
		Recycling and reuse	●	●	●		Average
		Reduce consumption		●		●	
		Commitment to environmental limitations	●				Somewhat

		and recovery					
	Clean production or environmentally friendly production (green manufacturing)	Use industrial production pattern and reduce waste	●	●		●	Average
		Use a basic corporate model		●	●		Low
		Use of alternative energy sources		●			Somewhat
		Use innovative production and reduce pollution		●	●	●	Average
Social level	Environmental Management	Meeting humanitarian needs	●				Somewhat
		Increase environmental awareness	●	●	●	●	high
Economic level	economic stability	Fixed economy	●	●	●	●	high
		Provide a self-contained lifestyle	●	●	●	●	high