Comparative Evaluation of Principles of Urban Design and Sustainable Development

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ABSTRACT

In the era of climate change and the declining natural resources, destruction of the ozone layer, increasing pollutions and fear of the greenhouse effects, any discussion of urban design would be less meaningful if it does not address the environmental problems. Long-term survival of man on the Earth is questioned in a situation where lifestyle is unsustainable. In these circumstances, a purely abstract debate, without addressing environmental concerns, on the aesthetics and quality of the cities can be considered a superficial one. Sustainability is an aspect of the efficiency of urban design in the era of climate change, meaning a development that does not harm the environment, and helps maintain the economic and social structures of city. This paper aims to present the criteria for “good urban design” in the era of climate change. First, the dimension of sustainable urban development is cited. Then, it is tried to examine the basic principles of a good urban design from the viewpoint of experts, and determine the level and extent of the consistency, by offering existing theories on urban sustainability and comparing the views of experts on the principles of urban design. Finally, those principles that can lead to the urban sustainability are separated by the various dimensions of sustainability.

Key words: Sustainable urban development, Dimension of sustainability, Principles of urban design, Climate change.

Introduction

The world is becoming an increasingly urban place. About 65% of the world’s population is expected to live in urban areas by the year 2025 [30]. Due to the rapid pace of urbanization, natural ecosystems are increasingly replaced by cities [12]. Urbanization promotes rapid social and economic development, but at the same time, leads to many problems, such as concentration of the population, traffic jams, housing shortages, resource shortages, biodiversity reductions, “heat island” effects, noise, and air and water pollution [29,17]. People are increasingly realizing the importance of a sustainable urban environment that will mitigate or eliminate these problems [20], and many countries have already enacted strategies to promote urban sustainable development [9].

Cities are complex systems affected by diverse social, economic and environmental factors, with many conflicts and interactions among these factors. Simultaneously, cities are sources of global environmental pollution and ecological damage, and serve as major sinks for materials, energy, information, capital, and population. In the broader sense, sustainable development means the capacity to meet the needs of the present without compromising the ability of future generations to meet their own needs. Urban sustainable development does not mean the sustainable development of any single economic, social, or environmental subsystem, nor simply adding to the sustainability of these subsystems. Instead, it attempts to balance economic growth, ecological construction, environmental protection, and social progress, and the difficulty of this challenge has made it a major focus of current research around the world [27].

Some of the most highly valued parts of our cities are instances of good urban design, areas which have delivered good investment returns and an attractive built environment over decades or even centuries. Good urban design pursues local identity and sense of place, cultural responsiveness and purposeful environmental innovation. It achieves a high level of quality, comfort, safety, equity, beauty and cohesion in the overall, physical outcome of all the development, planning, engineering, architectural and landscape design decisions that contribute to urban change.
This paper aims to develop a more comprehensive set of indicators and present the criteria for “good urban design” in the era of climate change. In the first step, dimension of sustainable urban development is cited. Then, it is tried to examine the basic principles of a good urban design from the viewpoint of connoisseurs, and appoint the level and extent of the consistency, by sacrifice existing theories on urban sustainability and comparing the views of experts on the principles of urban design. In the final step, those principles that can lead to the urban sustainability are separated by the various dimensions of sustainability.

**Urban Sustainability and its dimensions:**

Definitions of sustainable development expressed by different perspectives and groups attempt to define sustainability and sustainable development, sustainable communities and cities, as well as sustainable production. However, any effort to define sustainable development and sustainability, which is made from each point of view, must generally be open and flexible, and consider the following three cases:

- The relationship between society, economy and the environment;
- Equity in the use of resources and opportunities;
- Living with restrictions on the Earth.

Four main underlying concepts or obligations can be found from the definitions of sustainable development, as follows,

1 – *Futurity*:

Responsibility to meet the needs of future generations on natural resources and scientific and cultural supports

2 – *Environmentality*:

Responsibility for the effective protection and management of environmental and biological resources

3 – *Equity*:

Responsibility to make resources available, at the local and global scales based on equity and opportunities provided for all

4 - *Public Participation*:

Responsibility for the managers of community to identify problems related to the environment on the basis of public participation and free access to information [24]. To achieve the main objectives of sustainable development, it is necessary and unavoidable to jointly and simultaneously address the socio-economic dimensions/factors and environmental issues. A variety of internal and external conflicts can arise in almost all measures designed and implemented to promote sustainable development. For example, the prohibition of vehicular traffic in the downtown is a defensible measure to reduce air pollution in terms of environmental sustainability, but it has negative and harmful effects from the point of view of economic stability, due to some impact on businesses in downtown.

On the other hand, this may lack justification in terms of social sustainability, since the lack of vehicular traffic at night can lead to a feeling of insecurity among residents and passersby. Thus, a sustainable city requires an integrated development from economic, social and environmental aspects. [1]

The main dimensions of sustainable development are shown in the figure below.

![Fig. 1: The main dimensions of sustainable development (Randall, 2003)](image-url)
Ecological dimension of sustainable development:

Addressing the main ecological constraints (such as land, water, air, biodiversity and other elements of the natural environment) is the most fundamental measure that should be considered on sustainability. In a sustainable city, greater attention is focused on the use of the lands covered by urban development. Much of the future growth of population and housing needs in city or region can be met by populating existing texture of a city (endogenous development), optimal density and compactness of the city, the renovation and reconstruction of abandoned and old areas, as well as use change and restoration of existing old buildings.

The objectives of sustainable the city should be entirely consistent with the measures for reconstruction and renovation of old textures and areas of downtown because the goal of sustainable city is to use the existing lands in the city before the use and/or destruction of important natural lands and barren lands around the city. On the other hand, creating compact cities and preventing uncontrolled spread of them around require a sustainable means of transportation. A healthy and contaminant-free transportation, especially walking and cycling is dominant in the environmentally sustainable cities. Therefore, sustainable city must be formed so that it could facilitate the above activities. Sustainable city emphasizes on greening urban spaces as well as designing them based on trees and green spaces, urban parks, gardens and an interconnected network of open and green spaces in different areas. [21,25].

In an overall summary, the ecological dimension of sustainable development can be summarized as follows,

1 - Management of the development and design of land use:

One of the most fundamental challenges of sustainable design is to explain the development of cities and suburbs, in order to preserve the natural landscape and plantations, important natural settlements, as well as plant and animal species [37]. It is necessary to protect environmentally water, soil and biodiversity on which life depends. [38]

Urban areas obviously cannot be developed in a way that they had been grown in recent decades, because their development leads to many secondary problems associated with the use of vehicles, pollution, congestion, quality of life and the separation of different groups of the population, depending on their income and ethnicity.

2 - Urban Design:

A more appropriate design of cities does not just include the design of public spaces, alleys, neighborhoods and homes, but it also includes the design of parks and green spaces, patterns of regional development, transportation networks, as well as water and wastewater systems.

3 - Transportation:

Transportation systems have played a significant role in determining the shape and character of cities from the mid-19th century when the first horse-drawn carriages and street car lines started to decentralize the urban environment. The difference between motor vehicles and human needs can be explained by the activity in three areas:

A - Providing adequate transportation practices, particularly with an emphasis on walking, cycling and public transit.

B - Change of land use and urban design policies to support alternative practices and decrease in the number and length of trips required per day.

C - Profit of the transportation costs:

The environmental and social costs of driving should be consistent with the costs relating to fuel, the road use, parking of motor vehicles and the purchase of vehicles

4 - Preservation and reconstruction of environment:

One of the priorities of sustainable design is to help cities to better coexist with the natural environment. Plant species and ecosystems are among the cases that must be preserved in the natural environment [37].

5 - The use of materials and energy:

In the present era because of the increasing consumption of energy and non-renewable resources, the need to review the approach to energy consumption is a key item of sustainable development. Traditionally, the process of urban consumption begins with raw materials and leads to waste (garbage or waste) by consumers following the process from production to consumption. Cycle of sustainable resources seeks the reuse, recycling and recovery of garbage and wastes, as well as the reduction of consumption from the beginning.

6- Sustainable Building and Architecture:

Buildings are not only the major consumers of energy and materials, but also affect the relationship of man with the natural environment. [37] Environmental dimension is considered a predominant focus of sustainable development and as a pillar of human development. The discussion is mainly proposed to use natural and environmental resources. Since the issues in this area are less discussed in the literature, it can be said that environmental issues are the most challenging areas of sustainable development [35].
Social dimension of sustainable development:

To have a valuable and valid sustainability in a city, special attention should be paid to social and human issues. This means to create and protect active human environment, living spaces and the cities that can provide a high quality of life for citizens. Compared to environmental dimensions, social ones obviously need a more qualitative definition because the criteria such as the capacity of the normal range cannot be simply relied upon. Social components and elements of a sustainable city are emphasis on pedestrian and mix of uses, as well as on social functions as a unifying factor in buildings and public spaces. As many developments of a traditional city show, the goals, such as the walkability, human scale and dynamic civic spaces are clearly consistent with objectives of community sustainability. Creating active and vibrant urban spaces, of course, is part of a habitable place because walkability, as well as mix of uses and activities have created an appropriate density of people and business activities and a good mix of public pedestrian spaces and activities that the basis of the activities.

Sense of place is also an important dimension of sustainability. In many of new urban developments, people have not the least sense of belonging to a place because of lack of interest and value. A sustainable city will support the urban body and pattern that is uplifting, inspirational, memorable, and that engenders a special feeling of attachment and belonging Furthermore, a sustainable city creates and encourages a sense of place, by recognizing and addressing the bioregional context, i.e. ups and downs, natural beds, streams, rivers, hills, open lands, plant and animal habitats, and many other specific natural elements and factors of the place.

Addressing the social dimension of sustainability means that a sustainable city is one that creates a safe, humane and active, crime free environment by taking into account the specific objectives, such as appropriate and affordable housing, health care and providing other basic services to its citizens. Integration of social and environmental considerations is a conspicuous and distinct feature of a sustainable city [32].

MACED Association mentions "equality" in relation to the social dimension of sustainable development, and considers the creating the opportunity to participate fully in all activities, interests and decisions of a community as its own result (Mountain Association for Community Economic Development). Social action at the local level is the first step towards the participation of people in decisions that affect their lives. The importance of local partnership is that most of problems at the local scale have a very simple and trivial nature, and can be resolved by creating a locally proper efficient structure.

In addition, to achieve environmental sustainability, the parks and green space that are preferably created in the vicinity of primary schools are of paramount importance at the local scale. These spaces, in addition to their impact on the environment, can serve as meeting places of to create interaction between people of different ages and groups, and thereby can contribute to social stability.

It can be said the most important element of sustainability at the local level is the places to meet and encounter people because meeting with the neighbors and solving local problems through discussion and dialogue is a prerequisite for social stability. [7]. Stability should lead to the creation of a society based on justice and equality. A sustainable city must encourage social and cultural diversity.

Therefore, the sustainable city is a city where variety exists and is supported, where there are no significant segregation and separation between different income and social groups, where all individuals and groups have access to essential services and facilities, and where its inhabitants have equal opportunities. Many believe that since developed countries have consumed more than their share, social movements on sustainability and the concept of sustainable city try to establish equality in this regard. It is clear that many cities across the countries have kept their lifestyle and consumption levels up just by expanding the capacity of city and region range to the outside. [6].

The primary hypothesis of the community-oriented proponents is that society has moved too far in the direction of individual rights and, therefore, it has been far from the concepts of social responsibility and commitment to the large community. It is time that we accept and act our commitment and responsibility towards the community.

There are many ways to create the conditions, including the creation of spaces to which people commit themselves, in which invest and involve themselves, and which provide the places where people are made familiar together, participate in the activities of the city, and feel the sense of responsibility for the hygienic conditions and environment of city. Design and physical shape of a city can obviously play an important role in creating a sense of community in a city.

Low density and dispersed patterns of urban development and the lack of public spaces encourage separation, and reduce the relationship between people. The physical characteristics of a sustainable city help to create a sense of community, i.e. the sense of ownership, commitment and sense of belonging to a larger whole. Pedestrian spaces, cultural monuments, squares, parks, and other public places have the potential to create commitment and dependence to the community. [2]

Economic dimension of sustainable development:
The city's economy is another dimension of sustainability. A sustainable city is a city with an economic base that not only has no minimal adverse effect on the environment, but also is effective in reviving and improving its quality. Economic activities of the sustainable city must have a minimum of pollution, low energy consumption, products with no harmful substances that are biodegradable in the natural cycle, the use of sustainable materials and a closed process for producing durable goods.

In short, the economic base of a city should be ecologically sustainable as possible. Municipalities and other public institutions can help to encourage economic activities. By taking a variety of action, such as tax credit for activities consistent with the environment, investment and financial support for these activities, more accurate and stronger legislation and regulations, as well as training programs for owners of the activities, and officials [28,10,3]. A sustainable city must estimate the total real environmental and social costs, based on which can make appropriate decisions. A sustainable city must try as much as possible to rely on market forces, incentives and levers. In the city of Oslo, Norway, a total of nearly USD 74 million has been annually received for licensing the cars entering the downtown, which have been spent on public transportation network. [11]

Another aspect of economic sustainable development is to strengthen the economy based on the neighborhood. In this regard, the main idea is to try to achieve totally self-sufficient neighborhood. Local production of goods is quite reasonable in the cases where they are economically feasible and appropriate. Different levels of government intervention are possible in order to promote economic and social sustainability [37].

**The role of administrative authorities:**

Sustainable cities will be involved in major changes on how to administer and manage cities and urban management, and how to create policies on investment and decisions for the future of the city. Such changes require applying more serious plans on recycling and waste reduction, saving energy, using clean energy such as solar power, promoting and managing water conservation, and developing the pricing policies that cover the actual environmental costs, and consumption policies based on waste reduction, and finally encouraging the use of sustainable durable products and goods. [28,10,3]

Administrative authorities of cities and city councils have many financial strength, social influence and natural resources, and can be effective in providing solutions to protect the environment and to change patterns of energy consumption. City leaders have great influence to lead urban residents towards a sustainable future, focus on the issue of climate change and the interaction with the environment, and to culturalize them.

Economic strategies, legislation and drivers must be defined and implemented by the authorities at national, regional, urban, and neighborhood levels, in order to reduce GHG emissions in areas such as transportation, infrastructure development, building codes, air pollution, and especially energy consumption. It is very important to culturalize and present economic, social and environmental consequences and losses generated by climate change. To assess progress towards a sustainable future in relation to energy, some indices should be defined. [24].

**Important Issues about the dimensions of sustainable urban development:**

Given the description provided in relation to the dimensions of sustainable urban development, the important issues on each of the dimensions mentioned above can be presented in the table below as an overall summary.

**Table 1:** Dimensions of ecologically sustainable urban development

<table>
<thead>
<tr>
<th>Dimensions of sustainable urban development</th>
<th>Important issues</th>
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<td>• management of the development and design of land use</td>
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<td>• Urban design related to the uses and infrastructures consistent with the environment</td>
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<td>• Design based on climatic principles, and attention to the type of climate and its elements in the designs</td>
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<td>• Thermal and climatic comfort</td>
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<td>• Use of materials consistent with the environment</td>
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<td>• Designing climatic cities [24]</td>
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<td>• Efficient use of natural resources</td>
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<td>• More limited use of resources (energy, water, materials and land) in the materials cycle</td>
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<td>• Use of renewable and recycling resources</td>
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<td>• Resource management (effective management and protection of environmental and biological resources)</td>
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<td>• Increasing energy efficiency in buildings</td>
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<td>• reducing the need for non-renewable resources</td>
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<td>• Creating high-quality buildings and spaces consistent with the climate issues</td>
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<td>• Enhancing biodiversity in cities and neighborhoods</td>
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Ecological dimension

- Attention to ecology of organisms and their habitats [24]
- Adaptation of the built environment to the environment (ibid.)
- Correct positioning of the city and determining the establishment of hierarchy (ibid.)
- Preventing uncontrolled and non-systematic growth of cities (ibid.)
- Access to open spaces and their connection through green corridors (ibid.)
- Giving priority to the endogenous development, and preventing exogenous development as possible
- Creating optimal density and compactness to prevent further degradation of the environment (ibid.)
- Creating mixed uses to reduce the distances and trips between home, workplace and shopping place (ibid.)
- Use of local resources to reduce waste of embodied energy in constructions and urban building materials (ibid.)
- Addressing main ecological constraints such as land, climate and biodiversity
- Renovation and reconstruction of abandoned and old areas, and restoration of use change of old buildings in the city
- Environment health
- Reducing the need for private vehicles in movements
- Use of safe and non-toxic materials
- Minimizing the production of wastes and pollutions that are absorbable at the local and/or global scale and capacity [24]
- Development of efficient public transportation system in urban areas to reduce environmental pollutions
- Giving priority to pedestrians and bicycles in the design of the texture of urban neighborhoods and its continuity throughout city [24]
- The reduction of urban trips (business trips, transportation, etc.), and dispersing the motorized transportation (ibid.)
- Hierarchy of urban facilities and services and their proximity to environmental centers to reduce the pollution caused by vehicular traffic in order to access them
- Minimum pollution of air, land and water
- Reduction of greenhouse gas emissions
- Healthy and contaminant-free transportation, particularly walking and cycling
- The promotion of environmental qualities and visual delight

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<th>Table 2: Social dimensions of sustainable urban development</th>
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Principles of urban design from the perspective of experts:

A review of various theories of urban design reveals the similarities and differences between the notion of the quality of urban design and the key criteria that have been provided by theorists to submit a "good" urban design. Here, some of the most important theories in this field are pointed out in chronological order of release, in order to provide raw materials necessary to identify the main components of a good urban design.

Then, the components have been classified according to the dimensions of sustainable urban development that can contribute, so that we can determine how urban design must act in line with the objectives of sustainable urban development. In 1961, Jane Jacobs presented her classic book, "The Death and Life of Great American Cities", in which she, as a sociologist, analyzed and commented on the impact of physical characteristics of urban environment, especially streets, to facilitate or hinder social interaction and urban vitality and security. According to Jacobs, the most important criteria for a good urban design are:

1. Taking into account appropriate activities before attention to the visual order of environment;
2. Using the mixed use in terms of both the type of use and the presence of the buildings of different ages in an area;
3. Attention to the element of street;
4. Permeability (usability) of the texture, which means to propose the use of shorter blocks in cities;
5. Social Mix and space robustness [18]

By publishing his book, "A Theory of Good City Form" in 1981, Kevin Lynch states that proper quality of city design and consequently the improved quality of urban life depends on five criteria and two meta-criteria, as follows:

1. Vitality:
   It means the biological and sociological survivability of human in the environment of the city;
2. Sense:
   It means subjective ingravibility and the significance of urban places;
3. Fit:
   It means the adaptation of urban form with various activities and behavioral models;
4. Access:
   It means the ease of physical influence on various parts of the urban texture;
5. Control:
   It means the availability of options and involvement of citizens in matters related to the management and the use of public realm in the city.

   Kevin Lynch also proposes two meta-criteria to adjust the relations between the five criteria above. According to him, two main questions must always be considered when prescribing urban design measures and interventions on the basis of one of the above criteria (e.g., providing access).
   1. Is the proposed measure eligible for efficiency due to its cost? (meta-criterion of "efficiency"), and
   2. Which inhabitants or social classes will pay the cost of the measure above? (Meta-criterion of "justice"). [23]

Violich can be mentioned among other experts who have provided suggestions on the good qualities of urban design, especially from the perspective of spatial micro scale. In a paper entitled "Urban Reading and the Design of Small Urban Places" in 1983, he lists the desirable qualities that should be targeted in urban design, as follows:

1. Readability of environment
2. Freedom of choice
3. Creating motivation through the use of heterogeneous urban forms
4. Community livability versus private livability
5. Hearing the past sound means readability of cultural heritages;
6. Taking into account the regional-domestic ties in the form of plans [36]

One of the most famous sets of qualities of urban design, which has been presented by experts, is a proposal by a study group of the Joint Centre for Urban Design at Oxford Polytechnic. Although the set, which was developed and presented by Ian Bently et al. in a book, entitled "Responsive Environments", is not of considerable theoretical depth, it has become one of the major references used in professional circles, owing to the relative comprehensiveness and ease of understanding and attractive style of presentation and picturing. After excluding the qualities associated with functions and efficiency, as well as technical issues, such as regulation of environmental conditions, Ian Bentley et al. specify the qualities that had been less studied until that time, and propose, in the first place, seven criteria that must be observed in urban design, as follows:

1. Permeability:
   It means the provision of access (physical contact) and the visual relationship with various parts;
2. Variety:
It means the existence of functional variety, variety in forms, and variety of individuals and social groups in urban places;

3. **Legibility**:  
It means easy legibility of environment and easy way finding to the intended points and addresses;

4. **Robustness**:  
It means that the space has the ability to accept functions and to place different activities;

5. **Visual Appropriateness**:  
It means the appropriateness of the visual character of environment to function of the meaning mentioned;

6. **Richness**:  
It means attention to the delicacy and intricacy in different sensory stimuli (rather than visual stimuli);

7. **Personalization**:  
It means that residents and citizens should be able to somehow “put their mark on the city”, and own and personalize it to them in a way. [4].

Because of some failures, all the proposed qualities of responsive environments have faced many criticisms since the date of release. Finally, Ian Bentley paid attention to the criticisms in 1990. In a short paper entitled “Ecological Urban Design”, he offers three new norms as a complementary to previous seven norms, as follows,

1. Efficiency in terms of energy consumption  
2. Cleanliness (minimizing air pollution, etc.)  
3. Advocacy and support of nature and wildlife, as well as the maintenance of ecosystems [2].

Roger Trancik has undoubtedly a special place among the experts who have presented special and personal instructions to improve the quality of the urban environment. With the publication of a book entitled “Finding Lost Space” in 1986, he practically put problem-orientedness of urban design on his agenda, which certainly is a shift from the design of shapeless, random, and residual spaces to design of positive and meaningful locations. To overcome the problem of urban design in general, he believes that there is the need for an integrated and consolidated use of three theories of communication, form-context and space.

1. Keeping sequence of the movement (making connection);  
2. Enclosure of spaces;  
3. Continuity of edges;  
4. Control of axes and perspectives; and  
5. Mingling inside and outside spaces [34].

In a paper entitled “Opportunities for Innovation in Urban Design Education”, published in 1987, Coleman refers to a set of important qualities to be addressed in each successful urban design. He has formulated such qualities in the following six topics,

1. Historic preservation and urban restoration;  
2. Design for pedestrians;  
3. Vitality and variety of uses;  
4. Cultural context and environment;  
5. Natural context and environment  
6. Attention to the architectural values of environment [8]

In an article entitled “Toward an urban Design Manifesto”, which was published in the Journal of the American Institute of Planners in 1987, Allan Jacobs and Donald Appleyard, tried to promote a set of qualities that can be briefly listed as shown opposite:

1. Livability;  
2. Identity and control  
3. Access to opportunities, imagination, and joy;  
4. Authenticity and meaning;  
5. Community and public life;  
6. Urban self-reliance;  
7. An environment for all [19].

By reviewing a number of plans on America’s urban design, Michael Southworth as one of the leading graduates of Lynch’s urban design principles, summarizes the urban design qualities into the following seven components, in an article entitled “Theory and Practice of Contemporary Urban Design”,

1. Structure;  
2. Legibility;  
3. Form;  
4. Sense of place;  
5. Identity;  
6. Views and landscapes;  
7. Human or pedestrian scale [31]

Francis Tibbalds is one of the leading experts in urban design, who have presented a set of norms to achieve desirable environmental quality. He provided suggestions and norms for good urban design in three articles (i.e., “Planning and urban Design: A New Agenda”, “Design and Evaluation of Urban Design Codes”, and “Urban Design: Public Realm Versus the Private Realm”) which were published during the years of 1988 and 1990, as well as a book entitled “Making People Friendly Towns”,

According to Francis Tibbalds, the following are necessary to provide a high quality urban design,

1. Places must be considered before buildings;  
2. Lessons should be learned from the past, and one must respect the existing texture;  
3. Mixed use should be used in cities;  
4. Human scale must be observed in the design;  
5. Walking comfort must be provided;  
6. All community groups must be taken into account and consulted;
7. The legibility of environment should be considered as an objective;
8. Environments must be predicted and designed as flexible and adaptable;
9. Growth and change in the urban environment should be considered as a gradual process;
10. It should be tried to promote complexity, be joyful, and create a visual delight in environment [33].

Greene’s set of norms is another set of norms for urban design qualities:

In his article entitled “City shape”, which was published in 1992, Greene recognizes four main components for the quality of urban design, each of which is composed of several elements, as follows,

1. Function:
   It includes communication, security, climatic comfort and variety.

2. Order:
   It includes consistency, clarity, coherence and balance.

3. Identity:
   It includes the formation of associations, unity, character, and specificity.

4. Attractiveness:
   It includes scale, visual and functional alteration, vitality and harmony [13].

   In 1993, Brian Goodey, a leading theorist on urban issues, listed the qualities discussed in urban design, as follows:
   1. Vitality;
   2. Harmony with the existing context;
   3. Variety;
   4. Human scale;
   5. Permeability;
   6. Personalization of place (put their imprint on the environment);
   7. Legibility;
   8. Robustness;
   9. Deliberate and controlled changeability;
   10. Richness [14].

   As can be seen, there is a great similarity between Goodey’s and Bentley’s (in “Responsive Environments”) sets of norms, and therefore, it also suffers from the same environmental weaknesses and failures. According to a study by the London Planning Advisory Committee (LPAC) on the quality issues in the London city, a report with the title of “The Quality of the Urban Environment in London” was published in 1993, involving a set of norms which ensures the improvement of urban quality.

   Based on the recommendations of the report, the quality of urban environment depends on the availability of the following cases:
   1. Human scale and the compactness of the city texture;
   2. Appropriate structure of legibility and identity;
   3. Cleanliness and safety;
   4. Good urban management;
   5. Visual richness;
   6. Mixed use and activities;
   7. Existence of private and public spaces; and
   8. Ease of pedestrian and vehicular traffic [22].

   The studies that have been made by the Prime Minister’s Urban Design Task Force (PMUDTF) on the quality of urban environments in Australia, were published in a report entitled “Urban Design in Australia in 1994”, which recommended the following to improve urban design:
   1. Excellence in architecture and urbanization design;
   2. Wider distribution of environmental benefits in the population;
   3. Production of natural benefits based on attention to natural and built contexts of designs;
   4. Responsibility for local features and needs;
   5. Relevance of designs to the contemporary world;
   6. Leaving open the designs for adaptation to future continuing changes;
   7. Strengthening connection with the past [26].

   Further studies on urban design, especially with emphasis on the ecology-based issues in Australia, have been summarized and published by Haughton and Hunter in a book entitled “Sustainable Cities” in 1994. Based on the recommendations of the book, the quality of urban design in a sustainable city requires compliance with the following:
   1. Variety;
   2. Concentration;
   3. Democracy;
   4. Permeability;
   5. Security;
   6. Appropriate scale;
   7. Organic design;
   8. Economics and its appropriate tools;
   9. Creative relationships;
   10. Robustness;
   11. Consultation and involvement of users in the design [16].

Exploring the relationship between principles of urban design and sustainability:

The following table shows the relationship between the principles of urban design and sustainability, in terms of social, economic and environmental dimensions.
Table 4: Summary of views of experts on the relationship between principles of urban design and sustainability

<table>
<thead>
<tr>
<th>Principles of urban design commensurate with dimensions of sustainable urban development</th>
<th>Social dimension</th>
<th>Economic dimension</th>
<th>Environmental dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theorist</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Jane Jacobs [18] “The Death and life of Great American Cities”</td>
<td>- mixed use</td>
<td></td>
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<tr>
<td></td>
<td>- The ability of control and care</td>
<td></td>
<td>- Permeability</td>
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<tr>
<td></td>
<td>- Variety and richness of activities</td>
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<td>- Robust spaces</td>
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<td></td>
<td>- Community mix</td>
<td></td>
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<tr>
<td>Kevin Lynch [23] “A Theory of Good City Form”</td>
<td>- adaptability</td>
<td></td>
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<td></td>
<td>- Control</td>
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<td></td>
<td>- Community vitality</td>
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<td></td>
<td>- Meaning</td>
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<td></td>
<td>- Justice</td>
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<td></td>
<td>- Hearing the past sound, and reading the cultural heritage</td>
<td></td>
<td>- Biotic vitality</td>
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<tr>
<td></td>
<td>- Attention to native-regional ties</td>
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</tr>
<tr>
<td>Ian Bentley et. al. [4], “Responsive Environments” and Ian Bentley [5], “Ecological Urban Design”</td>
<td>- Variety of activities</td>
<td></td>
<td>- efficiency in terms of energy consumption</td>
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<td></td>
<td>- Legibility</td>
<td></td>
<td>- Minimization of pollution</td>
</tr>
<tr>
<td></td>
<td>- Personalization</td>
<td></td>
<td>- Support of ecosystems</td>
</tr>
<tr>
<td>Coleman [8] “Opportunities for innovation in urban design education”</td>
<td>- variety of uses and activities</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>- Design for pedestrians</td>
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<td></td>
</tr>
<tr>
<td></td>
<td>- Vitality</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Allan Jacobs and Donald Appleyard [19] “Toward an urban Design Manifesto”</td>
<td>- An environment for all</td>
<td></td>
<td>- urban self-reliance</td>
</tr>
<tr>
<td></td>
<td>- Vitality</td>
<td></td>
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<tr>
<td></td>
<td>- Identity</td>
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<tr>
<td></td>
<td>- Control</td>
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<tr>
<td></td>
<td>- Authenticity and meaning</td>
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<td></td>
<td>- Social life</td>
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<td></td>
<td>- Sense of Place</td>
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<td>- human (pedestrian) scale</td>
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<td></td>
<td>- Identity</td>
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<tr>
<td></td>
<td>- Pedestrian human scale</td>
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<td>- Attention to the need of all groups</td>
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<td>- Attention to pedestrians</td>
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<td></td>
<td>- Attention to pedestrians</td>
<td></td>
<td>- Mixed use</td>
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<tr>
<td></td>
<td>- Legibility</td>
<td></td>
<td>- Attention to pedestrians</td>
</tr>
<tr>
<td></td>
<td>- Human scale</td>
<td></td>
<td>- Mixed use</td>
</tr>
<tr>
<td>Greene [15] “City shape”</td>
<td>- variety of uses</td>
<td></td>
<td>- security</td>
</tr>
<tr>
<td></td>
<td>- Security</td>
<td></td>
<td>- Vitality</td>
</tr>
<tr>
<td>Brian Goodey [14] “The Qualities of urban Design”</td>
<td>- Vitality</td>
<td></td>
<td>- Variation</td>
</tr>
<tr>
<td></td>
<td>- Variety</td>
<td></td>
<td>- Human scale</td>
</tr>
<tr>
<td>London Planning Advisory</td>
<td>- Safety</td>
<td>- mixed use and activities</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>- Cleanliness</td>
</tr>
</tbody>
</table>
Table 4: (Continued) - Summary of experts' views on the relationship between principles of urban design and sustainability

<table>
<thead>
<tr>
<th>Theorist</th>
<th>Social dimension</th>
<th>Economic dimension</th>
<th>Environmental dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Prime Minister's Urban Design Task Force (1994) “URBAN DESIGN IN AUSTRALIA”</td>
<td>- Wider distribution of benefits in the population - Responsibility to local needs and features</td>
<td>- Flexibility of designs to accept and adapt to continuing changes - Strengthening connections with the past - Attention to and use of the natural context of environment</td>
<td></td>
</tr>
<tr>
<td>National Seminar on “Urban Design in Australia” (1996)</td>
<td>- Functional efficiency and justice - Sustainable development and attention to social and cultural environments</td>
<td>- sustainable development in accordance with economic environments - attention to local texture and character - Sustainable development in accordance with natural environments - Environmental justice and efficiency</td>
<td></td>
</tr>
<tr>
<td>Urban Task Force (headed by Richard Rodgers) (1999) &quot;Towards an Urban Renaissance&quot;</td>
<td>- Public realm</td>
<td>- optimization of land use and density - Attention to site - Sustainable buildings - Environmental responsibility</td>
<td></td>
</tr>
<tr>
<td>Department of Environment, Transport and Regions (Great Britain) (2000) “By Design”</td>
<td>- Quality of the public realm (safe and appropriate for all) - Variety - Mixing of uses - Identity - Legibility</td>
<td>- mixing of uses - Variety - mixing of uses - Landscape of the Earth, ecology and terrains</td>
<td></td>
</tr>
</tbody>
</table>

Conclusions:

To attain the key objectives of sustainable development, it is necessary and unavoidable to jointly and simultaneously address socio-economic dimensions/factors and environmental issues. Principles of urban design have consistency with the dimensions of sustainable development even before the application of sustainability concepts. The paper tries to find out the level and extent of consistency, by mentioning existing theories on dimensions of urban sustainability and comparing them with principles of urban design from the viewpoint of experts. The results indicate that the principles of urban design are the case for all aspects of sustainability, especially social and ecological
dimensions. In the desire to achieve sustainable urban structures, the development of a built environment has an implicit quality - the environment that is pleasant because of "good urban design". Given to current concerns associated with climate change and environment, the urban design must be in line with sustainability. In other words, the requirements of sustainable development closely reflect the agenda of urban design. Although urban design is rooted in social needs, the modern society is facing an environmental crisis of global proportions, and the effects of the crisis in the cities of the world; this defines the purpose and meaning of urban design. Based on the requirements of "sustainable development", conventional principles of urban design have been reviewed by experts, and some of the most referenced classic sources have been completed and published with the new revision and the additions that have been intended to meet the above requirements. After discussing sustainable development, architects and urban designers, like other experts in other fields, have provided models to adapt their activities in accordance with the above framework. Efforts have been proposed under various titles, such as "sustainable urban design", "green urban design", "ecological urban design," and so on. Urban planners need consciously to control the flow of city development from diverse aspects so that they can attract wider participation of citizens in decision-making, implementation and management of a city, and discover a solution in which the design has the least damage to the urban environment. The notion of sustainable development in global conditions implies that the eco-social development must have a growing trend, but the process of developments is not allowed to cause the destruction of the environment.

References

22. LPAC (London Planning Advisory Committee), 1993. " London’s Urban Environmental Quality