

Realization of the Ecocity Concept Considering the Effects of Urban Interchange (Overpasses and Underpasses): Qazvin City

Pouria Seyed Mosallaei ^a, Manoucheher Tabibian ^{b,*}, Seyed Mohammadreza Khatibi ^c

^a Department of Urban Planning, Qazvin Branch, Islamic Azad University, Qazvin, Iran

^b Department of Urban Planning and Design, Fine Arts Faculty, Tehran University, Tehran, Iran

^c Department of Urban Planning, Qazvin Branch, Islamic Azad University, Qazvin, Iran

Received 04 April 2024- Accepted: 20 June 2024

Abstract

All cities, especially megacities in developing economies, are facing undesirable conditions in terms of environmental health and people's quality of life. In this regard, one of the solutions that was considered to solve these challenges is the concept of Ecocity. Creating and developing residential patterns suitable for sustainable cities, emphasizing the positive effects of an environmentally friendly transportation system, is one of the main goals of Ecocity. On the other hand, the construction of interchange, like any urban project, has many effects on different aspects of the city and the lives of citizens. The main purpose of this research is to investigate the effects of constructing interchange in relation to ecocity goals. In this research, five main dimensions of environment and resources, transport, economic, socio-cultural and perceptual-visual were considered for an ecocity. Nine interchange in Qazvin city were investigated in relation to the fulfillment of the mentioned 5 dimensions and their sub-indices. The research method is field research, survey and indirect documentary. At first, the criteria were weighted by 15 professors of transportation and environment therefore, a coefficient was considered for each criterion. In the next step, the opinions of 20 experts (informed about the status of the examined intersections) and then 384 citizens were collected and ranked using AHP. All data were evaluated with Friedman's test and finally multiplied by the coefficient obtained in the previous step. Results showed that Shahid Rajaei Intersection scored the highest in terms of achieving the goals of the Ecocity. Regarding the scores, overpasses have scored better than underpasses in achieving ecocity goals. Furthermore, highest level of realization of an Ecocity goals in relation to the construction of interchange in Qazvin city, has been in the perceptual-visual aspects and the lowest level of realizability belongs to the dimension of environment and resources. In general, the construction of interchange in Qazvin city is not in line with the realization of an Ecocity and is far from it.

Keywords: Ecocity; Interchange; Overpasses; Underpasses; Qazvin

1. Introduction

Solving the traffic problems of cities has always been one of the main preoccupations of city planners and city managers. In this regard, the use of modern methods in the development of the transportation network and the advancement and expansion of engineering sciences in the field of construction of highways, bridges and tunnels have found a special place in today's cities. As the effects of the mentioned development, instead of creating a more livable environment, appear with the increase of problems in various dimensions. The reduction of prosperity and heavy economic costs, along with the large consumption of resources for construction, maintenance, reforms and repairs, can cause economic stagnation and nullification of the city's resources. On the other hand, the environmental problems caused by extensive encroachments on the surrounding natural environment and disruptions in social interactions, especially at the level of localities and local access to such projects, are manifested in the form of dissatisfaction, protests, and in general, in conflict with the people's wishes, which

ultimately It causes a serious challenge in the city and imposes heavy material costs and so on. So much so that a major part of the city's power and capacity will be used to compensate for the unforeseen problems caused by the implementation of these plans even years later. Now, in comparison, the country of Iran, which is on the path of development and badly needs to build and create infrastructure, the need to pay attention to the type of infrastructure development becomes doubly important; But instead, the development of such projects, including interchange in the country, has sometimes become such a goal that regardless of the general requirements of sustainable development and the urban ecological approach and the condition of each city and its localities, without any change and localization, in a similar way and despite the definition And the global expansion and clarity of the main concepts and indicators of the Ecocity are used repeatedly throughout Iran. Even in some cases, the construction of several uneven intersections (not due to need) is considered as a successful resume of the performance of a manager and his group, as well as a

* Corresponding Author Email: matabibian@yahoo.com.au

symbol of development in a city. This change of the face of the city is usually prescribed and operationalized even in small cities by concluding several study contracts with not much scientific value and spending an initial cost that is justifiable in comparison with the amount of macro changes that can be seen, even in small cities. If it is promoted now and without considering its future effects, it will not be long before they will consume most of the power of the cities in order to solve their unpleasant consequences. As it is in the opposite direction to the global developments that have been moving for decades in pursuit of pedestrianization and creating increasing restrictions for private cars in the urban arena, our cities strongly promote and pursue the creation of high-speed routes and the removal of obstacles and the preservation of high-speed pedestrian routes.

In the 1970s, because of the role that urban planning can play in the quality of the urban environment, efforts were made to identify and reduce the impact of urban factors on the environment that were vague and uncertain. Early examples such as Jacobs' struggle with the construction of the Manhattan highway and the view of the New Urbanism movement to separate the rider from the pedestrian, as well as the increasing restrictions to deal with the unimpeded and fast traffic of cars in the cities of developed countries, show this. The same goals can be observed in the definition of the Ecocity concept in 1975 by Richard Register and his colleagues at the Berkeley Urban Ecology Institute as a non-profit organization to "rebuild cities in balance with nature". This institution tried to build "Slow Street". The desired results from the application of these policies in advanced cities are not hidden and out of reach. The measures that have been taken since 1990 in Seoul and even New York to collect a number of problematic uneven intersections are proof of this claim.

Regarding the country of Iran and especially the case study of this research, the epidemic of construction of interchange spread to the historical city of Qazvin in 1388. The approval of the construction of more than 50 non-level overpasses and underpasses in the comprehensive city transportation plan and the sudden change in the face of this city in a period of less than ten years shows a clear example of this passion. Notably even so far, the master plan of the city has not been officially announced, and the traffic master plan itself was announced in 2013, i.e., 6 years after the start of the intersection construction. In some cases, the studies justifying the construction of an intersection, including location selection, underpass or overpass, and the type of structure and its materials... did not exceed a few pages, but were quickly approved and implemented. Examining and studying these plans has revealed its adverse consequences, especially at the level of the plan's localities. Apart from rare cases, constantly spending money and defining additional plans to maintain the efficiency of these intersections and to eliminate undesirable and unforeseen effects in the environmental, social, economic and even in the traffic dimension as the

main requirement justifying the construction of the intersection has become a repetitive thing and in some cases. In some cases, the plans that lacked proper and neutral efficiency from the beginning have now remained uncorrectable and have only imposed the waste of material resources and the creation of visual appendages on the shoulders of this city for years. In the case of interchange, the different aspects of overpasses or underpasses, the type of structure and the type of materials used, as well as its effects on the surrounding environment are less discussed, and as mentioned, most of the discussions are about the physical issues of urban highways, from a political, structural or traffic point of view. Therefore, in this study, the interchange implemented in the city of Qazvin from the perspective of social, economic and environmental dimensions and the consequences of their construction, along with the level and rank of the possible effects of the indicators in the realization of Ecocity goals are discussed. The period under investigation is from 2011 to 2021.

The two main questions raised in this research included below:

- 1- According to the effects of creating interchange implemented in Qazvin city, which project has been more successful in terms of realizing the goals of an Ecocity?
- 2- What has been the degree of realization of the goals of an Ecocity in relation to the impacts of interchange in Qazvin city?

2. Research Background

The concept of Ecocity came into being, it is affordable in the city within the ecological, the use of principal of sustainable development and the basic principles of ecological economics, urban economic way of promoting change from the point of view, in order to improve the city environmental quality for the purpose of seizing the city's main industrial structure adjustment of the layout to play the city resources, through overall planning and promote the comprehensive development of the city's ability to achieve sustainable socio-economic development (Mersal, 2016). According to definition of the World Bank, an Ecocity is a city that increases the well-being of citizens and society through integrated urban planning and management that takes advantage of ecological systems and protects and nurtures these assets for future generations (Hoai Nguyen & Huong Thi Vu, 2023).

The term "Ecocity" (ecological city) has so far been mainly used by movements that aimed to realize new and adaptive urban solutions as an alternative to current developments. One of the pioneers in spreading the idea is the "Ecocity Builders" organization in the United States, which organizes a series of "international conferences" dedicated to changing the shape of cities, towns and villages for the long-term health of human and natural systems. This organization and similar organizations describe an Ecocity through a number of principles, for example in the statement of the 5th Ecocity Conference in

China (August 2002). One of the main principles is to build cities for people, not for cars (Gaffron et al., 2005). The term Ecocity was first introduced in Richard Register's book "Ecocity Berkeley: Building Cities for a Healthy Future" (1987). Register's point of view about the Ecocity is a suggestion about building a city that supports the healthy body of the whole city like a living system through the land use pattern of the whole city, increases biodiversity and creates diversity in the roles of the city by applying patterns of evolution and sustainability. Register's point of view about the Ecocity is a suggestion about building a city that supports the healthy body of the whole city like a living system through the land use pattern of the whole city, increases biodiversity and creates diversity in the roles of the city by applying patterns of evolution and sustainability.

The UN Environment Program (2012) claims "the key to sustainability lies in the concept of eco-city". What differentiates the eco-city with conventional city is the urban environmental quality and livability which possess the following characters: compact, mixed-used developments, low-energy transportation, renewable energy generation and a reduced overall ecological footprint (Fei, et al., 2016).

Ecocity approach has been realized in many cities of the world. Including the city of Freiburg, Germany, whose sustainability policies date back to the 1970s, and is considered a sustainable city in terms of energy, transportation and technology. Economically and ecologically, this city has been successful in realizing the use of renewable energy (JomehPour, et al., 2018 quoted from An, 2016). Ecocity is the most important effort made in the direction of sustainable urban development. The framework for examining the purpose of the ecocity by arguing the necessity and urgency of the construction and implementation of the ecocity attracts the attention of officials and planners. During the construction of the Ecocity, four goals should be achieved: resource efficiency, environmental friendliness, sustainable economy and social harmony. Creating a final checklist

after evaluating the Ecocity's performance can serve as a navigation light to deal with the challenges of the Ecocity's progress. Information, participation, evaluation, dissemination and training should be considered to promote best practice to encourage and facilitate the exchange of experiences between cities. Encouraging the protection of the natural environment of urban areas and supporting environmentally friendly lifestyles through education, social participation and policy promotion is essential. It can also provide relatively practical strategies to officials and planners to minimize the obstacles on the path of Ecocity development and then promote urban development towards environmental, social and economic sustainability (Vasilyeva, 2018).

Eco-city, or stable city is a settlement, designed taking into account the influence on the environment. In such a city inhabitants seek to minimize their consumption of energy, water and food, to exclude irrational allocation of heat, air pollution by carbon dioxide (CO₂) and methane and also water pollution. The steady city can support itself with the minimum dependence on the surrounding area, and to make energy by the means of renewable sources. The main aspiration of the population of an eco-city is the reduction of the carbon trace. (Vasilyeva, 2018)

Cities and towns around the world are interested in the ecocity model. However, there is enormous diversity in how ecocities are built, including the level of performance that existing initiatives achieve. This concern with accountability, meaning the ability to achieve ecocity objectives for reducing human impact on the earth while simultaneously advancing socially just and livable human habitats, served as the impetus for development of these standards. The goal is to provide support and criteria by which cities can adopt measures that would enable them to successfully move toward becoming ecocities while simultaneously driving innovation and improvement in urban performance measurement and management (Ecocity builders, 2023). Table 1 provides a summary of definitions and comments related to ecocity.

Table 1
 Definitions and comments about ecocity

Atkinson 2007	Society is in organic conditions and in it, nature completely imposes its limiting conditions on human behavior (Bahrainy, 1995).
Gaffron 2005	The idea of ecocity is that it should be in balance with nature. This can be achieved through space-saving and energy-efficient settlement patterns, along with transport patterns, material flows, water cycles and habitat structures that are consistent with overall sustainability goals.
Gunawansa 2011	A city in balance with nature to minimize the necessary materials and inputs such as water, energy and food and its waste output including heat, air, water and polluted gases. Such a city should move in the direction of preserving the ecological footprint
Roseland 1997	The topic of ecocity is related to a complex set of seemingly unrelated concepts, such as urban planning, transportation, health, housing, energy, economic development, natural habitats, public participation, and social justice (Datta, 2012).
Sandoval Hamón et al., 2017	Ecocity is a city where health and environment are integrated and seeks the health and life of humans and nature.
Vasilyeva, 2018	Ecocity or steady city is a settlement that is designed with the impact on the environment in mind. In such a city, residents seek to minimize the consumption of energy, water and food, eliminate the irrational allocation of heat, air pollution by carbon dioxide and methane, as well as water pollution.

Wang, et al., 2011	Ecocities refer to ecologically sound cities where economic, social and natural systems are integrated so that residents can live a quality life. (Sandoval Hamón et al., 2017)
Hoai Nguyen & Huong Thi Vu, 2023	A human settlement based on the self-sustainable structure and function of natural ecosystems, developed in balance with the natural environment, is a place where people live and work with an emphasis on minimizing inputs from nature and waste from human activities.
Ecocity Builders.org, 2023	An ecocity is “a human settlement modeled on the self-sustaining resilient structure and function of natural ecosystems.” An Ecocity is a human settlement modeled on the self-sustaining resilient structure and function of natural ecosystems. The ecocity provides healthy abundance to its inhabitants without consuming more (renewable) resources than it produces, without producing more waste than it can assimilate, and without being toxic to itself or neighboring ecosystems. Its inhabitants’ ecological impact reflect planetary supportive lifestyles; its social order reflects fundamental principles of fairness, justice and reasonable equity. February 20th, 2010, Vancouver, Canada

(Source: Jomehpour et al., 2021)

In terms of form, Ecocity is a mixed-use city that considers all natural effects in its development. The widespread and responsive presence of public transportation, bicycles and pedestrian paths is evident in it, and the maximum use of renewable energy and climate measures to save energy consumption can be seen in it. In Ecocity, natural elements and plant and animal species have the same right to live as citizens. The urban green space can be seen in all physical dimensions, including the floor, walls and roof. An ecocity, while being in harmony with the ecological cycles of the biosphere, strengthens its local, climatic and cultural characteristics. The ecological adaptation of cities, as human footprints in nature, with their environment, means the unique shape of these cities, because the differences in climate, geography, culture, way of living, biological species, the type of renewable energy that can be used in the place, The mode of transportation that responds to the place, the special natural and cultural heritage, makes the shape of the city different from one place to another (Sharifian & Mofidi, 2015). Most of the so-called ecocity projects are large-scale green developments. Apart from theories and definitions, ecocity should be institutionalized, which largely requires defined goals and methods to achieve them. And this requires the integration of goals in policy coordination at different spatial levels for the collective effort of different stakeholders in a transparent and clear way (Deng et al., 2021). As mentioned earlier in the definitions, on the Ecocity Builders website, the following dimensions are proposed as the main criteria for an ecocity: (as shown in Figure 1)

1- Urban Design

The city is designed and developed with the underlying principle of access by proximity, providing residents with walkable access to open/green spaces, basic urban services, and affordable housing. It demonstrates environmentally friendly transport options and provides walking and transit access to close-by employment.

2- Bio-Geo-Physical

The city commits to responsible management of resources and materials as well as the generation and use of clean, renewable energy. It maintains a level of physical conditions that ensure clean air and access to clean and safe water. It fosters healthy soil and makes sure nutritious, locally grown food is available.

3- Socio-Cultural

The city provides access to lifelong education for all and facilitates conditions for vibrant human expression, knowledge, interaction and governance by promoting cultural activities and full community participation. It invests in an equitable economy that benefits people and planet and is committed to the wellbeing of every citizen, regardless of socioeconomic status.

4- Ecological

The city is committed to sustaining and restoring biodiversity of local, regional and global ecosystems, including species diversity, ecosystem diversity, and genetic diversity. It keeps its demand on ecosystems within the limits of the Earth’s carrying capacity and supports ecological integrity by maintaining essential linkages within and between ecological corridors.

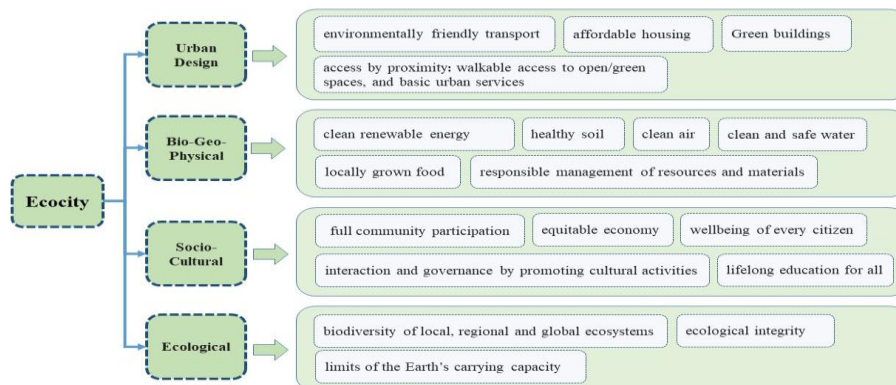


Fig. 1. Ecocity dimensions (Source: Retrieved from ecocitybuilders.org)

3. Ecocity Standards

Ecocity Standards are now at the forefront of global discussions on sustainable city development. At the same time, we have maintained our grassroots base with existing and new partnerships with our early partner cities, with like-minded nonprofits, and with our constituents in the San Francisco Bay Area. In order to successfully roll out the Ecocity Standards in a transparent manner with a high level of participation at the international scale while ramping up visibility and

influence through its next stage of development, testing and implementation, Ecocity Builders will seek to continue to develop organizational capacity, funding, programs and processes for collaboration with other stakeholders, including the public sector, foundations and the private sector (Eco city builders, 2023) The mentioned standards are given in Chart of the Figure 2. By using this chart, different societies can measure the level of ecocity realization. Although in the present research, we cannot fully use this chart because some factors must be added or subtracted due to the effects of interchange.

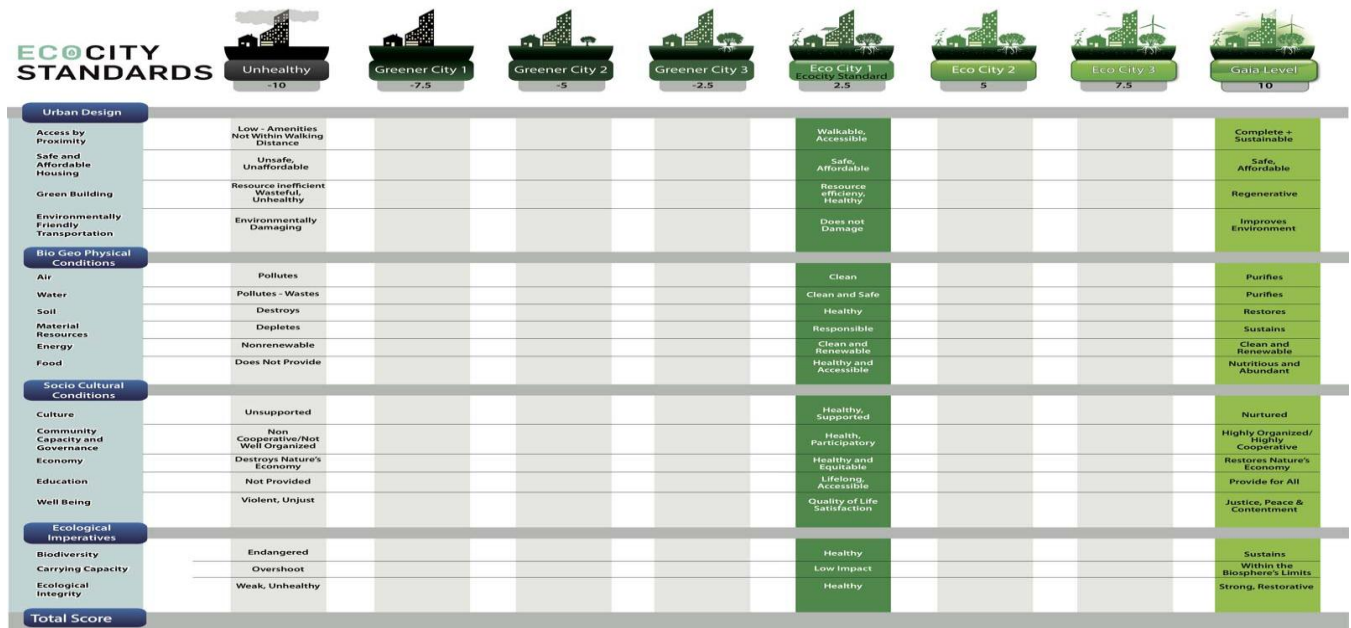


Fig. 2. Ecocity standards (Source: ecocitybuilders.org)

The effects of constructing interchange

The construction of interchange, like any urban project, both small and large, has many effects on different aspects of the city and the lives of citizens. Beyond the creation of urban transport connections, socially it may cause disintegration of neighborhoods, it may create better connections than in the past, it may decrease security by creating social anomalies, or vice versa, it may increase security. It can cause major and dramatic changes in the physical structure of neighborhoods. In the field of aesthetics, interchange especially overpasses, play a great role. Economic indicators are also very important both during the construction of intersections and after their operation, especially in the field of maintenance. On the other hand, interchange may themselves cause the economic prosperity of the surrounding area or, on the contrary, cause the area to be depressed. The visual perceptual index has a significant impact on orientation in the city as well as the mental image of people. Creating a non-level intersection can improve the legibility of the environment by improving the good visual qualities and provide a desirable view, or vice versa (Seyed Mosallaei, 2016).

As it was said earlier, the construction of interchange affects the city and the lives of citizens in different dimensions and components. If we want to provide an effective classification of these dimensions, we can generally classify the effects into three macro, middle and micro levels. The effects on the macro level are the area of the city that can be positive, such as strengthening the overall green space network or improving the quality of the city's legibility. Among the negative effects at the macro level, we can mention the production of garbage and waste due to destruction. In the middle dimension, which is considered the same as the level of the neighborhood or region, the improvement of the traffic situation and legibility of the region can be considered a positive thing. On the other hand, at the same level, that non-level intersection may cause a split in the urban fabric and reduce the interactions between citizens and residents of the neighborhood, or have a tremendous impact on residents' lives by affecting the price of land and the real estate. At the micro level - the area around the intersection- improving access is always positive, and on the other hand, noise and visual pollution caused by the movement of cars, can be considered a negative factor.

4. Theoretical Model

As it was said before, Ecocity generally includes four dimensions of urban design, socio-cultural, ecological and bio-geo physical. In this research, the authors tried to investigate the relationship between the impact of interchange on the city in relation to the dimensions and goals of an Ecocity; therefore, three general social dimensions were considered, each one has smaller dimensions and components can finally be measured by indicators. As it is shown in Figure 3, environment and resources can be measured by production of pollutants, recyclability, green space per capita, amount of encroachment on natural land and existing soil, level of interaction of the intersection with surface and subsurface

waters and adaptation to the climate, possibility of maintaining cleanliness, use of green and renewable energies and studies matching or related to ecological city concepts. Economic impacts can be measured by project costs, optimal and minimal use of land, the impact on the type and uses of adjacent services, impact on commercial and property prices, the possibility of generating income from the intersection, rate of creating wear and tear and reducing the cost of travel with a local approach. The socio-cultural dimension can be measured by local and public satisfaction, social cohesion and increasing the sense of belonging, improvement of public spaces and social interactions, the impact on social security, functioning in messaging and public awareness and the possibility of protecting people against natural disasters.

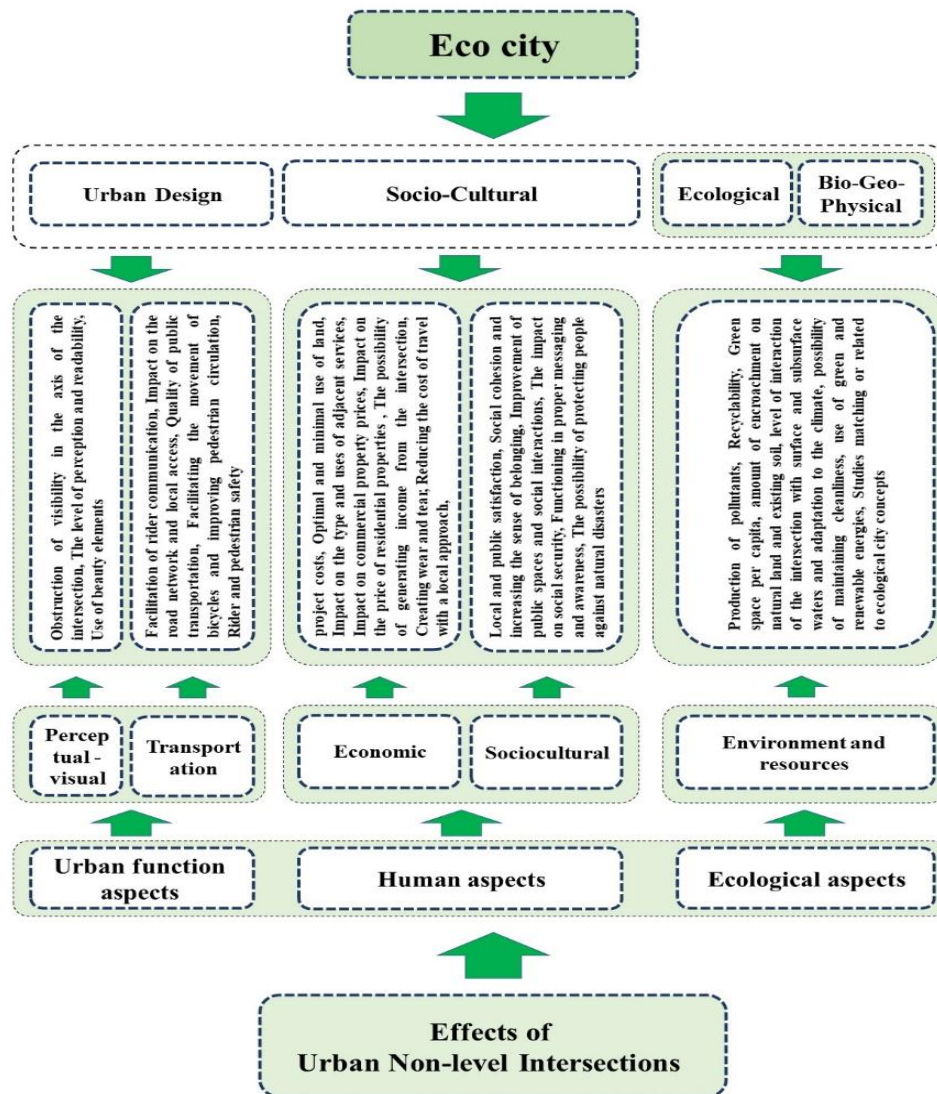


Fig. 3. Theoretical framework of the research

Transportation can be measured by facilitation of communication, impact on the road network and local access, quality of public transportation, facilitating the movement of bicycles and improving pedestrian

circulation and vehicular and pedestrian safety. And the perceptual – visual aspects can be measured by rate of visibility or obstruction in the axis of the intersection, the

level of perception and readability and the use of beauty elements and ornaments.

5. Case Studies Introduction

Figure 4 shows the location of all 9 intersections in Qazvin city. Among these intersections, 3 (Shahid Motahari, Nasrollah and Khalij-e Fars) are underpasses and 6 (Sardaran, Emam Reza, Shahid Rajaei, 9 Dei, 7 Dei and Qods) have been constructed as overpasses.

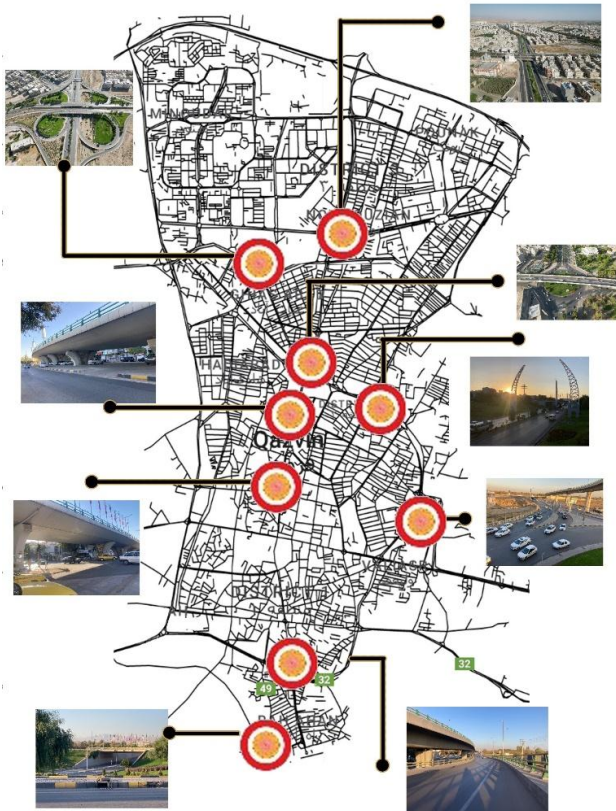


Fig. 4. location of the intersections in Qazvin city.

1- Shahid Motahari Underpass

In order to facilitate intra-city traffic, the construction of the Shahid Motahri project at the intersection of Shahid Motahri Boulevard and Imam Khomeini International University Boulevard was put on the agenda. The design of this intersection has been implemented as an east-west underpass, and there is no access to the north or south routes from the underpass. The area of the intersection on the north and southwest side has a low density of residential and commercial areas, and the main uses are in these educational areas. There is a significant empty space in the southeast part, and the northeast side is mainly residential and commercial.



Fig. 5. Shahid motahari underpass

2- Seyed Hassan Nasrollah Underpass

Seyed Hassan Nasrollah non-level intersection project is another important project in improving urban transportation. This project, which is located in the northeastern region of the city and at the intersection of Shahid Beheshti Boulevard and Shahid Modarres Boulevard, was completed by the National Construction Company within a period of 14 months. Nasroleh intersection was designed to solve traffic problems, especially in the east-west axis, but on the other hand, due to the growing trend of the northern regions and the increase in construction in Sortok and Velayat regions, the design of the square above the underpass was considered. So that the flow of north-south traffic does not suffer.



Fig. 6. Seyed hassan nasrollah underpass

3- Khalij-e Fars Underpass

Non-level crossing of the Khalij-e Fars with the aim of reducing semi-heavy traffic due to the large volume of vehicle traffic (especially heavy machinery) from Boyin Zahra and suburban companies to Qazvin and from Zanjan and Rasht ring road to Boyin Zahra road, and adjacent intersections in October 2015 was opened. This intersection was built on the path of Boyin Zahra Road and the railway in order to increase the traffic capacity of the intersection of Boyin Zahra Road with Esfahan Street, facilitate the access of traffic to and from outside the city and organize the entrance to Qazvin city, ease the traffic network of the route and increase people's satisfaction in the axis and also for an urban development and the creation of new social and economic capacities.



Fig. 7. Khalij-e Fars Underpass

4- Sardaran Overpass

With the aim of solving some of the traffic problems, Qazvin Municipality started to build another non-level intersection on the east-west axis. Sardaran project was started at the former location of Sardaran Square and the intersection of Shahid Beheshti Boulevard and Imam Khomeini University Boulevard with the design of Haraz Rah Consulting Engineers. The overpass is located in a position where residential uses are located at a significant distance from it. On the north-east and south-west sides, there are administrative centers, including the governorate and the North Electricity Department, and on the north-east side there is green space and a limited number of commercial uses. There is also a traditional garden and women's park on the southwest side.



Fig. 8. Sardaran overpass

5- Imam Reza Overpass

The position of Qazvin city in the transit of passengers and goods in the country is clear, and the presence of a city belt would be necessary. Therefore, in order to complete a part of the urban master plan and in accordance with the master plan of transportation and traffic that has been approved by the Supreme Traffic Council, after examining various options, the construction of Imam Reza Bridge in Jomhuri Blvd. was approved and implemented. The overpass of Imam Reza with the aim of facilitating the passage and smoothing the traffic in the west and east of Qazvin city and increasing the traffic capacity of the Jomhuri Boulevard as the southern belt of the city, establishing a connection between the Baghistan Bridge (Abu Tarabi) and the Jomhuri Boulevard in line with the completion of the eastern ring and reducing the traffic volume of Tehran-e Qadim square has been built. The construction of this project started at the end of 2013 and was opened in the winter of 2017.





Fig. 9. Imam reza overpass

6- Shahid Rajai Overpass

This overpass is located in the northwest of Qazvin city. This intersection connects Kowsar town located in the northern part to Qiyasabad neighborhood in the south, while providing secondary access to these areas on its main route, i.e., east to West Bahonar Blvd. It is located on the northeast side of the cultural and sport field and on the northwest side of a vacant land. In the southeast side of residential and commercial uses and in the southeast part of it, the same combination of uses with much less density can be seen. Besides, *Bazar River* passes from north to south under the western part of the plan.



Fig. 10. Shahid rajai overpass

7- Noh-e Dey Overpass

The project of the 9th-Dey overpass with the aim of facilitating and improving urban traffic and creating a flowing-traffic axis from the north to the south of Qazvin city was started in June 1998 and was completed on the 3rd of October 1990. The consultant, designer and supervision of this project was carried out by Hegza Consulting Engineers and Ansar Construction Company

has been working as a contractor under the supervision of the Technical and Executive Vice-Chancellor of Qazvin Municipality.

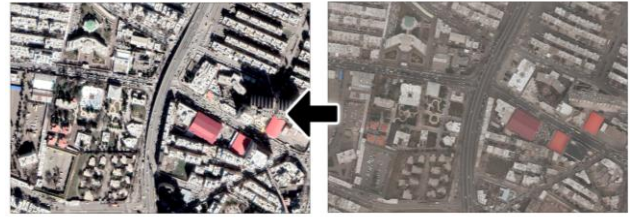


Fig. 11. Noh-e dey overpass

8- Haft-e Dey Overpass

The 7th Dey overpass was built at the intersection of Naderi and Bou-Ali streets. With the aim of improving traffic flow, reducing the traffic load at the intersection of Bou-Ali - Naderi streets, and smoothly connecting the north-south route of Naderi street. The consultant, designer and supervision of this project was also the responsibility of Hegza Consulting Engineers, and Ansar Construction Company has been working as a contractor under the high supervision of the Technical and Executive deputy of Qazvin Municipality.



Fig. 12. Haft-e dey overpass

9. Qods Overpass

The construction project of Qods non-level intersection started in May 2014 and was opened in September 2015. Facilitating traffic and reducing the traffic load of Shahid Beheshti Boulevard and Felestin Street, increasing the traffic capacity of Shahid Beheshti Boulevard and Payambar Blvd and easy access to the outside of the city are among the goals of the construction of the intersection. According to the documents, reducing more than 12 tons of air pollutants per year, reducing more than three million and 100 thousand liters of fuel, reducing noise pollution, eliminating physical collisions at the intersection, organizing more than 56 thousand daily traffic and improving transportation performance and public transmission is one of the benefits of building Qods Bridge.



Fig. 13. Qods overpass

6. Research Methodology

In this research, by using quantitative and qualitative methods, statistical, informational and expert needs were met. For this purpose, cross-sectional and longitudinal survey methods were used to receive the opinions of people and experts who know how to build these intersections (based on evidence and documents). In this research, 384 citizens (based on Cochran's formula) cooperated and participated.

reliability

According to the results of the Cronbach's alpha test, which are higher than 0.7, the reliability of the questionnaire is confirmed.

Weighting criteria

In general, 15 university professors in the field of urban planning and environment were asked to give weight to the criteria, then the final scoring and ranking was done by AHP method. Table 3 shows the criteria and their final scores.

As it is indicated in Table 2, in transportation and traffic dimension, the criteria of facilitation of communication, as the main goal of the construction of the intersection, has obtained the highest score. In environmental and resources, production of pollutants has gained the most importance. In economic aspects, project costs (cost per area, unexpected costs of opponents, predictability of costs required for management, maintenance and monitoring costs) have been given the highest importance that was predictable. In sociocultural aspects, the most important criterion is the impact on social security i.e., minimum points of surprise, visibility and availability during accidents, minimum access to surrounding houses, minimum theft of equipment and so on. In terms of perceptual – visual aspects, the level of perception and readability (readability of paths, signs, edges, etc.) has gained the most priority.

Table 2

Scoring the criteria based on their importance in realization of an Ecocity goals by AHP method

No.	Dimen sions	Indicators	Scores	
1	Transportation and Traffic	Facilitation of rider communication, as the main goal of the construction of the intersection (passing and local ridership, travel time, travel distance, elimination of nodes and red lights)	0.321	0.405
2		Impact on the road network and local access (local connection to the main axis, impact on travel demand, reduction or increase of local access routes and quality of access)	0.097	
3		Quality of public transportation (ease of movement and service, creation of bus station, taxi station, etc.)	0.212	
4		Facilitating the movement of bicycles and improving pedestrian circulation (maintaining the direct route of local traffic, the presence of a pedestrian bridge, the area of the sidewalk, etc.) after the construction of the intersection in the neighborhoods	0.114	
5		Rider and pedestrian safety (geometric design, visibility distance, night lighting, etc.)	0.256	

6	Environment and resources	Production of pollutants (the volume of materials consumed in relation to the area, gas produced in the process of producing materials, water consumed for the production of steel and cement and processing, pollution caused by traffic congestion during construction, noise pollution, etc.)	0.252	0.238
7		Recyclability (recyclability of consumables, recyclable water cycle, land recycling and the possibility and ease of collection after the end of the service life)	0.063	
8		Green space per capita (horizontal and vertical) and interaction with green space before and after construction	0.182	
9		The amount of encroachment on natural land and existing soil before construction	0.112	
10		The level of interaction of the intersection with surface and subsurface waters and adaptation to the climate (especially in cold seasons and atmospheric precipitation)	0.172	
11		The possibility of maintaining cleanliness and hygiene (preferably in a mechanized form)	0.060	
12		The amount of use of green and renewable energies (such as solar cells, etc.)	0.088	
13		Studies matching or related to ecological city concepts (phase zero and one studies by consulting engineers, employers or in upstream documents)	0.070	
14		Economic	project costs (cost per area, unexpected costs of opponents, predictability of costs required for management, maintenance and monitoring costs)	
15	Optimal and minimal use of land (the possibility and potential of defining new uses such as parking, urban space, service spaces, etc.) at the intersection		0.190	
16	Impact on the type and uses of adjacent services at the intersection		0.061	
17	Impact on commercial property prices around the intersection		0.113	
18	Impact on the price of residential properties around the intersection		0.153	
19	The possibility of generating income from the intersection (creating advertising boards, parking, booths, etc.)		0.098	
20	Creating wear and tear in the structure and around the intersection		0.054	
21	Reducing the cost of travel with a local approach and public transport at the intersection		0.076	
22	Sociocultural	Local and public satisfaction (during construction and after operation) within the intersection	0.233	0.130
23		Social cohesion and increasing the sense of belonging in the area around the intersection	0.163	
24		Improvement of public spaces and social interactions within the intersection	0.085	
25		The impact on social security (minimum points of surprise, visibility and availability during accidents, minimum access to surrounding houses, minimum theft of equipment, etc.)	0.341	
26		Functioning in proper messaging and awareness (with visible signs and banners)	0.065	
27		The possibility of protecting people against natural disasters (floods, earthquakes, etc.)	0.112	
28	Perceptual - visual	Obstruction of visibility in the axis of the intersection (for riders and pedestrians) and creating a favorable view at the intersection	0.246	0.077
29		The level of perception and readability (readability of paths, signs, edges, etc.)	0.305	
30		Use of beauty elements (including murals, flooring, elements and lighting, etc.)	0.233	

In the next step, the results of the questionnaires of the experts (who are informed about the construction of intersections) and the citizens were evaluated with Friedman's test in SPSS software. And at the end, the obtained numbers were multiplied by the weight of the criteria (resulted from AHP in the previous step) and the results were determined.

The 30 criteria of the Table 2 were included in the experts' questionnaire, but 10 items were omitted in the section asking citizens; (Criteria 7-9-12-13-14-15-17-19-20-27), due to the fact that documentary data were needed which were not available to the public and they were not aware of them, e.g., recyclability, project costs, The possibility of protecting people against natural disasters etc.

7. Results and Discussion

As it was said before, the experts have answered the questions according to the available documents regarding the 9 intersections under investigation, while the citizens have filled the questionnaires based on their experience with the intersections. In Table 3, the citizens' rating compared to experts'; as can be seen, the most significant point is that Shahid Rajaei Intersection scored the highest in both surveys in terms of achieving the goals of the Ecocity; therefore, the first question of the research is answered. Another noteworthy point is that the three intersections that are in the form of an underpass, namely Shahid Motahari, Nasrollah and Khalij-e Fars, are ranked at the lowest according to experts, and this also indicates

that criteria such as construction costs, the amount of land occupied, the possibility of recycling, etc., which was not included in the citizens' survey, has greatly influenced the realization of the goals of the Ecocity in the underpasses, and the overpasses have a better situation in this regard.

Table 3
Ranking of the non-level intersections success in terms of realizing the goals of an Ecocity

intersections ranking in terms of ecocity goals from the citizens' point of view	Score	intersections ranking in terms of ecocity goals from the experts' point of view	Score
Shahid Rajai	37.99	Shahid Rajai	60.57
Shahid Motahari	33.64	Sardaran	59.93
Noh-e Dey	32.40	Qods	53.20
Sardaran	32.09	Noh-e Dey	50.66
Qods	32.08	Imam Reza	47.30
Nasrollah	30.45	Haft-e Dey	45.46
Khalij-e Fars	30.28	Shahid Motahari	38.37
Haft-e Dey	28.12	Nasrollah	37.68
Imam Reza	27.58	Khalij-e Fars	37.64

To answer the second question of this research, we refer to the results of Friedman's test as it's shown in Table 5. According to the scores obtained by experts who had access to documents and statistics related to the construction of intersections, it can be seen that the highest level of realization of an Ecocity goals in relation to the construction of interchange in Qazvin city, has been in the perceptual-visual aspects with the score of 46.71. And the lowest level of realizability belongs to the dimension of environment and resources was with a score of 43.62.

The construction of these intersections has been more successful in terms of perceptual goals, and this is while the importance factor of this goal, i.e., the perceptual dimension, was at the lowest level of importance in the previous sections, so it can be concluded that the construction of interchange in Qazvin city has been far from achieving the goals of an Ecocity.

Table 4
Degree of realization of the goals of an Ecocity in relation to the impacts of interchange

Dimensions	Dimensions Scores	Number of Indicators	Indicators Scores
Transportation and Traffic	45.72	1	46.41
		2	47.24
		3	45.01
		4	44.99
		5	44.99
Environment and resources	43.62	6	32.02
		7	46.99
		8	45.01
		9	45.01
		10	44.99
		11	44.99
		12	44.99
		13	45.00
Economic	44.99	14	45.00
		15	45.01
		16	44.98
		17	45.00
		18	45.00
		19	44.99
		20	45.00
		21	44.99
Sociocultural	45.66	22	48.99
		23	45.01
		24	45.01
		25	45.01
		26	44.99
		27	45.00
Perceptual-visual	46.71	28	46.49
		29	46.41
		30	47.24

8. Conclusion

The concept of "Ecocity" has gained special importance as a relatively new approach in urban planning. As said before, from the point of view of scholars, ecocity has many aspects, the most important aspects of which in the field of urban development can be summarized in four areas: urban structure, economic and social aspects, circulation flows of energy and raw materials, and the field of urban transportation. The investigation of level and interchange is especially in the field of sustainable urban transportation and urban superprojects; Although it is definitely related to other dimensions of ecocity such as economic costs, strengthening social interactions, optimal use of energy and renewable materials.

In this article, the dimensions of the impact of interchange in relation to the concept of Ecocity and the realization of

its goals were investigated and prioritized. In connection with the objectives of Ecocity, five environmental, transportation, economic, social and perceptual dimensions were considered for the impact of the intersections.

In this study, 9 interchange in Qazvin city were measured in relation to an Ecocity goals. From the results, it can be seen that the transportation and traffic factors as the main objectives of the construction of the intersections have not been fully realized. One of the main slogans of Ecocity is a city with short distances, while the current intersections of Qazvin city have not only not reduced the traffic load in some cases, but have also caused other damages to the city. On the other hand, little attention has been paid to environmental aspects. In some cases, for the construction of the intersection, the existing green space has been destroyed or excessive pollution has been produced. Economically, the construction of these intersections, especially underpasses, has imposed a lot of financial burden on the city. Socially, it has also disturbed the citizens' comfort or even reduced safety and security. In terms of visual and perceptual aspects, the situation is a little better, but this dimension plays a lesser role in the realization of ecocity than the other dimensions, therefore the general assessment is that the construction of interchange in Qazvin city is not in line with the realization of an Ecocity and is far from it.

References

- An, Sarkar, (2016). Eco-Innovations in Designing Ecocity, Ecotown and Aerotropolis, *Journal of Architectural Engineering Technology*, 5: 1- 5.
- Atkinson, A. (2007). "Cities after oil – 1: 'sustainable development' and energy futures", *City*, Vol. 11 No. 2, pp. 201-213.
- Boone Christopher G. (2006). *City and Environment*, US: Temple University Press, translated by Manouchehr Tabibian, 2010, University of Tehran. (In Persian)
- Datta, A. (2012). India's Ecocity? *Environment, Urbanization and Mobility in the Making of Lavasa*. *Environment and Policy: Government and Policy*, 30, 982–996.
- Deng, W., Cheshmehzangi, A., Ma, Y. and Peng, Z. (2021). Promoting sustainability through governance of eco-city indicators: a multi-spatial perspective, *International Journal of Low-Carbon Technologies*, 16, 61- 72.
- Ecocity Builders (2013). *The Ecocity Framework*. Oakland, Ecocitybuilders Publication.
- European Commission (2011). *Cities of Tomorrow. Challenges, Visions, Ways Forward*, Publications Office of the European Union, Brussels.
- Fei, J., Wang, Y., Yang, Y., Chen, S., & Zhi, Q. (2016). Towards eco-city: the role of green innovation. <https://doi.org/10.1016/j.egypro.2016.12.029>
- Energy Procedia, 104, 165-170
- Gaffron, Ph., Huismans, G., Skala, F. (2005) *Ecocity: A better place to live*, Vienna: Facultas Verlags- und Buchhandels AG
- Gunawansa, A. (2011). Contractual and Policy Challenges to Developing Ecocities. *Sustainable Development*, 19, 382–390.
- Hoai Nguyen, T. & Huong Thi Vu, G. (2023) Eco-city Paradigm: Urban Planning Towards Sustainable Development Goals, *E3S Web of Conferences* 403, 01002 (2023), <https://doi.org/10.1051/e3sconf/202340301002>
- Jomehpour, Mahmoud, Etehad, Seyyede Shabnaz and Nourian, Farshad. (2019). Ecological City of Bojnourd Based on Scenario-based Future Studies, 3(7): 1- 30. <https://dori.net/dor/20.1001.1.24765864.1397.3.7.1.5>
- Jomehpour, Mahmoud, Etehad, Seyyede Shabnaz and Nourian, Farshad. (2020). Explaining the principles, dimensions and components of the ecological city approach (case study of Bojnourd city), 8(2): 391-413.
- Mersal, A. (2016). Sustainable urban futures: Environmental planning for sustainable urban development. *Procedia Environmental Sciences*, 34, 49-61.
- Mersal, A. (2017). Challenge and Opportunities in transferring a city in to green city. *Procedia Environmental Sciences*, 37, 22- 33.
- Mohammadi Ghafari, Parisa, Al-Madrsi, Seyed Ali & Moradi Abbas, (2022). Measuring and Prioritizing Ecological City Indicators in Urban Development with Structural Equation Modeling (SEM) (Study Case: Bandar Abbas city), *Urban Planning Knowledge*, 6(1): 58- 70. <https://dx.doi.org/%C2%A010.22124/UPK.2022.19232.1668>
- National Science Foundation, Workshop on Urban sustainability (2000), *Towards a Comprehensive Geographical Perspective on Urban Sustainability*, Rutgers - The State University of New Jersey.
- Organization for Economic Co-operation and Development (2012). *OECD Environmental Outlook to 2050: The Consequences of Inaction*, available at: www.oecd.org/env/indicators-modellingoutlooks/oecd-environmental-outlook-1999155x.htm.
- Register. Richard, and others, (2008) *Eco-City Summit Report*, San Francisco.
- Roseland, Mark (1997). *Eco-City Dimensions: Healthy Communities, Healthy Planet*, New Society Publishers.
- Roseland, Mark (1997). Dimensions of the eco-city, *Cities*, 14(4): 197- 202.
- Sandoval Hamón, L. A., Bayas Aldaz, C. E., Rodríguez Pomedá, J., Sánchez Fernández, F., Casani F., & De Navarrete, F. (2017). From Ecocity to Eccampus: Sustainability Policies in University Campuses. *Urban Regeneration & Sustainability*. Edited by Brebbia, C.A. & Galiano-Garrigos, A., 185–195.
- Seyed Mosallaie, P. (2016). Investigating the economic and social effects of constructing Non-level Intersections (underpasses and overpasses) on neighborhoods (Case: Comparison of Shahid Rajaei

- and Sardaran overpasses with Shahid Motahari and Nasr underpasses), Thesis for M.A. in Urban planning, Qazvin Islamic Azad University, Iran.
- Seyed Mosallaie, P., Khastou, M. (2017). Investigating the Social, Economic and Environmental Impacts of Constructing Urban Interchanges (Comparison of the Main Interchanges in the city of Qazvin), *Space Ontology International Journal*, 6 (3): 37- 57.
- Sharifian Barforoush, Seyedeh Shafagh, Mofidi Shemirani, Seyed Majid, (2015). The morphological criteria of Ecocity from the perspective of theorists, *Bagh-E Nazar*, 11(31): 99- 108.
- Tabibian, Manouchehr, (2004). City, sustainability; imagination or inevitable reality, *Cultural Research Letter*, 8(10): 111- 124.
<https://ensani.ir/file/download/article/20120514072955-1179-151.pdf>
- United Nations (2015) *Transforming Our World: The 2030 Agenda for Sustainable Development*, New York, NY, available at: <https://sustainabledevelopment.un.org/post2015/transformingourworld>).
- Vasilyeva, E. (2018) Eco-city or “steady city” as the way of improvement of living conditions for urban population, *MATEC Web of Conferences* 193, 01025, ESCI 2018.
- Wang, T., Yuen, B. (2011) *Eco-city Planning, Policies, Practices and Design*. Singapore: Springer.

Websites:
<https://ecocitybuilders.org/>