

The Influence of Architectural-Planning Structure of Cities on Their Sustainable Development

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Abstract—Existing indicators for sustainable urban development do not identify the features of cities' planning structures and their architecture. Iranian city has special relevance problem of assessing the conformity of their planning and development of the concept of sustainable development. Based on theoretical sources, the author concludes that, despite the existence of common indicators for sustainable development of settlements, specialized evaluation criteria city structure planning has not been developed. He is trying to fill this gap and put forward a system of indicators characterizing the level of development of the architectural-planning structure of the city. The proposed system of indicators is designed based on technical and economic urban standard indicators from different countries. Alternative designing systems and requirements of modern rating systems like LEED-ND comprise a criterion for evaluation of urban structures in accordance with principles of "Green" building and New Urbanism. Urban development trends are close in spirit of sustainable development and developed under its influence. The study allowed concluding that a system of indicators to identify the relevant architectural-planning structure of the city, requirements of sustainable development, should be adapted to the conditions of each country, particularly in Iran. The article attempts typology proposed indicators, which are presented in tabular form and are divided into two types: planning and spatial. This article discusses the known indicators of sustainable development and proposed specific system of indicators characterizing the level of development of architectural-planning structure of the city. This article examines indicators for evaluating level of city' planning structure development. The proposed system of indicators is derived from the urban planning standards and rating systems such as LEED-ND, BREEAM Community and CASBEE-UD.

Keywords—Architectural-planning structure of cities, urban planning indicators, urban space indicators.

I. INTRODUCTION

REPORT "Our Common Future", presented by the International Commission on Environment and Development in 1987, introduced into scientific use the term "sustainable development" [1]. It served as a basis for the concept of sustainable development adopted at the United Nations Conference on Environment and Development, held in June 1992 in Rio de Janeiro at the level of Heads of State and Government. As a result, a number of international instruments worked from all countries were encouraged to develop local agenda implementation of sustainable development strategies for countries, regions, and settlements. International interest in sustainable urban development is enhanced after the Istanbul United Nations Conference on

Human Settlements Habitat II (1996).

Regarding the cities development, the UN Commission has developed a system of indicators, which is taken as the basis of representation of UN-HABITAT in many countries. Sustainable development indicators are designed to give a comprehensive description of the state of urban transport infrastructure, environment, to show the level of sociocultural and social services. However, these data are statistical in nature and do not always reveal the problems associated with the development of the individual components of the urban organism, such as planning structure or building. For example, the number of hospital beds is not talking about a rational distribution of the hospital in terms of a city area or street network is not always indicative of the optimal layout. Thus, indicators of development planning structure and development should serve as the criteria that should guide the designers in the development of master plans for urban projects and projects of detailed planning. The system of such indicators for cities not yet been developed in any other country, although the performance criteria of urban planning decisions in the form of technical and economic parameters contained in the regulatory and legislative documents of many countries. Special value development of indicators of compliance architectural planning structure of the city acquires the concept of sustainable development in terms of Iran, where work on creating a national system of indicators of sustainable development has just begun. While in many countries representative of UN-Habitat appeared in the 90s.

II. MAIN PART

Urban planning structure consists of a framework (linear elements - streets, rivers, etc.) and units (community centers, located at the inter-section of the axes of planning - areas), as well as fill the filling framework [2]. Allocate natural components of the planning structure of the city (rivers, forests, water surfaces and anthropogenic man-made). In theory, urbanism identified patterns of development planning and building of settlements, established performance criteria of design decisions [3]. However, these criteria need to be clarified in the light of the concept of sustainable development.

Currently, the sustainable development of the city is seen at the level of the overall strategy and has not yet developed to clear planning standards, methods of design planning structure of the city and its buildings that meet the objectives of this approach. In the literature, sustainable development is treated as an urgent task that must be addressed by all residents and leaders of the city to provide high-quality urban environment,

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quality of life, the balance of the city and the natural environment. Sustainable urban development should ensure the creation of a healthy and beautiful, beloved residents of the city, providing full satisfaction their requirements [4].

The main goals of sustainable development settlements are:

- adequate housing for all;
- health and active old age;
- satisfying and gives sufficient work salary;
- healthy and safe environment to live in harmony with nature;
- personal and property safety and security;
- social stability, life surrounded by friends and neighbors;
- convenient access to urban infrastructure;
- preservation of historical and cultural, landscapes;
- high level of architectural and artistic development of settlements.

As can be seen from the list of goals they may be due to material planning structure of the city (availability of housing, healthy living conditions, the rational organization of functional areas, spatial accessibility to social infrastructure, etc.) In this case, the theoretical basis for the development of urban development projects on the scale of the city does not exist. The link between the problem of improving the architectural-planning structure of the city and the overall strategy of sustainable development is a system of indicators.

Indicator - a measure which gives an indication status or change of economic, social or environmental variable. Along with the indicators used indexes. Usually indicators describe the state of the phenomenon and always point to something outside the direct examination.

Index - a weighted indicator based on several indicators or other data. Using indexes acceptable where well understood causal relationships [5]. So, the UN Commission has developed the most comprehensive list of indicators of sustainable development. The indicators are divided into main groups:

- indicators of social aspects of sustainable development;
- indicators of the economic aspects of sustainable development;
- indicators of the environmental aspects of sustainable development (including the characteristics of the water, land, air and other natural resources, as well as waste collection and disposal);
- indicators of institutional aspects of sustainable development (programming and policy planning, research and development, international legal instruments, information technology, strengthening the role of major groups).

III. SIMILAR PROJECTS, STANDARDS AND RESEARCH

The most famous project to develop a system of indicators of sustainable urban development include: European Network for Urban Studies (Network on Urban Research in the European Union), Nordstat, Metropolis and several others. Belarus has also established a system of indicators for urban development [6].

An interesting study of ecological areas of urban development was held in the Architecture Faculty of the Slovak University of Technology in Bratislava. Methodology approach to the project "Ecocity" is determined using the following cornerstones:

1. Basic principles and goals that must be achieved in order to turn the dream into a real Ecocity.
2. Criteria catalog consists of a set of qualitative and quantitative indicators to provide a basis for the realization of the idea of sustainable urban development.
3. Recommendations are set of rules for actions and procedures to implement the concept of Ecocity.

According to [7] "Sustainable development is development that meets needs of the present without compromising the ability of future generations to meet their own needs."

Many countries have a lot of different standards for sustainability, sustainable urban development and sustainable city. However, not any countries have not developed a sustainable structure about city yet and this science are still a local scale science.

In preparation sustainability standards and criteria was attended by 22 countries, resulting in a prepared 59 rating instruments. About 50% (28 rating tools) from these rating tools developed by the United States. Compile information on standards, it can be concluded that all the international standards and criteria in the world designed for 7 categories:

1. City,
2. Planned Neighborhoods,
3. Existing Neighborhoods,
4. All Neighborhoods,
5. Landscapes and Parks,
6. Transport and Infrastructure,
7. Special Purposes.

Just 10% of these rating tools provides for Urban Planning Groups and the maximum trend of this rating tools are designed for Green Building Organizations with 26% [8]. Additionally, we can highlight the following system (Tables I and II) of international standards and instruments relating to the rating of urban sustainability, as well as the regulatory apparatus of the urban environment [9]. However, the existing system of indicators does not reflect the quality status of the planning structure of the city and its buildings. Interdisciplinary statistics about the city does not allow the identification of problems of development of its network of streets, mutual accommodation areas required for the development of urban planning project documentation. To date, highly specialized development indicators structure planning and building of cities has not been developed. However, the generally accepted criteria for the planning structure, compatible with sustainable development, allocated only two this compact form of the city and its population density. Work on the assessment of urban objects principles of sustainable development are carried out in many countries.

TABLE I
INTERNATIONAL STANDARDS RELEVANT TO THE RATING OF URBAN SUSTAINABILITY

Standards	Administrators	Websites	Scope
Humanitarian Charter and Minimum Standards in Humanitarian Response	The Sphere Project	http://www.sphereproject.org/	Water supply, sanitation and hygiene promotion, food security, nutrition and aid, shelter, settlement and non- food items, health services
International Standard 17065 - Requirements for Bodies Certifying Products, Processes & Services	International Standards Organization	http://www.iso.org/obp/ui/#iso:std:46568:en	General, structural, resource, process, management
International Standard 37120 - Sustainable Dev of Communities - Indicators for City Services & Quality of Life (also see 37101, 37150)	International Standards Organization	http://www.iso.org/iso/37120_briefing_note.pdf	Economy, education, energy, environment recreation, safety, shelter, solid waste, telecommunications, innovation, finance, fire, emergency response, governance, health, transportation, urban planning, wastewater, water, sanitation
Sustainability Assessment & Measurement Principles (Bellagio STAMP)	International Institute for Sustainable Development, Organization for Economic Cooperation & Development	http://www.iisd.org/pdf/2009/brochure_bellagiostamp.pdf	Guiding vision, essential considerations, adequate scope, framework and indicators, transparency, effective communication, broad participation, continuity and capacity

TABLE II
TOOLS FOR CITIES

Tools	Providers	Websites	Rating Categories
CASBEE for Cities	Institute for Bldg Environment & Energy Conservation, Japan	http://www.ibec.or.jp/CASBEE/english/	Nature conservation, local environmental quality, resource recycling, carbon dioxide absorption, living environment, social services, social vitality, industrial vitality, financial vitality, carbon dioxide trading
Comprehensive Plans for Sustaining Places	American Planning Assn, US	https://www.planning.org/sustainingplaces/complanstandards/	Livable built environment, harmony with nature, resilient economy, interwoven equity, healthy community, responsible regionalism
Eco-City	Ministry of Environmental Protection, China	N/A	Construction plan, independent environmental agencies, energy savings, environmental quality, ecological construction
Eco-Garden City	Ministry of Housing & Urban-Rural Development, China	N/A	Comprehensiveness, green space, cultural and natural landscapes, urban living environment, community participation, exemplary policy implementation
Low-Carbon City	National Development & Reform Commission, China	N/A	Integration of climate protection, green development, industrial GHG emissions, GHG emission database, low-carbon lifestyles
STAR Community	STAR Communities, US	http://www.starcommunities.org/	Built environment, climate & energy, economy & jobs, education arts & community, equity & empowerment, health & safety, natural systems, innovation & process
Sustainable Communities	Audubon International, US (available internationally, and for Existing Neighborhoods)	http://www.auduboninternational.org/sustainable-communities-program	Agriculture, economic development & tourism, education, environment, governance, housing, open space & land-use, planning zoning building & development, population, public safety & emergency management, recreation, resource use, volunteerism & civic engagement, transportation
BREEAM Communities	BRE Trust, Austria, Germany, The Netherlands, Norway, Spain, Sweden, United Kingdom	http://www.breeam.org/page.jsp?id=372	Governance, social & economic, well-being, resources & energy, land-use & ecology, transport & movement, innovation
CASBEE for Urban Development	Institute for Bldg Environment & Energy Conservation, Japan	http://www.ibec.or.jp/CASBEE/english/	Natural environment, area service functions, contribution to community, microclimate impact, social infrastructure, environmental management

IV. POPULAR RATING SYSTEMS

Ideology of sustainable development follows the researchers idea for "New Urbanism", developing rating system, such as LEED, which offered an assessment of residential structures, as well as the creators of the Smart Code ready planning templates for design fragments of the city. Famous rating systems of residential structures are LEED-ND (USA), BREEAM Community (United Kingdom), CASBEE-UD (Japan).

Particularly LEED-ND system is a distinguished system, which is a joint product of the US Green Building Council, the Congress of New Urbanism, and the National Defense Council. The pilot version of this voluntary assessment tool was introduced in 2007 with the aim of developing a sustainable neighborhood. Many projects in the United States

have adopted LEED-ND as the guiding framework for the district development plans. It is also used by developers in other countries. The main criteria of the standard are smart location and communication, planning and neighborhood design, green infrastructure and construction, innovation in the design process [10].

The system BREEAM stands for consideration of the principles of sustainable development at the earliest stages of the design process. According to the 2011 evaluation, criteria are divided into nine separate areas. The main areas are governance, social and economic development, prosperity, resources and energy, land use and ecology, transport and movement, innovation. Each line, in turn, is divided into separate criteria. Three assessments are available for each criterion. The group of experts determines the minimum

acceptable level of performance as the benchmark for comparison. Depending on the performance of a specific benchmark against (s), each criterion can get one, two or three points. The corresponding regional index is applied to the resulting assessment to give a final evaluation for this criterion. The arithmetic average of the scores of all nine areas is calculated and multiplied by 100 to determine the final figure. The technical guide BREEAM Communities, it was stressed that the standard version is only suitable for the evaluation of these projects are located in the UK. Any project outside the United Kingdom, which seeks to be certified, requires communication BRE Global and is used for the certification of BREEAM Bespoke Community. This is to ensure that the evaluation criteria have been adapted to the specific project development [11].

CASBEE-City Rating Systems are developed in Japan. In 2006, Japan Green Building Council and the Japan Consortium for Sustainable construction come together to determine the CASBEE-UD as a voluntarily tool for direction sustainable development. CASBEE-UD excludes evaluation of the interiors of buildings. The unique technique of assessment determines the quality of the environment (QUD) with considering the environmental burden (LUD) outside the

site boundary to calculate the environmental efficiency of the neighborhood. The evaluation criteria are divided into six groups (natural environment, service functions, area, contribute to the community, the impact of climate, social infrastructure and environmental management). Each group includes a number of criteria to determine the weights based on their relative importance in accordance with the decision of the expert group. The decision on the extent to which each criterion is done by comparing the performance with the specified criteria. Each group consists of a variety of criteria, which in turn are divided into separate sub-criteria and indicators. Each sub-criterion is evaluated on a scale that represents the five different levels of performance. The third level represents the normal situation, and it is used in Japan as a reference level for the evaluation. CASBEE-UD is used to assess the specific weight criteria. By sub-criteria, weighted scores are added to give an overall assessment of the criteria of a higher level. This procedure is repeated until the scores for environmental quality (Q) and the environmental load (L) are obtained. The final score of the environment is called the Building Efficiency Urban Development (BEEUD). Based on the achieved overall score, neighborhoods can qualify for one of the five levels of certification [12].

TABLE III
INDICATORS OF COMPLIANCE ARCHITECTURE-PLANNING STRUCTURE OF THE CONCEPT OF SUSTAINABLE DEVELOPMENT

Criteria	Indicators	
	Planning	Space
Placement and connection with the environment	The number of exchange lines connecting the city with the environment.	The value of suburban area.
	Availability of transport bypasses.	Accessibility to the city a higher hierarchical level.
	The presence of rivers, mountains and large forests	The proximity to the railway station, port, airport.
	City square	The difference in topography elevation within the city limits, m.
Planning structure	The density of the street network, km / km2	Accessibility to the city center.
	Street network connectivity (number of intersections per km2)	Distance between individual regions themselves.
	The area of the main functional areas	Accessibility to the periodic and routine maintenance, sports and recreational facilities.
	Balance functional areas	Coefficients diversity of housing types or integration of functions for individual zones.
Construction	The indentation building from the red line	Buildings height
	The length of the facade of the building	Buildings density on functional areas
	The maximum area of the quarter	The total built-up area (residential, public, industrial, etc.).
	Area section of single-family homes	Intensity coefficient buildings

Comparative analysis of the rating systems has revealed the lack of uniform criteria for assessing the resulting landscape and natural features of different countries, different requirements for transport services, development, and standards of living environment. Using the LEED-ND, developed in the United States, to assess housing education, located in Japan, showed very different results than its evaluation according to the criteria of the Japanese system [13]-[15].

As part of the "New Urbanism" charter, which originated in the eighties of the last century in the United States started to develop the system "smart codes" ready planning templates for the design of the city [16]. If we take into account the results of previous studies, we find that the finished planning decisions Smart Codes, probably not suitable for the conditions of Iran. At the same time, smart codes and rating

systems contain a list of criteria for planning and building of settlements, which may be taken as the basis for the development indicators of compliance architectural-planning structure for concept of sustainable development. In Iran there is a system of technical and economic indicators to assess the effectiveness of urban planning decisions, which basically copies the western examples. However, it needs a revision in terms of its compliance with the concept of sustainable development [17].

V.CONCLUSION

Summary of the results of previous studies led to the identification of two groups of indicators:

- *Planning indicators:* characterizing the state plan for the city and its planning structure (area of the city, the structure and length of the street network, the number of

nodal and zonal components);

- *Space indicators*: that reveal the nature of building and open spaces (height of buildings, building density, density of housing, width of streets, squares value), and identify temporal accessibility to places of attraction of the population.

The proposed typology of indicators matching architectural-planning structure of the concept of sustainable development (table 3) has incorporated the known technical and economic performance indicators of urban planning decisions, some criteria for rating assessment systems residential structures in USA, Japan, the United Kingdom, as well as planning templates, recommended Smart-Codes (USA). The specific value of the selected indicators for the conditions of the cities of Iran, of course, must be different from their foreign counterparts and are to be specified in the course of further research.

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