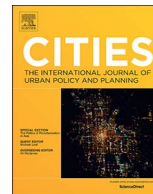




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Measuring sustainability of urban blocks: The case of Dowlatabad, Kermanshah city

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ABSTRACT

This paper tries to measure morphological characteristics of urban blocks through comparing an existed situation to sustainable development principles for urban form and applying an analytic assessment. The integral aim of this paper is identification of morphologically sustainable urban block and proposing an analytic assessment for measurement of sustainability of urban block. The three main morphological characteristics of urban block are size/length, configuration/grain and orientation. This descriptive-analytic paper uses scientific, empirical and quantitative method of studying of urban form through urban design perspective and French morphological school. The case study of present paper is Dowlatabad neighborhood of Kermanshah city in the west of Islamic Republic of Iran. This formerly informal/semiformal settlement has different problems in three initial characteristics. Approximately 13% of urban blocks are too long, some blocks are very large or very small, some areas have so many 4-way intersections, some areas have low permeability, majority of urban blocks have some cracks and the west side of neighborhood has an improper urban block orientation. Analytic assessment of sustainability of urban blocks of Dowlatabad quarters shows significant difference between adjacent and apparently similar quarters.

1. Introduction

The form of the contemporary city has been perceived as a source of environmental, social and economic problems. The first question is “how much and in which scale can we change our cities form”? Sustainable development says that strategies should focus more on the local level and the micro-scale and less on the macro-scale. One reason is the obvious fact that the existing urban structures are very permanent; it is very hard to change the macro level. However, on the micro level, the urban block level strategic adjustments are much easier to implement (Radberg, 1996). The variability of urban form at block scale directly affects outdoor climate, including heat island effects and air pollutant intensity and spread, and indirectly impacts indoor environmental quality and energy consumption through demand for artificial lighting, heating and air conditioning. (Osmond, 2008). The morphology of the urban block has been shaped traditionally by issues like land use, transportation, finance and globalization. As a result, many recent urban blocks are planned without consideration as to improving urban microclimate, enhancing outdoor conditions, respecting to neighbors and strengthening of social relationships. Now the second question is “which block sizes, shapes, orientations and

configurations can most flexibly achieved above mentioned concerns?” The answer is not clear as the first one was. It is essential to point out that to conceive the built form of the urban block is obviously a long and difficult process (Oikonomou, 2015). Moreover, though some aspects have been studied, there is little consolidated knowledge about the properties and performance characteristics of different block size, shapes and arrangement in terms of circulation, land use, building forms and other aspects (Siksna, 1997). Although these constraints, to make good change on urban blocks, we can get help from approaches like urban sustainable development. This global approach is known as the best solution to different urban issues. Although there are not unanimous agreements on urban sustainable development principles, measurement of sustainability of urban block is not impossible. We can look at urban sustainable development principles as local streets that finally will arrive at a unique main street called sustainability.

The need to provide practical solutions to the problems of urban unsustainability has generated a plethora of systems, methods and tools to help understand, manage and design the built environment. The paper focuses on measurement and quantitative analysis of urban block in terms of sustainability. A new quantitative method, based on a limited number of indices of block pattern, has been developed by using

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morphological measures and tools for analyzing urban form at block scale. These indices helped us in defining the physical characteristics of a particular urban environment, specifically the districts in our case, and by the use of these quantitative measures, it has been possible to differentiate the physical morphological features of the district.

The three questions of this paper are:

- What does the sustainable urban block look like?
- What are the main quantifiable indices of urban block?
- How can we measure the sustainability of urban block?

2. Literature

2.1. Critical review of literature

The debate over the ideal or desirable urban form dates back to the end of the nineteenth century, to popular proposals of Howard ([Jabareen, 2006](#)) and also his colleague, Unwin which talks about the balance between area of plot area of floor space and area of street. ([Berghauser Pont & Haupt, 2004](#)). However, the study of good urban form is still a relatively recent, undeveloped field and consists mainly of uncoordinated efforts undertaken by individual researchers. We have categorized existed literature in 8 classes. These classes and their examples are:

- 1) Some researchers have worked on sustainability of urban block, but their focus points are on architectural design and environmental considerations like energy consumption:
 - [Morello et al. \(2009\)](#) use an image processing technique to apply a geometrical model to design a sustainable urban block. This model focuses on environmental issues and especially energy consumption.
 - [Butters and Cheshmehzangi \(2016\)](#) design a pragmatic outline to make residential block more energy sufficient and more bioclimatic. Like so many similar studies they concentrate on architectural design such as solar system, ventilation and roof design instead of block design.
 - [Chen and Norford \(2017\)](#) evaluate sustainability of urban form including urban block in terms of environmental aspect in two case studies. Three indicators of their study are solar, ventilation and connectivity potentials.
- 2) Many researchers have assessed sustainability or suitability of urban form and even urban block in terms of distinct issues.
 - [Boarnet and Crane \(2001\)](#) assess the impact of urban form on different issues like mobility behavior and the relative environmental social impacts.
 - [Kouwenberg \(2013\)](#) tries to understand interrelationships between urban block characteristics and social organizations through historical query.
 - [Coppola et al. \(2014\)](#) define a system of assessment indicators for measuring sustainability of urban form in different land use and transportation situations.
- 3) There are some researchers that have taken general look at sustainability of urban block without any quantifying or analytic assessment.
 - [Moughtin \(1992\)](#) introduces compactness, connectivity and flexibility as three indices of sustainable urban form and also sustainable urban block.
 - [Williams, Burton, and Jenks \(2001\)](#) argue that sustainable urban blocks are characterized by compactness, mix of uses, interconnectivity and supporting by strong public transport and high standard of urban management.
 - [Dempsey et al. \(2010\)](#) examine the relative influence that different
- 4) Some researchers of urban form field, instead of sustainability assessment, have paid their attention to distinct problems.
 - [Jacobs \(1961\)](#) talks about great mistake of American cities about clearance of dense and mixed-use urban blocks.
 - [Levy \(1999\)](#) examines the different aspects of modern urban fabric as a relic problem. His work is relatively more relevant to sustainability notion, since he has talked about characteristics like density, compactness and continuity.
 - [Whiting \(2001\)](#) has an investigation about physical consequences of American downtown rebuilding.
- 5) There are some researches about quantitative assessment of urban form that their focus point is on higher scales like city and region form instead of urban block.
 - [Wassmer \(2000\)](#) examines urban form patterns in Sacramento, California and a small number of comparable cities.
 - [Galster et al. \(2001\)](#) conduct one of the most detailed analyses of compactness of urban form. They use 8 dimensions of compactness in 13 metropolitan areas and then based on normalized measures of those indices, they compute overall compactness ranking.
 - [Song and Knaap \(2004\)](#) evaluate compactness of two districts of Washington County, Portland, Oregon in terms of 5 overall parts consist of urban block. They assessed urban block indices for measuring some urban form qualities like connectivity and density not for overall measurement of urban block.
 - [Bin Kashem, Chowdhury, Majumde, and Rahman \(2009\)](#) attempt to employ Gini coefficient and Moran coefficient to quantify urban form in Rajshahi city in Bangladesh.
- 6) There are some researches about geometry of urban block without any analytic or formulated assessment.
 - [Krier \(1984\)](#) specifically concentrates on urban block and its morphological characteristics like size, shape and parameter. Although his proposals for urban block design are practical and less or more according to what we now call sustainable development, He doesn't try to have a quantitative assessment.
 - [Siksna \(1997\)](#) in an analytic way, describes a comparative study of block size and form of 12 north American and Australian city centers in terms of some indices like circulation and land use for analyzing the effect of block sizes and forms on subsequent urban development. Although he suggested interesting ranges for different geometrical characteristics of urban block, relationships between those characteristics in analytic way is neglected.
 - [Vialard \(2011\)](#) studies size, shape and configuration of urban blocks to measuring building footprint. She proposes measure of good fit between street and block for assessment of block performance through comparison of small areas of Atlanta and Savannah. Although her study has some quantitative details about urban block, holistic assessment of urban block is missing.
- 7) There are so many researches ([Australia, 2000](#); [Charlotte Department of Transportation, 2007](#); [Dawson Creek Council, 2008](#); [Leyland alliance LLC, 2008](#); [Metrasys, 2012](#); [NYCDOT, 2009](#); [T.G.M Guidebook, 2000](#)) about urban form standards and codes that majority of them have some ideal quantities for urban block especially about urban block geometry, but none of them have tried to have a holistic and thorough assessment of different indices of urban block.
- 8) There are some analytical methods and models for studying urban form that none of them offer a formulation or even a framework to assessment of urban block.

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