



A framework for assessing tall buildings' impact on the city skyline: Aesthetic, visibility, and meaning dimensions

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ABSTRACT

The impact of tall buildings on cities can be evaluated on several aspects. One of these aspects is the impression of these tall buildings on the cityscape, whereby observers judge these buildings based on their three-dimensional status in the city. Some of the criteria that influence this judgment are the status of visibility, meaning, and aesthetics of tall buildings in the city. In this research, the three aforementioned criteria have been investigated using an analytical network process (ANP) method. This multi-criteria decision analysis (MCDA) method is used to weigh the criteria and sub criteria of the research (according to 22 experts and by using Super Decisions 2.8 software). After determining the weight of each criteria, three tall buildings in Frankfurt including Main Tower, OpernTurm, and the European Central Bank were selected to compare their impact on the skyline of the city based on the three variables and their weight. To calculate the visual impact of these three buildings, the idea of square degree score has been used, in which the ratio of the visible surface of these buildings to the visual field of observers in urban open spaces, and in an area of 2500 m radius with a centralized building structure has been investigated by ArcGIS Desktop 10.5 software. In order to determine the effect of the meaning and aesthetics of these three buildings on the city skyline, a pictorial questionnaire was prepared and distributed among 420 participants. The participant's preferences were taken into account to assess the impact of tall buildings on the city skyline. In the next step, the weight of the criteria, which was obtained in the ANP method, was considered for the results of the visual, meaning, and aesthetic criteria of the three tall buildings of Frankfurt. Based on the technique for order of preference by similarity to ideal solution (TOPSIS), the priority of these buildings was identified in terms of impact on the city skyline. With regard to the impact of tall buildings on the city skyline, these three criteria, according to their weights, ranked as follows: the meaning criteria (with a weight of 0.436) had the highest impact, followed by the aesthetic criteria (with a weight of 0.340), and visual (with a weight of 0.234), respectively. Thus, based on these results it was found that the European Central Bank had the most positive impact (with a score of 0.471) on the city skyline, then Main Tower (with a weight of 0.467), and OpernTurm (with a weight of 0.061) respectively.

1. Introduction

High-rises have always been one of the most prominent elements of cities. The role of tall buildings in new city developments has drawn the attention of many researchers and critics in the past decades. Research on urban skyline shows that postcards and TV programs depict tall buildings as a significant component of the cities' image to attract people (Heath et al., 2000). Tall buildings need more attention because of their increasing numbers in modern cities world over and their exponential impact on the urban landscape (Short, 2007).

Although construction of tall buildings, in the modern sense, started in the 19th century, by the onset of the 20th century, realization had

dawned that the role of tall buildings was completely different from what was previously expected from these as well as their part in new developments (Gebhard, 1982). Hence, there have been various approaches to deal with the relationship of tall buildings in an urban landscape. The impact on historic environment, relationship to transportation system, their impact on permeability, sustainability, urban space, iconic role, and city skyline are among the common issues of tall buildings that have been studied during last decades (Al-Kodmany, 2017; Al-Kodmany and Ali, 2013; Charney, 2007; Gassner, 2009; Heath et al., 2000; Jencks, 2006; Short, 2007, 2012; Tavernor, 2007).

Based on previous research, from the points of view of fields including architecture, urban design, urban planning, and sustainability,

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the impact of tall buildings on cities can be generally considered because of three main features: 1-Effect of height and volume of tall buildings on the city and their role in forming new skylines (which is more related to visual dimension and its impacts); 2- Impact on the city as unique buildings with possible capacity of accommodating more humans and cars than other buildings (which needs to be considered owing to their cumulative functional effect on the city, such as causing heavy human and car traffic around the tall buildings); and 3- Environmental impact and their effect on the microclimate, wind circulation, and shading.

This research mainly focuses on the first-mentioned impact of tall buildings, which deals with their impact on the city skyline. This kind of impact is directly related to the visibility of tall buildings, and consequently indirectly affects the citizens and the city in other ways.

1.1. The Impact of tall buildings on the city skyline

1.1.1. Tall buildings

There is no universally accepted definition for the term “tall building”. In some cities, buildings with more than 12 stories are considered tall, in other cities 30–40 story buildings are not. In addition to the ambiguity of the term’s definition, there are various other terms related to tall buildings, which are not clearly defined, such as high-rise, skyscraper, tower, and super tall building (for definition of tower see [Veschambre, 2018](#)).

Based on the function of tall buildings, as well as the temporal and spatial conditions of these buildings, there may be differences in their definitions. At different time periods, different cities throughout the world have used different definitions for tall buildings, varying in relation to urban, firefighting, structural, and infrastructural features. Also, there are different definitions of tall buildings in different European cities. For example, in [Table 1](#), the definition of tall buildings in some cities in the UK is presented.

However, there is an unwritten agreement that tall buildings are the buildings which are considerably taller than the context (“[ctbuh.org](#)”, n.d.)

1.1.2. Skyline

Skylines form a prominent part of most cities, and each city has several skylines depending on the observer point. Due to the importance of skylines in the urban landscape, they have become a meaningful and important criteria for human civilization ([Attoe, 1981](#), p. xii). They represent the cultural, social, economic, and global character of cities ([Al-Kodmany and Ali, 2013](#), [Gassner, 2009](#)). The ziggurats in Mesopotamia, and pyramids and obelisks in old Egypt, which were built because of their civilizations’ beliefs, proves that skylines have

Table 1
Definition of tall buildings. Source: “[High Places: A planning policy framework for tall buildings](#)”, n.d.; “[Leicester City local development framework](#)”, n.d.; “[Plymouth Tall Buildings Strategy](#) February 2005”, n.d.; “[Tall Buildings SPD Review June 2012 – Portsmouth](#)”, n.d..

City	Definition of tall buildings
Birmingham	Any building significantly higher than its neighbours or make a recognizable impact on the skyline.
Plymouth	Any building which is significantly higher than its neighbours and/or which recognizably changes the skyline.
Portsmouth	Any building above 5 storeys in height Any building of 20 m or above in height (Most of the buildings in this city are two floors)
Leicester	A building over 20 m in height; and/or A building of any height, which is substantially higher than the predominant height of the buildings in the surrounding area; and/or A building, which would make a significant impact on the skyline of the city.

always been an important idea ([Mumford, 1961](#), [Stamps et al., 2005](#)). Skylines, as a symbol of the city, involve two interrelated parts: firstly a cognitive part, i.e. understanding the city by “reading” and “writing/drawing” it; and secondly, an interpretation part, i.e. expressing social and spatial relationships ([Gassner, 2009](#)).

In the past decades, efforts have been made to regulate skylines, including control of the buildings’ height, setbacks, the buildings’ volume, top of the buildings, and their color ([Stamps et al., 2005](#)). However, because each city has various skylines that have varied impacts such as political, economic, and cultural influences, it is not that easy to control the skylines.

Skyline is “a shape or pattern made against the sky, especially by buildings” ([Cambridge advanced dictionary](#)). [Gassner \(2013, 2009\)](#) studied the ways in which the term skyline was used through the last centuries. He shows that this term first appeared in the initial half of the 19th century, in the meaning of horizon, and later in the early 20th century, it was used to define silhouette of a city. He proposes that skyline is a “representation of the city from distant, low, and publicly accessible viewpoints.” In this definition of skyline the observer point has been added to the classic definition of the skyline, which just talks about the shape of the skyline as defined by buildings and trees against the sky.

In some research projects on skyline, to better understand this phenomenon, its social, economic and political dimensions are considered ([Skyline/HIGHRISE, n.d.](#)).

Considering the scope of this research mentioned in the “[Introduction](#)”, previous studies on the relationship between tall buildings and skyline can be divided into three main dimensions including aesthetic, visual, and meaning. The aesthetic dimension deals with the physical features of tall buildings and its skyline, and how the skyline could look more beautiful because of their presence. The visual dimension addresses how much of the tall buildings’ structure is visible and their impact on urban views. The dimension of meaning discusses the perceptions of people towards the presence of the tall buildings’ in the skyline and its representation for them. Therefore, in the following section, the tall buildings’ impact on the city skyline is considered in terms of the aesthetic, meaning, and visual dimensions.

1.2. Aesthetic, meaning, and visual dimensions

1.2.1. Visibility

Visibility analysis is among the best and easiest ways to study the impact of buildings on the city. [Appleyard \(1969\)](#) believes that there are three main features which help us recognize buildings, including form attributes, visibility attributes, and utility and significance attributes. Regarding visibility attributes, he argues that the more visible a building is, the more memorable it becomes. [Al-Kodmany and Ali \(2013, P.67\)](#) argue that “the visual impact of tall buildings on urban form extends far beyond their footprints.”

For a long time, the analysis of visibility conveyed the idea of a building being either visible or non-visible; however, [Fisher \(1994\)](#) argues that in the real world, tall buildings are not considered to be visible or non-visible. He suggests that visibility should be considered as a fuzzy logic that shows how much of a tall building is visible instead of visibility and non-visibility.

[Oh \(1998\)](#) suggests that two things must be simultaneously considered in visual analysis: firstly, how much of that is visible, and secondly, how important is it.

[Rød and van der Meer \(2009\)](#) demonstrated how the impact of proposed tall buildings on the city can be assessed by GIS-based visibility and dominance analysis. They added the dominance concept based on the distance of building from the observation point to make the visibility of tall buildings more real.

[Van der Hoeven and Nijhuis \(2012\)](#) carried out a visibility analysis of high-rise buildings’ development using GIS-based map that showed visual coverage and cumulative visibility of tall buildings. They offered

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