ISSN: 2008-5079 / EISSN: 2538-2365
DOI: 10.22034/AAUD.2019.147680.1675

Investigating the Visual-Psychological Pollution of Tall Buildings through Fish Eye Images and Citizen's Opinion; Case Study: Pastor and Jahannama Tower in Hamadan*

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Received 14 September 2018; Revised 20 May 2019; Accepted 30 June 2019; Available Online 20 December 2020

ABSTRACT

High-rise construction and the studies relevant to these buildings emphasize the various impacts of these visual elements in the cities. However, the psychological effects of these buildings, including the sense of oppression that citizens endure, have been neglected. In the present study, the sense of oppression that citizens endure from these tall buildings was studied. If this subject is studied carefully, it can be influential in the regulations of the tall building construction in the paths and the improvement of the psychological health of the citizens. Therefore, two studies were conducted; in the first part of the research, the sense of oppression inducing from the simulated Pastor Tower and changes in its configuration through the fisheye images were comparatively compared with the tolerance of the sense of oppression enduring by the citizens (the results of the previous studies). In the second part of the research, through the simulation of the Jahan Nama tower in Hamedan City, the perceptual oppression resulted from the buildings with the visual weights of 6%, 7%, 8% (the tolerance of the sense of oppression in the previous studies), 9%, and 10% and the effect of the trees on the mental oppression (in citizens' perspective) were investigated. The results of the first part indicated that the trees covering the façade of the simulated Pastor tower in the Mirzadeh Eshghi Street reduced the mental oppression resulted from the tower and is tolerated by the citizens. However, the mental oppression induced by this tower (simulated) from Pastor Avenue is high and a threat to the psychological health of the citizens. The results of the second part also indicated that the buildings with visual weights of 9% and 10% had the maximum mental oppression and the minimum openness and pleasantness. In contrast, the building with the visual weight of 7% was perceived with more openness, pleasantness, and likelihood of restoration. Moreover, by increasing the number of trees in front of the building, the mental oppression was reduced and the openness, pleasantness, preference, and the likelihood of the restoration of the landscape were increased.

Keywords: Sense of Oppression, Fisheye Images, Solid Angle, Citizens' Perception, Permissible Value of Sense of Oppression.

* This paper is extracted from the Ph.D. thesis of the fourth author entitled "Strategic Principles (guidelines) of designing tall buildings with the approach of visual quality and mental health of the citizens" that was conducted under the supervision of the first author and advice of the third author in Shahid Rajaee Teacher Training University of Tehran in 2020.

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1. INTRODUCTION

Psychological sustainability and the impact of the environment on people's psychological health is an important issue that has been studied in several studies (Rollings, Wells, Evans, Bednarz, & Yang, 2017; Vaid & Evans, 2016; Dong & Qin, 2017; Zhang & zhang, 2017; Diez & Mair, 2010, p. 125; Evans, 2003; Francis, Wood, Knuiman, & Giles-Corti, 2012; Pfeiffer & Cloutier, 2016). Urban environments and the tall buildings in them have many visual and psychological effects on citizens. In previous studies and theories about high-rise construction (tall building), the visual effects and architectural preferences of these buildings from the perspective of citizens have been addressed (Al-kodmany, 2011, 2017; Heath, Smith, & Lim, 2000; Karimimoshver & Abrarasari, 2014; Samavatekbatan, Gholami, & Karimimoshaver, 2016). Despite numerous studies related to the visual effects of tall buildings, the psychological effects of the architecture of tall buildings and their placement (setting) have received less attention. Citizens are daily affected by the stress and oppression imposed by cities and the design of buildings, which in turn can cause depression and challenge their psychological health. However, the effect of various factors on oppression and depression is not fully measured (Tamannaee & Tabatabaian, 2014; Asgarzadeh, Koga, Yoshizawa, Munakata, & Hirate, 2009). Mental oppression (i.e., sense of oppression) in the studies of Asgarzadeh et al. is a type of hidden environmental stress with a permanent effect. It occurs when a person is surrounded by tall buildings and violates his personal space and can cause stress, fatigue, decreased concentration, and inefficiency in the individual performance (Asgarzadeh et al., 2009; Asgarzadeh, Lusk, Koga, & Hirate, 2012; Maki, 2006; Zarghami, Karimimoshaver, Ghanbaran, & SaadatiVaghar, 2019). Limited studies have been conducted in Japan on the mental oppression caused by architecture and landscape. Researchers have studied the factors, such as the physical shape of the building (Takei & Oohara, 1977a, 1977b, 1978; Ohno, Tsujiuchi, & Inagami, 2003; Asgarzadeh et al., 2009; Asgarzadeh et al., 2012; Asgarzadeh, Koga, Hirate, Farvid, & Lusk, 2014), body-color (Takei & Oohara, 1978; Hiyoshi & Takei, 1990), texture and angle of view (Hwang, 2007), trees and plants covering façade (Ohno, Tsujiuchi, & Inagami, 2003; Asgarzadeh et al., 2009, 2010, 2012; Takei & Oohara, 1981), observer distance to the facade (Takei & Oohara, 1978; Asgarzadeh et al., 2009, 2012, 2014), the distance from the tree to the observer (Asgarzadeh et al., 2010, 2014) and individual and group buildings (Hwang, 2007) on mental oppression. Some studies also presented equations to estimate the mental oppression imposing by the building (Takei & Oohara, 1977, 1978; Hwang, 2007; Asgarzadeh et al., 2012). They introduce the mental oppression imposing by a building with 8% visual weight (solid angle) (Ω) or the confirmation factor of the building with 8% (Ψ) as the permissible value of the sense of oppression enduring by the citizens and considered a building with a visual weight of more than 4% (i.e., solid angle or the building configuration) as the influential factor in the urban environment (Takei & Oohara, 1981, Asgarzadeh et al., 2012). The study by Bokharaee (2017) entitled the oppressive environment: an analytical investigation of the role of building and settings reviewed the conducted studies in the environment oppression (the mental stress of the environment) and classification of the influential factors in this regard in two groups of the dependent factors on the building and settings (context). In this study, the variables related to the configuration, morphology, and the state of the building were considered as the dependent factors on the building. Also, the factors such as vegetation and viewer's distance from it, Sky and land View and the size of the setting (distance from the building) were classified in the factors dependent on the settings of the building (Bokharaee, 2017).

Controlling the mental oppression resulted from the environment and buildings make the designers' community more responsible (including urban and regional planners, architects, and urbanists) (Bokharaee, 2017). If neglecting the hidden impact of the mental oppression continues, the psychological health of the citizens will be in danger because the long-term oppression has severe and serious impacts on all the vital organs, such as the heart and arteries issues. Therefore, if people do not find a way to reduce the stress, their health will be endangered via various ways (Hamid & Babamiri, 2012, p. 310; as cited in Grahan & Stigsdotter, 2010). Considering the importance and analysis of reducing the mental oppression (oppressive environment: Asgarzade et al. 2012) resulted from the tall buildings in the psychological sustainability of the cities, few practical studies have been conducted on the mental oppression imposing by the tall buildings on the citizens in Iran (the studies are limited to Japan). The necessity to investigate this subject was taken into account in the present study by computational simulation (practically) and the perspective of the citizens. Thus, in the first part, based on the determined criterion (a building with a visual configuration factor of 8%) introduced in the previous studies as the threshold of the tolerance of the mental oppression by the citizens, one of the tall building of Hamedan city (Pastor Tower located in the intersection of the Pastor street and Mirzadeh Eshghi street) is analyzed in terms of the sense of oppression enduring by the citizens. In this part, the permissible value of the sense of oppression resulted from the formal simulated scenarios were investigated (based on the previous studies on the mental oppression: resulted that oppression from a building with the visual weight of 8%, is the threshold tolerance of the mental oppression by the citizens (Takaei & Oohara, 1981; Asgarzadeh et al., 2012)). Then, the effect of the vegetation of the building on reducing mental oppression was analyzed in the mentioned formal scenarios.

In the second part of the research, the Jahan Nama

tower in Hamedan (located in Jahan Nama Street) was selected and simulated. In this part, the tolerance threshold of the sense of oppression by the citizens and the impact of the trees were analyzed using the opinions of the respondents (in contrast to the previous part, this section did not accept the criterion determined in previous studies conducted on other countries as the tolerance threshold of the mental oppression as the basis for the analysis, and the criterion, determined by the citizens of the Hamedan city was analyzed and applied).

According to the reviewed issues and given that there is a research gap in the studies related to mental oppression, the present study seeks to answer the following questions: is the mental oppression imposing by the Pastor tower on citizens (the peripheral paths) the permissible value? In the streets where the Pastor tower is located, how the role of the vegetation can be explained in reducing mental oppression? By assuming that the distance of the viewer to the building is fixed in each one of the paths, in which formal scenarios of the Pastor tower (change in the width and height of the façade) the visual weight of the building is in the permissible range (in terms of mental oppression)? How to explain the oppression dissatisfaction caused by buildings with visual weights of 6, 7, 8 (stress tolerance threshold in previous studies), 9, and 10%? How is the effect of trees in front of a tall building on the oppression resulted by building (felt by citizens) explained?

2. RESEARCH THEORETICAL FOUNDATIONS

In this section, the main concepts of the psychological-perceptual effects of the urban landscapes are reviewed, and the mentioned concepts are presented in the conceptual research model.

2.1. Oppression Resulted From Facing the Tall Buildings

Living in compact and crowded cities has been considered a threat to the psychological health of the citizens. In the contemporary urban areas of Iran, the growing increase in the buildings can be witnessed that has established alone and are in contrast with their settings. These buildings are shaped as high and semi-rise buildings by land use, volumes, scales, and various colors (Azizi & Motevaseli, 2012). They have traffic, visual, and environmental impacts on the city and citizens that have been studied in the previous studies (Karimimoshaver & Winkemann, 2018). However, the psychological effects of tall buildings have been neglected among the impacts of the tall buildings. These effects have been only considered in limited studies in Japan. In these studies, the oppression implies the psychological effects caused by surrounding tall buildings on citizens and felt by them visually. These effects have consequences such as the violation of the comfort and personal privacy of the citizens and instability (Hwang, 2007; Asgarzadeh et al., 2012; 2010; 2009). Shortly, the oppression can be considered as the undesirable psychological pressure caused by the violation and dominance of the buildings with large configurations that challenge the mental and psychological states of the citizens. Therefore, naturally, humans sought to resolve this psychological pressure and distance from it (Bokharaee, 2017). Oppression is presented as a sense of oppression in the environment in a domestic study conducted in this regard (Ibid, 2017). In this study and an in a comprehensive view, as stated in the previous studies, the effect of factors on the oppression is analyzed in two groups of the factors dependent on the building (appearance, façade, and state of the building), and the factors dependent on the setting of the building (the viewer's distance from the building and the vegetation in front of the building and the visibility of that, the sky and land view in the building landscape).

In the present study, after consulting with experts in this field, the unfavorable feeling that people feel when facing tall buildings was called a "sense of oppression". Then, the effect of both categories of factors related to building and settings of the building on the sense of oppression (imposed on citizens) was studied (Fig. 1).

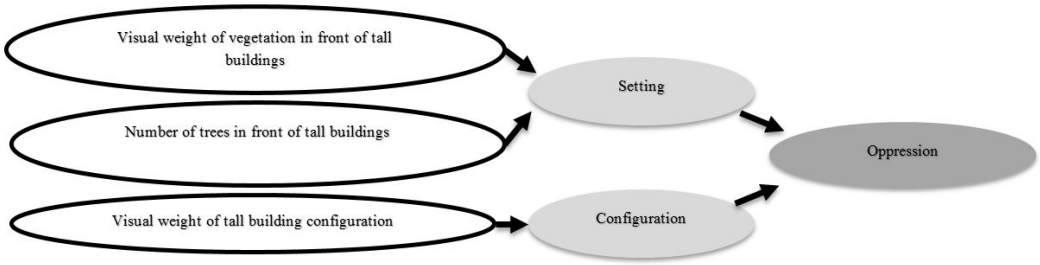


Fig. 1. Conceptual Research Model

2.2. The Psychological Qualities of the Urban Landscapes: Openness, Pleasantness, Preference, Restoration Likelihood

The psychological effects of the buildings and the urban environment are measurable in various ways. One of the most common ways applied in the pioneer studies of this research is the evaluation of the urban landscapes by the citizens and based on the psychological variables. Some of the most significant

variables are openness, pleasantness, preference, and restoration likelihood.

The openness of the landscapes refers to the scope of vision (lack of limit in vision) in the landscapes. The pleasantness and preferences of the landscapes are also among the psychological variables that evaluate the degree of a person's interest in the landscapes (Asgarzadeh, Lusk, Koga, & Hirate, 2012; Lindal & Hartig, 2013). The quality of the restoration of the environments (which is evaluated through the restoration likelihood) replaces the negative feelings with the positive feelings and modifies the physiological provocation and stimulation, and can be influential in the cognitive function of the users (Ulrich, 1993; Hull & Micheal, 1995; Han, 2003). Kaplan and Kaplan and Ulrich (the main theorists of the psychological restoration and restorative environments) believe that the restorative environments are the environments affecting in reducing the stress of individuals (Han, 2003).

3. RESEARCH METHOD AND TOOLS

In this section, the study area will be introduced. In the following, the research methodology and tools will be described in detail.

3.1. Study Area

In the present study, Pastor Towers and Jahan Nama Towers in Hamedan were studied. Pastor Tower is one of the oldest tall buildings in Hamedan, which is located at the Pastor crossroads of this city. The approximate height of this tower was 51 meters and the approximate width of its facade was 40 meters from Pastor Street and 30 meters from Mirzadeh Eshghi Street (Fig. 2).

Jahan Nama Tower is also located in the 30-meter (approximately) Jahan Nama street. The approximate height and width of this tower were assumed to be 60 and 15 meters, respectively. In the second part of the present study, in order to simulate, the building of Jahan Nama Tower and the building under construction to its left, formed a tall building together (Fig. 3).

Fig. 2. Pastor Tower of Hamedan

Fig. 3. Jahan Nama Tower of Hamedan

3.2. Research Method

The current research method includes three parts:

A) Analysis of the oppression caused by the changes in the configuration of the tall building based on the international standards (results of the previous studies),

B) Investigation of the perceptual- mental oppression and oppression satisfaction caused by the buildings with visual weights of 8% (6%,7%,8%,9%,10%) and comparison of these results with the permissible value of the sense of oppression presented in the international studies (in the previous studies, the oppression caused by the building with 8% visual weight was proposed as the tolerance threshold of the citizens (Takei & Oohara, 1981; Asgarzadeh et al., 2012)), and

C) Investigation of the effect of changes in the vegetation in front of the building on the oppression felt by the citizens.

In the first part of the research, the configuration of the Pastor Tower was changed based on ten scenarios (five configuration scenarios of the Pastor street and five configuration scenarios of the Mirzadeh Eshghi street). In the following, the visual weight of the Pastor tower (simulated) and the trees in front of it were calculated using the solid angle. Then, based on the international studies in which the oppression of the building with a visual weight of 8% (solid angle of 8%) was proposed as the tolerance threshold of the citizens (Asgarzadeh et al., 2012), the tolerance of the oppression caused

by various scenarios was analyzed. (the calculation method of the visual weight of the building has been described in the following section in detail). The second and third parts of the current research were conducted by the participation of 20 citizens of Hamedan city. In the first step, the complex of Jahan Nama tower (integrated with the adjacent building) was simulated in a variable range of the visual weight (solid angles) of 6%, 7%, 8%, 9%, and 10%. Then, by assuming the 28-meter distance of the viewer from the complex, the actual images (landscape) and fisheye images of each of the five scenarios were provided. According to the international studies conducted in this regard (Ibid, p. 4), providing the usual images was implemented based on a 100-degree horizontal field of view and an 85-degree vertical field of view (These angles associate the human field of view in a glance: simulation of these settings was done through 3D MAX software). In the following, the fisheye images were inputted in Spconv software, and the solid angle of the building was calculated (solid angles of 6%, 7%, 8%, 9%, and 10%). In the second step of the research, the number of trees in front of the Jahan Nama tower complex was simulated in four scenarios. In the first scenario, there was no tree in front of the building. In the second scenario, there was a tree in front of the building. Two and three trees were considered in the third and fourth scenarios, respectively. The landscape images of the mentioned scenarios (in both steps) were also ranked by respondents and based on a 7-question questionnaire. Therefore, each of the respondents ranked the images (landscape) based on the sense of oppression, oppression dissatisfaction, openness, openness satisfaction, pleasantness, preference, and restoration likelihood (Asgarzadeh et al., 2012; Lindal & Hartig, 2013). The items were extracted from the literature of this subject and translated by the first author to Persian. In the following, the second translator translated the translated items into English. Finally, the third translator compared the Persian version and the Latin version of the items. The result of this process was seven items of sense of oppression, oppression dissatisfaction, sense of openness, openness satisfaction, pleasantness, preference, and restoration likelihood. The seven questions were investigated based on the opinions of five experts in architecture and psychology. Cronbach's alpha coefficient was applied to calculate the questionnaire reliability. The value of Cronbach's alpha was obtained more than 0.7 for seven variables, indicating the reliability of this scale. In the developed questionnaire, demographical characteristics of the respondents, such as age, gender, and education level were also collected in addition to the seven research variables. To control the representation conditions and intervening factors such as traffic and noise pollution, the questionnaire was sent online and through email and social networks to the number of citizens. Eventually, 20 citizens participated in the research process. Each of the participants responded to the seven questions related to the images shown to them. In general, every respondent completed a questionnaire that included nine sections (nine images) with seven questions. The results indicated that 70% of the respondents were male, and the rest were female. 5% of the respondent had a master's degree, 70% of the respondents had a bachelor's degree; also, 10 % had an associate degree, and 15% had a diploma. Moreover, 70% of respondents were in the age group of 20-30 years old, 15% were in the age group of 30-40 years old, 10% were in the age group of 50-60 years old, and 5% were in the age group of 40-50 years old.

3.2.1. Measuring the Visual Weight of the Building and Vegetation Using Fisheye Images

The visual weight of the building and vegetation in front of it was calculated using a solid angle (3D view angle). To estimate the solid angle of the buildings as well as the sky and tree factor, Nikon Coolpix 995 and FC-E8.21X fisheye converter or the software simulations were used to provide the spherical images. Then, the obtained images were inputted into the Spconv software, and the solid angle was calculated (based on percentage) (Asgarzadeh et al., 2012) (Fig. 4). To estimate the solid angle of the building based on the spherical images (fisheye), the fisheye of the viewer's view (Camera) was set vertical on the façade when providing the photos, and the camera angle was set at 30 degrees to the building.

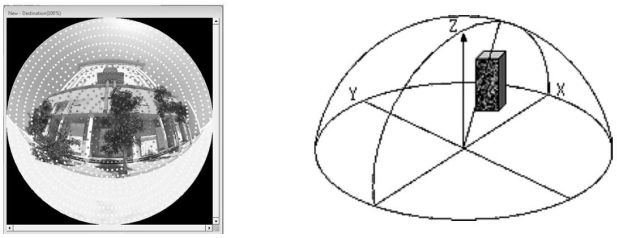


Fig. 4. (A) Right: Calculation of the Solid Angle. B) Left: Calculation of the Solid Angle of the Building and Trees in the Spconv Software
(Asgarzadeh et al., 2012, p. 4)

3.2.2. Defining Configuration Scenarios of Pastor Tower

After studying the current situation of Pastor Tower from each street, five formal scenarios of each street were defined and analyzed based the above method. The modeled tower in the present study was examined from the Pastor Street, assuming a height of 51 and

a width of 40 meters. In Mirzadeh Eshghi Street, the results were analyzed assuming a height of 51 and a width of 30 meters (Tables 1 & 2).

3.2.3. Defining Configuration Scenarios of Jahan Nama Tower and Its Vegetation

In the second section, the Jahan Nama tower and its adjacent building (Fig. 3) formed a high-rise urban body (a building). This section includes two separated parts. In the first part, after analyzing various configurations of the building in the Spconv software (inputting the fisheye images of the configurations and calculating their visual weights), the simulation of the Jahan Nama Tower complex was implemented in a way that the visual weights of the building be 6%,7%, 8%, 9%, and 10% (five scenarios) (Table 3). In the next part, the height of the Jahan Nama tower was set and simulated equally to its adjacent building. In the following and by assuming the identical building (the identical configuration), the number of trees in front of this building was changed. Therefore, in the first scenario, there was no tree in front of the building. In the second, third, and fourth scenarios, there were 1, 2, and 3 threes in front of the building, respectively (Table 4).

4. ANALYSIS AND DISCUSSION OF THE RESEARCH FINDINGS

In this section, the findings related to the impact of building conditions and its settings on the psychological status of the citizens will be reviewed, separately.

4.1. Evaluation of the Changes in the Configuration of the Pastor Tower Based on the Permissible Value of the Oppression Proposed in the International Studies

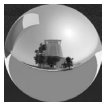
In this part, scenarios presented in the first part of the current research are classified into two groups:

A) The solid angles of the Pastor Tower from Mirzadeh Eshghi street (Table 1) and

B) The solid angles of Pastor Tower from Pastor Street (Table 2).

In this section, based on the previous studies, the oppression caused by the building with the visual weight of 8% has been considered as the tolerance threshold of the oppression by the citizens (Takei & Ohara, 1981; Asgarzadeh et al., 2012). Accordingly, the results of the studying the assumed Pastor tower from the Mirzadeh Eshghi street indicated that by assuming the viewer in the middle of the street, the solid angle of the building and trees is 16.9%, and is not in the permissible value according to the oppression. However, by subtracting the solid angle of the building from the solid angle of the trees covering the façade, the solid angle is reduced by 7.9%. Although this value is less than 8%, it is on the borderline of the permissible and non-permissible value. The viewer was standing on the sidewalk edge, facing the Pastor Tower in the second aspect of this street. In this state, the total solid angle of the building and streets is 10.6% which by subtracting the effect of the trees, is reduced by 6% and is in the permissible value. In two studied cases, the effect of trees can be seen in reducing the solid angle and oppression imposing by the building (Table 1). While the observer was stationed at the edge of the sidewalk facing Mirzadeh Eshghi Street, four formal scenarios were examined (Table 1 & Figs. 5-8). The basis of the changes in these scenarios was the situation of the tall buildings in Hamedan city. In the first scenario, assuming that the width of the façade is fixed (from Mirzadeh Eshghi street), the height of the building was reduced by 30 meters (height to width ratio: 1). In the second scenario, the height of the façade was reduced by 15 meters. Therefore, the height to the width ratio of the façade was 0.5. In the third and fourth scenarios, the height was considered fixed, and the width of the façade was reduced by 25.5 and 17 meters. Also, the height to the width ratios were 2 and 3.

Table 1. The Changes in Formal Scenarios and Their Impact on the Solid Angles (Percentage) of the Pastor Tower from Mirzade Eshghi Street

Height	Width	Ratio	Viewer's Distance		The Difference between the Solid Angle of the Building and the Solid Angle of the Covering Trees	Solid Angle of Trees Covering the Building	Solid Angle of Building and Covering Trees
51	30	1.7	15		7.9	9	16.9
51	30	1.7	26		6	4.6	10.6
30	30	1	26		4	5	9

Height	Width	Ratio	Viewer's Distance		The Difference between the Solid Angle of the Building and the Solid Angle of the Covering Trees	Solid Angle of Trees Covering the Building	Solid Angle of Building and Covering Trees
15	30	1.2	26		1.8	4.5	6.3
51	25.5	2	26		4.3	3	7.3
51	17	3	26		2.5	2.7	5.2

The results of each one of the four scenarios were presented in Figures 5-8. The results indicate that where the height and width of the façade had been 30 meters, and the height to the width ratio was 1, the solid angle of the building and covering trees was 9% and is in the non-permissible value. However, by subtracting the impact of the trees, covering the façade, the value was reduced by 4% (Figs. 5 & 6). Therefore, it is in the permissible range. In a scenario in which the height of the façade was 51 meters and the width of the façade was 25.5, (the height to the width ratio of the façade: 2), the solid angle was 7.3 at the beginning. After applying the impact of the trees, the solid angle was reduced by 4.3, which does not violate the permissible value (Figs. 7 & 8). In the other two scenarios, the solid angle of the building and the covering trees, and the difference of the solid angle of the building from the trees was in the permissible range. In these scenarios, the total solid angle of the building and trees was higher than 4%, and this value imposes the oppression based on the empirical background. However, the imposing oppression by solid angles of 4-8% is tolerable by the citizens. Although in these two scenarios, by applying the impact of trees, the pure solid angle of the building is less than 4%, and the imposing oppression is more desirable (Figs. 5-8).

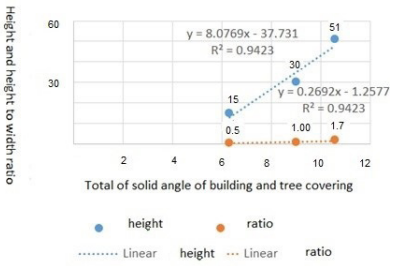


Fig. 5. Distribution Diagram of Facade Height Values and Height to Width Ratio and the Total Solid Angle of the Building and the Solid Angle of the Covering Trees

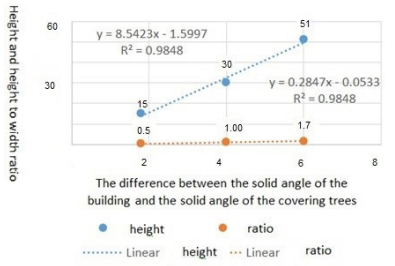


Fig. 6. Distribution Diagram of Facade Height Values and Height to Width Ratio and the Difference between the Solid Angle of the Building and the Solid Angle of the Covering Trees

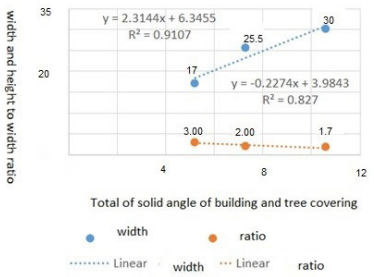


Fig. 7. Distribution Diagram of Facade Width Values and Height to Width Ratio and the Total Solid Angle of the Building and the Solid Angle of the Overlying Trees

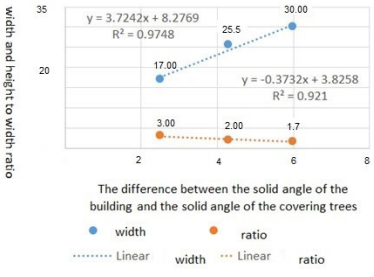


Fig. 8. Distribution Diagramof Facade Width Values and Height to Width Ratio and the Difference of the Solid Angle of the Building from the Solid Angle of the Covering Trees

The solid angles of the modeled tower of Pastor from Pastor Street (before and after the formal changes) were investigated in Table 2.

Table 2. Change of the Formal Scenarios and Its Impact on the Solid Angles of the Pastor Tower from Pastor Street

Height	Width	Ratio	Viewer's Distance		The Difference between the Solid Angle of the Building and the Solid Angle of the Covering Trees	Solid Angle of Trees Covering the Building	Solid Angle of Building and Covering Trees
51	40	1.27	19		10.6	8.9	19.5
51	40	1.27	16		15.8	6.8	22.6
40	40	1	16		15.7	6.5	22.2
20	40	1.2	16		13.6	5.5	19.1
51	25.5	2	16		8.9	4	12.9
51	17	3	16		7.6	2.8	10.4
51	40	1.27	14		17.3	6.8	24.1
51	40	1.27	10		19.9	10.2	30.1
51	40	1.27	7		19.2	17.7	36.9

The results of this part also indicate that (based on the tolerance threshold of the oppression stated in the previous studies) in all situations (in different distances of the current situation of the modeled Pastor Tower: height: 51 meters and 40 meters width), the solid angle of the building and the covering trees is more than 8% and is in the impermissible range (Table 2). In one of the scenarios in which the height of the building was considered fixed (51 meters) and the width of the building was reduced by 17 meters, and the height to the width ratio is 3, the total solid angle of the building and the covering trees was 10.4% which is in the impermissible range. Indeed, after reducing the impact of trees, this value was reduced by 7.6%, leading to a more desirable situation in terms of oppression (Figs. 11 & 12). The impact of trees on reducing the oppression from this street in the other three formal scenarios is considerable. That is, in the three scenarios (height: 40 meters, width: 40 meters, and ratio: 1, height 20 meters, width 40 meters, ratio: 5, and height 51, and width 25.5, ratio: 2), the trees have led to the reduction in the solid angle of the building. However, due to the 8% difference of the solid angle of the building from the trees, in these situations, impressible oppression is imposed on the citizens (Figs. 9-12).

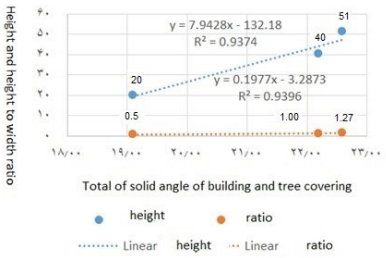


Fig. 9. Distribution Diagram of Facade Height Values and Height to Width Ratio and the Total Solid Angle of the Building and the Solid Angle of the Covering Trees

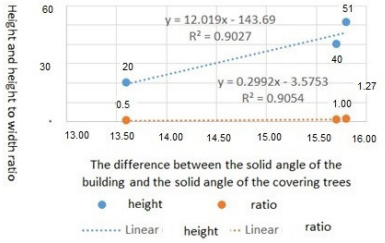


Fig. 10. Distribution Diagram of Facade Height Values and Height to Width Ratio and the Difference between the Solid Angle of the Building and the Solid Angle of the Covering Trees

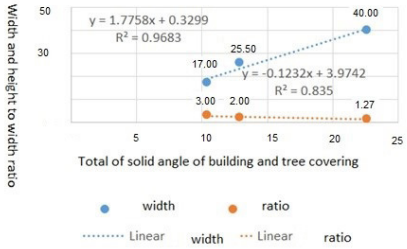


Fig. 11. Distribution Chart of Facade Width Values and Height to Width Ratio and the Total Solid Angle of the Building and the Solid Angle of the Overlying Trees

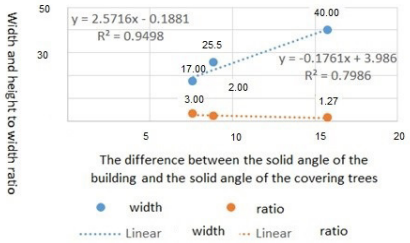


Fig. 12. Distribution Diagram of Facade Width Values and Height to Width Ratio and the Difference of the Solid Angle of the Building from the Solid Angle of the Covering Trees

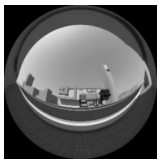
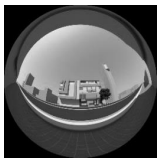
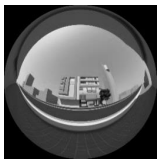
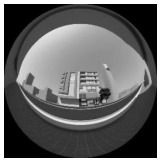
In the conclusion of this section, the current situation of the modeled Pastor Tower from two streets of Pastor and Mirzadeh Eshghi were compared in terms of oppression (Based on the tolerance threshold of oppression in the previous studies). The results indicated that the situation of the modeled Pastor Tower from the Pastor street and with the height to the width ratio of 51 to 40 meters, the solid angle is higher than 8% in the maximum distance of the viewer from the building (in the middle of the sidewalk facing the tower). Thus, its imposing oppression is beyond the tolerance of the citizens who face this simulated building from Pastor Street. However, in the modeled Pastor Tower from the Mirzadeh Eshghi street (which has more width), is more desirable. In two situations in which the Pastor tower was evaluated from this street, the total solid angle of the building and the covering trees was higher than 8%. However, after reducing the solid angle of the trees covering the building, its value was reduced by less than 8% and was in the permissible range.

4.2. Comparing the Perceptual- Mental Oppression (According to Citizen's Opinion) in the Buildings with the Visual Weight of Surrounding 8%

In previous studies, the oppression caused by a building with the visual weight of 8% was proposed as the permissible value of the oppression by the citizens. However, the tolerance threshold of the oppression was proposed in the conducted studies in Japan and was defined based on Japanese people's opinion. Therefore, it is required to evaluate the accuracy of this criterion in other countries. In the present study, the buildings with the visual weights of approximately 8% (criterion determined in the previous studies) were modeled to study the criterion's accuracy in the simulation environment.

In Table 3, the formal scenarios related to the buildings with visual weights of 6%, 7%, 8%, 9%, and 10% were presented (Table 3). In Table 5 (left), the results of ranking the stated scenarios based on the oppression, oppression dissatisfaction, sense of openness, openness satisfaction, pleasantness, preference, and restoration likelihood variables were presented from respondents' point of views (Table 5).

Table 3. The Formal Scenarios of the Building to Achieve the Building with Visual Weights of 6%, 7%, 8%, 9%, and 10%

Number of Images	Visual Weigh of the Building (Solid Angle)	Viewer's Image	Fisheye Image
1	6		
2	7		
3	8		
4	9		
5	10		

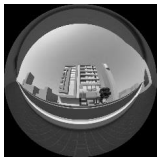
The results of the evaluation of the scenarios related to the visual weight of the buildings by respondents also indicated that by increasing the visual weight of the building, the oppression perceived by the citizens increases as well and leads to the reduction in the citizens' satisfaction. Moreover, by increasing the visual weight of the building from 6% to 10%, the openness (satisfaction with openness), pleasantness, preference, and restoration likelihood in the landscape has been decreased (Table 5, left graph).

Furthermore, the oppression dissatisfaction of the building in the visual weight of 6%, 7%, 8%, 9%, 10% showed that based on the perspective of the research sample, the oppression satisfaction of the building with 10% visual weight was more than other angles. In the 7-points Liker scale, the values of 1 to 3 indicate low oppression (oppression dissatisfaction), and 4 shows the average oppression dissatisfaction, and values 5-7 represent the high oppression dissatisfaction. The oppression dissatisfaction of the visual weights of 6%, 7%, 8%, and 9% was lower than 4. Also, analysis of the graphs of this section indicated that the building with 7% visual weight was perceived with higher openness, pleasantness, and restoration likelihood. In contrast, the buildings with 9 % and 10% visual weights were perceived with lower openness and pleasantness. In terms of preference, the respondents preferred buildings with 8% and 9% visual weights.

4.3. Investigating the Impacts of Changes in the Vegetation in Front of the Building on the Oppression Endured by the Citizens

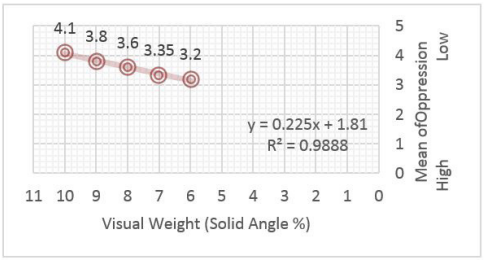
The scenarios related to the changes in the vegetation in front of the building were presented in Table 4. In Table 5, the results of ranking the related scenarios to the changes of the trees in front of the building were presented based on the variables of oppression, oppression dissatisfaction, sense of openness, openness satisfaction, pleasantness, preference, and restoration likelihood (in respondents' perspective).

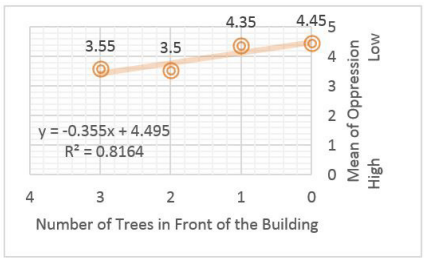
Table 4. Related Scenarios to the Changes in the Trees in Front of the Building

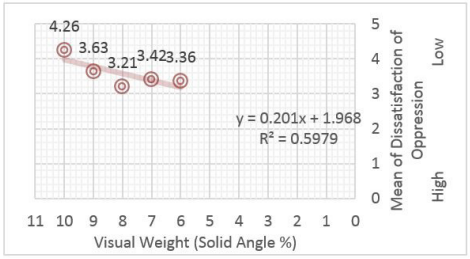
Number of Images	The Number of Trees in Front of the Building	Viewer's Image	Fisheye Image
6	0		
7	1		
8	2		
9	3		

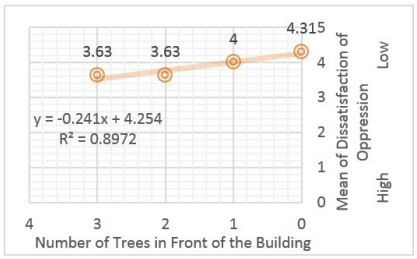
The evaluation results of the related scenarios to the change of trees in front of the building indicated that by increasing the number of trees in front of the building, the oppression (oppression dissatisfaction) endured by the citizens was reduced, and the sense of openness (openness satisfaction), pleasantness, preference, and restoration likelihood of the landscape were increased (Table 5, graphs on the right). The positive impact of the vegetation on reducing stress and improving the psychological health of the people has been proven in many theories, and previous studies and the findings of the current study were in line with these studies (Ulrich, 1983; Kaplan & Kaplan, 1989) (Gatersleben & Andrewes, 2013).

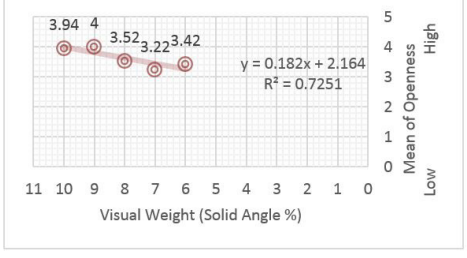
Table 5. The Results of Ranking the Related Scenarios to the Change in the Trees in Front of the Building in Respondents' Point of Views (The Graphs on the Right), and the Results of the Related Scenarios to the Change in the Visual Weight of the Building in Respondents' Point of Views (Graphs on the Left)

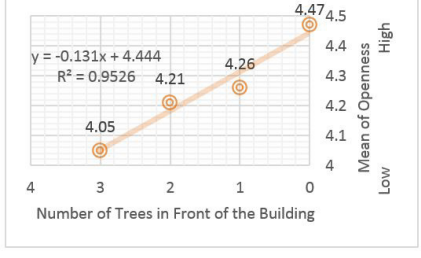


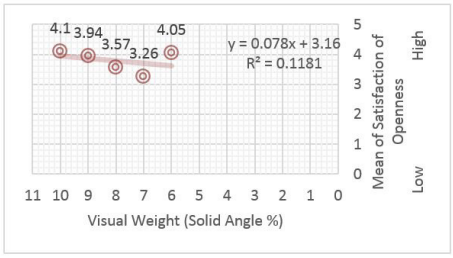


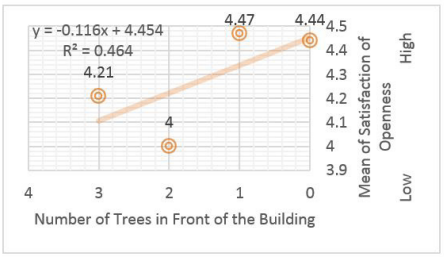


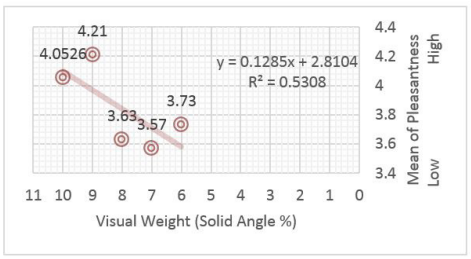


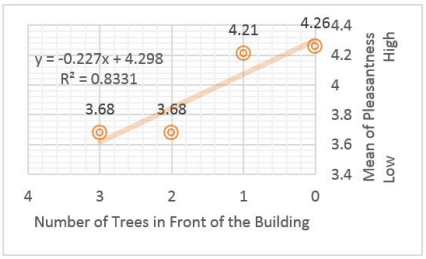


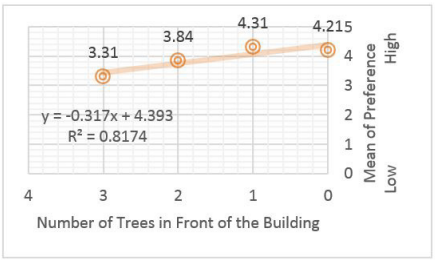


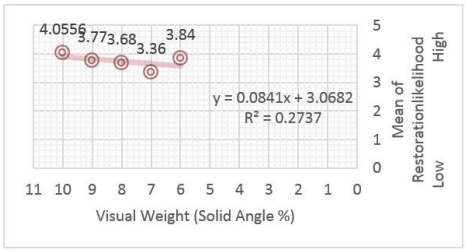


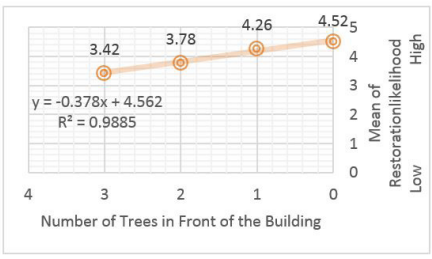












5. CONCLUSION

The present research studied the oppression caused by the tall buildings based on the configuration and their settings. The research area of the present study was Hamedan city. This city experienced high-rise constructions and the formation of several tall buildings in its streets. Two tall towers of this city (Pastor Tower and Jahan Nama tower) were selected and studied as the case studies. The present study was conducted based on two field studies. The first field study evaluated the endured oppression from the modeled Pastor Tower and the changes in its configuration (by assuming the vegetation in front of the building to be fixed) in each one of the streets. Then, the caused oppression was compared with the permissible value of the sense of oppression enduring by the citizens.

In the second field study, Jahan Nama Tower and citizens of Hamedan have formed the setting and case study. The building of the Jahan Nama tower and its adjacent under-construction building were studied as a tall building (one tall building). The purposes of the second filed study were the comparison of the permissible value of the sense of oppression that citizens endure (determined in the previous studies) with the society's tolerance threshold of the oppression and investigation of the impact of trees on the oppression imposed by the buildings.

The results of the first study indicate that the oppression imposed by the modeled Pastor Tower is beyond the tolerance of the citizens who face the modeled building from Pastor Street. However, the situation of the modeled Pastor Tower from the Mirzadeh Eshghi Street was more desirable. In the positions of this street, in which the Pastor Tower was evaluated, the total solid angle of the building and the covering trees was higher than 8%. After reducing the solid angle of the trees covering the building, this value was reduced to less than 8% and was in the permissible range. It does not mean that the modeled Pastor tower does not impose any oppression on the citizens from the Mirzadeh Eshghi Street, but it means that the trees covering the façade of the Pastor Tower from the

Mirzadeh Eshghi street made the oppression imposed on the citizens be in the permissible and endurable range of 4-8%. To achieve the height and width values that oppression of them is endurable by the citizens, the researchers manipulated the width and height of the Pastor Tower's façade from each street. Four scenarios in Pastor street and four scenarios in Mirzadeh Eshghi street indicated that the vegetation assumed in front of the Pastor Tower in Pastor street is too less to make the oppression imposed by the tower endurable. Therefore, two architectural guidelines were presented. Providing more vegetation in the body and basis of the Pastor tower from Pastor Street and reduce the width of the tower to a fewer value. However, the first guideline is more practical regarding the built tower, and the second guideline can be applied when designing new towers in the streets similar to Pastor Street. Moreover, the results showed that the trees in front of the modeled Pastor Tower from Mirzadeh Eshghi Street have a considerable role in making the oppression caused by the tower endurable.

The results of the second field study presented that by increasing the visual weights of the building from 6% to 10%, more oppression was felt by the citizens and the satisfaction with the oppression, openness (satisfaction with openness), pleasantness, preference, and restoration likelihood of the landscape was decreased. Moreover, analyzing the oppression dissatisfaction of the building in visual weights of 6%, 7%, 8%, 9%, and 10% showed that in the perspective of the research sample, the oppression dissatisfaction of the buildings with visual weights of 6%, 7%, 8%, and 9% was in the average level. However, the oppression dissatisfaction of the building with 10% visual weight was high and led to more dissatisfaction from other angles. The results also indicated that the buildings with visual weights of 9% and 10% had the minimum sense of openness and pleasantness, while the building with 7% visual weight was perceived with higher openness, pleasantness, and restoration likelihood. In terms of preference, the respondents preferred the buildings with visual weights of 8% and 9%. The results of the evaluation of the changes in the trees in front of the building also showed that by increasing the number of the trees in front of the building, the openness (openness satisfaction), pleasantness, preference, and restoration likelihood have increased. Also, the oppression dissatisfaction felt by the citizens was decreased. This finding is in line with many studies in psychological health. Also, the positive impact of the vegetation on the psychological health of people was emphasized in various studies.

Considering that the present study is one of the first domestic studies in the field of oppression caused by tall buildings in urban landscapes, therefore, it may have shortcomings and limitations (i.e., simulations, criteria related to oppression tolerance threshold and adaptation of respondents' evaluation conditions with real conditions of exposure to tall buildings) which requires further studies in this field.

ACKNOWLEDGMENT

In this paper, we would like to appreciate the support of Dr. Morteza Asgarzadeh (Harvard University Senior Researcher) in sharing a copy of Spconv software and his guidance during the research.

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HOW TO CITE THIS ARTICLE

Zarghami, E., Ghanbaran, A.H., Karimimoshaver, M., & SaadatiVaghar, P. (2020). Investigating the Visual-Psychological Pollution of Tall Buildings through Fish Eye Images and Citizen's Opinion; Case Study: Pastor and Jahannama Tower in Hamadan. *Armanshahr Architecture & Urban Development Journal*. 13(32), 125-139.

DOI: 10.22034/AAUD.2019.147680.1675
URL: http://www.armanshahrjournal.com/article_120077.html