

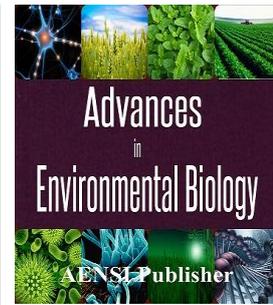


AENSI Journals

Advances in Environmental Biology

ISSN-1995-0756 EISSN-1998-1066

Journal home page: <http://www.aensiweb.com/AEB/>



Examining Thermal Comfort in Designing Commercial Streets regarding Urban Sustainability – A Case of Mollasadra Commercial Street in Shiraz, Iran

¹Zahra Barzegar and ²Maryam Rasaeipoor

¹Department of art & Architecture, Payame Noor Universtiy (PNU), P.O. BOX, 19395-3697 Tehran, IRAN.

²Department of art & Architecture, Payame Noor Universtiy (PNU), P.O. BOX, 19395-3697 Tehran, IRAN.

ARTICLE INFO

Article history:

Received 12 October 2014

Received in revised form 26 December 2014

Accepted 1 January 2015

Available online 18 February 2015

Keywords:

Sustainable Development; Urban Sustainability; Thermal Comfort; Energy; Commercial Street

ABSTRACT

Nowadays, the concept of sustainable development occupy a special place in urban management, and what is important is to pay attention to non-renewable resources, especially energy, which is part of environmental case in urban sustainability, and to protect it for future generations; in designing spaces, it can provide the human thermal comfort while maintaining minimum energy consumption. The present study examined energy consumption and thermal comfort, presence or absence of sustainability in Mollasadra Commercial Street located in Shiraz, Iran. A naturalistic approach was applied to the research. After collecting information, questionnaires, developed on questions such as times when the sun shines on the street and shop's vitrine, the times when the shade reaches vitrines and pavements and using cooling and heating equipment in two hot and cold months of the year, were administered to survey 120 samples including shopkeepers. The summer result showed using cooling equipment, when the people go shopping, varied from 70% to 93.30% since there is a direct non-desirable sunshine in the street, and the lack of proper shade, and the winter results showed using heating equipment varied from 53.3% to 100% since there is not an appropriate sunshine. It demonstrated a high energy consumption to meet comfort and the absence of sustainability in Mollasadra Street designing.

© 2015 AENSI Publisher All rights reserved.

To Cite This Article: Zahra Barzegar and Maryam Rasaeipoor., Examining Thermal Comfort in Designing Commercial Streets regarding Urban Sustainability – A Case of Mollasadra Commercial Street in Shiraz, Iran. *Adv. Environ. Biol.*, 9(2), 387-391, 2015

INTRODUCTION

The rapid urbanization is often at the expense of the loss of valuable ecosystems and lands for satisfying the urban demands. Moreover, if the current and future urban areas continue with the same resource consumption practices without regarding the future needs, serious environmental, social and economic problems are expected [1].

Nowadays, unfortunately, the indiscriminate use of non-renewable natural resources causes an imbalance in the ecosystem. Providing solutions to regulate the use of these resources and preserving it for future generations, therefore, is a challenge the men faces today; it takes a lot of effort around the world.

Iran experiences different climates and what is important is to adapt building design for climate changes in order to use all facilities in constructing optimizely. Architecture has a strong influence in man and his soul; it can be said it plays a vital role in spiritual welfare of society, and can change man's life drastically. Applying efficient materials and design to reduce energy use, therefore, can be regarded as a positive points that should be considered in sustainable architecture and widely in sustainable urbanization.

This research is to examine energy sustainability in commercial streets, one of the most useful and crowded ones. To this aim, Mollasadra Commercial Street located in Shiraz, Iran has been chosen. The questionnaires have measured the shopkeepers' level of satisfaction regarding the condition of this street and the amount of energy required to attain the hot and cool states of the shops in a warm and a cold season.

Sustainable Development:

Development arose from the early 19th century [2]. The notion *sustainable* as an adjective for development, is also a condition in which the desirability and the available facilities are not decreased over time. It is derived

Corresponding Author: Zahra Barzegar, Department of art & Architecture, Payame Noor Universtiy (PNU), P.O. BOX, 19395-3697 Tehran, IRAN.
E-mail: zahrabarzegar86@yahoo.com

from the Latin *Sustenerere* meanse to hold and denote to long-life durability [3]. Sustainable Development is a concept used at the time of The Declaration of Cocoyoc in Mexico in 1970's. It has its roots in ecological sustainability, first addressed in the World Conservation Strategy [4]. Independent World Commission on Environment and Development (WCED) defined it as meeting "the needs of the present without compromising the ability of future generations to meet their needs". This simple, vague definition was also the foundation for *Agenda 21*, the document that emerged from the United Nations Conference on Environment and Development as a sustainable development action plan for the 21st century [5].

Sustainable development is a new form of governance which encourages social participation of all those involved in decision-making process; it has three dimensions of economic, environment, and social components; in fact it is their intersection [6]. In this regard, environmental sustainability focuses on development done by preserving essential ecological process and emphasize on its protection; economical sustainability pays attention to the utilization and management of resources for future generations; social and cultural sustainability highlights public control over their destiny during development [7]. Thus, certainly, doing programs contribute to the sustainable development can improve living conditions, and provide societies with a high income in almost all domains such as education, health, energy, etc.

Shen et al. [1] added another category- governance- to the three mentioned ones, and believe the rapid urbanization is often at the expense of the loss of valuable ecosystem and lands for satisfying the urban demands. It can be concluded, therefore, what is important in sustainable development is urban sustainable development.

In 1975, Richard Register and a few friends in Berkeley, California, founded Urban Ecology as a nonprofit organization to "rebuild cities in balance with nature. Since then, the organization has held conferences on urban problems and submit proposals toward the goal of shaping cities upon ecological principles [5]; it was a point to start a challenge.

However, what makes it possible to achieve sustainable development is to create good institutes, agencies and organizations with competent authorities [6]. Alberti [8] also emphasize it and believes urban patterns impact on natural resources and environment. He continues urban planners and managers need to recognize that their decisions affect ecological systems far beyond the city boundaries or the region; thus the design and management of cities are crucial to global sustainability. In this regard it is necessary to pay attention to Eco-cities, i.e. cities built based on environmental principles, since in them the city and the environment connect with each other and the energy is obtained from renewable resources [5].

In Iran also there are a lot of researches conducted on sustainable development and urban sustainability among them these ones, done on sustainability and climatic design, can be mentioned: [9]; [10]; [11]; [12]; [13]; [14].

Based on what is said it can be concluded that urban sustainable development is an important issue that should be seriously considered in the designing and planning. In this paper the environmental aspect of sustainable development and the subject of renewable energy saving will be examined in the design of a crowded commercial street in Shiraz, Iran. Thermal comfort is not also apart from energy saving; they are closely related to each other. In the next section, therefore, it is briefly discussed.

Thermal Comfort:

According to ASHRAE (15), thermal comfort is affected by air temperature, humidity, air velocity, and mean radiant temperature (MRT), as well as nonenvironmental factors such as clothing, gender, age, and physical activity. The combination of all these factors create a zone in which people feel satisfaction.

Thermal comfort can be considered as one of the main factors towards design of energy efficient buildings, disregarding that causes an increase in energy consumption, results to an irreparable loss to country's economy, and lays the groundwork for environmental degradation definitely [16].

Regarding the importance of it, a great deal of work has been devoted to thermal comfort among them: [17], [18], and Gagge [19], as the pioneer experts in the realm of thermal comfort, believed thermal comfort is strongly related to the thermal balance of the body; [19] examined it according to the environmental parameters; [20] also have considered the adaptive thermal comfort and sustainable thermal standards for buildings.

Furthermore, In Iran, researchers also show their interest in this area by conduction a large number of investigations such as: [21] using Psychometric chart and Predicted Mean Vote (PMV) estimated thermal comfort zone. [16] concluded that in estimating thermal comfort, ASHRAE RP-884 adaptive model project is more close to Iranian's Standards; [22] employing ASHRAE comfort software determined the need for cooling, heating and humidity; [23] used Olgyay's approach in order to modify the boundary of its thermal comfort [24] studied the condition of air for human comfort and examined the importance of climatic elements in thermal conditions; [25] using Ecotect and Vasari investigated the critical points of microclimates; [1] used physiological equivalent temperature to predict thermal comfort mean; [27] employed Olgyay's approach in order to draw the sun chart needed in Shiraz.

The mentioned researches listed above, and the likes, all confirm the importance of human thermal comfort in building design. This research, in one hand, by considering thermal comfort, and on the other hand, considering environmental aspect of sustainable development examined the Mollasadra Commercial Street regarding climatic design, and assess its sustainability.

Case Study:

Mollasadra Street is located in Shiraz, Iran (Fig. 1). This city enjoys a semi-arid climate [27]. According to the 25-year GPA Statistics (1951-1975), the mean maximum temperature of Shiraz is 38.53°C in Tir (June-July) and the minimum is nearly 0.43°C in Dey (December-January). This research, therefore, considers only these two months to evaluate the amount of energy consumption for heating and cooling.



Fig. 1: Mollasadra Street location in Shiraz (source: google earth)

The mentioned street, north-south in direction, located in the south corner of Namazi square, built in 1981. According to Shiraz Municipality official website, it has 30 meters wide and 760 meters long. In this study the most crowded part of the street with various uses is chosen.

RESULT AND DISCUSSION

In order to do this research, the hottest and coldest months of the year (Tir and Dey) were chosen according to the GPA Statistics. The questionnaires were administered to the 60 shopkeepers of east part of this street. Fig 2 and Fig 3 represent the results for Tir and Dey respectively. Shopkeepers also were asked the common ways they employed to create shade.

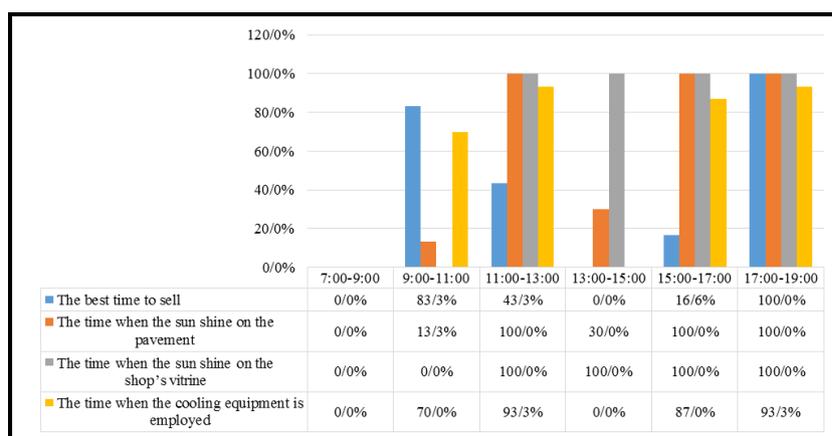


Fig. 2: Questionnaire results during summer days (Source: authors)

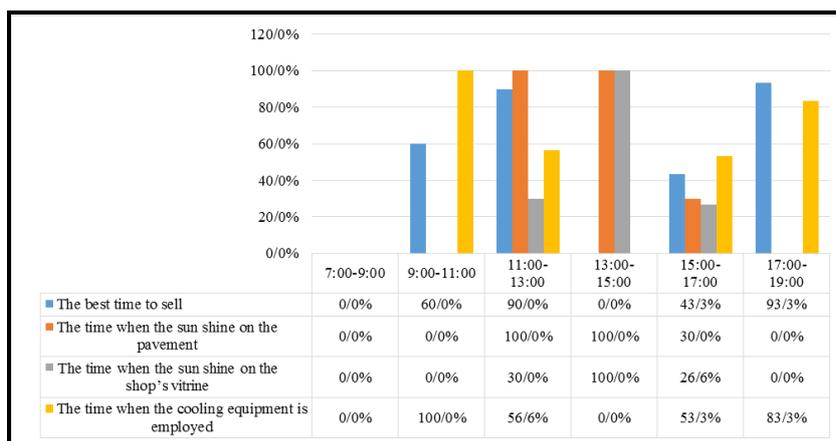


Fig. 3: Questionnaire results during winter days (Source: authors)

Summer Results:

The results of summer questionnaires indicated, 83.3 % of shopkeepers believe the best time for selling is between 09:00 and 11:00, and 100% of them knew 17:00 to the 19:00 as the best time of selling in the evening (See Fig. 2). The existence of shadow is the reason of obtaining good results in these hours. These shopkeepers also stated that sunshine can be seen on the pavement after 11:00 A.M. and that is why the customers do not have a tendency to go shopping since they feel direct uncomfortable sunshine. The shopkeepers also have to use cooling equipment which show a high percentage from 9:00-13:00 and 17:00-19:00. It is worth noting that due to the existing of sunshine and lack of customer, the shops are closed at certain times and the result 0 is mentioned for them in the diagrams.

According to the survey conducted, as the trees cannot provide a good shade thus the 62% of shopkeepers use canopies in front of their shops to create shade. The trees, however, cannot solve the problem and the cooling equipment need to be used.

Winter Results:

The result of Fig. 3 introduced that the best time for selling is between 11:00-13:00 (with 95%) and 15:00-17:00 (with 89%) since there is no shade in these times. The sun can provide the heat needed for shopkeepers and customers. According to the results the heating equipment are used in the best times when the street faces a lot of customers and it demonstrates a high energy consumption as it is inevitable to use the heating equipment to provide thermal comfort of both shopkeepers and customers.

It is worth noting again that due to the existing of sunshine and lack of customer, the shops are closed at certain times and the result 0 is mentioned for them in the diagrams.

Overall Result:

The survey's results clearly show, due to the lack of proper shade in summer and desired sunshine in the winter, a high percentage of energy is consumed to heat and cool and provide thermal comfort. Energy and fuel resources are among non-renewal ones or takes many years to create again. In this regard, the designers should consider the best and the most proper ways in building and city constructing in order to provide comfort for men and conserve the energy for next generations.

Ways that can be suggested in the streets to meet comfort and use energy fewer is employing canopies in front of the shops, and planting more shade trees (since they can blot out some of the summer sun and create shade with their full dense green foliage; in the winter also the sun rays can move across the foliage and feel the pavement and produce heat).

Conclusion:

During normal rest and exercise the average vital organ temperature is near 37 °C. The body's temperature control system tries to maintain this temperature when thermal disturbances occur [19]. Therefore, being situated in the condition with higher or lower temperature, the body needs cooling or heating equipment to preserve its temperature.

Sustainable development is based on human consciousness toward himself/herself and the earth's natural resources, and is searching to find a sustainable way of life for human beings; it is against excessive consumption, wasting resources and neglecting the future generations [3].

It is so helpful to present plans to preserve the earth and its natural resources and environment. In this regard, the essential role of architects, urban designers and planners to protect earth's resources and employing

proper materials and building orientation cannot be denied. Commercial streets, as a place which accept a large number of people daily, need to enjoy a proper design to response human thermal comfort using the minimum amount of energy.

REFERENCES

- [1] Afshari, H. and A.A. Taghvai, 2014. Guidelines for Designing Residential buildings in Harmony with the Climate of Khorramshahr. *Geographic Space*, 13(42): 71-102. (In Persian)
- [2] Alberti, M., 1996. Measuring Urban Sustainability. *Environ Impact Assess Rev.*, 16: 381-424.
- [3] ASHRAE Standard, 2011. Heating, Ventilating, and Air-Conditioning Applications. American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. Atlanta.
- [4] Barrow, C.J., 1995. Sustainable Development; concept, value and practice. *Third World Planning Review*, 17(4).
- [5] Barzegar, Z., M. Mirshamsi, 2014. Drawing the Timetable of Climatic Need by Means of Determining the Olgay Method Thermal Comfort Zone in Shiraz Semi-Arid Climate in Iran. ICSAUD 2014: International Conference on Sustainable Architecture and Urban Design to be held in Istanbul, Turkey, accepted.
- [6] Chowdhury, A. and C. Kirkpatrick, 2003. *Development Policy and Planning*. Taylor and Francis. England
- [7] Cowen, M.P., W. Shenton, 1996. *Doctrines of Development*. Routledge.
- [8] Fanger, P.O., B.M. Ipson, G. Langkilde, N.K. Oleson, Christensen S. Tanabe, 1985. Comfort Limits for Asymmetric Thermal Radiation. *Energy and Buildings*, 8: 225-236.
- [9] Ghibklo, Z., 2002. Methods for Estimating Thermal Comfort Zone. *Honar-ha-ye-ziba*, 10: 68-74. (In Persian)
- [10] Hashemi, F. and Sh. Heidari, 2011. Examining the Winter Yard in Cold Climate. *Name-y-e Memari va Shahrsazi*, 6: 139-154. (In Persian)
- [11] Heidari, Sh., 2011. Comfort Temperature of Iranian People in City of Tehran. *Honar-ha-ye-ziba Memari-va-Shahrsazi*, 38: 5-14. (In Persian)
- [12] Heidari, Sh. and Sh. Ghafari Jabari, 2010. Determining Thermal Comfort Period for Tabriz. *Modares Mechanical Engineering*, 10(4) 37-44. (In Persian)
- [13] Henson, J.L.M., 1990. Literature Review on Thermal Comfort in Transient Conditions. *Building and Environment*, 25(4): 309-316.
- [14] Mahmoudi, V. and V. Majed, 2012. Planning Sustainable Development with an Approach to Core Planning (a Proposal for Planning Sustainable Urban Development in Tehran). *Rahbord*, 21(64): 43-72. (In Persian)
- [15] McIntyre, D.A., 1982. Chamber studies- reduction and absurdum. *Energy and Buildings*, 5(2): 89-96.
- [16] Monshizadeh, R., 2012. Thermal Comfort and its Effect on Height of Buildings in Microclimate of Urban Spaces, *Geographical Journal of Environmental Bases Territorial Planning*, 20: 109-126. (In Persian)
- [17] Nicol, J.F., M.A. Humphreys, 2002. Adaptive thermal comfort and Sustainable Thermal Standards for Buildings. *Energy and Buildings*, 34: 563-572.
- [18] Partovi, P., 2009. The Principles and Concepts of Sustainable Urban Development from Viewpoint of a Phenomenological Approach. *Journal of Architecture and Urban Planning*: 2(2): 19-34. (In Persian)
- [19] Ramezani Gourabi, B. and Z. Kazemnezhad, 2011. The Study of Sustainable Development and Climatic Design in Mountainous Zones: A Case Study: Masouleh Town, Iran. *Environmental Based Territorial Planning (Amayesh)*, 4(14): 21-38. (In Persian)
- [20] Roseland, M., 1997. Dimension of Eco-City. *Cities*, 14(4): 197-202.
- [21] Sadeghi Ravesh, M.H. and S.M. Tabatabaei, 2009. Estimating Thermal Comfort in Dry Climate, *Hoviatshahr*, 3(4): 39-46, 2009. (In Persian)
- [22] Salehi, E., 2007. Role of Urban Planning Codes and Regulations in Fulfilment of Good City and Sustainable Urban Development (Case Study: Tehran). *Journal of Environmental Studeis*, 32(40): 51-62. (In Persian)
- [23] Sarvar R. and M.N. Mosavi, 2011. Sustainable Development Evaluation of West Azarbaijan Cities. *Geography*, 9(28): 7-28. (In Persian)
- [24] Shaghaghi, Sh. And M. Mofidi, 2008. Relationship of Sustainable Development and Climatic Design of Buildings in Dry Cold Regions (Case Study: Tabriz). *Science and Environmental Technology*, 10(3): 105-120. (In Persian)
- [25] Shen, L., J. Jorge Ochoa, M.N. Shah, X. Zhang, 2010. The Application of Urban Sustainability Indicators – A Comparison between Various Practices. *Habitual International*, 35: 17-29.
- [26] Zahedi, Sh.A.S. and A. Najafi Gholami, 2006. Sustainable Development, a New Conceptual Framework. *Modarres Human Sciences*, 10(4): 43-76. (In Persian)
- [27] Zakerian, M. and A. Parhizkar, 2010. Sustainable Urban Development (Case Study, Cities in Yazd Province). *Geographical Journal of Territory*, 7(25): 93-103. (In Persian)