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The Effect of Street Design on Thermal Comfort (Case Study: Ferdowsi Street on the 12 Region of Tehran)

Amir Shakibamanesh, Professor of Urban Design
*Ava Farahbod, Master Student of Urban Design

The microclimate of urban open spaces is influenced by several factors such as urban morphology and geometry, urban density, vegetation, water level and surface characteristics. As more than a quarter of the urban areas are usually covered by streets, designing urban streets plays an important role in creating the urban climate. Among the influential and observable climatic elements in the thermal comfort of the streets, we can mention the wind flow. Wind flow on city streets in addition to reducing heat stress at high temperatures. If accelerated, it can weaken heat islands and remove contaminants trapped in street corridors. Due to its topographic location, high density and high population growth rate, the city of Tehran is in a critical position due to the lack of attention to the climate in the city, thermal comfort in the urban open space has decreased and the quality of life has decreased.

The main goal of this study is to measure thermal comfort in the study area and to investigate the factors affecting the creation of thermal comfort with emphasis on wind flow, and for this purpose, strategies and solutions which are appropriate and applicable are presented in the area.

In this article, a part of Ferdowsi Street, between Ferdowsi Square and the intersection of Islamic Republic, has been selected as a case study.This street is a north-south street with a width of 30 meters and its surface is asphalt with an albedo coefficient of 0.1. In this street, due to the existence of commercial lines, both the presence of pedestrians and motor traffic are high, which cause traffic congestion due to noise and air pollution. In addition , the waste generated by commercial units also cause environmental pollution. Essential data was collected by field harvest with hotwire anmometer in three days of June 1398 and modeled using ENVI MET software. First, the area of Ferdowsi Street with southwest direction (angle of 240 degrees) was modeled with high accuracy in the grade of 50 * 50 * 30. Then, according to the field harvest information at three points in the range of average air temperature and humidity per hour, data was entered into the software. Also the buildings were modeled based on the number of floors * 3 meters. In the area of Ferdowsi Street, only vegetation is present linearly at the edges. And ofcourse the dense vegetation in the courtyard of the British Embassy is also important. Therefore, in modeling the current situation, trees with an average height of 15 meters and a dense canopy with continuous placement (based on aerial photos of the area) in passages and yards have been used. Due to the fact that the facade material in most of the buildings in the area is made of brick (with an albedo coefficient of 0.3), so in modeling the current situation, brick facade material is considered for ease of work.

Since the flooring in most of Ferdowsi Street was made of asphalt, so in modeling for the ground, asphalt was considered. In the results, we can see in parts of Ferdowsi Street where vegetation is scattered linearly, trees act as rigid barriers and reduce wind speeds along the passage. Also, in yards with dense vegetation, the wind speed does not increase and its intensity

decreases. The height variation of buildings play a decisive role in the flow and wind speed. The wind reacts differently when dealing with tall buildings. Current situation maps show that in parts of Ferdowsi Street where there is more elevation, wind flow and speed also increase. Since Ferdowsi Street is almost proportional in height, changes in wind speed are less noticeable.

In general, wind speed in most parts of Ferdowsi Street is less than 0.5 meters per second. Which causes the wind not to flow well in this street, which can justify the existence of pollution and relatively unsuitable thermal comfort in this street. For this purpose, at the end of the research, a policy map and street design strategies were presented that help improve wind flow in the area and thus the thermal comfort of pedestrians.

Keywords: Thermal Comfort, Urban Street, Wind Flow, Envi-Met

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* Corresponding author: Ava Farahbod, farahbod.ava@gmail.com

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