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Analysis of Factors Affecting Urban Architecture Design by Ecological Geography Environment

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Abstract. With the continuous expansion of the urban population and the improvement of people's living standards, urban architecture plays more and more important role on the people's life and cities' development. Many scholars have emphasized the importance of the surrounding environment during design the buildings. However, there are few researches about the effect of the natural geographical factors on the construction design. How to integrate modern urban buildings with the natural geography environments, and suit measures to local conditions remains a problem. Therefore, this study analyzed the principle of ecological and geographical environment affecting the urban construction design and security measurements to provide more comprehensive understanding of the interaction between the natural geography and construction design. And then we took Beijing as an example to give some constructive suggestions for its future building design. Meanwhile, this study also focuses on the future changes of geographical environment to improve the utilization of geographical environment and design efficiency.

Keywords: Geographical environment; ecological environment; urban construction; architectural design.

1. Introduction

The development of urban architecture has grown rapidly and become mature gradually in China. However, with the speed of China's industrial development and population issues, architects try to express the spatial information and beauty of architecture when designing urban architecture. They learned from the Western excellent architecture but ignored local geography which is the main factor leading to the "acclimatization" of the buildings. This causes a problem that the space function has not reached the maximum utilization standard, but also due to a large number of safety problems. The reason is that the basic architectural concept is missing—the harmonious symbiosis between architecture and environment. "Design with nature" (McHarg, 1969) proposed the relationship between the human and the nature, by describing the coast (New Jersey coast), the basin (Potomac), regional or geographic units (Worthington Valley, Staten Island), metropolitan areas (Philadelphia Metropolitan Area, Northwest Washington), cities (Washington, DC, Philadelphia, Richmond) and so on. The performance of different landscape buildings; "Architecture, starting from that day" (Toyo Ito, 2013) also mentioned that island cities are facing natural disasters and man-made disasters. To make sure the roles the buildings played, Wu et al. (Wu et al.,) mentioned the importance of urban architecture and the relationship between architecture and the natural environment. In the book "Chinese ancient Feng Shui Learning: Architecture and Geographical Environment", Yu et al. (Yu et al.,) analyzed the quality of the building environment and promoted the living from ancient Chinese Feng Shui physical and mental integrity including quality control, external environment and psychological effects, so as to have a



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comprehensive understanding of the building and the geographical environment. Meanwhile, in 2005, China enacted the Code of Design of Civil Buildings to divide China into different climate zones. The building climate zone includes 7 main climate zones and 20 subclimatic zones. The above documents all emphasize the importance of geography research and architectural design in the early stage of architectural design, as well as the damage and destruction of buildings when the geographical environment changes. However, there are few scholars to focus on the potential harm and possible disasters of the geophysical surroundings. Therefore, this paper starts from the ecological geography environment and conducts cross-disciplinary research through analysis and experiment. As for different terrains, geomorphology and climate characteristics, we summarize their influence on urban architectural design in different regions, and provide a certain theoretical foundation for urban buildings in different regions. At the beginning of the design, designers can comprehensively consider the impact of eco-geographic environment on urban architectural design. Taking Beijing's urban architectural design and development as a case, we study the geographical environment changes in Beijing in the past 20 years and analyze its influence on urban architecture. The conclusion can be made that designing urban architecture should not only focus on the geographical environment in front, but also pay more attention to the changes and development of the future ecological and geographical environment.

2. Method

2.1. *The Concept of Terrain and its Impact on Urban Architectural Design*

Terrain refers to various forms of the earth's surface, specifically the various states of high and low undulations that are commonly presented by fixed objects distributed above the surface. Most of the urban buildings are distributed in plains and basins. Other areas such as plateaus, mountains, and hills are not suitable for the construction of a large number of urban buildings due to various natural geographical factors such as climate and altitude, so they are not mentioned here. The first one is the plain. Most of the plains are alluvial rivers with flat terrain, warm and humid climate, suitable for human habitation and the construction of large high-rise buildings. The plain area is a region with relatively uniform natural conditions and has few obstacles to the development of urban architecture. The urban form is not restricted by the geographical environment and has certain uniqueness. It also can be expanded radially in a checkerboard pattern. Urban districts such as Lhasa and Beijing are like chessboards, and there are no specific restrictions on the scale and height of buildings. The other one is the basin. From the geographical perspective, the basin can be divided into outer basins and inner basins. The outer basin is rich in precipitation, cloudy and foggy, with weak solar radiation, such as the Sichuan Basin. While the inland basin is far from the ocean and relatively arid because warm and humid gas is difficult to reach. And more sunlight leads to abundant solar radiation. Due to the relatively closed topography of the basin city, the static wind is frequent. The pollutants formed by the atmospheric inversion layer and the aerosol diffuse slowly and have adverse impact on the higher buildings. Compared with other topography, the heat island effect is prominent, hence it is necessary to consider the urban circulation and the distribution of super high-rise buildings in the design of the buildings.

2.2. *The Concept of Landform and its Impact on Urban Architectural Design*

Landform is the general term for various forms of the earth's surface. The landscape has a direct impact on the layout and landscape of the city. From the layout, the gentle terrain is conducive to urban development.

2.2.1. River landform Fluvial landform. The general term for various erosions and accumulations formed by rivers acting on the surface of the earth through erosion, handling and accumulation. The rivers play the most frequent and active geomorphological role on the surface of the earth, mainly in mountainous and plain areas. Urban buildings are distributed on both sides of the rivers, such as Lanzhou City, which extends westward along the Yellow River.

2.2.2. Artificial landform artificial landform. Man-made landforms are the general term for the landforms that human beings shape on the surface of the earth. The role of human beings on the surface

geomorphology of the earth is comprehensive, both constructive and destructive. Also, human beings directly change the geomorphological processes and types, as well as indirectly change the landforms through various social activities, production, and scientific practices. This study mainly describes the process of human beings to establish a new urban geomorphology system through the development of cities. We also focus on the change of the process and type of landforms through engineering and technical activities. Urban ground subsidence caused by excessive groundwater exploitation is another attention.

2.2.3. Yellow land appearance. The yellow landform is a product of strong erosion during the accumulation of loess, which includes the erosion of pure natural processes and the erosion of human factors. At this stage, a small number of cities are distributed on the topography of the yellow land. With respect to the design of urban buildings, it is necessary to consider the use and transformation according to local conditions to maintain ecological balance and control soil erosion.

2.3. The Concept of Climate and its Impact on Urban Architectural Design

Climate is the general state of the atmosphere in a certain area and is a comprehensive manifestation of various weather processes. The most basic elements of the climate are temperature and precipitation, in addition to prevailing winds. The temperature and precipitation can determine the urban architectural characteristics of different regions, and the wind direction and speed affect the distribution and height of the buildings.

2.3.1. Tropical monsoon climate. The main feature of the tropical monsoon climate is the high temperature throughout the year, with drought, rain. It is mainly distributed in the southern part of the Asian continent from 10° to 23° north latitude, and is unique to Asia. Representative cities include Hainan, Sanya and Kaohsiung.

2.3.2. Subtropical monsoon climate. The subtropical monsoon climate is characterized by an average temperature of more than 0 °C in January, and an average temperature of about 25 °C in July. The wind direction in winter and summer changes significantly. The annual precipitation is generally above 1000 mm, mainly concentrating in summer. The summer is hot and rainy, and the winter is mild and humid. The cities represent Nanjing, Shanghai, Suzhou, Hefei and Hangzhou in China.

2.3.3. Temperate monsoon climate. The temperate monsoon climate is characterized by high temperature and rain in summer, affected by tropical cyclones. And the southeast monsoon from the tropical ocean brings abundant precipitation, while the winter is cold and dry with the lowest temperature below 0 degrees Celsius. The reason is higher latitude, close to the winter wind source, lower and flat terrain, which make the winter wind stronger. Representative cities include Beijing and Jinan.

3. Case Results and Discussion

3.1. Introduction to the Study Area

Taking Beijing as an example, Beijing is located at 115.7°-117.4° east longitude and 39.4°-41.6° north latitude. The center is located at 39°54'20" north latitude and 116°25'29" east longitude, with a total area of 16412 square kilometers. Beijing's topography is composed of mountains and plains. Its mountainous area is 10,200 square kilometers, accounting for 62% of the total area. The plain area is about 6,200 square kilometers. The terrain of Beijing is high in the northwest and low in the southeast (see the left of Figure 1). The landform is the expression of man-made landforms. People have changed the original landforms through a large number of engineering and technical activities to develop the city and established a new urban landform system (see the right in Figure 1).

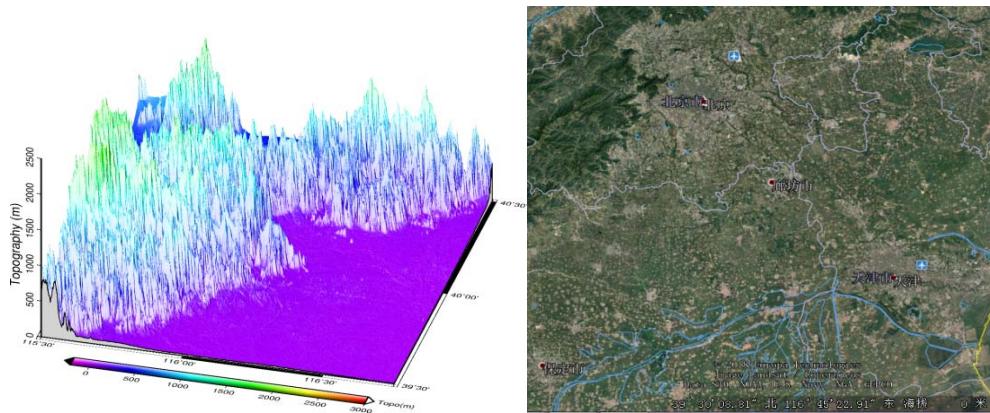


Figure 1. The three dimensional topography and objective classification.

Beijing is a continental monsoon climate affected by Mongolia's high pressure and has four distinctive seasons, i.e. windy springs, hot and rainy summers, mild autumns, and cold and dry winters (Figure 3). The overall air humidity in Beijing is low according to the precipitation simulated by numerical weather prediction (WRF). As for urban buildings, the effect of humidity is small. The main reason for this is that the Beijing area is surrounded by the special geographical environment of the mountains (see Figure 1). The cold air blowing from the northwest is blocked by the mountains. Due to the warming effect, the winter in Beijing is warmer than other areas of the same latitude. The annual average wind speed in Beijing is between 1.8 and 3 meters per second. In the whole year, the spring wind speed is the largest, the winter is second, and the summer wind speed is the smallest. The wind field wind speed map of the experimental site (Figure 4) illuminates that the overall wind speed in Beijing is small, so it will not have much impact on the height of the building.

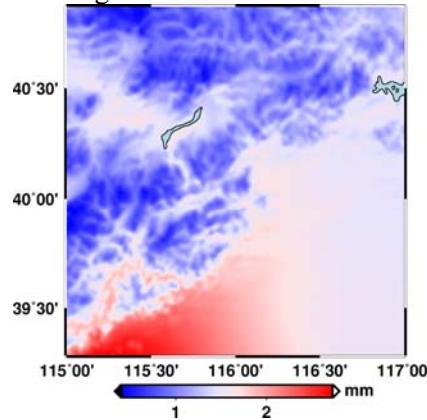


Figure 2. The water vapor humidity map of Beijing in January, 2019.

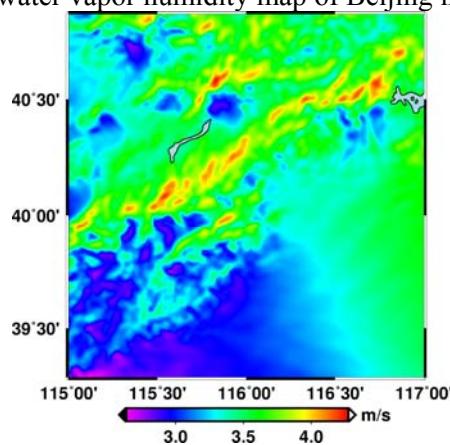


Figure 3. The mean wind speed map in Beijing on the January, 2019.

3.2. Analysis of the Relationship between Research Area Characteristics and Architectural Design

Urban buildings in Beijing's high-density areas are concentrated in the eastern and southern plains. Due to the limitation of topography in the western and northern mountainous areas, the buildings are sparsely distributed and the building density is generally low. In the plain area, due to the deep soil layer, the foundation is soft and the sand layer is multi-streamed, the foundation needs to be reinforced and waterproofed during construction. Meanwhile, with the continuous improvement of water demand in recent years, the excavation of groundwater has been expanded, and the geology has also been subsided. Therefore, in the future, when designing buildings, attention should be paid to the reinforcement of foundations.

Beijing can ignore the impact of air humidity and wind speed during urban construction. However, as a megacity, Beijing has a high density and population density, and the urban heat island effect is particularly obvious. The population density affects urban surface temperature, and urban surface temperature has a direct impact due to urban heat island effect. Therefore, in order to alleviate the impact of urban heat island effect, the distribution distance of urban buildings is particularly important. Buildings should conform to the norms, and factors such as spacing, green space, number and density, layout, group combination and space environment should be considered in planning and design.

4. Conclusion

In summary, the eco-geographic environment is the first and most important step in urban architectural design. Before designing urban buildings, fully understanding the ecological and geographical environment can judge the reasonable probability of land use in advance and improve land utilization. For the government and society, it can save unnecessary costs and develop unnecessary areas without causing high cost and waste of manpower and material resources. For the natural environment, reasonable development, giving priority to ecological environment issues is a top priority and adaptation. Designers should analyze the overall environment of the building from different angles, including topography, landforms and climate characteristics, and try to satisfy people's life, social education and other activities without compromising the natural environment. Security and building safety provide a guarantee. Moreover, in the preliminary research, combined with the actual situation and long-term practical experience, comprehensive analysis of the impact of the specific geographical environment should be made in order to make urban architectural design better development and make a more healthy and comfortable life environment for people.

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