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Research on Design Strategies of the Commercial Pedestrian Street in Summer-Hot and Winter-Cold Area

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Abstract

This article proposes that street direction, *H*/*W* ratio and landscape greening design are the three important reference indexes for the comfort level of the commercial pedestrian street through case study of commercial pedestrian streets in areas where it is hot in summer-hot and winter-cold areas. The article also proposes strategic recommendations regarding the design of these reference indexes in this area to provide a valuable reference for the creation of comfortable and humane commercial pedestrian streets.

Key words: In summer-hot and winter-cold areas; Commercial pedestrian street; Wuhan; strategies

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INTRODUCTION

Commercial Pedestrian Street refers to Commercial Street with comfortable and attractive pedestrian space. Its pedestrian space is mainly composed by streets and buildings. Commercial Pedestrian Street is a shopping and leisure environment that people love. This kind of commercial street whose subject is human beings originated in Copenhagen in 1962. Nowadays, commercial pedestrian streets have become the business card in numerous cities. On these streets, people can shop, dine, get entertained, do SPA, and get relaxed. In addition, most of these pedestrian streets are located in prime urban areas, so pedestrian streets in modern cities have become a new mode of commercial districts which have combined with shopping, dining, leisure and tourism.

Commercial pedestrian streets generally are organized into indoor and outdoor commercial pedestrian streets. Compared with indoor commercial pedestrian streets, the layout of outdoor commercial pedestrian streets provides ideal linear outdoor space for tour, leisure, shopping and provides the opportunity to get close to the natural environment and incomparable advantages that indoor commercial streets don't have. From the early design methods of pedestrian streets in China, most of them inclined to aesthetic design of the building facade and internal environment of the commercial streets and did not pay enough attention to the outdoor environment dominated by the city's climate. This design guide has brought a lot of difficulties and challenges for the design of urban pedestrian streets in areas where it is in summer-hot and winter-cold areas. This article starts from the analysis of typical cases and conducts discussions and research on the design strategies of outdoor pedestrian streets (hereinafter referred as pedestrian streets) in areas where it is hot in summer and cold in winter.

1. AN OVERVIEW OF AREAS WHERE IT IS IN SUMMER-HOT AND WINTWE-COLD AREAS

1.1 The Range of Areas Where It Is in Summer-Hot and Winter-Cold Areas

According to China's building climate division, Yangtze River Basin and its vast surrounding region located in central China are the area where it is in summer-

hot and winter-cold areas. The range of this area is roughly south of the Longhai Line, north of Nanling, and east of Sichuan Basin. It can be generally described as the middle and lower part of Yangtze River Basin, including two municipalities directly under the Central Government, Shanghai and Chongqing, all of Hubei, Hunan, Jiangxi, Anhui, and Zhejiang, the eastern half of Sichuan and Guizhou, the southern half of Jiangsu and Henan, the northern half of Fujian, the southern part of Shaanxi and Gansu, and the northern part of Guangdong and Guangxi, involving 16 provinces, municipalities and autonomous regions with the coverage of 1.8 million square kilometers. The population living in urban and rural regions of this area is 550 million. Its GDP takes up about 48% of the country. It is the most densely populated and economically more developed area in China and its political and economic position is extremely important.

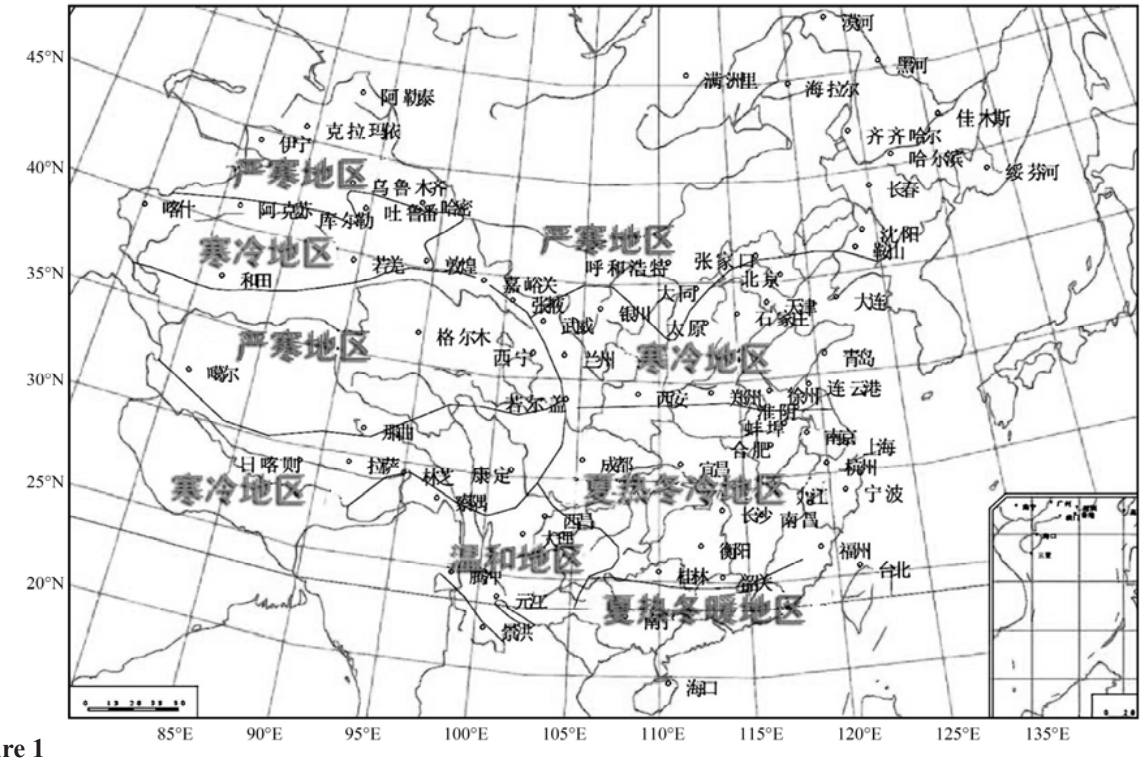


Figure 1
China's Building Thermal Zoning Map

1.2 The Climate of the Area

The most significant climate characteristic makes it hot in in summer-hot and winter-cold areas with four distinct seasons. It is sultry in summer and cold and wet in winter. The day temperature difference is small; the annual precipitation is large; there is little sunshine; in a word, it is quite uncomfortable.

The climate characteristics are mainly as follows: it is often rainy with heavy rain and storms in summer. It is hot in day time; the calm wind rate at night is high, so it is difficult for the heat accumulated during the day time to distribute and the temperature maintains high. In winter, when a strong cold wave arrives at this area, as it is blocked by Nanling and southeastern hills, the cold air strands, therefore it is cold for quite a long time. In January, the average temperature is generally 8～10℃ lower than other regions of the same latitude in the world and it is the coldest area in winter with the same latitude in the world.

Table 1
The Average Temperature of Each Month in Major Cities in China (Unit:℃)

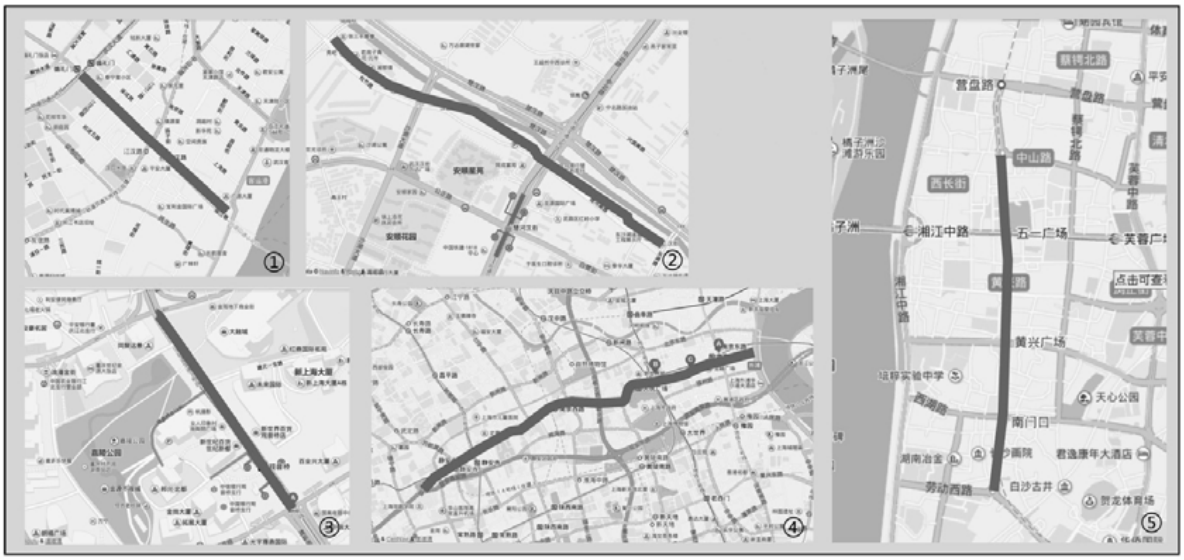
	City	Month											
		1	2	3	4	5	6	7	8	9	10	11	12
1	Shanghai	3.5	4.6	8.3	14	18.8	23.3	27.8	27.7	23.6	18.0	12.3	6.2
2	Hangzhou	3.8	5.1	9.3	15.4	20	23.3	28.6	28	23.3	17.7	12.1	6.3
3	Nanjing	2.0	3.8	8.4	14.8	19.9	24.5	28.0	27.8	22.7	16.9	10.5	4.4
4	Hefei	2.1	4.2	9.2	15.5	20.6	25.0	28.3	28.0	22.9	17.0	10.6	4.5
5	Nanchang	5.0	6.4	10.9	17.1	21.8	25.7	29.6	29.2	24.8	19.1	13.1	7.5
6	Wuhan	3.0	5.0	10.0	16.1	21.3	25.7	28.8	28.3	23.3	17.5	11.1	5.4
7	Changsha	4.7	6.2	10.9	16.8	21.6	25.9	29.3	28.7	24.2	18.5	12.5	7.1
8	Chongqing	7.2	8.9	13.2	18.0	21.8	24.3	27.8	28.0	22.8	18.2	13.3	8.6
9	Chengdu	5.5	7.5	12.1	17.0	20.9	23.7	25.6	25.1	21.2	16.8	11.9	7.3

2. DESIGN STRATEGIES OF COMMERCIAL PEDESTRIAN STREETS

2.1 The Direction Choice of Pedestrian Streets

China is located in the northern hemisphere and it is in the monsoon climate zone. The winter wind is mainly northwest wind and the summer wind is mainly southeast wind; therefore, when we choose the base location for pedestrian streets, the key point is to ensure two main elements: winter sunshine and summer ventilation. According to the climate characteristics of this area in the northern hemisphere, the ideal street direction should form 30°~60° with the prevailing wind directions and meanwhile avoid direct sunshine in summer.

From a few typical pedestrian street cases in areas where it is in summer-hot and winter-cold area in China, there are three common street directions: 1) north-south (such as Huangxing Road in Changsha); 2) northeast-southwest (Nanjing Road in Shanghai); 3) northwest-southeast (such as Jianghan Road and Han Street in Wuhan).



① Jianghan Road's pedestrian street (Wuhan)
② Han Street (Wuhan)
③ Guanyinqiao pedestrian street (Chongqing)
④ Nanjing Road's pedestrian street (Shanghai)
⑤ Huangxing Road's pedestrian street (Changsha)

Figure 2
Direction Analysis of Pedestrian Streets in Areas Where It Is in Summer-Hot and Winter-Cold Areas

The pedestrian street on Huangxing Road in Changsha is a case in north –south commercial street. In summer, this direction can effectively guide the summer wind and meanwhile avoid prolonging direct sunlight. The field research has found that, the direction sunlight time on Huangxing Road's pedestrian street is only within 11 AM - 3 PM. But in winter, both the east and west have been blocked by building, so the sunshine hours are slightly short and the temperature is low. It is less comfortable.

The pedestrian street on Nanjing Road in Shanghai is in northeast-southwest direction (33º north by northeast). The street in such direction has direct sunlight for a long time in summer and it is hard for the southeast monsoon to get imported. During the 2010 World Expo, we personally experienced the prosaic street on Nanjing Road. The sunshine hours were long in day time in summer. Pedestrians were squeezed to walk in the shadow of buildings on both sides to prevent direct sunlight. The walking comfort level is small.

The pedestrian streets on Jianghan Road and Han Street in Huhan and Guanyinqiao in Chongqing are all in a northwest-southeast direction (respectively 43º, 34º and 55º north by northwest). For pedestrian streets in such direction, the bigger the angle is, the less direct sunlight in summer time is and the higher the comfort level is.

Let's take Jianghan Road and Han Street as an example to further detailed analysis. The northerly shift allowable angle value difference between the two streets is 9º. The pedestrian street on Jianghan Road is close to north-south direction, while the humdrum street on Han Street is close to east-west direction. Based on the author's personal experience, in the afternoon in August of 2013 at about 3.30 PM, there was not any direct sunlight in the pedestrian street on Jianghan Road. In addition, the street direction is the same as that of the city's summer monsoon. Although the outdoor temperature was not despondent, there were a lot of people playing on the street. However at the same time on Han Street, basically it was under direct sunlight and there were few people on the street. After 5 PM, people began to collec on this street and it reached peak flow in the late afternoon.

To summarize the above case analysis, we can draw the following conclusion: in areas where it is in summer-hot and winter-cold areas, the direction of the pedestrian street should be mainly in northwest-southeast direction and avoid east-west shift thereby to reduce direct sunlight hours in summer time and improve the comfort level of the outdoor space of the pedestrian street.

2.2 The *H*/*W* Ratio of the Pedestrian Street

Beside the direction and orientation, another factor which influences the comfort level of pedestrian streets is *H*/*W* ratio.

Buildings on both sides of the pedestrian street determine the style and feature of the pedestrian street and thus define the boundaries of the pedestrian street. The enclosure, segmentation and interlude of streets and buildings bring different feelings and cognitions to people. The ratio of the width (*W*) of the pedestrian street and the height (*H*) of the buildings on both sides can bring people to the following psychological feelings:

Table 2
Analysis of the H/W Ratio and Psychological Feelings

H/*W* ratio	Psychological feelings
W/*H*<*L*	There is a sense of closure.
W/*H*=1	The height and the segmentation are well-proportioned.
W/*H*>1	There has the feeling of leaving.
W/*H*>4	It loses the reciproca influence.

Discussions on the ratio between building height and street width are not a new topic, but here we are discussing the best ratio for commercial pedestrian streets in areas where it is in summer-hot and winter-cold areas by changing the scale of physical space so as to improve the microclimate and increase the comfort level.

Jianghan Road is 1,600 meters long and 10 to 25 meters wide with an average width of 15 meters. Buildings on both sides are 5 layers with a height of 15-17.5 meters. Figure 3 is the actual view and a cross-section view of Jianghan Road. Its *W*/*H* ratio is ≤1. The total length of Han Street is 1,500 meters and the width is 10 to 25 meters with an average width of 10 meters. The street width of Han Street is almost the same as that of the Jianghan Road, but the buildings on Han Street are mainly 2-3 layers with a heights of 6-10.5 meters and *W*/*H* ratio ≥1 (Figure 4).

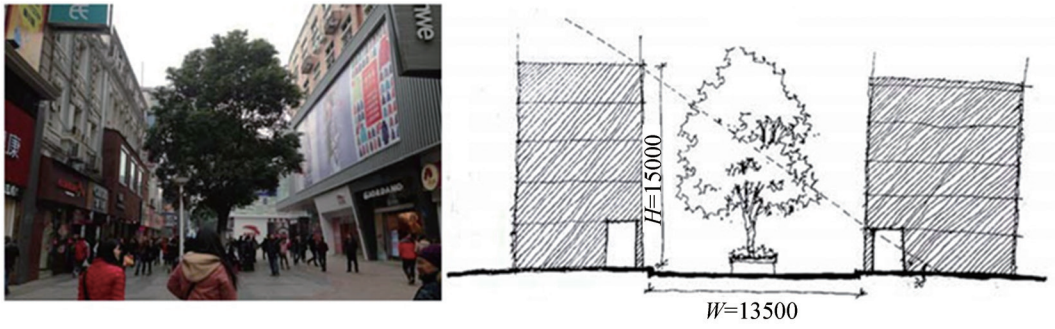


Figure 3
A Real View and A Cross-section View of Jianghan Road

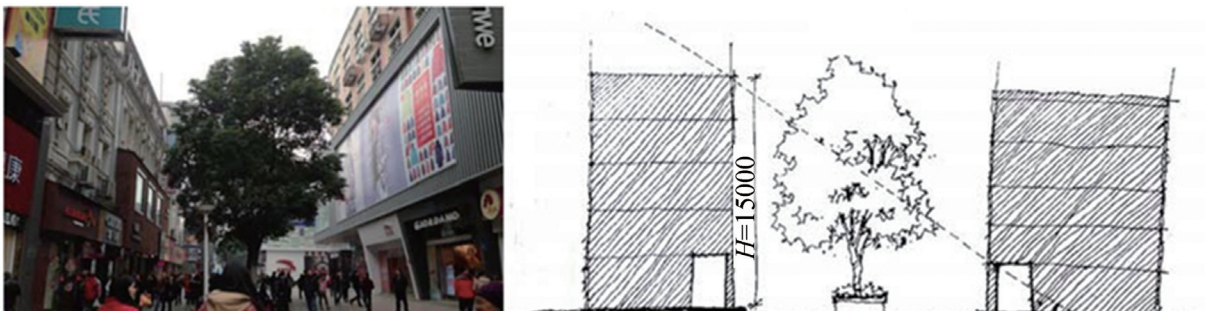


Figure 4
A Road View and A Cross-Section View of Han Street

The average sunshine angle of Wuhan is about 30.63°; therefore in hot summer, especially at noon, the shadow formed by the buildings on Jianghan Road can significantly lower the temperature of the outdoor street. In addition, there are draughts formed by the high-rise buildings, which make the street cooler. However, because buildings on Han Street are lower, the building shadow cannot play a significant role in improving the microclimate, which directly results in a higher outdoor temperature in summer and has a significant impact on the flow of people.

2.3 Landscape Green Design of Pedestrian Streets

As an essential manifestation of the human spirit and life style of the city, pedestrian streets are important open space where urban population concentrates. Therefore, commercial pedestrian streets should be ecological space where the landscape is beautiful with plenty green land and pleasant environment. Commercial pedestrian streets are generally located in the city center where "heat island effect" is quite serious. Choosing appropriate green plants can bring shade, coolness, noise reduction, air purification and other effects. It has been proved by experiments that in the hot summer after the tree canopy blocks, absorbs and reflects solar radiation, the amount of light under the tree is only 1/5 of that outside of the tree canopy. Therefore, the increase in plant landscape on commercial pedestrian streets can effectively reduce the adverse effects brought by "heat island effect" and bring a pleasant landscape environment to pedestrian streets.

As shows in Figure 5, some sections of the pedestrian street on Jianghan Road were developed with consideration of the special climate of this area where it is in summer-hot and winter-cold areas. There are 20 sets of huge trees on the 700-meter street north of Zhongshan Avenue on Jianghan Road. Seat chairs and green ornaments were set around the three pools. It appears that no matter it is in summer time or in other seasons, a large number of people gather there with rich outdoor activities. Compared with Jianghan Road, the newly built Hang Street seems pale regarding the green setting. There is not any fixed green belt on the whole street. It only uses small removable flower beds and shrubs (Figure 6) to decorate the walking space, and the green rate is low. Basically, the design did not consider the special needs of the pedestrian street in the area where it is in summer-hot and winter-cold areas. Although the flowers and shrubs can be replaced with the seasons changing, they cannot be shade, nor lower the temperature. Its effect on adjusting the microclimate is minimal.

Figure 5
Jianghan Road

Figure 6
Han Street

Referring to pedestrian streets in other cities in areas where it is in summer-hot and winter-cold areas, the greening method of Nanjing Road in Shanghai and that of Jianghan Road in Wuhan is very similar, combining the use of trees and flower beds. Huangxing Road in

Changsha adds green nodes to the above method of city bronze carvings, becoming a combination of green and ecological notes on the pedestrian street. While the Guanyinqiao pedestrian street in Chongqing built in 2006 takes the advantage of the only one city park in the main urban districts of Chongqing—Jialing Park and actively creates a major ecological business district melting eco-watching, sightseeing, shopping, leisure and entertainment as one. The green rate of the whole pedestrian street is up to 40% especially with large trees on both sides of the pedestrian street which can effectively block the sunlight in summer and the monsoon in winter. Therefore, no matter what the time is, Guanyinqiao Pedestrian Street is always full of people, bustling and crowded.

Figure 7
Nanjing Road in Shanghai

Figure 8
Huangxing Road in Changsha

Figure 9
Pedestrian Street in Guanyinqiao in Chongqing

In summary, when we conduct green design for commercial pedestrian streets where the flow of people is large and the land cost is extremely high, we can use the strategy of street trees and shade trees as the base supplemented with flower beds and flower pools. We can also try to take the use of the basic greening in front of the shop, corner greening, roof greening, and scaffolding greening etc. to create complex green space. In this way, we can improve the microclimate of the pedestrian street in areas where it is in summer-hot and winter-cold areas, but also provide a valuable ecological business environment for shopping, leisure and tourism for the pedestrians.

CONCLUSION

After the above comparative analysis, we can see that street direction, H/W ratio and landscape green design are three important reference indexes regarding the comfort level of pedestrian streets. Taken altogether, in areas where it is in summer-hot and winter-cold area, the direction of the pedestrian street should be in north-south direction and it should avoid west-east direction in particular. The W/H ratio of the pedestrian street should be ≤ 1, which brings building shade to reduce the temperature in summer and improves outdoor space utilization. The choice of large trees will improve microclimate and at the same time brings pleasing visual effect.

Compared with winter, summer is the season in which people have abundant outdoor activities. Therefore, the content of this paper is mainly concentrated on the summer. Although we cannot change the basic climate conditions of areas where it is in summer-hot and winter-cold areas, we can still provide more valuable references in creating pleasant and positive city walking space by summing up experiences and lessons from existing cases, timely summarizing effective design strategies and using a variety of techniques.

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