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## Flexible Space Design of Community Greenways in Temperate Zone of Asia -- Beijing Case Study

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## Flexible Space Design of Community Greenways in Temperate Zone of Asia -- Beijing Case Study

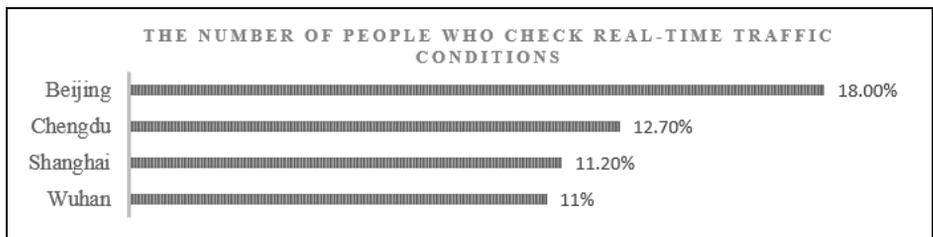
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### Introduction

Heavy traffic, poor air environment and fast-paced city lifestyles are a growing major problem for residents in Beijing. Beijing is a place for people's daily work but almost nobody use the word liveable to describe it. In view of the common diseases of urbanization above, it is time to use greenways planning to improve Beijing living environment.

According to China's major cities traffic analysis report of AutoNavi in 2015, the Beijingers possess strong time-saving consciousness. (AutoNavi Traffic Big Data, 2016). At the same time, it is concluded from the questionnaire investigated by the Sina microblog in 2012, the need of riding for Beijingers are both directly and potential. (Beijing Municipal Institute of city Planning & Design, & Beijing Beilin Landscape Architecture Institute CD.LTD, 2014). According to the results of users, using greenways to build a more time-saving, convenient and comfortable transportation system is feasible in Beijing.



**Figure 1. China's major cities traffic analysis report of AutoNavi in 2015**

### Literature review

International research on greenways has been done over several decades. However, the progress in our country is about decades only. The aspects of greenways system design, and application, etc. are lacking.

In the field of application: The first greenways system had been set up in 2010, the Pearl River Delta of Guangdong Province built six provincial greenways and numerous in-depth city level greenways, which compose of the greenway net there, which the total length is around 1600 km. (Guandong Urban &

Rural Planning and Design Institute, 2010). The development of greenways in Beijing follows the principle as “Beijing city greenways system planning” which had been set up in early 2014. It is planned to build the city level greenways 1000 km in five years from 2015, which lead to the district level greenways and community greenways in excess of 1000 km area to meet the daily needs of fifty thousand people every day. (Beijing Municipal Institute of city Planning & Design, & Beijing BeiLin Landscape Architecture Institute CD.LTD, 2014).

The word "flexibility", in other countries, has been used in “flexible spaces ” and “flexible behaviours”, they studied the relationship between neighbourhood spaces and neighbourhood behaviours. (J Kotus, 2009). On the other hand, the phrase "flexible design" begins in 20 to 50 s last century. From the discovery of new building materials to the thinking of space flexibility, Mies van der Rohe opened up the study of multi-functional space design. (Mies Van Der Rohe. Xianjue Liu, 1992). The word "flexible space design" was used as a residential flat and small or medium-sized apartment design method, which had been attracted by scholars in China. The contradictory between the certainty of room and demand uncertainty solved by the change of building materials, space module, etc. (Weilong Wang, 2013). (Chen Zhe, 2006). But the study of urban greenways network construction yet to be perfect so far.

In the high-density Beijing, from the perspective of planning, the flexibility of the residence design and flexible space design of city greenways have the same place.

## **Goals**

Beijing greenways construction has been started from 2012. Over the fact, greenways have a lot of problems, such as inconvenient usage, insufficient user, less time to be used, less function, unsafe factors and so on, which lead people to get blocked in the process of the greenway using. One of the important reason of those problems is too much reference of the western and the Pearl River Delta’s greenways had been used in Beijing greenways, so as that ignoring the northern climate conditions and the characteristics of Beijing. Factors like huge population, hot summer cold winter, developed transport system and square ring radial road network decide the special usage of Beijing greenways.

The flexibility of the greenway design includes three points. First of all, Spatial overlay design can response to weather conditions in temperate zone, which Improve environment of the greenway and increase usable area of the

greenway in high density urban. The second point, we can conclude from the multi-functional design of the greenway to prolong the using time of the greenway. Peeling people to join and use the greenway by proactively join some activities and auxiliary facilities. Thirdly, we should take the using time into account. Increasing the time to use greenways within one day or one year can make people to stay longer in greenways.

## Objective and Method(s)

### Objective

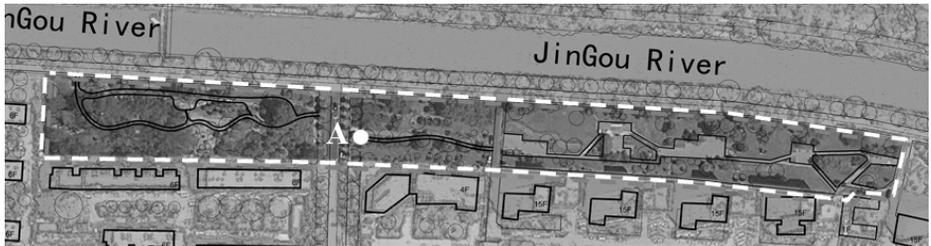


Figure 2. Case Location

The case which selected for studying in this paper is a part of a greenway south of Jingou River in Haidian district in Beijing, this greenway is also known as the Yongyin Canal greenway. The greenway is divided by Wanshouzhuang Road in central forming two part. Specific greenway sample is in the dotted line. The length of the greenway is about 400 meters. Residential area is on the south side of greenway and a minor road placed the north side. Zhugezhuang Road, which is about 7m wide between greenway and JinGou River.

### Method(s)

Table 1. The questionnaire sample

Gender	Female			Male	
Age	6-12	12-18	18-30	30-60	60-
You can select more than one, in the functions which you used in daily life.	1. Exercise 2. Relax 3. Traffic 4. Community 5. Play				
You can select 3 factors what you believe are the most serious problems to be solved.	1. Plants 2. Bicycle 3. Road Network 4. Function Division 5. Post-maintenance 6. Active Space 7. Facility 8. Sanitary Conditions				

Field research method, observation method and questionnaire method have been applied in this experiment. A total of 200 questionnaires (Table.1) are issued by the author in this area from the Sept. to Nov. 2015, temperature changes from 29 ° C to 11 ° C. Data was classified and analysed by Excel. Moreover, the author observed the entry point A for pedestrians counting.

## Results

### 5.1 Greenway Spatial overlay design Research

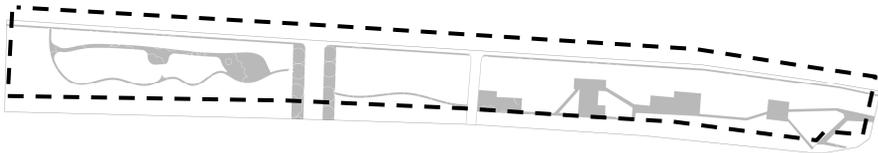


Figure 3. Path and Square Area

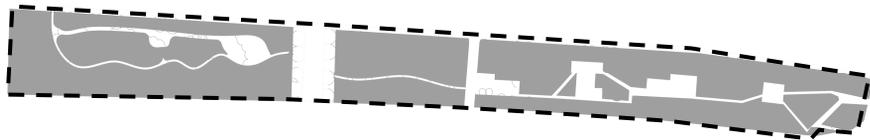


Figure 4. Tree and Grass Area

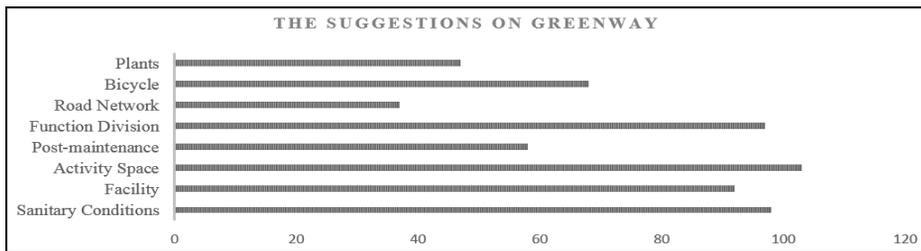


Figure 5. The Suggestions on Greenway

According to the contract of areas in figure 3 and figure 4, it can be seen clearly that the reachable region of the greenway is about 17%. The area of this greenway is 18980 m<sup>2</sup>, so the net area is about 3227 m<sup>2</sup>. Assume users of greenway just come from the south 6 buildings (ignoring the third one from left to right, which is under construction), according to an one child Chinese family mode, it is calculate the number of users is 1800, that is, greenway area is 2.11m<sup>2</sup> per person in this case. Comparing this data with 'Proceedings of China's land greening in 2014', there are lags behind park green areas 12.64 m<sup>2</sup> per urbanite (The national afforestation committee office, 2015). In other word, if people in the 6 buildings want to use park green space for activities, this greenway is far from enough, not to mention using the greenway as transportation. In addition, from the results of figure 5, three most important suggestions to this greenway are functions division unclearly, loss of activity space and poor hygiene. In conclusion, given the location of this greenway, it plays important role on transportation, the actual usable area is low, and the daily activity area is too small.

In view of the problems of the lack of usable area, there are roughly four improvement strategies: (1) Ground layer: In order to satisfy the demands in the morning and evening peak, increasing road width properly from 2m to 3 ~ 4m and change the quarter turn to rounded. At the same time, the open space area should be increased. Fragmentary use areas, such as triangle, long and narrow areas, can be merged to form a complete activity space. (2) Pay attention to the second floor design. Increasing certain functions in the corridor space on the second floor, such as culture exhibition, viewing platform, etc., this method can not only improve the utilization rate, save area, provide shelter, enrich space, but promote connectivity as well. (3) Developing the function of underground and half underground of greenway. Such as bicycle, motor vehicle parking, rainwater collection, storage, etc.

### 5.2 Greenway Multifunctional Design Research

**Table 2. The Summary of Functions**

Existing Function	Supplementary Function
Relaxing	Bicycle Parking
Practice	Parking
Transportation	Rainwater Collection
Isolation of Noise and Pollution	Cultural Exhibition
Recreation	Ride Path
Dog Walking	Elderly activity center
Beautify the Environment	Library
Communication	Commercial

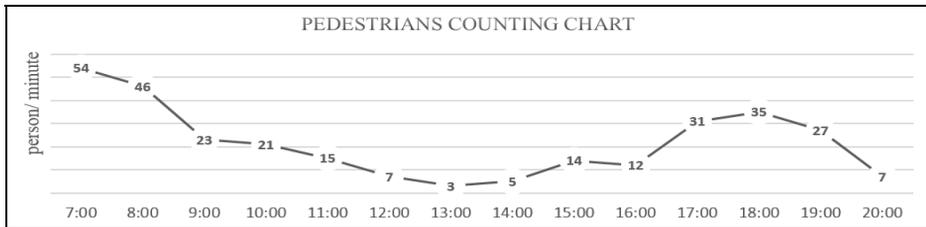
As shown in table 2, through observation and questionnaires, the existing functions in this greenway have some problem. For example, the greenway lacks consideration of bikes, has no consideration of bicycle parking problem. Functional division of dynamic and quiet mixed at the same time, the users interfere with each other. According to current situation, the author lists some supplementary functions in table 2.

Considering the features of the community greenways in Beijing, the greenways function improvements are as follows: (1) The combination of path functions increases the number of paths. Greenways can design fast-moving bicycle lanes and footpaths by the side of the Zhugezhuang Road, arrange abundant roundabout landscape trails in the middle part, layout quiet flat footpaths inside. (2) According to the movement and age, reduce interactions of users by zoning planning. (3) According to the characteristics of northerners, provide activities in shelter environment in this greenway for better tolerance.

### 5.3 Multi-period and Multi-Season Greenway Design Research

**Table 3. The Average Temperature in Beijing**

The Average Temperature	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Daily Maximum Temperature	2° C	5° C	12° C	20° C	26° C	30° C	31° C	30° C	26° C	19° C	10° C	3° C
Daily Minimum Temperature	-9° C	-6° C	0° C	8° C	14° C	19° C	22° C	21° C	15° C	8° C	0° C	-6° C



**Figure 6. Pedestrians Counting Chart**

As can be seen from the Table 3, (www.tianqi.com, 2016) Beijing's annual temperature change is distinctly. Compared with the southern warm climate, there are four month s' average temperature less than or equal to 10 ° C in Beijing. On the other hand, windy and dry weather have certain influence to people use. Figure 6 (Random Check Statistical figure of 3 Days Traffic Variation on the Hour from Sept. to Nov. 2015), it can be seen that using peaks appear in the morning and evening rush hour, using time is concentrated in this greenway. This figure shows that this greenway mostly used in traffic service. During non-peak hours, there is a certain potential. Designers should come up with more plans to add more functions which can attract more users to use in the greenway in this time. We should adjust the greenway design to combine with the habit of activity during the day night less activity schedule.

Optimization strategy of greenways time using problem are as follows: (1) Cultural and commercial activities are joined in regional areas aimed at the customers between 9:00am to 5pm. In addition, adding essential functions to promote tis liveness, such as: bicycle parking area, bicycle rental area, elderly activity center and so on. (2) Combined with the special climate conditions in north China, Beijing's air quality , windy weather and other adverse effects, greenways could provide shelters environment and lighting facilities to extend service period (Zhengwang Wu and Yuting HAN 2015). Seats and other facilities are arranged dispersedly, so as to use in different times and different climate conditions. (3) Guiding the elder to use slow trails in greenways to

avoids conflicts with passenger flow in rush hours, it can raise the efficiency of the greenways and prevent small area traffic congestion.

## Conclusion

(1) According to the climate conditions of temperate regions and different needs for outdoor activities from south, we put forward the strategies in purpose of extending using time in greenways. To promote activity in off-peak hours, greenways could supply functions, provide shelters environment and initiatively attract users. (2) In view of the fast-paced life of high-density cities in China, two improvements are presented. Firstly, Greenways spatial overlay design. Based on the development of ground floor, second floor, and the underground half underground space, greenways usable areas provide largely in the limited space. Secondly, Space multi-functional design. In this aspect, the greenway environment will become better by planning road network, enriching activities and planning reasonably function zoning.

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