

Design Strategy of Community Greenway Connectivity of High-density Urban Asia – A Case Study on Beijing

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Introduction

In the high-density Asian cities which expand rapidly and witness explosive growth in population, the construction of urban community greenways can effectively mitigate the heavy pressure that human beings impose on natural and humanistic environment. In Beijing, poor connectivity is one of the major challenges community greenway construction faces. This paper performs a field survey on the established community greenways in Beijing and their surrounding communities, finding that greenway connectivity is affected by the problems like interference with motorways and unsound greenway planning system in development process. The survey analysis demonstrates that the poor connectivity of community greenways is embodied between greenway, community and surrounding service facilities. To address the problems above, a detailed study on the strategies that improve connectivity of community greenways is conducted.

Review

The construction of the greenway network engineering known as Emerald Necklace Park System was first proposed by Law Olmsted in 1867 (Steiner, 2004). Now, many Asian countries have commenced greenway construction, like China, Japan, South Korea and Singapore. In China, urban greenways are categorized into three levels: regional greenway, urban greenway and community greenway (Hu and Dai, 2013). Community greenway is the extension of urban greenway network as well as the supplement to greenbelt of community cluster. As the connection between community greenbelt and resident's major activity places, community greenway provides convenient and safe green walking space and agreeable leisure place for residents, and bears the responsibility for maintaining close contact with surrounding communities and rendering services for them (Yao, 2012). Currently, there are few studies on how to improve greenway connectivity. Some experts argue that the passageways should be not only connected to the open space and ecological resources, but also integrated with the residential zones and their surrounding service facilities to raise the attainability and availability of every facility (Wang et al., 2014). In greenway construction, connectivity is the key to establish a greenway network (Jang and Kang, 2015). The interconnected network first requires that the greenway network itself should be

interconnected and then connected with the landscape around to constitute an orderly environment (Forman, 1995). As regards the selection of community greenway routes, more attention is paid to the harmony with the residential zones and public space with a large flow of pedestrians rather than network structure (Hu and Dai, 2013). Thus, there is a need to give further consideration to the network planning of community greenway, residential zones and public service facilities. Apart from this, the focus of greenway planning and design should be placed on the interconnectivity, overall protection and system construction of green space (Wang et al., 2011). Greenway construction mainly ensures the continuity of every part in greenway by way of land assignment and borrowing (Tan, 2006). Thus, not only the interconnectivity between community greenway network and the surrounding environment but also the continuity between every green space should be guaranteed.

Method(s)

This paper first ascertains the greenway construction mode, greenway category and characteristics by dint of literature review. Relevant data show that the key to improve connectivity of community greenways lies in not only the network connection between community greenway and residential areas as well as public service facilities, but also the connection between every green space within community greenways. In consideration of this, the strategies on improving community greenway connectivity are proposed from this three aspects. Since the community greenway construction in Beijing is still in the initial stage, section-by-section construction is implemented by stages, and no continuous and systematic community greenway system has taken shape. Therefore, this paper designs and analyzes three typical community greenway sections that have been completely built in Beijing as actual cases with a view to verifying the feasibility of improvement strategies (Table 1).

Table 1. General Situation of Beijing's Community Greenway Cases

Section name	Length	Width	Construction ways
Section of a community greenway in the south of Yaojiayuan Road	1600m	40-100m (including total width of railway)	Along two sides of railway
Greenway section 1 of Kunyuhe Community	1700m	130m	Along with west side of Kunyuhe
Greenway section 2 of Kunyuhe Community	563m	40-60m	Along the east side of Kunyuhe

Results

Community and Greenway

(1) A major connection greenway should be built to connect community greenway with surrounding communities within the service scope of community greenway. One or more routes that run through the entire service scope of community greenway can be selected from existing roads between community greenway and every residential cluster, and then transformed into simple and independent greenway route(s) based on original slow traffic system. This can be exemplified by partial section of the community greenway in the south of Yaojiayuan Road, Chaoyang District, Beijing City (Figure 1).

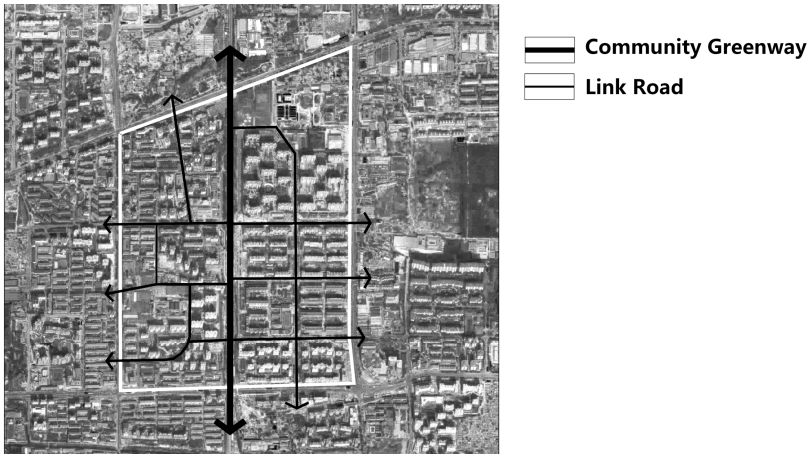


Figure 1. sketch map of community's external connection passage

Additionally, in the greenway transformation design, the sidewalk and motorway may be separated by landscape vegetation such as low shrubs (Figure 2), which can ensure an independent greenway space and that people's visual field will not be influenced. Furthermore, multi-level vegetations including arbors, shrubs and grasses may be planted to increase greenway's green area and landscape by various means like three-dimensional landscaping.

(2) Independent greenway exits and entrances connected with major connection greenways should be established in every community so as to avoid mutual interference between sidewalk and motorway, especially during peak commuting hours. The exit and entrance may be established based on transformation of existing independent slow traffic system or near community's main entrance.

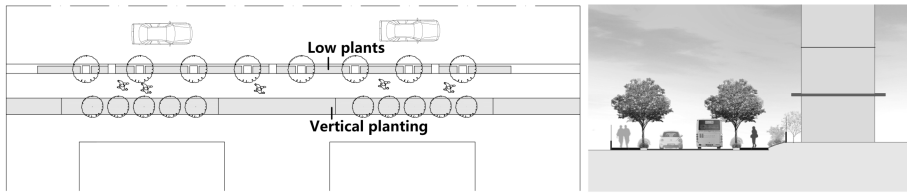


Figure 2. plan and sectional sketch map of connection greenway transformation

(3) Internal connection greenway that connects every residential unit within the community should be built and the independent greenway entrance should be linked to the external environment to constitute a whole system. One or more routes that run through the residential area the community greenways reach should be selected from existing roads between community greenway and every residential cluster and then transformed into simple and independent greenway route(s) based on original slow traffic system. For example, in the

two residential areas in the partial section of the community greenway in the south of Yaojiayuan Road, Chaoyang District, Beijing City, three major roads in existing slow traffic system are transformed (Figure 3).

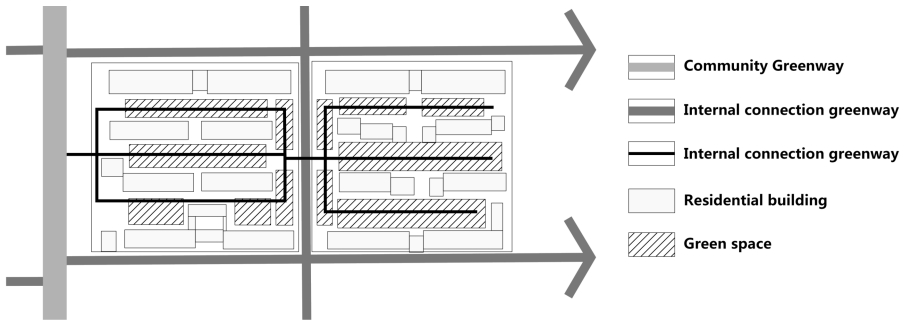


Figure 3: sketch map of community's internal connection passage

(4) The parking problem in old community should be addressed to provide more construction and service space for community greenways. The parking building or underground parking lot may be built to manage the parking of vehicles which can address the problem that there is insufficient space for community greenways, or the combined design of parking space and greenways may be proposed to rebuild semi-underground garage and the parking roof may be equipped with diversified community greenways.

Greenway and Intersection

(1) Three-dimensional traffic system (such as overpass or underground passageway) may be built in greenway intersection and linked to the slow traffic system of community greenway. The interference from motor vehicle may be removed through an independent greenway connection passage. This can prevent the slow traffic system from being cut off by urban motorways.

(2) Road section permitting, double-layer greenway should be established. The "second-layer greenway" above or under the ground may be built in parallel to existing greenway routes in the form of underground passageway or overhead greenway system. Meanwhile, two independent but interconnected greenway systems should be established by linking the step to every node of greenway above the ground as well as an entrance which can release the traffic pressure and provide. For example, in greenway section 1 of Kunyuhe Community, the "second-layer greenway" route is designed based on original greenway route (Figure 4; Figure 5).

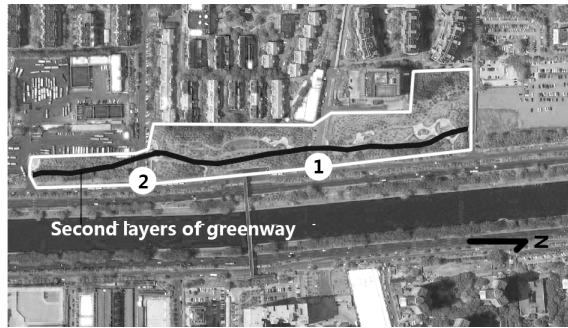


Figure 4: greenway section 1 of Beijing Kunyuhe Community

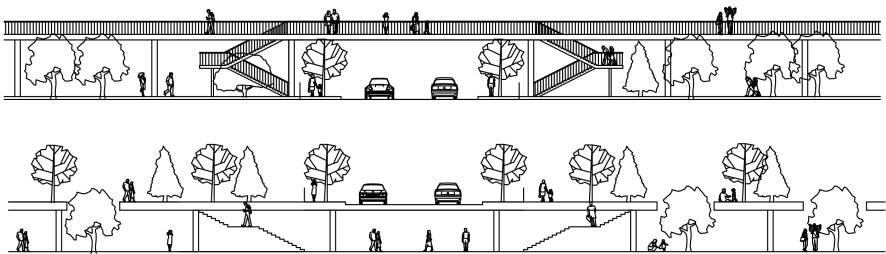


Figure 5: sketch map of "second-layer greenway" system at intersection 1, 2

(3) The intersections with large flow of pedestrians (such as community's main entrance, and the intersections linked to subway or bus station) should be furnished with the multi-function open space where users may go, wait for

people, stay and walk. Besides, this space can be linked with greenway's slow traffic system so as to evacuate pedestrians in greenway intersection and mitigate the pressure on motorway during peak commuting hours.

Greenway and Surrounding Service Facilities

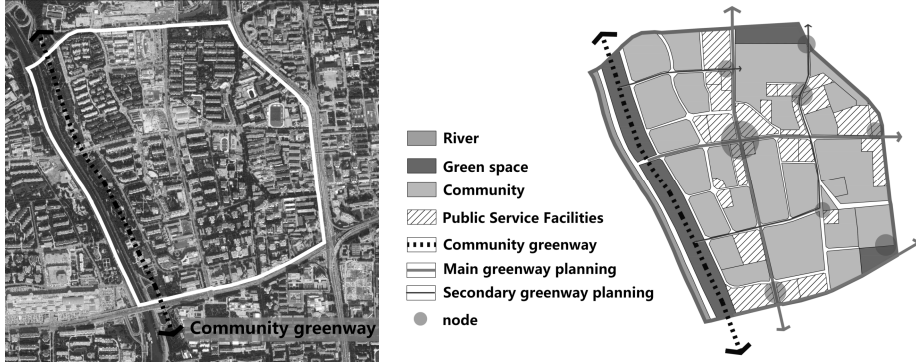


Figure 6: greenway network sketch of greenway section 2

A complete community greenway network system should be established and linked to the surrounding public service facilities, and the community greenways and nodes at corresponding grades should be built according to their functional nature, use frequency and extent of demand which can provide a variety of diversified greenway space and buffer space. Additionally, there are independent greenway entrance around public service facilities whereby people can reach the destination most conveniently. For instance, in greenway section 2 of Kunyuhe Community in the south of Beijing's North Fourth Ring (Figure 6), greenway network can be used to set up a well-organized greenway network system, which can improve the use frequency of greenways and the attainability of public service facilities around the community.

Discussion

This paper emphatically studies the strategies on improving the connectivity of community greenways in Beijing. it suggests that multilayer greenway connection passages should be established to constitute a hierarchical community greenway system to improve connectivity of community greenway, and the service efficiency of community greenway. In addition, this paper also advises building three-dimensional traffic system and "double-layer greenway" between greenway and intersection to remove the obstruction of intersection. There is another suggestion that the intersections with large flow of pedestrians should be equipped with multi-function open space that can help evacuate people and reduce the mutual interference between different flow

lines to guarantee the unobstructed greenways. To construct community greenway in high-density Asian cities, it is first necessary to ensure community greenway connectivity to raise its use frequency, alleviate traffic pressure of urban motorways, and reasonably evacuate community people. Second, a community greenway system should be constructed to heighten land service efficiency, integrate and share community resources, improve urban living environment, build a livable urban living space and guide the sustainable development of cities.

Conclusion

According to the actual condition of relevant cases, multilayer and multi-type community greenway systems have been planned and constructed to link community greenways with surrounding communities and public service facilities. In these systems, community greenway is taken as a bridge between community and surrounding facilities to constitute an orderly whole. In this way, community greenway will play a more effective role. It is hoped that the suggestions proposed may help to improve community greenway planning.

Acknowledgement

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