Discussion About Applications of Vine Devices in Stony Urban Environment

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Abstract. In this paper, the author proposed to set shelves covered by vines to cope with the environmental problems caused by too hard urban space. The author discussed comprehensive effects of the greening device in terms of improvement of environmental landscape and people-oriented experiences and promotion of applications of vines by combining with cases of specific cities.

Severity of Urban Environmental Problems and the Countermeasures

Objectively speaking, original natural environment is not convenient for life and development of human being. Even worse, it might bring tremendous threat to the survival of human being. Hence, while conforming to the nature, people have to renovate and transform the environment proactively to create conditions favorable for their development so that they can remain invincible. Since appearance of carve and nest dwelling, human being have acquired the ability to build artificial habitation independently. They started to live where there are living resources instead of living where there is a cave. Since then, civilization of human being has proceeded rapidly. This might be the first major interest originating from people’s reformation of environment. Thereafter, people started to build up artificial habitation to resist various natural and man-made adverse impacts and create good conditions for their daily life and long-term development. Consequently, construction of artificial habitation is regarded the top priority which decides survival and development of human kind.

Human being love inhabiting a place together inherently and modern society is marching toward the objective of high urbanization at an unprecedented speed. Inhabitation brings huge benefits to people. With continuous expansion of inhabitation scale and transformation of modes of production and consumption, many accompanied, previous or hidden negative effects increase and even evolve into a fatal factor which may endanger the environment of cities or the earth. For firmness and durability, artificial inhabitation environment is primarily characterized in its hardness. “Reinforced concrete forest” is a word commonly used to describe urban environment vividly. As a matter of fact, based on the concept of “stony” geographically, it is also appropriate to describe the urban environment as an extremely “artificial stony space”, which may embody urgency and severity of urban environmental problem more intuitively. Stony desertification of natural environment means human being misuse karst slopes which have been barren already and lead to such disastrous geological phenomena as water and soil erosion, bareness of mountains and rocks and environmental imbalance. Its hazards include extremely barren lands, drought, frequent floods and infertility. Similarly, hard facilities in cities, e.g. buildings, roads and squares, have a dominant position in urban land use, so there are many characteristics similar to natural environment suffering stony desertification. This might be one of the sticking points for which cities suffer from natural disasters frequently. Even worse, people bring hazardous factors, e.g. waste gas, waste water, industrial residues, noises and vibration, to urban space continuously and intensively during their production and living and thus further aggravate environmental degradation of cities. Direct victims of stony desertification of natural environment are only a few populations across a broad area, while a stony city is normally homeland of millions of residents!
Facing increasingly severe urban environmental problems, we should make every effort to cure the problem and take all sorts of measures concurrently instead of putting on the last straw that breaks the camel’s back. In a certain sense, for a city which is like a camel carrying a very high load, the negative effect exerted by an individual project or a local area may be a straw. However, as time passes, it is the straw that we do not attach importance to that make urban environment to be on the brink of breakdown. Rainfall collects in depressed areas and leads to water-logging; sewage flows into and ferments in rivers and lakes; rubbishes are piled up across cities and haze stays in the air and cannot disperse; urban heat island makes cities in hot areas even burning in summer. People have suffered a lot from these negative things. It is really urgent to alleviate burdens on the environment. It is hard for a camel to stand up again after it is overwhelmed. Meanwhile, we should not neglect the positive effects brought when we make every effort to cure the environmental problem. In the modern urban environment with severe ecological conditions, every single positive action of us is of value and should be highly regarded and encouraged. Although the idea of sponge city is of no use in extreme climates, its huge value in comprehensive environmental protection is undisputable. Similarly, the comprehensive green system composed of green spaces on roofs, walls, balconies and other building positions will inevitably have a great role in the improvement of the urban environment. However, for the reasons of awareness, regulations, costs and techniques, it’s still hard to give full play of the value. Likewise, such long-term measures as transaction of carbon emission permit and replacement of lands for construction purpose cannot have an obvious effect in solving urban environmental problems, but they still have a huge value in environmental protection generally.

In this paper, the author put forward the strategy of vine devices to relieve the severe hardness of modern urban environment based on the idea that we should make every effective effort to cure environmental problem. The strategy aims at solving the problem of outdoor hard space in cities at a microcosmic level. It is dedicated to fully tapping the green potential of hard spaces to improve green coverage ratio and people-oriented experience of urban spaces in flexible manners from the time and solid space dimensions. Certainly, the strategy has limited role in overall improvement of urban environment; the problem of excessive hardness of cities remain to be cured from sources, e.g. scientificity and rigor of urban planning and preciseness and reasonableness of space utilization and design; however, the people-oriented functions of vine devices as an external dust mask and sunshade at places with a high population cannot be ignored. Besides, since vines are the primary plants employed in the strategy, it will promote play of the value of vines in urban spaces.

Technical Construction and Features of Vine Devices

Technical Construction of Vine Devices

The device is composed of vines, shelves, base and other main elements. The combination of base and shelves makes for planting and climbing of vines. They constitute a greening device which is extensively applicable to hard spaces of cities. Depending on the specific environment and conditions, the device can be classified into three categories generally, i.e. fixed type, suspended type and moveable type.

**Fixed Type.** It means vine devices built up at fixed positions on horizontal sites, e.g. floors and roofs. Such devices are similar to vine shelves commonly used in urban parks and green spaces. As there is no need to move them, their horizontal and vertical dimensions and shapes may vary flexibly based on site conditions and their specific functions. Its shelves and planting beds can be built separately. In hard environment, this device is applicable extensively to open parking ground, square edges, midair of slopes of underpass tunnels, roofs, pedestrians and waiting area of canalized green islands.

**Suspended type.** It means vine shelves suspended on fixed positions of such vertical parts as pedestrian overpasses, balconies and windows of buildings. However, for safety, the base should be as small as possible with exception of planting beds of veins. It is better that the extrusion part should not exceed 0.5-0.6m from the wall. Besides, shelves should be connected firmly with the
base to be a solid and integral part. If burglar meshes are installed on windows or balconies of houses, it is allowed to place giant flow pots directly and plant veins. When suspension devices are built on pedestrian overpasses, they are expected to be built on piers and two sides of piers so that they exert the smallest impact on structure of bridge. There will be the best effect when planting beds are suspended on both side of the bridge symmetrically and upper shelves are connected to be an integral one.

**Moveable Type.** It is a special unit greening device that is movable, can be horizontally and vertically combined and is devised specific to those hard spaces needing flexible use of spaces without conditions to plant shading trees. For the purpose of showing images of shops or implementation of various activities in holidays, the square in front of a commercial building, for example, are simply created to be a hard tile ground with some shrub beds and pot cultures which make no sense in shading. We cannot imagine the situation in hot summers at such a place where gathers a great many populations. Yet planting of trees at these places is inconsistent with the needs of image showing and spatial change or it is not suitable to plant trees there as a result of underground facilities or complete hardening of ground. Therefore, it seems the dilemma of such places can be only solved by means of movable vine devices. To move or combine the devices, light hoisting equipment is required. The unit should not be too large. It is appropriate that length of the side ranges from 2.4m through 2.7m and the overall height stays at around 3.6m. To form a scenery independently and various combinations, unit plane elements may be made into a square or an equilateral triangle. The patterns of shelve top may change flexibly. For those needing horizontal splice, the shelve top at the splicing side should not have a protrusion; for those needing vertical splice, the lower shelve top should be flat. The base should be a complex that integrating the functions of corner planting bed, terrace edge seating, channels, steps, passages and rainwater collection. The terrace should be placed with water permeable tiles. Rainwater is stored in the hidden box at the side of the flower bed and the overflow belt leads to the flower bed. After some time, roots of veins may extend into the water pool through the overflow belt to form plants by water, which makes for water saving and device maintenance.

**Features of Vine Devices**

**Taking Advantages of Growing Characteristics of Vines and Expanding Applications of Vines.** (Woody) vines are characterized in their failure to stay vertical in the course of growth. Instead, they must twine around or climb their organs or other objects to rise and get better growing conditions. They have abundant species, strong vitality and rapid growth. Moreover, most vines have more than one ornamental features through their leaves, flowers, fruits and stems. [1] Rising by clinging to other objects, they need not consume plenty of nutrients to grow strong trunk, which makes for growth of branches and leaves. Similarly, needing not to be strong and deep in earth, their roots are dense capillary roots which are in favor of nutrient absorption. Shallow roots make them suitable to be planted in flower beds and pots (depth of earth: 0.45-0.55m) on the hard site. Shelves of the device serve to support climbing of veins, which soon form a shade over the shelves and wrap the greening device. This will greatly enrich green landscape in cities and give more space for utilization of veins in cities.

**Shaping Vines.** Veins do not have a fixed form normally. Their forms change with the objects they cling to, which makes it possible to guide and shape veins by using shelves and create green landscape in diversified forms that conform to the environment.

**Offering Sunshade under Shelves Better than Trees.** It is certain that the role of trees is irreplaceable in environmental protection, but even if we manage to plant trees on hard sites, there might be a risk of lodging due to the shallow roots, little earth and bad growth. In this circumstance, vines are easy to grow and the cover on shelve top and suspensions on the shelves offer a better sun shade. Moreover, the stability of the device is guaranteed. If we set supports of shelves at corners and along edges, aggregate leisure space may be created.

**Offering a More Environment-friendly Rain Shade than Pavilions and Corridors.** Pavilions and corridors have the functions of sun and rain shading, but they are artificial and of a high cost.
Construction of a great many pavilions and corridors may increase hardness of urban environment. Although vine devices cannot keep out rain, they have a good sun-shading and cooling effect in summer and its cooling effect is even superior to those hard pavilions and corridors. Pavilions and corridors absorb or reflect sunlight, but the energy absorbed will be radiated to the environment in the end. Sunshade offered by veins of devices not only provides a shady and cool place for us, but absorb and disperse energy by means of photosynthesis; meanwhile, veins absorb water at a low temperature continuously from soil layer to neutralize external high temperature. Moreover, if we choose deciduous veins, people may enjoy warm sunshine under the device in winter. What I have to mention is that the device has common environmental effect of all plants. Thus, the device is more environment-friendly in comparison with pavilions and corridors.

Selection of Urban Nodes and Analysis of Extensive Applications and Great Environmental Protection Value of Vine Devices

The author is going to extend the discussion by taking some typical urban nodes of Wuhan as examples.

To Make Sightseeing Platform on the Flood Control Dam More People-friendly

People always show a special preference to river view. Under flood threat, however, riverside cities are forced to build dykes and walls to prevent floods. Consequently, rivers and cities are always separated for a long time. In recent years, as people gradually recognize huge comprehensive values of river views, cities started to upgrade and reform dykes and flood-control walls one after another. They attempted to make the top of dykes a sightseeing platform and enhance affinity between rivers and cities. Some parts of riverside with favorable conditions built urban parks with various functions on beaches. Nevertheless, in many sections of rivers, especially in urban core areas, it is still a rigid appearance from riverbanks to the top of dykes as a result of narrow land and importance of flood control.

Wuhan is well known as a “river city”. Two rivers meet at the core area of Wuhan. The city is divided into several parts, which stay by the river like a turtle and a snake in form respectively. There are many buildings and towers. Bridges connect the separated parts. These are the most magnificent scenery of Wuhan. It achieved remarkable success in reformation of riverside banks and dykes in recent years. However, affected by limited lands, banks and dykes seem rigid and exposed. Two sides of Yangtze River Bridge, especially the sightseeing platforms on the top of flood control dykes from the intersection of Minzhu Road to the intersection of Zhonghua Road in Wuchang, are such examples. These are the best sightseeing points where visitors watch and experience the magnificence of Wuhan and almost every single visitor comes here to watch river. Still, only some flowering shrubs are interspersed at the side of the city by means of flower pool. Without the function of sunshade, visitors will probably not stay for a long time under the scorching sun in summer. It is necessary to furnish some sun shading facilities appropriately. Vine devices will make the space more people-friendly and beautiful. Surely, vine devices are also generally applicable to greening and people-friendly reformation of all other sightseeing platforms by river. (Figure 1)

![Figure 1. Vine devices on the banks of The Yangtze river.](image1)

![Figure 2. Vine devices on Shouyi block square.](image2)
To Strengthen Spatial Flexibility of the Main Square in the North of the 1911 Revolution Museum

Taking the opportunity of centennial of the 1911 Revolution, Wuhan managed to create an extraordinary urban landscape belt of the Museum of Wuchang Uprising of 1911 Revolution centered in the 1911 Revolution Museum, echoed by Hubei Theater and surrounded by Ziyang Lake in the south and She Mountain in the north. It shows landscape, revolution history and artistic sentiment of Wuhan. As a core project, the 1911 Revolution Museum covers a large land with a stunning main building that conforms to the theme built. Its external environment is concise and magnificent with functions of greening and relaxation. However, it is still necessary to further improve the space of the main square in the north. This might be the common aim of the majority of similar squares.

Normally, pattern and scale of a square directly relates to the nature and scale of the building and people flow. The peak of people flow is taken as a design basis normally. This square is no exception. Since the project is especially important and the relating event has an unusual influence, it is supposed to be reasonable to build an extremely large square to hold a grand ceremony of important anniversaries and reflect the epic magnificence of the event. The problem lies in that there are extremely limited days of important anniversaries. As there are not so many visitors ordinarily, such a huge square seems excessively spacious. After the shock at the first glance, people will feel boring. Meanwhile, it not only wastes precious space, but leads to harsh microclimate of the square as there is nothing to defend against winds in winters and sunshine in summers. Therefore, it is quite necessary to furnish a spatial element which significantly adjusts the environment on the square so that the square becomes strongly flexible in different applications. A certain number of movable vine devices could offer green coverage and sunshade; reorganize and utilize vacant space of the square reasonable through plane combination of the devices; splice multi-layer green towers which conform to the nature of the square by piling them up. Vine device is an appropriate choice as an environmental regulator. (Figure 2)

To Apply Vine Devices Extensively in Jiedaokou Urban Node Area

This area is one of the main urban nodes located on Wuluo Road, a trunk road of Wuchang in east-west direction. It has almost all features and weaknesses of modern urban nodes. There are a great number of high buildings and commercial buildings. Traffic jam and crowds of people are common phenomena on the wide road. Bridges and tunnels are built at the intersection. Pedestrian overpasses fly over the road. It is modern but crowded and noisy. The most unbearable thing is that there is hardly any large green space and even no shading tree in such a huge block as a result of tight lands and excessively hard site. It goes too far although most urban nodes are characterized in hardness. Actually it is possible to improve the situation by taking appropriate measures. The author selected several important parts of the block to discuss flexible application and effects of vine devices. (Figure 3)

To Improve the Hard Environment of Chicony Square in Front of the Entrance of Commercial Buildings. The square is about 100m in width and about 30m in depth. It is rare in the place where the cost of land is extremely high. As there is an underground shopping store, it is actually a roof square with hard tiles placed. Scarp without guards is designed along the road. In terms of functions, it is adequate for pedestrians. If square vine devices are employed to create a straight green leisure promenade by splicing the vine devices with the scarp at the outer side of the square, it will greatly improve spatial experience of the block and eliminate potential safety hazard of the scarp. (Figure 4)
To Tap the Potential of the Vacant Space in the Midair of Slope of Underpass. The slope of underpass in the street is open. This improves traffic capacity and makes the road wider, but increases hardness of the street where land is very tight, so it is valuable to explore greening measures. As a matter of fact, it is sufficient to keep a clear space of 4.5m above the slope for the traffic purpose and the remaining clear space is spare part. In consideration of this point, it is suggested that we should build up a shed frame in an appropriate form with light steel members and plant vines in existing greening grooves at both sides. It is anticipated that a green shed landscape with considerable scale will come into being. Although they cannot offer a shade for pedestrians, they are beautiful and play a positive role in the aspects of noise, exhaust gas and dust control and microclimate regulation in the street. In addition, the green shed may buffer visual accommodation of drivers who drive in and out of the underpass. (Figure 5)

To Improve People-oriented Experience of Pedestrian Overpasses. To ensure smooth traffic and safety of pedestrians, all cities are building various overpasses. Overpasses gradually become a vital passage of pedestrians, but it is a compromise measure that requires pedestrians give way to the traffic. Pedestrians have to climb up and down or take a roundabout way usually. Consumption of physical strength of pedestrians is increased in certain degree. Against the social background of fast-aging, it is necessary to attach more importance to our care for people. The actual situation is that barrier-free slopes cover large areas and are terribly long, that no escalator or barrier-free elevator is furnished and that exposed concrete bridges or steel bridges are built in most cases. The overpasses listed in this paper are good examples. In practice, to furnish elevators and escalators, plenty of funds are required for equipment procurement and daily maintenance and operation. It remains to be solved during further development of the society. There are still some practical things to be done. In addition to various glass bridge roofs and landscape bridge roofs appearing in many cities, as mentioned above, bridge roofs made up by vine shelves may be an economical and environment-friendly choice that acts as a scenery and is beneficial to people. There is also a greening potential to be tapped in stairs, slopes and bridge bodies. (Figure 6)
Conclusions

Human beings have had deep understanding of huge value of vines in terms of environmental protection and landscape. We may discover almost every mode of application of vines in cities. [2] Although the strategy proposed in this paper is completely original, it may not be the initial one. In the severe current urban environment, especially in the hard environment, it is indisputably important and urgent to grow more plants, especially sun-shading plants. And it might be an indispensable technique to find effective experience and methods in the course long-term extensive applications of vines to better satisfy actual needs of the society. This is also the aim of this paper.

References
