New Technicalized Green Space Landscape Design

YING XU¹, QINGPING ZHANG²*, SIYUAN LIU²
1. School of Art, 2. College of Landscape Architecture
1. Jiangsu University, 2. Nanjing Forestry University
1. No.301, Xuefu Road, Zhenjiang City, Jiangsu Province 2. NO.159, Longpan Road, Nanjing City
CHINA
1. xuying110111@126.com, 2. qpzh@njfu.edu.cn

Abstract: This article analyzed the dialectical relationship between landscape and technology at multi angles, as well as the new technological trend for urban green space design and construction from multidimensional views, especially it made a dissertation on the subject of the technologized design methods and the sustainable technological innovation and the diversified development with the support of ecological technology.

Keywords: landscape technology; sustainable technology; landscape design

With the rapid technological development of modern material and processing and environment, the modern landscape has gradually become the highly uniform product combining art and technology. On the one hand, it is more artistic for the modern landscape technology, Olmsted said at the rostrum of Harvard University, “what the landscape technology is one kind of art, the most important function is to create the environment how beautiful it is looked at for human activities...... this objection is required to make offset, that is a mission for landscape technology”[1], the quickly changing modern landscape technology was applied to gardens, plaza, urban park, outdoor space system, nature reserve, earth landscape and regional planning design for landscape through artistic means and methods; on the other hand, it was technological for the modern landscape art, with the application of high and new technologies, which was used widely in the field of landscape, the content of technology became more higher in the landscape art, the creative ideas and techniques for the landscape have made a great change consequently[2].

1 The Integration of Art and Technology

With the exchange of modern landscape and other kind of art and subject, it began to show multiple forms. The modern landscape needs a variety of technologies for support, the technologies enable the function of landscape realizable and designing more freedom, it is enabled to communicate more information about emotion and personality which’s out of the function as a symbol, this is just those landscape designers who are assiduous with emotional orientation in an attempt to seek for high-tech; simultaneously the technology provides the modern landscape design with more idealistic influence and inspiration.

Hargreaves showed through practices that science and art can be integrated in the landscape design perfectly, his design reflected many issues what the society faced, and the ideas what he resolved the complex issues, as well as the concept what he integrated the environmental issues with the social culture. The landscape design not only was required to accord with the ecological principle, and also should consider the cultural succession of and the artistic form. He was used to get the reasonable and magnified earth surface’s modality and the plants collocation through the analysis of scientific eco-process, while the art was highlighted, and also the ecological principle was followed. For example, the analysis was made on what the river eroded the riverside, it was summarized that a dendritic ravine system, based on the principle, the sculptural terrain
was created and applied to the waterfront environment, which expressed the water fluidity, it produced an artistic effect dramatically, and also it was a measure to reduce the erosion of water flow (Fig.1)[3]. Hargreaves’ works made culture interrelated with nature and earth and human being, which’s a dynamic and open system.

WEISS Landscape Design Office utilized a zigzag green platform to connect Seattle city which’s divided by road and rail with the waterfront area for renewing the relationship between them, it turned into the infrastructure for the landscape, which’s a green and open space on the waterfront integrated with the means of urban transportation, and its underlayer space can ensure the urban transportation unaffected, the upper-layer space was used as Olympic Sculpture Park, which was awarded the 2007 world top ten architectural wonder by American "Time" magazine (Fig.2). Because it’s required to across over a busy road and rail, in order to meet the requirement of special structure, the overall project utilized the modern technology which the mechanical layer-fixing system was developed to complete the structure according to the site condition. The entire system was established by means of stacking with the steel baskets loaded with gravels and stones, and then finished by reinforcing with the netlike plastic alternate layers and tamped anchor, perfectly coordinated the relationship between the foundation and the slope retaining wall, which’s safer than the concrete retaining wall at the time of an earthquake, the cost was very economical[4]. The modern landscape designers renovated the traditional landscape concept, the applied new technologies and methods greatly extended and enriched the environmental landscape concept and the representation.

With the improvement of domestic technologies and construction standards, and the increasing cooperation and exchange between the Chinese landscape industry and the overseas, the domestic landscape design also began to consciously use and represent the new technologies, such as Chengdu Weinan River Park, Beijing South Hall Park, Tianjin Bridge Park, and etc, the parks showed the integration of technology and art, some new eco-technologies were used to dispose the ecological issues such as wastewater recycling in eco-park, eco-restoration of waste areas, and so on, and that combined the utilization of technology with the eco-education and the recreational activities. Chengdu Flowing Water Park is the first urban eco-park in the world as the theme of "Water Conservation", which showed the international advanced sewage treatment of the constructed wetland system, it simulated and reproduced the complete process how the sewage was turned to clear in the natural environment, through the certain technical means, it displayed the new eco-measure or the process flow to the citizens, which made the function of popularizing eco-education (Fig.3).

![Fig. 1 The wetland in Renton park, Washington](image1)

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Photograph: Theories and Practice of Modern Landscape Architecture in the West*

![Fig. 2 Olympic sculpture park, Seattle](image2)

*Fig. 2 Olympic sculpture park, Seattle

![Fig. 3 Flowing Water Park in Cheng du](image3)

*Fig. 3 Flowing Water Park in Cheng du
Photograph: http://www.zgfjyl.roboo.com/*
2 The Tools and Methods Technologized for Design

The modern technology provided the tools with powerful technical support for the implementation of project, especially the development of computer technology, which was able to simulate and elaborate the complex sites and design results through the computer modeling technology, the computer technology also enabled the designing in manner of human psychology and behavior for organizing the environmental space, making visual appreciation as main scape, based on the integrated perception rather than the simple visual perception. The emergence and development of new technologies not only brought the change on materiality, but also the people's ideas have been changed. In the space of computer, the bran-new relationship and the design concept have been developed, the appearance of landscape has also been changed from some point of view. Yokohama International Port Terminal, which design was made by FOA Office, was realized depending on the powerful capability of computer model analysis and the precise process capacity of modern materials, so as to form the system of complex function interpenetrating the urban open space and the hub of communications (Fig.4).

Fig. 4 Yokohama international port, Japan
Photograph: Zhu Long Image Library

The development of modern technologies, such as aerial survey, remote sensing, GIS, internet, and etc., also have been more comprehensive applied. The statistics based on the main information sources such as remote sensing, land utilization, weather and green space, utilizing the technology of GIS space-analyzing, making a dynamic monitoring and an integrated assessment for urban heat island effect and green space distribution[5]. The development and research on the green three-dimensional computer information systems of the green space landscape, provided a powerful tool on a reliable theoretical basis and an easy operation for the forecast of the green space construction program with eco-environmental quality and decision-making after the green planting plan is realized. Utilizing the technology similar to Building Information Modeling for a sustainable garden design during the whole process of engineering construction project such as designing, construction, operation and maintenance, to simulate and analyze the performance of lighting, ventilation, shock resistance and comfort, it is able to know the information about the energy consumption, water usage and eco-benefit throughout the park’s lifecycle, and can be visually presented, so as to achieve the sustainable design.

The movement of design method has a direct relationship with the development of science & technology, through the development in decades, in the field of design, the method itself has finally become a study-design methodology. In the implementation of landscape project, the landscape designers are responsible for whole technical process and design and control for results, therefore, the design activities make a very important function, the method which the activities relied on directly affect all stages in the implementation of project. So the design methodology is an indispensable part in the technical activities, which is related to the success or failure for the landscape project. The landscape design method was technologized, that is to decompound the issues into the essential forms, as basic components, assembling these in a certain manner of configuration, so as to form a complete program. The technologized landscape design method is represented most direct for the application of model, according to the specific landscape project or the landform, it is required to change the initial mode to a variety of landscape works derived from prototypes or models, the emotional and random inspiration should be constrained within modes at the beginning.

3 The Recycle of Recycled Materials

The eco-design and the recycled design and the principle of sustainable development enable the park design at the start to stress the recycling of recycled materials and the application of eco-materials. The recycled materials have transformative potential
inclusion of scrap metals, waste paper, scrap plastic, scrap rubber, scrap building materials and electronic waste, the recycle of recycled materials are mainly regarded as the scraps such as building materials, industrial materials, brick debris and tile gravels, industrial waste residue and production raw materials. According to the ecological principle, the design uses the original recycled materials as possible at the site for formal and functional reconstruction, so as to maximize the potential of recycled materials in the limit, to reduce the non-recycled energy consumption during production, processing and transportation, to reduce the disposal cost for removing the original scraps during the construction and also for new wastes, to reduce the negative impact which is made by the design for the natural environment, and to retain the characteristics of local history and culture on the basis of it, and to enhance its capability of self-regulation[6]. Because the applied materials are likely to make harm directly to people, other life-form, landscape environment and natural resources system in the landscape park construction, resulting in

![Fig. 5 Recycling utilization of abandoned material in Ziegelei Park, the city of Heilbronn, Germany](image)

**Photograph:** The New Landscape in Europe

consumption for non-recycled resources, therefore the recycle of recycled materials and the application of new eco-materials are required strictly and carefully to comply with the principles of bioecology and economy, for example, in Heilbronn Brickworks Park, German, the construction was commenced in 1990, Karl Bauer, an architect, was responsible for the planning, the designer retained the residual steep walls with yellow clay soil when the soil was removed by the original brickworks, so as to build the natural reserve, and the local materials were used, in order to take full advantage of residual scrap materials such as gravel after demolished the construction which was used for road base, or the additive of water permeability was added to the soil, the residual stones were used for building the retaining wall, the old railway was changed to the curb (Fig.5)[7]. These scrap materials were turned to the recycled landscape resources in the eyes of designers, using the local materials, and carrying through the technical processing and the reproduction of art and the demonstration of eco-restoration process, in result, the original scrap materials were turned to the resources for the construction of new landscape.

In addition to the reuse of waste materials, the recycle of recycled materials are also represented as the innovation of ecological materials. Relative to the resources consumption of traditional materials, the secondary pollution may occur in the production process, non-resolvability and competitive environment, the ecological materials have the characteristics such as low carbon, high energy, less energy consumption, high utilization ratio, non-toxic and harmless, low load to environment, high recycling efficiency and good environmental harmonization. In the early 21st century, a large number of new eco-materials emerged in the field of the western modern landscape parks, which promoted the transformation and integration of landscape parks with aesthetic and functional and ecological attributes, it realized the expression and practice of ecological ideas what the landscape designers required. Meanwhile, in order to meet the requirements of expandability and environmental harmonization and comfortability in the field of human activities, the eco-materials applied to the design practices were compatible for decoration, diffusibility, mobility, digestion & transformation capabilities, in order to resolve the issues such as vertical planting, solidified soil, rainwater infiltration and others. For example, the application of standardized and modularized green wallboards achieved the idea of standardized vertical planting system, extended a new practical interface for the conventional vertical planting which relied on liana, it made plant species diversified for choices, and more flexible structural configuration, and also improved the ecological system and the environmental adaptability (Fig.6); moreover, the application of degradable solid earth material provided the feasibilities through the physical, chemical and biological degradation technologies for soil solidification and plant growth (this kind of new solid soil material has the characteristics of porosity and water absorption and high reliability, easy for irrigation, ventilation, drainage and water conservation, suitable for recycling waste land and contaminated land, as well as transforming adverse soil environment to the medium of plant growth); the application of earth's surface ecological materials, such as recycled rubber cover and water penetrating concrete and asphalt, also it's capable of
reshaping the two-dimensional ground to the multi-dimensional spatial structure, and the surface structure of landscape park has the functions of respiration, exchange, pollution isolation, directing water flow and conserving water source[4].

Fig. 6 Two vegetal walls envelope the interior perimeter of the space and encase a steel staircase and walkways.


4 The Innovation of Sustainable Technologies

At present, the sustainable landscape design technologies mainly include the collection of water resources, the utilization of green energy, wastes treatment and the resources management of sustainable landscape, and so on. The flexibility of green energy is big, the required fuel source is extensive, strong adaptability, clean and non-pollution, but the photoelectrical and thermal conversion efficiency are lower, so especially the technologies transforming green energy to landscape is very important[8]. The transformation is an important part of the recycle process, it is how the data exchanges have been made among landscape and field environment, culture and condition, related to the design potential of landscape parks[9]. As the conditional factors which influence the area conformation, the energy conversion is represented for an interpretation, clarifying and describing the numerous invisible power sources existing in the place; at the same time, the transformation means a change, it can be used to illustrate the operating mechanism from nature to landscape; its sources may be solar energy, tidal and wind energy, collected by mechanical equipment, and assorting with the data sensors, converting the collected energy into other new forms, or determining the changeable conditions at the site, e.g.: the Courtyard in the Wind in Munich, Germany (Fig 7)[4], the wind energy was obtained and converted into power energy through the impeller on the top of the building, supplying power to the rotating platform which was for the machine via the complex connecting device, in order to drive the earth’s surface, infrastructure and manual rotation. The design of Courtyard in the Wind transformed the mechanism of green energy into the power of landscape through the field own natural condition and the advantage of wind energy, and showed its process and principle to visitors, endowed with its special experiences for the landscape.

Solar sewage treatment wall is an ecological wastewater treatment system, which was conceived by John Told, a biologist, the experiment has been carried out on a small scale. The facilities were scattered mounted on the wall along the street in the city, this kind of wall has a narrow and thin configuration like greenhouse, the south side and the top are transparent, the north side was structured with black painted bricks or concrete. The solar radiation energy can be absorbed and retained by this device. Inside wall, the ordure crusher and an ozone sterilization device are located at the sewage

Fig. 7 Courtyard in wind, Munich, Germany

entrance. The major part inside wall was composed of several vertical fiberglass shallow slots falling layer by layer, the sewages fall down to the bottom, each layer has the special cultivated aquatic plants to carry out decontamination. The principle of this device was simple, just use the principle of greenhouse, as well as the plant and biologic technologies to treat the sewage. This is a complete biological mode, does not discharge toxins into nature, it is an urban infrastructure, will also become an unique urban landscape[10].

In the project of design, through ingathering and utilization of rainwater, resolving the issues such as waterscape construction, green space irrigation and internal cleaning, so as to achieve self-sufficiency for the ecosystem, and also the designer’s ecological idea was fundamentally represented. For example, North Duisburg Landscape Park, retained and used the old drainage transformed to a waterscape park, and took advantage of new wind energy conversion facility to drive the water purification system, through the process such as initial disused flow, filtration, storage and recycle, completed the process of plant irrigation in small park using the ingathered rainwater resource[11].

![Fig.8 Floating island: floating habitats](image)

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The technology of Bio-floating Island was realized through the combination of various plants adapt to the aquatic environment, and assorted with a large area of substrate, so as to form the floating island, effectively maintaining water quality and health with special microbe and ventilation system, which was applicable to the eutrophied water body, water garden, river, stream and waste water, so as to remove excess nutrients, heavy metals and other harmful substances (Fig.8)[4]. Compared with the natural terrestrial island, the bio-floating island is more flexible, light and economical. The microbe in the stratum of floating island can either make function of which assorted with plant root to mitigate algae growth in the eutrophied water body, or converting nutrition to absorbable substance applicable to the plants for nutrient supply. The sustainable biotechnologies were applied to the bio-floating island, combining with animal, plant, microorganism and other natural elements, so as to create many tracts of oasis full of vitality in the bustling and hustling city.

The biological control technology and the treatment technology utilize the biotransformation mechanism, it is important to focus on the absorption of plant and the synthetic bacteria and the treatment capabilities of hazardous chemicals and surplus nutrients, the landscape park design which limited to ecology, physics and engineering in the long-term, encountered an unprecedented challenge and opportunity, consequently it was extended to broader area[4]. For the contaminated lands, the conventional treatment measure was to transfer the pollutant and remaining industrial equipment and materials to the outside of the area, but, with the emergence of energy crisis, the rising cost of consumption resources and the promulgation of more rigorous waste disposal draft, the conventional pollutant treatment mode was changed to the on-site treatment strategy, and the landscape park intervened in it, and playing the role that adding fuel to the fire for this new treatment practice. For example, the Biologic Treatment Park, which locates on Weifen Peninsula, in northern Sydney, Australia (Fig.9) was formally open to visitors in March 2005, the design retained the original industrial debris at the site, it was skillful to

![Fig.9 Carradah Park in North Sydney, Australia](image)

Fig.9 Carradah Park in North Sydney, Australia
make use of a variety of digestive operating mechanisms to make a comprehensive treatment for the environmental area, e.g.: restored the biological soil from the microcosmic point of view through plant, bacteria and fungi, with the geographical advantage at the site, introducing the beach wetland, removing the residual contaminant, and recycling the infrastructure at the site to introduce runoff into wetland, using both micro and macro in parallel way to restore the vital force of landscape[4].

In addition to the ecosystem reconstruction and landscape restoration for the industrial waste land, the technological innovation of sustainable landscape park also represented the model of artificial wildlife habitat scape in the urban environment and the construction of vertical landscape and ecosystem. Following the plant growth and the evolution and renewal rules of ecosystem, and providing the condition for the growth of plant and wildlife by the man-made intervention system, accordingly playing the dynamic role of human activities and the initiative of natural systems. The modeling of vertical landscape means the integrated concept of landscape park and architecture, its technologic essence is based on the vertical side of building, embedded organic, active plant epidermis, habitat and ecosystem, in order to achieve the local self-sustaining and ecological balance local for urban landscape, of which the organic plant epidermis has a successive change such as germination, growth, maturity and decline, and has the relationship of increase by level on height, mass and strength. Moreover, the technological application of bio-harbor wild floating island created the feasibility for the construction of natural habitat in the urban environment. This artificial habitat island scape assembled and cultivated by manpower was formed, it can effectively maintain water quality and health through the function of microorganism.

5 the Diversified Trend in Support of New Technologies

With the development of study, the modern landscape design faces more complex issues, and that some new terms have been given, such as landscape pollution and landscape regeneration. The landscape pollution is the integration of various elements threatening the health of landscape system, it is undeniable that many defects remain in the current urban landscape system, such defects or damaged landscape spots, virtually, that is a concrete representation of landscape pollution; the landscape regeneration is the landscape restoration and reconstruction research based on the complete eco-system and the natural - human system ecosystem for the landscape pollution configuration in the process of urban landscape construction and development, mainly including eight aspects such as landscape restoration, reconstruction, reformative, improvement, repair, renewal, replanting and regeneration[14].The eight aspects require the involvement of a variety of design technologies, including the treatment and recycle on the both levels of macro and micro for the contaminated soil at the site; utilizing original industrial relics, creating natural and vitalistic landscape; accumulating rainwater through a renovated infrastructure, providing the ecological condition of habitats for frogs and other small wild animal; meanwhile, the constructed wetland pooling rainwater effectively prevents from the residual pollutant draining into other water body; the purification process with microorganism as medium is adopted to provide new habitats for wildlife; the natural landscape on the waterfront shoreline is restored, the rich natural resources and cultural marks are displayed.

Spain Natural Park is a classic representative case. The former park was a landfill area, the restoration project commenced on the three basic aspects: resolving complex technical issues, creating a new public space, and a new landscape, integrated the multi-disciplinary technical strength, so as to recycle the place (Fig.10). At first, starting from the technical aspect, to establish a reasonable work
strategy, based on the geometric form of landfill area, to determine the area requiring for stability and protection, and then to lay out the pipelines to collect biogas, to remove the permeated liquid, the runoff of rainwater is introduced into the rainwater cistern, at the same time, the kinetic energy which was produced by using biogas drive the irrigation system; subsequently the landfill area was reconstructed to an Italian style mesa garden, turned to the public space with multiple roads allowing traffic and pedestrian, on the treatment of landscape, the agricultural plantation landscape was adopted, well adapted to the restored damaged areas, it was the most reasonable and most effective way. The project showed the meaning that not only pursue the landscape, also showed the proper attitude that the new society treats the environment.

The development of eco-technology is an important driving force to promote the progress of present landscape design, the Netherlands landscape designers cooperated closely with the eco-technological experts, in the practices, they created a series of technical means with both practical and landscape value, e.g.: on-site rainwater-reserving storage technology, diversified revetment engineering measures, natural or biological sewage purification technology, groundwater recharge technology, plant gene engineering, and etc. these technologies enable the ecological ideas implemented. In order to enable the real eco-design focusing on the holism implemented, the designers not only set up the natural reserve in the park, so as to protect the ecologically wetland and river system, growing wild plants unculti vated in the constructed environment, but also implementing ecological and sustainable ideas in a complete design process, the ecological evolution process was extremely concerned on the aspects such as location selection, project selection, development mode, construction by phase, and process monitoring, consequently, the time span of planning and design lasted more than a decade for some projects[15].

In the early 21st Century, the ecological ideas among architects, landscape architects, artists and public's consciousness obtained unprecedented recognition, and its theoretic research and technical practice in the field of landscape park planning and design are also flourishing. the rapid development of materials and technologies also effectively expressed the designer's maturing ecological ideas, value system, cognitive channel, aesthetic orientation and the practical process of sustainable landscape park design during the process of landscape construction.

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References:


