



Study on the Eco-Control System of Sustainable Expressway Landscape

Leichang Huang*, Fucun Cao*, Shilin Shen*, Ying Chen** and Xun Gu*

*Art & Design School, Dalian Polytechnic University, Dalian 116034, China

**Sinochem Lantian Co., Ltd, Hangzhou 310051, China

Nat. Env. & Poll. Tech.

Website: www.neptjournal.com

Received: 5-8-2013

Accepted: 8-9-2013

Key Words:

Eco-control
Expressway
Sustainable landscape
Ecosystem
eco-thinking

ABSTRACT

With the quick urbanization and rapid economic globalization, expressway, as the most important portion of the highway networks, has been developed at an astonishing speed, which brought on increasingly severe ecological environmental problems although contribution greatly to human. Therefore, it is necessary how to promote economic development and at the same time to control the negative impact of expressway, which means it should be a sustainable expressway landscape, an expressway with human and nature in harmony. In this paper, the characteristics and the faced changes of a sustainable expressway landscape have been analysed. The eco-control system for the sustainable expressway landscape was constructed including both the theory control system and the technology one, adopting ecology, landscape, planning, cybernetics and related expressway theory to a whole new theory guiding the control process. It is an integration among the series of engineering technologies, the methods and guarantee of a sustainable expressway landscape. The technology control is in three layers, i.e., master control from two sides of planning and key nodes, subsection control mainly for the detailed expressway attribute of inside and outside elements, management control crossing the whole living process cycle of expressway. The eco-control system of sustainable expressway landscape would be implemented from three scales: macro-planning control, meso-design control and micro-engineering and technical control.

INTRODUCTION

Expressway: Nowadays, there is a growing realization around the world that humans are harming the natural environment (Byoung 2011). A major part of ecological problems is connected with transport. The effect of transport on the environment involves mainly penetration of harmful substances in the form of gases, fluids and solids into the atmosphere, lithosphere and hydrosphere, as well as producing energy, noise and vibration. The influence of highway is more complicated and diverse.

With continuous economic growth, Chinese fast traffic networks, mainly being composed of expressway, are developing at a fast speed. Environmental problems caused by expressway become a focus. The development of expressway lead to two results: one is society has erected extremely huge economic benefits, the space-time concept having changed people and their life-style, while the development has also brought about heavily environment problems (Schultz & Zelezny 1999).

Sustainable landscapes: Sustainable development, as defined by the United Nations World Commission report, is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. There are literally hundreds of definitions for 'sustainable' but the basic idea is that if something is sustainable it can keep going indefinitely. Natural systems have

been operating successfully for millions of years. Nothing made by humans can do that.

Sustainable landscapes are concerned with the planning and design of outdoor space. The scope of design of outdoor space may range from revegetation of a large bush block to the detailed design of small courtyard spaces intimately linked to a sustainable home. The extent and type of vegetation is obviously important but sustainable landscape design can do many things including providing practical solutions to reducing water use through water sensitive design and as part of a wastewater treatment system. Sustainable landscape design is an approach to designing and constructing the artificial landscapes that surround our buildings. Ideally, these landscapes should maintain themselves and survive by being part of the natural cycles of the local environment. In many cases this means finding out what the original local environment was like, which is often difficult. Sustainable landscape means putting back much of what was in place before development. It may also mean introducing things that were not there before.

The great thing about sustainable landscapes is that they can simultaneously address aesthetics and amenity, water management, air quality, passive design, climate modification, biodiversity habitat creation and local food production. A sustainable landscape can thrive with minimal inputs of labour, water, fertilizer and pesticides. Creating a sustainable landscape means working toward a thoughtful balance

between resources used and results gained. By factoring in environmental considerations, you can create a pleasant place that is part of an environmental solution rather than an environmental problem (Ding & Lu 2010).

Expressway construction is a work generally with a long cycle of more than three years, while the landscape construction is about one year to one and a half year, which will play an important role to restore the destroyed environment due to the expressway construction (Ding & Lu 2010). Therefore, the expressway landscape can decrease the impact on the environment, save the post maintenance costs and reduce the master workload.

Sustainable landscape design is the effective way to resolve the contradiction between human and land resources in the subject of landscape architecture, and ecological control technology is the guarantee of sustainable landscape design (Lei-Chang et al. 2010).

Eco-control: Sustainable ecological landscape system is put forward aimed at a series of ecological environment problems caused during the whole process of expressway construction. Eco-control is a concept to adapt the sustainable development in the world including all industries, especially the landscape architecture, which refers to wide fields of human, aesthetics, engineering, vegetation, ecology, etc. however, the research on it has only started.

An eco-thinking model of landscape design was founded by Huang Leichang in the case study of Tong Niu-ling, he thinks that the eco-thinking model of landscape design consists of eco-thinking in the visual design presenting sensory enjoyment, the environmental conservation and development with the least damage, the culture of the site, and the eco-thinking in design process of public participation (Lei-Chang et al. 2010).

THE CHARACTERISTICS OF SUSTAINABLE EXPRESSWAY LANDSCAPE

Inside characteristics - expressway itself: In terms of expressway itself, it is mainly madeup of road pavement, more than two traffic lanes, centre green belt which separates the road into the positive and negative road, while considering the green driving visual and reflection of the opposite light, road shoulder protecting the expressway from the rain and keeping normal work, amenities including lighting, rescue, guidance system, related services, etc., fences keeping up the auto safety warning the road board and reducing the damage of traffic accidents, and all the before were done for the traffic flows, the main part, and all the inside landscape design must have been done according to the local culture (Fig. 1).

Outside characteristics - environment: Ecosystem is the

whole system, including not only the organism-complex, but also the whole complex of physical factors forming what we call the environment (Henry David Thoreau 2008). Outside characteristics of expressway refers to its environment: first is the geographical location, the area it crosses which decides the scope it can affect, the environment pressure; the natural elements are also important, means the nature such as the vegetation, animal, water, forest, soil, each is a single ecosystem; and of course the local or the regional climate has close relationship with other environment elements or ecosystem (Fig. 1).

CONSTRUCTION OF ECO-CONTROL SYSTEM OF SUSTAINABLE EXPRESSWAY LANDSCAPE

The Construction of the Eco-Control System

The eco-control system of sustainable expressway landscape was madeup of theory of eco-control system and technologic one. Adopting ecology, landscape, planning, cybernetics and related expressway theory to a whole new theory guiding the control process, while the after is an integration among the series of engineering technologies, the methods and guarantee of a sustainable expressway landscape. The technology control in three layers includes master control from two sides of planning and key nodes, subsection control mainly for the detailed expressway attribute of inside and outside elements, management control crossing the whole living process cycle of expressway. And the eco-control system of sustainable expressway landscape would be implemented from three scales, i.e., macroscopic-planning control, meso-design control and micro-engineering and technical control (Fig. 2).

Theory of Eco-control System

Theory of eco-control system mainly include closely related subjects like ecological theories such as patch-corridor-matrix theory, construction and function theory, landscape heterogeneity and landscape optimization etc., that all comes from ecology; the related theory of cybernetics are mainly key ones for the eco-control system; and the "full-life-cycle" theory would pay attention to the whole process so that close a whole circle, of course the urban planning and landscape design theory would be good for the master control, which is also necessary. And here, only each theory combines with expressway's concrete situation closely did it would play important role for a sustainable expressway landscape.

Technology of Eco-control System

Technology eco-control system mainly was madeup of two parts: master control and subsection control. The before

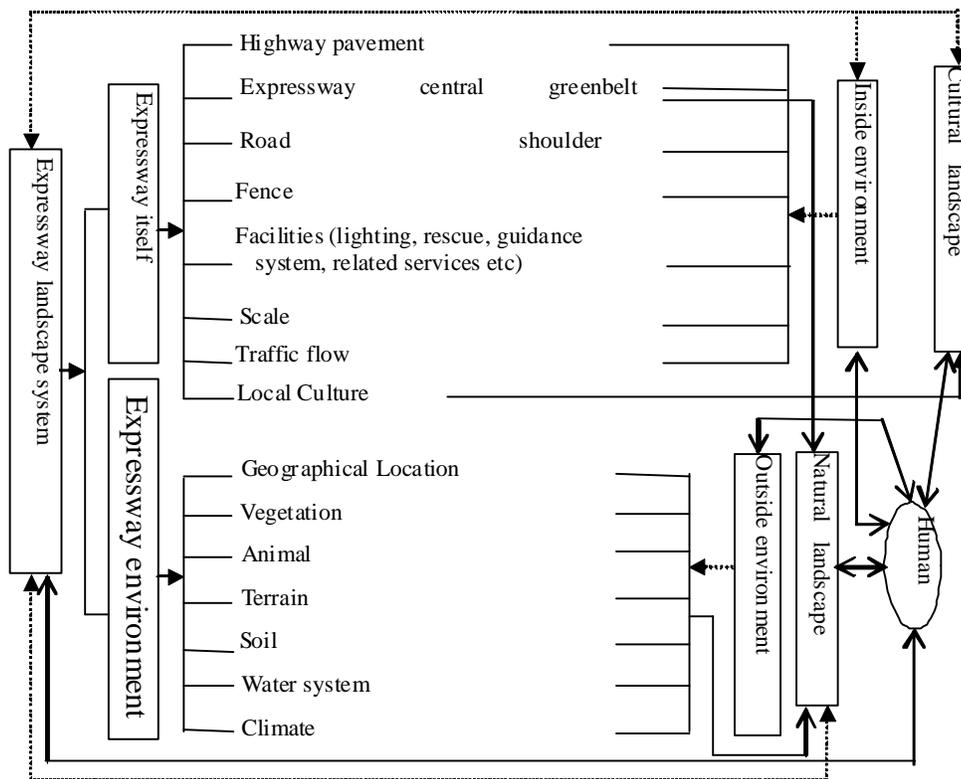


Fig. 1: The composition of expressway landscape ecosystem.

would select reasonable expressway site and key nodes which impact the environment heavily; the full-life-cycle management is necessarily adopted to master control for its whole life process. The after would control by responding engineering into expressway's inside and outside environment characteristics.

ECO-CONTROL SYSTEM IS A DEVELOPING ONE

Just as the sustainability, with the progress of technology, the original problems would be solved easily and the fresh problems would need to be controlled for the balance between the environment and the expressway, meaning a sustainable expressway landscape. The related theory and technical system would be also updated in common.

MASTER CONTROL, ECO-ENGINEERING KEEP UP WITH IT

Ecological design has been defined as any form of design that minimizes environmentally destructive impacts by integrating itself with living processes (Van der Ryn & Cowan 1996). Ecological engineering is the design of sustainable systems, which integrate human society with its natural environment for the benefit of both (Mitsch 1996).

It recognizes the relationship of organisms (especially humans) with their environment and the constraints on design imposed by the complexity, variability and uncertainty inherent to natural systems. Successful ecological engineering will require a design methodology consistent with, ecological principles (Scott et al. 2001). In terms of the eco-control system, master control must be the first, all the eco-engineering would service for this aim.

As a significant level of the reformation and transformation of our society has been provoked by environmental deterioration, ecological approaches in environmental design have drawn much attention from professionals as an alternative world view and also as a practical design approach. Particularly in landscape architecture, ecological understanding has been at the very core of the profession since its emergence and plays an important role in the decision making processes.

While ecology supports the profession with an objective rationale, aesthetics plays another major role in providing various understandings about the aesthetic experience of people, which is rather subjective. However, the ways to seek the balance between them are still controversial (Byoung 2011).

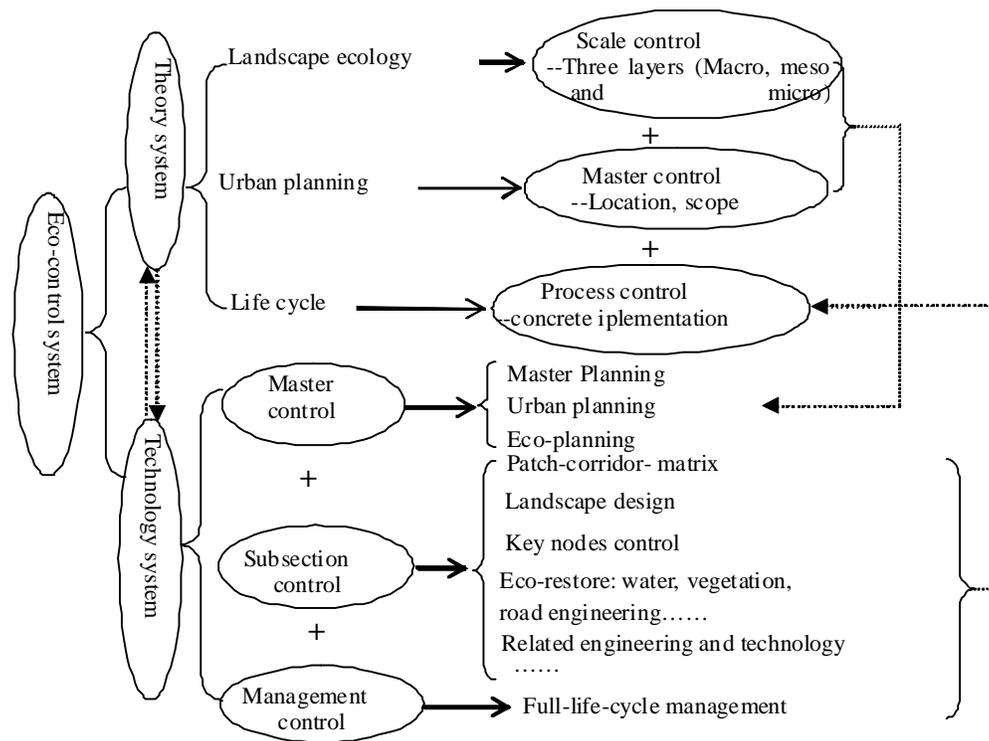


Fig. 2: The eco-control system of sustainable expressway landscape.

COST CONTROL

Cost benefit is another rule for a sustainable landscape. In a sustainable landscape design, the consideration of cost effectiveness is impacted by the processes, plants and hardgoods used in the implementation of that landscape, and by the quality of each. A simple low cost landscape should be as sustainable as an extensive high cost landscape. In many cases, the installation cost of a sustainable landscape may be less.

ACKNOWLEDGMENT

The authors want to thank the anonymous reviewers for their helpful comments and suggestions. The authors are grateful to the support of the National Natural Science Foundation of China (Grant no. 31270747). The authors are also thankful to the Education Department of Liaoning Province (Grant No. w2011029) for the financial support.

REFERENCES

- Byoung Wook Min 2011. An Ecological Aesthetic in Restructuring Urban Landscapes. Two Cases in Seoul, South Korea. Arizona State University.
- Ding Jing and Lu Tong 2010. Discussion on the sustainable development of expressway landscape, Shanxi Architecture, 36: 290-291, 292 (In Chinese).
- Henry David Thoreau 2008. Walden, Pan Qing-ling transl., Beijing: China International Broadcasting Publishing House.
- Lei-Chang Huang, Shu-Hong Ye, Xun Gu, Fu-Cun Cao, Zheng-Qiu Fan, Xiang-Rong Wang, Ya-Sheng Wu and Shou-Bing Wang, 2010. A sustainable landscape ecosystem design: A case study. Annals of the New York Academy of Sciences, 1195: 154-163.
- Mitsch, W.J. 1996. Ecological engineering: A new paradigm for engineers and ecologists. In: Schulze, P.C. (Ed.), Engineering Within Ecological Constraints. National Academy Press, Washington, DC, 114-132.
- Schultz, P.W. and Zelezny, L.C. 1999. Values as predictors of environmental attitudes: Evidence for consistency across cultures. Journal of Environmental Psychology, 19: 255-265.
- Scott, D., Bergen, A., Susan, M., Bolton, B. and James, L. Fridley, 2001. Design principles for ecological engineering. Ecological Engineering, 18: 201-210.
- Van der Ryn, S. and Cowan, S. 1996. Ecological Design, Island Press, Washington, DC.