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Life-cycle Environmental Friendly Construction of a Large Scale Project: A Case Study of the Shanghai World Expo 2010

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Abstract

Environmental friendly construction is one of the key tasks for the construction professionals. Large projects, which have great environmental and social impact, should act as the models of environmental friendly construction. In this paper, the authors have concluded some measures which are taken to promote positive impact of the World Expo Shanghai 2010 on environment and human health. The findings of this case study can be referred by construction professionals when conducting large scale projects

Keywords: Sustainable construction, Environmental friendly construction, Green building

1. Background

As one of the largest important projects in China recently, the Shanghai World Exposition 2010 uses "Better City, Better Life" as its theme. The main theme includes “Blending of Diverse Cultures in the City”, “Economic Prosperity in the City”, “Innovation of Science and Technology in the City”, “Remodeling of Communities in the City” and “Rural-urban Interaction”. Since 1851, the World Exposition has attained increasing prominence as grand event for economic, scientific, technological and cultural exchanges. Many creative inspirations and thoughts of human being have been shown and promoted through cross-country, cross- culture and cross-technology interaction. The Shanghai World Exposition 2010 is the first registered world exposition in a developing country. During the 184 days of exposition, the participants will use this important platform to explain urban civilization to the full extent, as well as display historical experience, exchange innovative ideas and demonstrate perspectives in the future, especially learning from each other how to create an environmental friendly society and realize the sustainable development of human being.

The Expo 2010 Shanghai program consists of many sub-projects such as the major pavilions, the public utilities, the transportation infrastructures, the park, as well as the logistic facilities etc. The main pavilions can be further divided as participants’ self-built pavilion, rent pavilion, and joint pavilion. Most of the buildings are temporary, except the Theme Pavilion, the China Pavilion, the Expo Center and the Performance Center. These four buildings are permanent which will not be demolished after the exposition. All of these sub-projects make the Expo 2010 Shanghai program as a large, complicated and multi-stakeholders system.

In order to manage so many sub-projects and present to the world a successful, splendid and unforgettable exposition, the organizer has made a set of systematically management ideas for this large program. Environmental friendly construction is among one the management ideas which mainly concentrates on the environmental protection and human healthy across the life-cycle stage of this large program.

2. Related research

To realize environmental friendly construction in the Expo 2010 Shanghai, the organizer refers to the related research and practice in both construction management and sustainable development fields. Literatures review of environmental friendly construction shows a fruitful result. The definition of sustainable development is described as: “those paths of social, economic, and political progress that meet the needs of the present without compromising the ability of future generations to meet their own needs” (Steele 1997). Based on the concept of sustainable development given by United Nation, the implementation plan has been made in different industrial field. Sustainable construction is the result of the application of sustainable development in the construction field. Wim Bakens (1997) put forward the trend in building and construction fields after concluding the former research. In his paper, sustainable development and construction is

regarded as one of the six main trends in the future. Afterwards, many sustainable tools and guidelines have been established to promote sustainable construction, such as GBTool (Cole, J., and Larsson, N 2002), LEED (United States Green Building Council 2002) and BREEAM (Dickie, L. and Howard, N 2000). Furthermore, Wim Bakens emphasized that sustainable development and construction were expected to have a marked effect on topics and priorities in construction research program. After nearly ten years of research and practice, Kimberly R. Bunz, Gregor P. Henze, P.E, and Dale K. Tiller (2006) deliver their survey of sustainable design practices in North America, Europe and Asia. This survey includes how to realize sustainable design in all the phase of the life-cycle of a building, such as programming, design, building construction, building operation and finally demolition. The authors also make a comparison between different countries and regions. Tables comparing programs from different regions are provided for each phase in the life cycle of a building that can be used by building design professionals as a reference guide to sustainable design around the world. The tables presented by Kimberly R. Bunz et al. also highlight specific requirements or concerns that are applicable in a particular region. They also provide a body of knowledge for the construction professionals to realize sustainable construction by means of making a systematic plan.

Environmental friendly construction is a branch of sustainable construction that concentrates on environmental protection and human health. Life-cycle assessment (LCA) is regarded as a useful method for analyzing and assessing the environmental impact of a material, product, or service throughout its entire life cycle, usually from the acquisition of raw materials to final disposal. Kwangho Park et. al.(2003) use LCA to assess the environmental impact of highway projects. As mentioned in the former paragraph, Kimberly R. Bunz, Gregor P. Henze, P.E, and Dale K. Tiller(2006) analyze the sustainable guidelines based on the project life-cycle. All of the above research can be referred to when implementing environmental friendly construction in the World Expo Shanghai 2010.

3. A framework of life-cycle environmental friendly construction for a large project

Project life-cycle is the definition of a project from cradle to crave. In order to realize environmental friendly construction, the project should be not only environmental friendly in the programming phase, but also in the design, building construction, operation and demolishing phase. Due to the fact that the owners, the designers, and the end users (sometimes they are not the owners) do not involve in the whole life-cycle of a project, it is always difficult for each part to contribute throughout the project life-cycle. As a result, who should be responsible for the life-cycle environmental friendly construction of a project usually has no answer. In the technical research of life-cycle project construction, the main topics usually concentrate on the technical issues which emphasize the technical guideline of sustainable design and construction. As mentioned above, Kimberly R. Bunz , Gregor P. Henze, P.E. , and Dale K. Tiller(2006) have conducted a systematic survey about the situation of sustainable building design practices in North America, Europe, and Asia. Based on the comparison of the application of sustainable construction across different countries, we can find out the main concept and the approach to use sustainable construction tools and techniques is following a technical line. The international sustainable building guidelines and standards, both national and regional, such as LEED, ASHRAE, GreenGuide from the United States, C-2000 IDP, CBIP and GBTool from Canada, BREEAM from the United Kingdom, Guideline for sustainable building from Germany, GreenCalc from Netherlands, CASBEE from Japan, and GBRS from Korea, are presented and compared according to their main indicators. By using these guidelines and standards, the construction professionals may have a technical consultant in order to realize the concept of sustainable construction.

The common tendency of the research and practice of environmental friendly construction is toward the life-cycle oriented direction. That is, environmental friendly construction should not only be considered in the construction phase, but also in the operation phase. In addition, the demolishment should also be considered as an important aspect. Therefore, to realize environmental friendly construction in Shanghai World Expo 2010, the construction, operation and post-exhibition issues should all be concerned .

4. Case study of the Shanghai World Expo 2010

4.1 The Characteristics of Shanghai World Expo 2010

In order to realize environmental friendly construction, the project management team of Shanghai World Expo 2010 decides to apply the concept of environmental friendly construction in this large specific program. The characteristics of Shanghai World Expo 2010 lie in three parts:

- A huge amount of construction work should be finished in a short time
- Different organizations from all over the world take part in this large program
- Most of the buildings are temporary buildings that are going to be demolished after the exhibition.

According to these three characteristics of Shanghai World Expo 2010, the application of environmental friendly construction should address the following issues:

- How to make a systematic plan at the early stage of the whole project?

- How to establish a uniform standard to regulate the management process of project?

4.2 Environmental friendly construction of Shanghai World Expo 2010

To answer the above two questions, based on the international sustainable construction guideline as well as the characteristics of Shanghai World Expo 2010, the implementation of environmental friendly construction of this large program includes the following aspects shown in table1.

The environmental friendly construction of Shanghai World Expo 2010 mainly concentrates on the following aspects:

- General requirement
- Oversight of the organizer
- Management of hazardous items
- Sanitation
- Waste disposal

The "general requirement" has pointed out the basic elements to implement environmental friendly construction. The "oversight of the organizer" has mentioned authority and responsibility of the organizer to make sure the project will be conduced in an environmental friendly way. The "management of hazardous items", "Sanitation", "Waste disposal" has emphasized the issue of human health, which can also be regarded as one part of environmental friendly issue. All these requirements are written in the document of project management of the Shanghai World Expo 2010. It undoubtedly acts as the regulation to drive all the official participants to conduct the project in an environmental friendly way.

5. Conclusion

The implementation of environmental friendly construction is the responsibility of construction professionals. Large projects, which have great impact on environment and human society, should act as the models of environmental friendly construction. In the Shanghai World Expo 2010, much effort has been given to promote the positive impact on environment and human society throughout the project life-cycle. In this paper, we have concluded some measures taken to implement environmental construction in this large project. Actually, environmental friendly construction is one of the most important tasks of the Shanghai World Expo 2010. Many measures are continuously added or improved with the progress of the project.

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References

Cole, J., and Larsson, N. Green Building Challenge 2002: GBTool user manual, International Initiative for a Sustainable Built Environment, Ottawa, 2002.

Cole, R.J. and Larsson, N. GBC 2000 Assessment Manual: Volume1: Overview 2000.

Cole, R.J. Building Environmental Assessment Methods: Clarifying Intensions, Building Research & Information, Vol.27, No.4/5, pp230-246 1999.

Dickie, L. and Howard, N. Assessing environmental impacts of construction: Industry consensus, BREEAM and UK Ecopoints, BRE Digest No.446, May. Building Research Establishment, UK. 2000.

http://www.expo2010china.com/ last accepted 12/12/2007.

Kimberly R. Bunz, Gregor P. Henze, P.E, and Dale K. Tiller , Survey of Sustainable Building Design Practices in North America, Europe, and Asia, Journal of Architectural Engineering, Vol. 12, No1. 33-62 , March , 2006.

Kwangho Park; Yongwoo Hwang; Seongwon Seo and Hyungjoon Seo, Quantitative Assessment of Environmental Impacts on Life Cycle of Highways, Journal of Construction Engineering and Management, Vol.129, No.1 , 25-31 January / February , 2003.

United States Green Building Council, Green Building Rating System for New Construction and Major Renovations (LEED-NC) version 2.1, Washington, D.C. 2002.

Wim Bakens, International trends in building and construction research, Journal of Construction Engineering and Management, Vol123, No.2 , 102-104 June, 1997.

Table 1. The content of environmental friendly construction

Item	Content
General requirement	● Official participants shall take necessary measures of environmental protection with regard to the use of water, electricity, and air conditioning within their exhibition zones. The Organizer may recommend further environmental protection measures to official participants. ● Official participants shall ensure that their sites, pavilions and exhibition space consistently comply with environmental protection, health, radiation protection and security requirements as well as limits stipulated by the Laws and Regulations. Official participants shall, in particular, avoid causing water and air pollution, soil contamination, generation of harmful noise and vibration, and the production of hazardous waste. They shall properly manage, store and dispose of hazardous waste. ● Official participants shall bear all liabilities for disturbing residents or damaging the environment as a result of breaching the Laws and Regulations in their construction
Oversight of the Organizer	● The Organizer has the authority to order official participants to stop actions that damage the environment at the expense of official participants. Should official participants fail to obey the order, the Organizer has the authority to stop the activities causing pollution and restore the polluted area to what it was at the expense of official participants ● .Officials from the competent departments of the Chinese Government will be sent to the Expo Site to work closely with the Organizer to ensure compliance with the relevant regulations on environmental protection and guarantee full protection of the environment.
Management of Hazardous Items	● Should official participants need to store hazardous items (including radioactive materials) on the construction sites, they shall, with the approval of the Organizer, set up warehouses for hazardous items in compliance with radiation protection and other requirements. The warehouses shall be clearly marked and shall be under the management of designated staff to prevent hazardous items and radioactive materials from endangering human health and damaging the ecosystem and surrounding facilities.
Sanitation	● Official participants shall take measures to ensure adequate ventilation, natural illumination and lighting within their exhibition zones and take necessary anti-moisture, anti-noise, anti-quake and deodorization measures. ● Official participants shall ensure the normal and safe functioning of the facilities for water supply, drainage, and sanitation as well as equipment for ventilation, air conditioning, etc. within their exhibition zones.
Waste Disposal	● Official participants shall keep their exhibition zones clean, place waste receptacles, separate waste for recycling and remove waste. ● Official participants shall not dispose of waste within their exhibition zones without the approval of the Organizer. Official participants shall comply with the laws and regulations with regard to waste disposal. ● When waste disposal service is provided by the Organizer, official participants shall bear the cost of such services based on the size of their exhibition zones and the nature of their commercial activities.