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Green darning city, taking the tenth China (Wuhan) international garden EXPO design as examples

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Abstract

The paper takes design of the tenth China (Wuhan) International Garden EXPO as an example, concludes the development direction of low-carbon parks in China, and highlights the use of sponge city and green architecture design. Firstly, the paper introduces overview and design cases of the EXPO. Then, the paper elaborates the goals of low-carbon design. It describes the low-carbon technical application of the EXPO park, i.e. comprehensive design based on overall coordination and avoidance of conflicts, intelligent city planning, processing technology of existing landfill, conducting onsite balance work for earthwork, water recycling system planning, building ecological low-carbon architecture, building and repairing of ecological darning bridge, etc. Besides, the park also adopts design principle of sponge city. As an urban oasis, Wuhan International Garden EXPO darns the divided city; as a public space, it provides an ecological space for more citizens to visit and enjoy. Its example is a reference for design of low-carbon parks in China in the future.

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1. Introduction

Along with the development of economy, population explosion and burning of the coal and petroleum, carbon dioxide emission has risen extensively and the concentration of carbon dioxide in the atmosphere has increased

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dramatically, which leads to abnormal global climate change mainly characterized by climate warming and threatens human living environment and physical & psychological health. Nowadays, the global warming and global greenhouse effect have become the most concerned environmental issues in this century. On January 14, 2016, the World Economic Forum, with headquarters in Geneva, released the Global Risk Report of 2016 which claimed that the ineffective measures of dealing with and solving the problems of climate change have been the greatest global risk of 2016. The climate change of the ecological environment has already become the hottest topic in the world. Garden plants and green land are the important part of ecological environment and is playing crucial roles in city carbon cycle. Increasing the number and area of garden and green land absorbs the man-made emissions of carbon dioxide and release oxygen, which improves the living conditions of urban residents directly [1]. Therefore, the development of low-carbon city garden is a crucial part of the future urban development.

British is the first country that came up with the low-carbon concept and advocates actively low-carbon economy. In 2003, British first put forward the "low-carbon concept" in the Energy White Paper *Our Future Energy - Creating a Low-carbon Economy*, which aroused wide concern of the society at that time. V. Whitford, from the University of Manchester in UK, published the "Natural Process Form of the City - Indicator Research of Regional Ecological Operation" in 2001, of which the research on city trees' carbon sink and carbon respiration was conducted and simply calculation method was proposed [2]. The zero energy consumption community in British Aberdeen, completed in 2002, verified the feasibility of the low-carbon community through more than 10 years of practical operation experience with the concept of sustainable development and green building. With constant deepening consciousness of carbon dioxide reductions in order to deal with the global warming in the world, apart from "low-carbon economy", "low-carbon technology", "low-carbon energy", "carbon footprint", "low-carbon city", "low-carbon community" and a series of new concepts and new policies arise at the historic moment, which opens up a new road towards low-carbon civilization in the world [3].

Starting with the basic requirements of the "low-carbon" concept, blending the low-carbon concept into the urban park design is the future development direction. On the basis of social, ecological and economic benefits regarded as the fundamental functions of normal urban parks, and with emphasis on early-stage management, planning plan, construction and maintenance management during the whole life cycle, low-carbon urban park aims to improve the energy efficiency, reduce energy consumption, increase carbon sink and reduce carbon emission, and form good climate environment urban park with "low emission, low cost, low energy consumption, low pollution and high efficiency" [4]. Low-carbon urban park is equipped with the features of low carbon footprint, low carbon emission, low carbon cost, high carbon sink ability and so on, which adjusts microclimate and provides visitors with a suitable climate for feeling the nature [5]. In recent years, as low carbon pilot cities, Beijing, Shanghai and Baoding successively have Nanhaizi Park, Chongming Forest Park, Expo Houtan Park, etc., and win pretty good social effects.

Low-carbon urban park not only provides solutions to low-carbon urban development, but also brings new development opportunities. To explore low-carbon urban park is the only way to develop low-carbon city. Low-carbon urban park has played an important role in dealing with climate warming and reducing energy consumption [6]. The low-carbon design concept of urban park mainly reflects in four elements: mountain, water, plants and buildings which are the four basic elements of landscape [7]. The construction of mountain, water, plants and buildings are the main work or main methods of building landscape [8]. The practice of low-carbon parks in China also starts from these four elements. Low carbon concept is found here and there from design to construction. Low-carbon park conforms to the needs of development of the era more easily than ordinary urban park and must have extensive and profound significance.

2. Research Object - Wuhan Expo Garden

The 10th China International Garden Expo was held in Wuhan, Hubei. The Garden covers an area of 213.77 hectares, including 176 hectares public green area, 6.1 km long greenway, 48,000 arbors, 60.8 hectare shrubs, 36.5 hectares lawn and more than 410 kinds of plants. The Garden is located in the combining area of urban center and suburb city, which is separated by ring road into south and north parts sutured by the Garden. The northwest area is close to Jinyin Lake, a natural lake in downtown thus it is easy to create garden waterscape by obtaining water from the nature lake. Jinkou refuse landfill, the biggest domestic waste landfill site in Asia, make the ecological

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