

## The Study of Sustainable Design and Green Architecture in China

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### Abstract

The aim of the study is to provide an overview of the current position of the People's Republic of China with its green building action plan and the built buildings in the country that manifested the idea of sustainable design and green architecture. Recognized green building principles and strategies are stated as a guide in proving the sustainability of the buildings in China when compared to their know sustainable features. A descriptive study was conducted with the use of secondary data collection as the methodology which delivers the main purpose of the study in gaining insights and providing an overview of the sustainable design and green architecture in China. Related studies and the literature are verified first by the author s to insure reliability of provided information. As a result, the green building action plan is defined and related to the current five-year action plan of China, example buildings in the country that incorporates sustainability principles and strategies are provided, and the common basis of sustainable design and green architecture are briefly discussed..

**Keywords:** Architecture, sustainability, sustainable design, green architecture, green building action plan, five-year plan, principles, strategies

### 1. Introduction

Green architecture is the philosophy of architecture that promotes the sustainable use of energy and other resources. This includes the conservation of energy, reusing and safeness of building material, and the consideration of the location and sitting of a building with its impact on the environment. Building resources are known to have consumed more than half of the world's resources which is 16% of Earth's freshwater resources, 30-40 % of all energy supplies, 50% of all withdrawn war materials from Earth's surface, 40-50% of waste deposit in landfills and 20-30% of greenhouse gas emission. Since the World War II, architecture and building boomed which continued until the 1990s without proper consideration to the depleting resources until 1994 when Leadership in Energy and Environmental Design (LEED) of the United States provided a metrics in which building designs are assessed for their environmental responsibilities such as sustainable site development, conservation of water and energy, reusing and renewing of old materials, and the indoor environmental quality of the buildings (Britannica, 2019).

Sustainable design, sustainable architecture, or ecological design focuses on the thought of constructing buildings which are social, ecological and environmental sustainable with the goal of promoting a healthy environment for occupants and lessening the negative effect of the building to the environment. Similarly to green architecture, the key principles of sustainable design also includes the optimization of the site, minimization of the use of non-renewable resources and energy, and the enhancement of the quality of indoor environments. The concept is also known to be cost-friendly for both short-term and long-term budget and is effective in lessening the carbon footprint of the building (Scranton Products, 2019).

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The People's Republic of China is known to be one of the world's largest contributor to climate change with the highest emission of carbon dioxide. Urbanization throughout the years has constantly expanded in the country which includes mainly the construction and refurbishment of buildings in various cities. As such, the country has continuously implemented various ideas for a more sustainable and green Chinese buildings. The Emission Trade System was implemented in 2015 regarding the emission of carbon dioxide and the Green Building Action Plan implemented by the Chinese Ministry of Construction and National Development, and the Reform Commission together with the set-up of subsidy systems for energy saving in existing systems (Novel, 2021).

The study aims to provide an overview on the current position of China with its sustainable development on building design and green architecture. It is intended for Chinese and foreign students as an appropriate and applicable material for further researches on the subject. Professionals and the general community would gain insights on the sustainability of Chinese buildings design and green architecture for further understandings. Architectural principles and strategies are also outsourced from international practices of the engineering and architecture sector.

## 2. Methodology

The study made use of secondary data collection to gather data for the aim of providing an overview on the sustainable design and green architecture in China and outsourcing of sustainable and green architectural principles and strategies. Online journals, articles, and academic papers regarding the green building action plan of China, the current state of China's sustainable development on buildings, and the outshored sustainable architectural principles and strategies are used in the data gathering process. Literature considered are within the five (5) to seven (7) age limit of published literatures in order to ensure the study's timeliness and appropriateness considering the rule of validness of research materials and the constantly changing trends in the field of architecture.

## 3. Results and Discussion

Secondary data gathering has been done regarding the sustainability of human resource management and the process of building a strategic human resources management plan. Overview of the current state of China's sustainable design and green architecture and the formed outshored sustainable architecture principles and strategies are incorporated in order to form the conclusion of the study. Data gathered from secondary resources are verified to be reliable based on the indexed journals of websites and through the verification system of Google.

### 1.1 Green Building Action Plan of China

Since 1953, the Chinese government has implemented five-year plans which is a series of social and economic development initiatives set through meetings of the Central Committee and National Congress. Targets for economic development and growth, domestic reform and international policies are mapped out and discussed during the meetings. For the year of 2021-2025, the five-year plan focuses on the "internal cycle" which intends "to strengthen the domestic economy and consolidate social development" (Grunberg & Brussee, 2021). Sustainability is prioritized on an 8% level and urbanization, infrastructure and regional coordination is prioritized on a 10% level which is lesser compared to the previous two plans. Currently, there are 27 key projects – new airports, new road and new railroads – are eyed in the areas of construction and regional development. On the other hand, fewer projects are dedicated to the environment and sustainability area. Tougher climate policies and carbon dioxide emission caps are not mentioned in the 14<sup>th</sup> plan (Grunberg & Brussee, 2021). Urbanization and the continuity of the country's green building plan which is mostly directed on buildings is not affected mostly by the new five-year plan however the sustainability of new projects stated on the plan are unsure since they are mostly roads. Implementations of the green building action plan to the new projects are yet to be studied.

### 1.2 Current State of China's buildings' sustainability

China has been known both for its massive contribution of carbon dioxide emission and its implications of sustainable development for the past years. Architects and architectural firms in the country has taken sustainable design into consideration and produced several eco-friendly infrastructure in the country.

A. Research and Development Center in Beijing – A 200,000 square ft. center with the following features: narrow foot print, four story atrium for maximization of natural ventilation, living roof that reduces pollution caused by storm water runoff, solar thermal system, low-flow fixtures that limit water usage, exterior glass system that provides natural light and a censored motorized blind system (RMJM, 2017).

B. China Merchant's Bank – A building with gold accreditation certification from LEED. Materials used are close to source and are mostly recyclables, renewable energy sources are included, and a sustainable design is applied that maximized the use of light and other aspects of the environment. The construction of the building is also known to have 75% of its waste diverted from disposal with post and pre-consumer recycled content of 20% (RMJM, 2017).

C. Shanghai Towers – 43 green and energy-saving technologies were integrated in the buildings with a reduced energy consumption of 21% and water usage by 40%. There is a double glass façade which increased natural light and reduced heating and cooling cost and a reduced carbon footprint due to the landscaping of one third of the site (Lazarova, 2017).

D. Bamboo Town, Baoxi Zhejiang Province – Bamboo is referred to as the “green gold” in China which is recognized by architects to have demonstrated sustainable rural revitalization. The town which includes a museum, workshop, a bridge and other caverns are mostly made up of bamboo with little inclusions of steel which is environmental friendly and are designed to be integrated to the surrounding bamboo forests (Lazarova, 2017).

### **1.3 Outsourced Sustainable Architectural Principles and Strategies**

As by the the international definition of green building, the principle and common strategies are closely related to that of China's green building action plan.

#### **1.3.1 Principles**

1. Optimize Site Potential - According to the WBDG Sustainable Committee, “The site of a sustainable building should reduce, control, and/or treat storm-water runoff. If possible, strive to support native flora and fauna of the region in the landscape design” (KMB, 2021).

2. Optimize Energy Use – Reducing the dependence of buildings to fossil-derived energy and promoting the use of available renewable resources like solar and wind energy (KMB, 2021).

3. Conservation of water – Freshwater scarcity is increasing globally. Water should be used efficiently in construction and recycling should be practiced if possible. Incorporation of water flow reducing designs and strategies are advised (KMB, 2021).

4. Enhance Indoor Environmental Quality – Maximizes natural light by the use of glass façade and avoidance in the use of materials with high-VOC emissions (KMB, 2021).

5. Optimize Operational and Maintenance Practices – Specify materials and systems that simplify operational practices and reduce maintenance which would be cost-effective and would reduce life-cycle costs (KMB, 2021).

#### **1.3.2 Strategies**

1. Passive Sustainable Design – Consideration of sun orientation and climate for placement of windows which will reduce energy consumption and enhance use of natural light and ventilation (HMC Architects, n.d).

2. Active Sustainable Design – Implementation of highly efficient energy use for lesser environmental and carbon footprint (HMC Architects, n.d).

3. Renewable Energy System – incorporation of solar or wind energy if applicable to reduce fossil-based energy consumption (HMC Architects, n.d).

4. Green Building Materials and Finishes – Prioritize and partner with environmental companies for the materials to be used – as much as possible opt for recyclables (HMC Architects, n.d).

5. Native landscaping – Reduce irrigation needs and carbon footprint by incorporating plants, trees and grass native to the location (HMC Architects, n.d).

6. Storm Water Management – Implement storm water management to reduce runoff and the negative environmental impact of buildings (HMC Architects, n.d).

### **Conclusion**

Currently, the Green Building Action Plan of China is being implemented in the country with the drive of sustainable urbanization. With a new five-year plan, the focus of the country to urbanization, infrastructure and regional coordination, and sustainability are relatively lower compared to past plans which is expected to have an impact on the implementation of the green building action plan. Various buildings are already standing high

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in the country with various sustainability strategies and principles which shows that green architecture and sustainability design is recognized by architects in the country. Green building principles and strategies which commonly manifest the conservation of water and non-renewable energy, reducing of carbon footprint and construction waste, and the optimization of the site and the environment around is stated as a guide the green architecture and sustainable design. As viewed based on the stated principles and strategies which are also recognized by LEED, buildings in China like the Shanghai towers are sustainable in design and have already incorporated green architecture that marks the recognition of architects in the country for green buildings..

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