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Research on Construction and Development of Green Airport

Xiong Li[1,*], Xiaoqing Chen[2], Ziyun Liu[3]

[1] *Aeronautical Study & Airport Simulation Department, China Airport Planning & Design Institute Co., Ltd., Beijing 100029, China*
[2] *Dept. of Technology 3rd, Chinese Aeronautical Establishment, Beijing 100101, China*
[3] *Air Traffic Management Dept., Quanzhou Jinjiang International Airport, Quanzhou, Fujian 362200, China*
[*] *Corresponding author. Email: lixiong_cacc@163.com*

ABSTRACT
The construction of green airport is the key way to realize sustainable development, efficient operation and environmental integration. The basic characteristics of green airport included: resource saving, environment friendly, efficient operation and people-oriented. On the basis of investigating the development history of green airport, the key technologies and experiences of large hub airport in energy conservation and emission reduction, environmental improvement and efficient operation were analyzed. This paper analyzed the problems existing in the construction of green airport in China, and put forward some development suggestions.

Keywords: *Green airport, Construction, Sustainability, Environment, Operation.*

1. INTRODUCTION

The concept of green airport originates from the concept of sustainable development and is the product of the combination of the concept of sustainable development and the airport industry. With the increasingly obvious constraints of resources and environment, China's civil airports strive to reduce their impact on the ecological environment while providing safe and high-quality services, which is the need of promoting ecological civilization construction and the sustainable development of civil aviation industry. It is the development direction of future airport construction to build an airport that uses resources more efficiently and has lower impact on environment. Under reasonable environmental load, the airport can operate safely, smoothly and efficiently [1].

In January 2020, the Civil Aviation Administration of China issued the Outline of action for the construction of four characteristics airport CAAC (2020-2035). The outline requires that the top-level design of the construction of four characteristics airport should be carried out in 2020, the objectives, tasks and paths of four characteristics airport construction should be clarified. From 2021 to 2030, we will comprehensively promote the construction of four characteristics airport and build several benchmark airports. From 2031 to 2035, we will deepen and improve the construction of four characteristics airport, and comprehensively build a safe, efficient, green, intelligent, convenient, and harmonious four characteristics airport.

This paper investigated the development history and practice of green airports in China and abroad, and analyzed the key technologies and operating experience of large hub airports in energy conservation and emission reduction, environmental improvement, efficient operation and humanistic services. This paper analyzed the problems existing in the construction of green airport in China, and puts forward some development suggestions.

2. CONCEPT AND CHARACTERISTICS OF GREEN AIRPORT

According to China's green Airport Planning Guidelines issued in 2018, a green airport is a resource-saving, environment-friendly, high-efficiency and people-oriented airport within its full life span. Green airport is an airport that provides healthy, convenient and comfortable use space for the public, safe and efficient operation environment for aircraft, and coordinated development with the region [2].

A green airport should have the following four characteristics, as shown in Figure 1:

(1) Resource conservation is the primary feature. Resource conservation refers to reducing resource demand, saving costs, improving resource utilization, and giving priority to renewable resources, including land saving, energy saving, water saving and material saving.

(2) Environmental friendliness is an important principle. Environmental friendliness refers to two aspects including environmental airworthiness and environmental harmony. Environmental airworthiness refers to reducing the impact of clearance environment and electromagnetic environment on the safe operation of the airport, and environmental harmony refers to creating a good indoor and outdoor environment to reduce the impact of the airport on the surrounding environment.

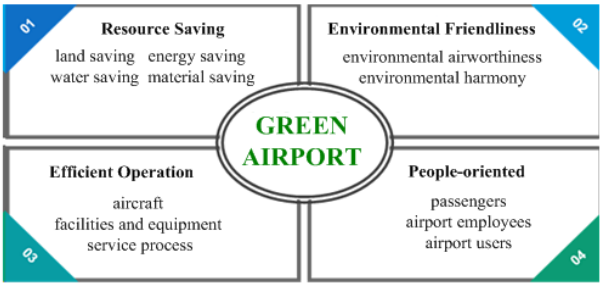

Figure 1 Characteristics of green airport.

(3) Efficient operation is the core. Efficient operation refers to the efficient operation and process of aircraft, facilities and equipment in the airport area. Performance for passengers and users to provide efficient air transport services, reduce aircraft taxiing, take-off waiting time, taxiing distance and so on. Improve the operation efficiency of facilities and equipment, establish convenient, fast and efficient flow of people, logistics and information, etc.

(4) People-oriented is an important embodiment. People-oriented means to provide passengers, airport employees and airport users with efficient, high-quality and convenient services and comfortable environment through humanistic care, so as to improve airport service satisfaction.

Resource conservation and environmental friendliness are the two basic characteristics of green airports. Efficient operation and humanized service are the two core characteristics of green airports.

Kunming Changshui International Airport (Figure 2) is the first airport in China to fully practice the concept of green airport. Green airport construction has been carried out systematically from the aspects of land use, greening and landscape, environmental protection and humanized service. A number of green airport construction indicators are put forward in the design, and green practices cover the main functional areas of the airport. Kunming new Airport terminal is the first domestic terminal to obtain three-star certification of green building design. The green construction of Kunming Airport has attracted the attention of Federal Aviation Administration (FAA) in the United States.

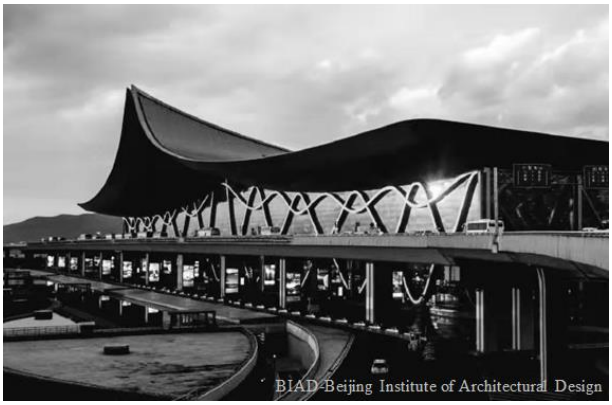

Figure 2 Kunming Changshui international airport.

Beijing Daxing International Airport (Figure 3) has carried out the top-level design of a green airport, set high standards for the construction of a green airport, and made full use of national, provincial and ministerial scientific and technological innovation research achievements to create national and industrial scientific and technological innovation projects [3]. Beijing Daxing Airport takes planning and design as an important starting point, and at the same time realizes 3-star green building and 3A energy-saving building terminal. It has become a demonstration project leading the construction of green airports by applying renewable resources ， clean energy vehicles and practicing the concept of sponge airport.

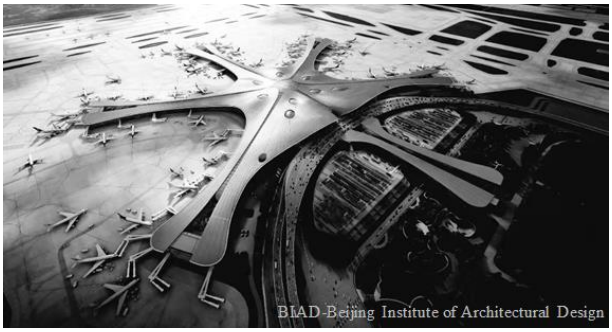

Figure 3 Beijing Daxing International Airport.

3. GREEN AIRPORT CONCEPT AND PRACTICE ABROAD

Airport Council International (ACI) defines a sustainable airport as "one that takes a holistic approach to managing airports to ensure they achieve economic viability, operational efficiency, conservation of natural resources and social responsibility". In order to realize the concept of green airport and sustainable airport, foreign aviation developed countries have successively launched green airport and sustainable airport planning and put it into engineering practice [4].

The FAA launched a program in 2010 to support sustainable airport development [5]. Later, Los Angeles International Airport published The Sustainable Design and Construction Requirements of Los Angeles International Airport by referring to Leadership in Energy and Environmental Design (LEED), the Green building evaluation system of the United States [6]. In the latest version in 2017, requirements for the design and planning of sustainable airports are put forward from six aspects: master plan, energy efficiency and renewable energy, water saving and water conservation, material saving and resource efficiency improvement, and environmental quality. In 2018, the Sustainable Development Airport Manual (V 3.3 version) released by the Chicago Aviation Administration set up the green airport rating system from four aspects: planning, design and construction of green airport, operation and maintenance of green airport, and terminal users. As of December 2019, Chicago O'Hare International Airport and Chicago Midway International Airport rated 127 projects, including air traffic control towers, airport runways and more, during the design and construction phase of a green airport using the Sustainable Airport Handbook [7,8].

In 2014, the airport operators association of UK presented the achievements of Heathrow Airport and Manchester Airport in limiting carbon emissions and reducing noise in the Sustainable Airport: Improving the Environmental Impact of the UK's Global Gateway, and formulated the carbon emission reduction plan for 2030 and 2050. The architectural design of Heathrow Terminal 2 prioritises sustainability and passenger experience, and is one of the early terminals to achieve the new version BREEAM (Green Building Assessment System) assessment [9].

In 2005, Narita International Airport of Japan formulated the master plan of ecological airport, and put forward the plan and target of airport energy conservation, emission reduction and resource recycling. It innovatively proposed the “3R” plan to reduce, reuse and recycle waste and wastewater [10]. For the sustainable development of the region and the airport, Narita Airport has put forward the 2030 Eco-airport Vision, and Kansai Airport Group has established an "Environmental Promotion Committee" in three Kansai airports (Kansai International Airport, Osaka International Airport and Kobe Airport). Both of them set corresponding goals in CO_2 emission, resource recycling, surrounding environment symbiosis and environmental management, so as to realize the purpose of ecological airport.

4. PROBLEMS IN GREEN AIRPORT CONSTRUCTION

Energy consumption, environment and operation efficiency are the main problems restricting the development of green airports in China.

(1) Energy consumption problems plaguing airport development

On November 4, 2016, the Paris Agreement on climate change officially came into force. China has pledged to increase the proportion of non-fossil energy to around 20% by 2030, and to reduce CO2 emissions per unit of GDP by 60-65% compared with 2005. China's CO2 emissions will reach the peak and strive to reach the peak earlier. The aviation industry is the only industry in the world to halve its carbon emissions by 2050, with IATA proposing a 1.5 percent annual increase in fuel efficiency by 2020 and a 50 percent reduction in carbon emissions from 2005 levels by 2050. These requirements mean that the airport construction is facing increasing pressure of energy conservation and emission reduction, and the requirement of energy consumption reduction in green airport construction is very urgent.

(2) Environmental problems restrict the development of airport

The noise problem is the primary problem restricting the development of airport. The operation of airport will have a certain environmental impact on the surrounding areas, especially the impact range of aircraft noise is large, lasting and not easy to reduce. In 2009, there were about 166 civil transport airports in operation in China, with 24 large airports severely affected by noise. Meanwhile, the local air quality of the airport and its surroundings has become the second major problem restricting the construction of the airport. Air quality over the airport is mainly affected by aircraft operations, apron activities, energy production, engine testing, fire training activities and waste emissions from vehicles passing through the airport. In addition, waste in the terminal (Figure 4) and aviation waste (Waste generated by passengers in the process of flying.) are also environmental problems that restrict the development of the airport.

Figure 4 Airport Terminal Waste.

(3) Airport operation efficiency needs to be improved

With the increase of flight volume, the normal flight operation has been a problem for large airports. The increasing scale of airports will indirectly lead to the increase of flight taxiing distance. Flight delays caused by the unsmooth operation of large hub airports will quickly affect the operational efficiency of the entire airline network.

5. CONCLUSION

As a place to provide healthy, comfortable and beautiful indoor environment for passengers, the construction of green airport should meet the needs of operation and service. The realization of green airport needs special thinking and planning according to the location, needs and people.

(1) The top-level design of green airport needs a life-cycle perspective. At the beginning of airport planning, green concepts such as land, environment, transportation and energy should be injected. Green key indicators and supporting standard system should be determined in the design stage. In the process of construction, attention should be paid to saving resources, avoiding damage to the environment and forming process data. During the operation period, continuous improvement should be carried out centering on data and efficiency in terms of resource consumption and environmental assessment.

(2) Green airport construction is a complex whole system project. A green airport is a resource-saving, environment-friendly, high-efficiency and people-oriented airport within its full life span. There are movement areas, terminal areas, working areas, etc. The operation system includes aircraft, ground vehicles, energy stations, terminals and other facilities with multiple functions. The implementation of green airports must be more complex.

(3) The operation of green airport requires the participation of more dimensions of personnel. Green airports not only need to ensure the comfort of passengers, but also need to think from the perspective of managers and put green performance such as safety, comfort, economy and flexibility into practice.

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