International Civil Aviation Organization

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Agenda Item 4: Provision of AOP in the Asia/Pacific Region

— Planning & Design of Aerodromes

APPLICATION AND PRACTICE OF DIGITAL ASSISTED TECHNOLOGIES FOR AIRPORT SITING

(Presented by China)

SUMMARY

With the continuous maturity of digital technology, digital assisted technology for airport siting in China has been widely applied since 2018. This paper presents application and practice of digital assisted technologies for airport siting.

1. INTRODUCTION

What is Digital Assisted Technology for Site Selection?

1.1 Digital Assisted Technology for Site Selection is a general term that refers to the use of digital technologies such as Geographic Information Systems (GIS), Building Information Modeling (BIM), and Big Data to conduct comprehensive analysis, modeling, and evaluation of factors related to airport site selection. It is applied to various stages such as suitable area analysis, site screening, site comparison, site optimization, and site visualization.

1.2 By systematizing complex site selection problems and collecting, organizing, and analyzing data, Digital Assisted Technology for Site Selection provides hierarchical decomposition at different levels and forms comprehensive evaluation results through quantitative calculations, which is an application of quantitative and qualitative decision analysis methods to solve complex problems.

Application of Digital Technology in Airport Siting in China

1.3 With the continuous maturity of digital technology, digital assisted technology for airport siting in China has been widely applied since 2018, including hub airport siting represented by Foshan New Airport and Chongqing New Airport, and site selection for new airports represented by Enshi in Hubei, Baicheng in Xinjiang, and Jinzhai in Anhui. Based on the concept of digital twins and using the 3D GIS platform as the data foundation, various site selection-related elements are incorporated, such as remote sensing data, terrain and landform data, drone oblique photography data, urban planning data, ecological protection red line data, and farmland data. This is combined with site suitability analysis technology, site modeling technology, and rapid optimization technology to effectively improve the quality of site selection, the accuracy of calculations, and the scientific nature of site selection.

2. DISCUSSION

GIS-Based Multi-Source Data Fusion

2.1 Airport site selection involves the comprehensive consideration of many factors and a process of balancing the pros and cons. Factors considered include land and space planning, urban planning, surrounding airports and airspace, ecology, meteorology, terrain and landforms, and many other factors. Traditional airport site selection often involves on-site inspections, research, map work, and experiential judgments, which result in long working cycles and subjective issues. Using GIS data for airport site selection evaluation indicators can dynamically determine the suitability of the site selection range. By applying multi-source, heterogeneous, and massive data processing and real-time fusion technology, spatial quantitative expressions are implemented. Expert systems, hierarchical analytic methods and subjective judgments are used to analyze and determine the weights of site selection factors. By incorporating weighted overlay analysis, multiple levels of suitable areas are dynamically generated.

2.2 Compared to traditional empirical site selection, the amount, comprehensiveness, and precision of the analyzed data is larger, more comprehensive, and more detailed, which increases the scientific, comprehensive, and accurate determination of suitable site selection areas, and greatly narrows the scope of site selection.

Earthwork Cut-and-Fill Algorithm for Integrated Airspace and Ground Airport Site

2.3 Earth and rock excavation projects account for a large portion of the investment in airport projects, especially in mountainous high-fill airports, where earth and rock excavation investments can reach 30-50% of the total investment. In order to save total airport project investment, it is particularly important to optimize earth and rock excavation quantities and save costs. By using BIM technology to construct a digital model of the original terrain, the optimal location and height of the topography are finely calculated based on design conditions such as the design scope and slope parameters. The method can reduce earth and rock excavation quantities and save the owner's investment costs.

2.4 The traditional earthwork calculation method separately calculates the net clearance and ground earthwork of the site, while there are redundant calculations for the overlapping parts of net clearance and ground earthwork which are difficult to separate, resulting in large errors in earthwork quantities. This calculation technology adopts integrated modeling of the airspace and ground, which includes models of the flight program restriction surface, the site land border plane, the slope model, and the Digital Elevation Model (DEM) digital elevation data to calculate the earthwork quantity and the corresponding site elevation in one step, solving the problem of site elevation calculation under the balance of airspace and ground excavation. The method solves the redundant calculation problem caused by the independent calculation of airspace and ground, greatly improving the efficiency and accuracy of earthwork calculations.

Rapid Modeling Method for Three-Dimensional Parameterized Airspace and Ground Integrated Site

2.5 Traditional site selection methods mainly use two-dimensional expressions, which have limited expressiveness and are not intuitive in analyzing sites. By using parametrically constructed business models, multi-model computing, and visualization, the site can be analyzed comprehensively, three-dimensionally, and intuitively, hidden problems can be discovered, and risks can be avoided. The method solves the problems of traditional site selection being too planar and manual, incomplete and unintelligent linkage between airspace and ground, and non-intuitive analysis. The method effectively eliminates the problems of traditional site selection being prone to missing hidden points and causing engineering hazards.

Fast Optimization Site Selection Technology Based on BIM/GIS Platform

2.6 Key technical indicators such as earthwork, demolition, and noise for each site are calculated based on the high-precision three-dimensional terrain and site (coordinates, configuration, terrain, etc.) model, flight program surface model, noise contour model, and other models. Within the site research scope, BIM/GIS technology is applied to move and rotate the runway configuration in batches, quickly and comprehensively analyze the integrated earthwork quantity, noise impact, demolition and other factors, and explore the optimal location of the site. This method can quickly determine the optimal trend and position of the site.

3. ACTION BY THE MEETING

3.1 The meeting is invited to:

a) note the information contained in this paper;

b) note that the digital assisted technologies are very helpful for airport siting;

c) encourage other APAC States to share their experience in using digital assisted technologies for airport siting; and

d) discuss any relevant matters as appropriate.

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