

**60th CONFERENCE OF
DIRECTORS GENERAL OF CIVIL AVIATION
ASIA AND PACIFIC REGIONS**

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AGENDA ITEM 3: AVIATION SAFETY

**SAFETY RECOMMENDATIONS FOR THE PLANNING AND
CONSTRUCTION OF AIRPORTS ON PLATEAUS AND
COMPLEX TERRAINS**

(Presented by the People's Republic of China)

SUMMARY

The complex topography, unpredictable climatic conditions, and fragile ecosystems of plateaus and complex terrains have long posed difficulties for airport construction worldwide. Drawing on the experience of building over 40 airports in such terrain environments, China recommends to the International Civil Aviation Organization (ICAO) and the States that relevant airport construction should comply with the safety requirements outlined in ICAO's Annex 14. In addition, specific recommendations are provided regarding site selection, design and construction of such airports.

SAFETY RECOMMENDATIONS FOR THE PLANNING AND CONSTRUCTION OF AIRPORTS ON PLATEAUS AND COMPLEX TERRAINS

1. INTRODUCTION

Challenges in the Planning and Construction of Airports on Plateaus and Complex Terrains

1.1 Key challenges:

- a) Highly undulating terrains and complex topography create numerous factors that affect safe operations.
- b) Complicated obstacle clearance and highly variable weather conditions bring challenges to site selection and flight.
- c) Harsh cold and low-oxygen environments can lead to weakened performance of facilities and equipment, as well as increased fatigue among airport personnel.
- d) Plateau ecosystems are fragile and difficult to restore once disturbed.
- e) Energy supply tends to be more difficult in these areas.

1.2 Given the difficulties and safety risks associated with building airports on plateaus and complex terrains, some States and regions often choose to significantly deviate from the standards set out in the Annex 14 and lower corresponding safety requirements during airport planning, design and construction. At the same time, the Aerodrome Design and Operations Panel (ADOP) of ICAO has introduced the concept of “Altiport” and working on the development of the global guidance for design and operations of Altiports, which are primarily used by aeroplanes with take-off mass less than 5,700 kg and different in geometric profile from aerodromes used for conventional take-offs and landings where Annex 14, Volume I requirements are applicable.

1.3 China supports the safety standards outlined in the Annex 14 which represent the bottom line for ensuring aircraft operational safety and a prerequisite for airport construction. In areas which are already subject to heightened safety risks, such as plateaus and complex terrains, any further deviation from the Annex 14 would significantly increase the safety hazards of the airports in these areas.

1.4 China has accumulated experience from the construction of more than 40 plateau and high-plateau airports. The physical characteristic indicators of these airports, such as runways, taxiways and runway strips, have all been developed in strict compliance with the standards set out in the Annex 14, without any deviations or exemptions. However, given the massive engineering efforts and investments required to address extremely high obstacles, obstacle control at airports in these areas may be limited to only those deemed critical. Meanwhile, the RNP AR flight procedure has been adopted to better adapt to complex operational scenarios.

1.5 At present, China is developing the Guidelines for the Planning and Construction of Plateau Airports as a civil aviation standard, which aims to provide guidance for site selection, design, and construction of airports in relevant regions while fully meeting the safety requirements of the Annex 14.

2. DISCUSSION

2.1 In response to the challenges concerning high plateau airport construction, China’s Guidelines for the Planning and Construction of Plateau Airports puts forward the following solutions.

2.2 To address the challenge of complex geological foundations at airport sites, China recommends avoiding areas which are prone to natural disasters such as mudslides, landslides, and flash floods. For adverse plateau geological conditions such as permafrost, saline soil, liquefied soil, weak soil, and collapsible loess, China has developed foundation treatment solutions based on years of exploration and research, which can now be promoted and implemented.

2.3 To tackle the difficulties posed by complex terrains and topography, China has proposed measures including building bridge structures, installing reflective nets, deploying arresting systems and setting up approach lighting bridges. Currently, the arresting systems have been installed at over 13 airports in China. Although these airports already meet the 90-meter Runway End Safety Area (RESA) requirement, China believes the arresting systems are an effective way to enhance safety at plateau airports. Additionally, China has proposed at previous ADOP meetings that the approach lighting bridges are a cost-effective and reliable solution for airports located on the plateaus or with the complex terrains, and recommends that the Visual Aids Working Group (VAWG) consider incorporating this recommended practice in the Annex 14 or related design manuals.

2.4 To address the challenges in airport site selection, China has proposed the use of digital technologies to assist this job. These technologies, based on tools such as GIS and BIM, enable systematic sorting and organization of the questions regarding complex site selection and analysis of complex data, breaking them down into hierarchical levels and producing comprehensive evaluation results through quantitative calculations. This approach combines quantitative and qualitative decision-making analysis to tackle complex challenges. Digital site selection integrates big data collected via various new technologies, applies statistical and analytical methods for more precise indicators and accuracy analysis, and allows for quantitative analysis. Through 3D modeling and visualization, it intuitively presents key site elements, helping identify hidden hazards and support decision-making while mitigating risks. For instance, it enables visual analysis to determine the feasibility of construction of lighting strips, assess potential obstruction of navigation stations, and detect whether any structures exceed the three-dimensional limits of procedure and performance surfaces. Improved accuracy and scientific nature in site selection ultimately contribute to more stable flight operations and enhanced aviation safety. This approach has already been successfully applied at new airports in Foshan and Chongqing, as well as airports in Enshi, Baicheng and Jinzhai, demonstrating practical outcomes.

2.5 In response to complex obstacle clearance and volatile meteorological conditions, China recommends conducting focused analyses on adverse meteorological factors such as wind shear, low visibility, strong winds, thunderstorms, and sandstorms, based on years of practical experience. China also recommends the active adoption of RNP AR flight procedures for relevant airport construction projects.

2.6 To cope with extreme cold and low-oxygen conditions during high-altitude airport construction, China recommends the simultaneous development of essential facilities such as oxygen supply, heating and power supply systems. China also recommends the establishment of support bases at airports to protect the health and safety of construction workers and provide a comfortable working environment for future operational personnel.

2.7 Given the ecological fragility and the difficulty of restoration after destruction in these areas, China consistently advocates the principle of prioritizing ecological conservation and proactively implements ecological and environmental protection solutions. China emphasizes the need for environmental impact and risk assessments during the planning and design phases. Drawing from engineering experience, China proposes the idea of developing effective restoration measures in early planning for land occupation management, pollutant recovery and treatment, and earthwork area revegetation.

2.8 Taking into account the unique advantages of these areas in terms of environment and resources, China recommends fully utilizing natural resources such as solar, geothermal, and wind energy in airport construction. For example, clean energy as a heat source for heating systems has been widely used at plateau airports in China, contributing to sustainable resource utilization.

2.9 China previously shared its experience in the airport construction on plateaus and complex terrains at multiple Asia-Pacific events on invitation, arresting the attention from international counterparts. In this context, China is expediting the development of the Guidelines for the Planning and Construction of Plateau Airports, with an English version underway to facilitate global accessibility. China also actively engages in ICAO's ADOP research by contributing technical expertise. We welcome the States and the regions to share their experience in building airports on the plateaus and complex terrains, pay close attention to the operational safety risks arising from deviations from the Annex 14, and collaboratively advance ICAO's research on Altiport in a prudent manner, with a shared goal of promoting the safe, environmentally sustainable and steady progression of such airport construction worldwide.

2.10 Conclusion

- 1) Airports located on the plateaus and complex terrains face significant challenges in their construction and operations due to fragile ecosystems, complex terrains, and stringent safety requirements. States are recommended to focus on environmental protection, site selection, and safety in the construction of plateau airports;
- 2) The ADOP to carry out research on Altiport in a prudent and well-considered manner, and encourage the States with relevant experience to actively join it and share safety risks and jointly participate in research on development of international guidance documents;
- 3) The requirements in the Annex 14 serve as the fundamental safeguard for the safe operation of airports. The States are called upon to pay close attention to the safe operating conditions of plateau airports. It is recommended that physical characteristic indicators such as runways, runway strips, and RESA during construction of plateau airports should comply with the requirements in the Annex 14;
- 4) States should share their experience in plateau airport planning and construction to jointly improve the quality of planning and construction of global plateau airports; and
- 5) China has committed to accelerate the preparation of the Guidelines for the Planning and Construction of Plateau Airports and share its English edition, which would be of great help to airport planning and construction. Other States are welcome to refer to and make use of it in the future.

3. ACTION BY THE CONFERENCE

- 3.1 The Conference is invited to note the information contained in this paper.

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