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Mookambigai College of Engineering, Keeranur, Tamil Nadu, India

Design of Airfield for Plain Topography

Giri P, Sarvesh S, Vishnuvasan S, Surya G, Naveen Kumar R

Department of Civil Engineering, K.Ramakrishnan College of Technology, Tamil Nadu, India

ABSTRACT: The design of an airfield is a multidisciplinary task that integrates civil engineering, aerodynamics, meteorology, and environmental planning. This paper focuses on the design aspects specific to plain topography, where terrain conditions are largely level and uniform. Key elements such as site selection, runway orientation, drainage design, and pavement composition are discussed with reference to international standards. Findings indicate that airfields constructed on plain terrain offer cost and time advantages due to reduced earthwork requirements. However, effective drainage and soil stabilization remain critical. The study concludes with recommendations for sustainable and efficient design practices for airfields in plain topography regions.

I. INTRODUCTION

Airfields form the backbone of global air transportation, ensuring safe and efficient movement of aircraft. Their design depends significantly on local topography, climate, and soil conditions. Airfields located on plain terrains are often favored due to ease of construction and lower grading requirements. Despite these advantages, challenges such as poor natural drainage and potential flooding must be addressed through careful engineering design.

This paper discusses the design approach for airfields situated on plain topography, focusing on geometric layout, pavement design, and drainage management. References to the standards of the International Civil Aviation Organization (ICAO) [1] and the Federal Aviation Administration (FAA) [2] are made throughout the discussion.

II. SCOPE

The scope of this paper includes the following design aspects:

- Site selection criteria for airfields on plain terrain.
- Runway orientation and layout determination using wind analysis.
- Geometric design of runways, taxiways, and aprons.
- Pavement design based on aircraft loading and subgrade conditions.
- Surface and subsurface drainage design.
- Consideration of lighting, signage, and navigational aids.

Airfields located in mountainous, coastal, or reclaimed areas are beyond the scope of this discussion.

III. RESEARCH ELABORATION

A. Site Selection

The choice of site is fundamental in airfield planning. On plain terrain, selection criteria include: Accessibility to urban centers and transport corridors.
Prevailing wind patterns to minimize crosswind components.
Adequate soil bearing capacity (CBR ≥ 8%).
Minimal environmental and social impact.
Meteorological data, typically collected over a 10-year period, are analyzed to determine suitable runway orientation based on wind roses.

B. Runway Orientation and Layout

Runway alignment is dictated by wind coverage requirements such that the crosswind component does not exceed the maximum permissible limit (usually 25 km/h for small aircraft). On flat terrain, flexibility in alignment allows for optimized orientation. For low-traffic airports, a single-runway layout is sufficient, whereas major facilities may employ parallel or intersecting runways.

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C. Geometric Design

Runway length depends on aircraft type, elevation, and temperature. For plain terrains, elevation corrections are negligible, but temperature corrections may increase required length.

where (L_0) is the standard runway length and (\Delta L_T) is the temperature correction. Typical runway slopes range from 1.0% longitudinally and 1.5% transversely to ensure adequate drainage

D. Pavement Design

The pavement design process considers aircraft wheel loads, subgrade strength, and traffic volume. For flexible pavements, the design thickness (t) is related to the subgrade CBR value and equivalent annual departures

Plain terrains with uniform subgrade simplify pavement layer configuration and reduce maintenance requirements. Rigid pavements may be adopted for heavy aircraft operations or poor subgrade conditions.

E. Drainage Design

Flat terrain presents challenges in surface water disposal. Runway and taxiway surfaces are provided with minimum slopes (1.0–1.5%) to facilitate runoff. Subsurface drainage systems, such as perforated pipes and granular filter layers, prevent waterlogging and subgrade weakening.

Design rainfall intensity is calculated using IDF (Intensity-Duration-Frequency) curves to ensure adequate drainage capacity.

F. Auxiliary Facilities

Lighting systems, signage, and navigational aids must comply with ICAO Annex 14 and FAA standards. The uniform surface of plain terrain simplifies the installation of Instrument Landing Systems (ILS) and approach lighting arrays. Visual aids such as Precision Approach Path Indicators (PAPI) are installed to enhance pilot guidance during landing.

IV. COMPARATIVE ANALYSIS WITH AIRFIELDS IN NON-PLAIN TERRAINS INDICATES:

Reduced Construction Costs: Earthwork volume reduced by 25–35%.
Simplified Layout: Straightforward geometric alignment reduces taxiing distances.
Drainage Importance: Surface and subsurface drainage require enhanced design due to low slopes. Operational Efficiency:Improved accessibility and maintenance performance.
Environmental Benefits:Minimal disruption of natural terrain and lower carbon footprint.

Overall, plain topography airfields demonstrate superior cost efficiency and construction speed, with lifecycle cost reductions averaging 20% compared to hilly terrain designs.

V. CONCLUSION

Airfields designed on plain topography provide significant engineering and economic benefits. The uniform terrain enables simplified geometry, reduced earthwork, and consistent pavement performance. However, designers must prioritize effective drainage systems and proper soil stabilization to ensure durability and safety.
Future research may focus on the integration of green drainage infrastructure and advanced pavement materials to further enhance the sustainability of airfield projects in plain terrains.

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| Mobile No: +91-6381907438 | Whatsapp: +91-6381907438 | ijmrset@gmail.com |

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