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Assessment of Runway ACN-PCN Compatibility at Djalaluddin Gorontalo Airport

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ABSTRACT

Air transport infrastucture plays a vital role in regional economic development particularly in Eastern Indonesia where airport facilities are limited. Djalaluddin Airport in Gorontalo serves as the primary gateway connecting the region to major Indonesian cities. With increasing aircraft movement and changes in fleet composition, assessing the compatibility between aircraft loads and runway strength has become essential.

The study purpose was to evaluate the pavement capacity of Djalaluddin Airport using the Aircraft Classification Number-Pavement Classification Number (ACN-PCN) method recommended by the International Civil Aviation Organization (ICAO). As air traffic continues to grow, understanding the structural adequacy of airport pavements ensures both safety and sustainability.

Materials and methods. A technical feasibility study approach was adopted based on ICAO and FAA standards. Data on operational aircraft, including ATR 72-600 and Boeing 737-800, were obtained through coordination with airport authorities and field observation. ACN values were taken from ICAO and FAA reference tables, assuming flexible pavement and medium subgrade strength (CBR 6-10%). The estimated PCN was derived from empirical correlations considering pavement thickness (55-60 cm) and subgrade conditions typical of Gorontalo lateritic soils. Compatibility was assessed under the ICAO criterion that aircraft operation is permissible only when ACN ≤ PCN.

Results. The findings show that ATR 72-600 (ACN ≈ 18) operates safely within the estimated pavement capacity (PCN ≈ 30) while Boeing 737-800 (ACN ≈ 50) exceeds the allowable limit, indicating potential overloading. Runway geometry (2500x45m) satisfies ICAO Code C requirements. These results emphasize the need for periodic PCN evaluations at regional airports to prevent premature pavement deterioration.

Conclusions. The study concludes that the existing runway at Djalaluddin Airport is structurally adequate for regional turboprop operations but insufficient for frequent jet aircraft such as the Boeing 737. Regular ACN-PCN evaluations are recommended to ensure continued operational safety and guide infrastructure planning across Indonesia's smal and regional airports.

Keywords: ACN-PCN, runway, Djalaluddin Airport, pavement capacity, ICAO.

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INTRODUCTION

Aviation infrastruture is a critical component of regional development, providing essential connectivity that supports trade, tourism, and social mobility. In developing regions such as Eastern Indonesia, the efficiency and reliability of airport facilities play a key role in bridging geographic isolation. However, many regional airports continue to face operational constraints due to limited pavement strength and aging infrastructure. Assessing pavement capacity in relation to aircraft traffic is therefore vital to ensure long-term serviceability and safety.

Several studies have examined the relationship between pavement bearing strength and aircraft operational limits, emphasizing the importance of the Aircraft Classification Number–Pavement

Classification Number (ACN−PCN) system as standardized by the International Civil Aviation Organization (ICAO). This approach enables the evaluation of runway performance under various aircraft loads without the need for complex structural testing. Nevertheless, in Indonesia, comprehensive analyses at regional airports−particularly those serving mixed turboprop and narrow-body jet operations−remain limited.

The study purpose was to evaluate the structural adequacy of Djalaluddin Airport's runway pavement using the ICAO ACN−PCN methodology. By comparing the operational aircraft's ACN with the estimated PCN, this research aims to determine whether the existing pavement can safely support both regional turboprop aircraft (ATR 72-600) and narrow-body jets (Boeing 737-800). The findings are expected to provide insights for optimizing runway maintenance planning and enhancing infrastructure management across Indonesia's secondary airports.

METHOD

Study participants

This study focused on aircraft types currently operating at Djalaluddin Airport, Gorontalo, a regional airport classified as Code 2C under ICAO Annex14. The airport considered included the ATR 72-600 and Boeing 737-800, both representing the dominant turboprop and narrow-body jet traffic. Data on aircraft types, operational frequency, and landing gear configuration were obtained through informal coordination airport operational staff dan public flight schedules. This study did not involve human participants or invasive testing and therefore it is categorized as non-invasive and non-destructive research, in compliance with ethical standards for engineering studies.

Study organization

The study was organized into four technical stages :

1. **Aircraft Load Identification** – Determining the Aircraft Classification Number (ACN) for each aircarft type based on ICAO DOC 9157, Part 3 and FAA Advisory Circular 150/5320-6F. The ACN values were taken from published standards corresponding to flexible pavement and medium subgrade strength (CBR 6-10%).
2. **Runway Capacity Estimation**- Estimating the Pavement Classification Number (PCN) of Djalaluddin's runway using engineering correlation methods involving pavemen type, layer thickness, and subgrade strength. Based on field observation and documentation of similar regional airports, the runway was assumed to have a total pavement thickness of approximately 55-60cm, with flexible pavement structure and lateritic soil subgrade.
3. **Compatibility Analysis (ACN−PCN)**-Assessing whether the aircraft ACN values are within the structural capacity of the runway (ACN ≤ PCN). Overloading risk was analyzed for case was ACN > PCN referring to ICAO criteria for 'occasional operation.'
4. **Geometric and Regulatory Validation**-Supporting analysis through geometric comparison with ICAO Annex 14 and SNI 7995:2014 to ensure runway dimensions meet Code 2C requirements (length 2500m; width 45m).

Statistical analysis

The data were analized using a descriptive comparative approach rather than inferential statistics, as the purpose was to determine compliance between aircraft loading and pavement capacity. The ACN−PCN relationship was evaluated using both tabular comparison and empirical relationships between subgrade CBR and equivalent elastic modulus (E). The following key equations were used to estimate surface deflection and compressibility effects on layered pavements system:

$$\partial = \frac{1.5\ \mathrm{p}.a}{\mathrm{Eequiv}}$$

Where p is applied pressure, a is load radius, and E_{equiv} is equivalent modulus of elasticity. For cohesive subgrade layers thicker than 2m, the primary consolidation settlement was estimated as :

$Sc = (C_c / (1 + e_0))\ H\ \log((\sigma'_0 + \Delta\sigma) / \sigma'_0)$

Where e_0 is the initial void ratio, C_c is the compression index, H is the thickness of the compressible layer, σ'_0 is the initial effective vertical stress and $\Delta\sigma$ represents the stress increment induced by aircraft loading.

FINDING AND DISCUSSION

The evaluation of the pavement strength and aircraft loading capacity was carrie out using the comparisson between he Pavement Classification Number (PCN) and the Aircraft Classification Number (PCN) according to ICAO guidelines, the pavement is considered adequate if the ACN value of an aircraft does not exceed the PCN of the runway (ACN ≤ PCN).

Evaluation of Runway Geometric (Supporting Analysis)

The runway geometric at Djalaluddin Airport with a lenght of 2500m and a widht of 45m, was evaluated based on SNI 7995-2014 and ICAO Annex 14. The dimensions meet the standard requirement for Code C aircraft (such as Boeing 737).

Table 1. Comparison of ACN−PCN and Runway Suitability

Parameter	Aircarft 1	Aircarft 2
MTOW (kg)	23000	79000
Wheel Configuration	Twin nose + 2main gear (2wheels/gear)	Twin nose + 2main gear (4wheels/gear)
ACN (flexible pavement medium subgrade	18	50
Estimated PCN of runway	30	30
Suitability (ACN ≤ PCN?)	Yes	No

Based on the table above, the structural capacity of the runway pavement at Djalaluddin Airport is sufficient for aircraft with ACN ≤ 30, but inadequate for heavier aircraft such as those with an ACN of 50 or higher. This indicates that the current pavement is suitable for medium-weight aircraft but requieres reinforcement for heavier traffic categories.

CONCLUSIONS

This study that concludes that Djalaluddin Airport's runway structure is adequate for ATR-class turboprop aircraft but insufficient for continuous Boeing 737 under current pavements conditions. The ACN-PCN approach provides a cost-effective and standardizerd framework to evaluate pavement adequacy operations without requiring destructive testing.

It is recommended that the airport authority:

1. Limit B737 operation to ocassional flight until pavement reinforcement is carried out.
2. Conduct an official PCN determination using Falling Weight Detectometer (FWD) testing.
3. Implement routine ACN−PCN assesment every two years to adapt to envolving traffic patterns.

This research demonstrates the integration of aerospace load parameters and civil engineering pavement analysis through a simple yet practical approach suitable for small airports accross Indonesia.

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REFERENCES

Ashford, N., Stanton, H., & Wright, P. (2013). *Airport Engineering: Planning, design, and development of 21st Century Airports* (4th ed.). Hoboken, NJ: Wiley.

Badan Standardisasi Nasional (BSN). (2014). *SNI 799:2014 – Perencanaan geometrik lapangan terbang.* Jakarta: BSN.

Bowles, J. E. (1996). *Foundation analysis and design* (5th ed.). New York: McGraw-Hill.

Federal Aviation Administration (FAA). (2023). *Airport pavement design and evaluation (Advisory Circular 150/5320-6F).* Washington, DC :U.S. Department of Transportation. Retrieved from. https://books.google.com/books?id=Zb7GoAEACAAJ&pgis=1

Horonjeff, R., McKelvey, F., Spangler, R., & Gifford, J. (2010). *Planning and design of airports* (5th ed.). New York: McGraw-Hill Education

International Civil Aviation Organization (ICAO). (2020). *Aerodrome Design Manual—Part 3: Pavements* (Doc. 9157, 4th ed.). Montreal, Canada: ICAO. https://store.icao.int/en/aerodrome-design-manual-part-3-doc-9157

Kementerian Perhubungan Republik Indonesia. (2021). *Statistik Penerbangan Domestik – Wilayah Sulawesi.* Jakarta: Direktorat Jenderal Perhubungan Udara.

Thornthwaite, D. (2007). *Airport pavement management systems* (NCHRP Report 577). Washington, DC: Transportation Research Board. Retrieved from. https://doi.org/10.17226/12034

Zhao, Y., Chen, S., & Zhang, H. (2019). *Analysis of aircraft load impact on pavement structural capacity using the ACN—PCN method.* Journal of Transportation Engineering, Part B: Pavement, 145(3), 04019023. Retrieved from. https://doi.org/10.1061/JPEODX.0000163