PLANNING OF TURN PAD AREA AT THE END OF THRESHOLD 24 AT NAMROLE AIRPORT, MALUKU PROVINCE

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ABSTRACT
Namrole Airport in South Buru Regency, Maluku Province, is a class III airport that requires airside facility development due to increasing aircraft movements. One of the urgent needs is the construction of a turn pad at the end of runway 24 to support ATR 42-300 aircraft maneuvers so they can turn 180° safely and efficiently. This study aims to plan the turn pad dimensions, determine the thickness of flexible pavement using the FAA Manual method and FAARFIELD software, and calculate the Cost Budget Plan (RAB) according to PM 78 of 2014 and HSPK South Buru Regency 2024. The data used include aircraft specifications, soil CBR values, and flight traffic data, with validation through COMFAA software to obtain the PCN value. The planning results show that the need for a turn pad area of 325,875 m² with a pavement thickness of 41 cm (FAA Manual) and 35.6 cm (FAARFIELD). The COMFAA analysis resulted in a PCN of 15.5 F/C/X/T, while the RAB estimate reached Rp524,900,000.00.

Keywords: *Turn Pad, FAA Manual, FAARFIELD, COMFAA, Flexible Pavement.*

1. INTRODUCTION

Namrole Airport operates under the Ministry of Transportation, Directorate General of Civil Aviation, as a class III airport located in Lektama Village, Namrole District, South Buru Regency, Maluku Province. Geographically, the aerodrome reference point (ARP) of Namrole Airport is at coordinates 03°51'10" South Latitude and 126°42'09" East Longitude. The airport runway has dimensions of 1,200 × 30 meters with a PCN strength of 12/F/C/Y/T, which indicates a flexible pavement with low bearing capacity and a PCN value determined through technical analysis.

This airport serves commercial flights using Trigana Air's ATR 42-300 aircraft with a capacity of 42 passengers and a flight frequency of four times a week (Monday, Wednesday, Thursday, and Saturday). Its location, approximately 154.55 km from Ambon, makes this airport a strategic air transportation alternative because it can reduce the travel time between Namrole and Ambon from approximately eight hours by sea to only about 30 minutes. In recent years, demand for air transportation services in Namrole has continued to increase, as reflected in the growth in passenger numbers and aircraft movements.

This increase in flight activity has prompted the need for airside facility development, particularly at the end of runway 24, which currently lacks a turn pad. The lack of a turn pad limits aircraft's ability to perform 180° maneuvers at the end of the runway, creating safety risks such as deviations from course and potential one-wheel lock incidents. This issue was also identified in Decree of the Director General of Civil Aviation No. PR 21 of 2023 as an operational issue that requires immediate attention to ensure the safety and efficiency of aircraft movements at Namrole Airport.

This research was conducted to plan the turn pad area at threshold 24 of Namrole Airport, with a focus on three main aspects: (1) determining the dimensions of the turn pad area according to the characteristics of the planned ATR 42-300 aircraft, (2) determining the thickness of flexible pavement using the FAA Manual method and FAARFIELD software, and (3) calculating the cost budget plan (RAB) based on the provisions of PM 78 of 2014 concerning cost standards within the Ministry of Transportation and HSPK of South Buru Regency in 2024. The results of this planning are expected to be a technical reference for the development of airside facilities at airports with similar characteristics, as well as providing academic references for educational institutions and policy makers in the field of air transportation.

2. LITERATURE REVIEW

2.1 Airports and Airside – Landside Division

An airport is a primary facility designed to handle the takeoff and landing of aircraft. Every airport is required to have a runway, and large airports also have various facilities for passengers and flight service providers (Ervinda & Ariebowo, 2023). Generally, airports are divided into two areas:

- Airside, namely the part of the airport directly related to aircraft operations, including runways, taxiways, aprons and navigation facilities.
- Landside, namely areas that are not directly connected to aircraft movements, such as passenger terminals and vehicle parking areas.

2.2 Airport Airside Facilities

According to PR 21 of 2023, airside facilities at Namrole Airport, Maluku, consist of:

2.2.1 Runway

A runway is the main path used by aircraft for takeoff and landing. Runways can be constructed using flexible or rigid pavement. Their design and strength must be tailored to the type of aircraft being operated.

2.2.2 Taxiway

A taxiway is a connecting path between a runway and an apron, allowing aircraft to move on the ground. Types of taxiways include:

- Aircraft stand taxilane – a lane on the apron for parked aircraft.
- Apron taxiway – a path across the apron area.
- Rapid exit taxiway – a fast exit from the runway designed with a sharp angle to speed up the runway exit for aircraft that have just landed.

2.2.3 Apron

An apron is an aircraft parking area on the airside of an airport that is used for boarding and disembarking passengers, light aircraft maintenance, and loading and unloading baggage and cargo.

2.3 Runway Turn Pad Area

A runway turn pad is an area at the end of a runway that allows an aircraft to make a full 180-degree turn without requiring additional runway length. According to PR 21 of 2023 and ICAO Aerodrome Design Manual (2006), the turn pad must have a pavement strength equal to or greater than the runway because this area withstands high shear stresses during slow aircraft maneuvers. Runway turn pad design involves:

- Pavement layer with adequate friction, to prevent the danger of wheel slippage.
- Runway shoulder (shoulder) with a certain width, to protect surfaces from erosion due to jet blast and reduce the risk of Foreign Object Debris (FOD).
- Geometric specifications that take into account the Outer Main Gear Wheel Span (OMGWS) of the largest aircraft in operation.

2.4 Types of Dimensions and Safe Distances of Runway Turn Pads

According to KP 39 of 2015 and PR 21 of 2023, runway turn pads are classified based on aerodrome reference codes (Code Number and Code Letter) adjusted to runway length, wingspan, and aircraft OMGWS. A minimum clearance is determined to prevent the landing gear from extending beyond the edge of the turn pad when the aircraft cockpit is in the design position.

Table 1 Aerodrome Reference Codes

Aerodrome Reference Code				
Element Code 1		Element Code 2		
Number Code	Reference Long Landus Pacu	Letter Code	Wingspan (wing span)	Wheelbase Width- Outer Main Wheel (OMGWS)
1	Less than 800 m	A	Until and less than 15 m	Until and less from 4.5 m
2	800 m and less than 1,200 m	B	Up to 15 m and less than 24 m	Up to 4.5 m and not enough from 6 m
3	1,200 m and less than 1,800 m	C	24 m and less than 36 m	6 m and not enough from 9 m
4	1,800 m and More	D	36 m and less than 52 m	9 m and not enough from 14 m
		E	52 m and less than 65 m	9 m and not enough from 14 m
		F	65 m and less than 80 m	14 m and not enough from 16 m

Table 2 Safe Distance Between Landing Gear and Turning Area Edge

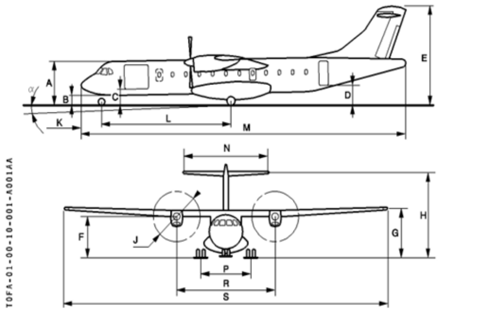
	Outer Main Gear Wheel Span (OMGWS)			
	OMGWS<4,5m	4,5m≤OMGWS<6m	6m≤OMGWS<9m	9m≤OMGWS<15m
Clearance	1,5m	2,25m	3 ma atau 4 mb	4m
a:jika tum pad dimaksudkan untuk digunakan oleh pesawat denganwheel base <18m				
b:jika tum pad dimaksudkan untuk digunakan oleh pesawat denganwheel base ≥18m				

2.5 Critical Aircraft Identification

Identifying critical aircraft is the first step in designing turn pads and airport pavements (Aerodrome Manual Part 1 Runways, 2006). The critical aircraft at Namrole Airport is an ATR 42–300, with reference code 2C, wingspan 24.57 m, OMGWS 4.1 m, and MTOW 16,700 kg. This data is used to determine the geometric dimensions and strength of the pavement structure.

Table 3 Types of Aircraft in Operation and Their Specifications

No	*Type* Pesawat	REF code	Wingspan (m)	OMGWS	Panjang	Clearance	MTOW
1.	ATR 42-300	2C	24.57	4.1	22.67	4.5	16700



VERTICAL CLEARANCES (A → H)						
	OPERATING EMPTY WEIGHT		MAXIMUM RAMP WEIGHT			
	CG 16.4%		CG 12%		CG 36%	
	ft	m	ft	m	ft	m
A	10.57	3.22	10.35	3.15	10.55	3.21
B	1.93	0.59	1.71	0.52	1.91	0.58
C	3.84	1.17	3.61	1.10	3.76	1.15
D	4.80	1.46	4.53	1.38	4.35	1.33
E	25.43	7.75	25.14	7.66	24.78	7.55
F	10.26	3.13	10.03	3.06	10.10	3.08
G	12.34	3.76	12.09	3.69	12.07	3.68
H	22.99	7.01	22.69	6.92	22.34	6.81
α	– 1°.515		– 1°.445		– 0°.921	
J	∅ 12.9 Ft		∅ 3.93 m			
K	5 Ft 6.3 in.		1.683 m			
L	28 Ft 9.7 in.		8.781 m			
M	74 Ft 4.5 in.		22.670 m			
N	23 Ft 11.8 in.		7.31 m			
P	13 Ft 5.4 in.		4.100 m			
R	26 Ft 6.9 in.		8.100 m			
S	80 Ft 7.4 in.		24.572 m			

Figure 1 ATR 42-300 Aircraft Specifications

2.6 Aircraft Classification Number (ACN) and Pavement Classification Number (PCN)

KP 93 of 2015 states that ACN describes the pavement strength requirements for an aircraft, while PCN indicates the strength of the airport pavement. Aircraft can operate if ACN ≤ PCN.

- ACN is calculated based on wheel load, landing gear configuration, and subgrade type.
- PCN consists of five elements: pavement strength value, pavement type (R/rigid or F/flexible), subgrade strength category (A, B, C, D), wheel pressure category (W, X, Y, Z), and rating method (T/technical or U/aircraft).

Table 1 ACN Planned Aircraft

Jenis Pesawat udara	Massa All - Up (kgs) (Massa Apron Maksimum) (Massa Operasional Kosong)	Beban pada satu roda gigi utama (Main gear leg) (%)	Standar tekanan ban pesawat			ACN Relatif							
						Subgrade perkerasan Rigid				Subgrade perkerasan Flexible			
						High	Medium	Low	Ultralow	High	Medium	Low	Ultralow
			psi	kg/cm^2	mPa	K=150 MN/m^3	K=80 MN/m^3	K=40 MN/m^3	K=20 MN/m^3	CBR=15%	CBR=10%	CBR=6%	CBR=3%
ATR 42 Basic Tires	16720	46.2	109	7.66	0.75	9	10	10	11	8	9	10	11
	10285					5	5	6	6	4	5	5	6

2.7 Flexible Pavement Structure

According to AC 150/5320–6F and the Ministry of Public Works standards, flexible pavement consists of several layers:

- Subgrade – the bottom layer that is compacted as a foundation.
- Subbase Course – a granular layer to increase the bearing capacity and protect the base soil.
- Base Course – a granular or asphalt concrete layer that provides the primary structural strength.
- Surface Course – an asphalt layer that provides friction and protection against the weather.

Table 5 Subgrade Bearing Capacity for Flexible Pavement

NO	Subgrade Category	Subgrade CBR Value (%)	Subgrade CBR Value Interval	Code
1.	Tall	15	CBR>= 13	A
2.	Currently	10	8 < CBR <13	B
3.	Low	6	4 < CBR <8	C
4.	Very Low	3	CBR >= 4	D

Table 6 Aircraft Wheel Allowable Pressure Categories

NO	Subgrade Category	Allowable Pressure (Mpa/Psi)	Code
1.	Tall	Unlimited	W
2.	Currently	1.5/218	X
3.	Low	1.0/145	Y
4.	Very Low	0.5/73	Z

2.8 Pavement Planning Methods

Pavement calculations can be done manually or using software:

- The FAA manual method involves calculating pavement thickness using logarithmic equations, graphical curves, wheel load calculations, and equivalent annual departure.
- FAARFIELD (Federal Aviation Administration Rigid and Flexible Iterative Layered Design) is used to calculate runway and turn pad pavement thickness according to AC 150/5320-6G.
- COMFAA is used to evaluate PCN and ACN and to assess the Cumulative Damage Factor (CDF) due to various types of aircraft in operation.

2.9 Cost Budget Plan (RAB)

In addition to technical aspects, turn pad and pavement design requires cost calculations outlined in a Cost Budget Plan (RAB). The RAB includes estimates of material requirements, labor wages, and other supporting costs based on the volume of work (Juansyah et al., 2017).

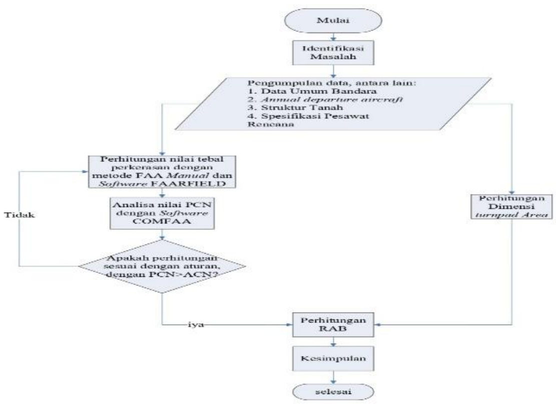
3. METHODOLOGY

This study aims to plan the pavement thickness and dimensions of the turning pad area at the end of the threshold 24 of Namrole Airport, Maluku, with a comprehensive approach that combines manual methods and FAA standard-based software.

3.1 Research Design

The research approach is descriptive, aiming to evaluate existing conditions and formulate technical solutions based on applicable theory and regulations. The planning process is presented in the form of a flowchart as a systematic guide from the initial stages to the final calculations.

Figure 2 Planning Flowchart



3.2 Data Collection

Data was collected through two sources: direct observation at Namrole Airport and secondary data from relevant agencies. The data used include:

- General airport data, including aircraft traffic statistics and the Aerodrome Manual.
- The specifications of the planned aircraft, namely the ATR 42-300 as a critical aircraft according to the reference code 2C.
- Soil CBR data, obtained through airport testing results during On The Job Training activities.

This data is used to calculate pavement thickness, determine turn pad dimensions, and evaluate Pavement Classification Number (PCN) values.

3.3 Pavement Thickness Design

Pavement thickness is calculated referring to KP 93 of 2015 with two approaches:

- The traditional manual method, using FAA charts to determine layer thickness based on subgrade CBR values, critical aircraft loads, and annual movement.
- Graphical methods, to speed up the calculation process and visualize the relationships between design parameters.

3.4 Turning Pad Dimensioning

The dimensions of the turn pad area are determined following Aerodrome Design Manual Doc. 9157 Part 1, which takes into account the wingspan and outer main wheel spacing of the largest aircraft operating at the airport.

3.5 PCN Evaluation Using COMFAA

PCN calculations are carried out using COMFAA software according to the KP 93 2015 guidelines. The process includes:

- Entering existing and planned aircraft traffic data.
- Verifying the pavement parameters resulting from manual calculations.
- Input the pavement thickness, CBR value for flexible pavement or modulus k for rigid pavement.
- Run a PCN batch to obtain PCN values appropriate to the airport pavement.

3.6 Pavement Design Verification Using FAARFIELD

Pavement thickness is verified using FAARFIELD according to FAA AC 150/5320-6G, with the following steps:

- Determine the type of pavement and layer structure.
- Input traffic mix based on aircraft data and actual load.
- Adjust aircraft weight and departure frequency if necessary.
- Using the Design Thickness function to obtain optimal thickness recommendations.
- Evaluate the required subgrade density before installing a new layer.

3.7 Volume and Cost Estimation

After the design thickness and dimensions are determined, work volume calculations are performed to prepare a Cost Budget Plan (RAB). Costs are calculated based on the 2024 South Buru Regency HSPK, taking into account labor requirements, equipment, materials, and the costs of the main activity units.

3.8 Research Location and Timeline

The research was conducted at the Maluku Class III Airport Operator Unit, spanning the planning, data collection, analysis, and report writing stages. The research timeline was structured in stages to ensure integration between technical calculations and field verification.

4. DISCUSSION

4.1. Increased Air Traffic and the Urgency of Turn Pad Planning

Air traffic at Namrole Airport experienced a significant increase between 2021 and 2024. Operational data shows that passenger numbers increased from 3,089 in 2021 to 12,215 in 2024, while annual aircraft movements rose from 134 to 308. This increase is in line with the increased connectivity within South Buru Regency and the strategic role of Namrole Airport in supporting logistics distribution and public mobility.

The increasing frequency of flights demands adequate airside infrastructure, particularly the turn pad area, which serves as a place for aircraft to perform 180° turns at the end of the runway. Without proper turn pad planning, the risk of runway edge erosion, reduced operational safety, and excessive loading on the pavement will increase. The aircraft planned to operate at this airport is the ATR 42-300, which is categorized as Code Letter B according to ICAO Annex 14.

4.2. Calculation of Turn Pad Area

The turn pad geometry planning refers to the Aerodrome Design Manual Doc. 9157 Part 1 and KP 39 of 2015 concerning Technical Standards and

Operational Civil Aviation Safety Regulations (PKPS). The ATR 42-300 aircraft has a wheelbase of 8.78 m and an Outer Main Gear Wheel Span (OMGWS) of 4.1 m. Based on ICAO provisions, the minimum clearance between the main landing gear and the edge of the turn pad for aircraft code B is ≥ 1.5 m.

The calculation of the turn pad area is done using the trapezoid area formula:

L = ((A+B) x t)) : 2)

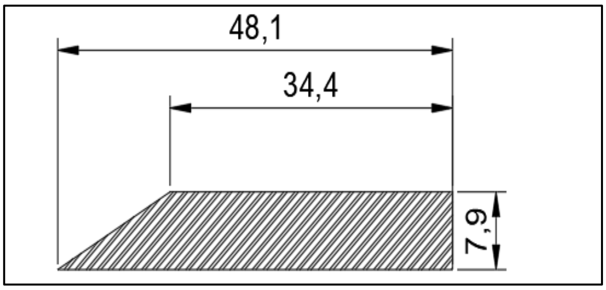
Dengan ;

(A+B) = 48,1+34,3 = 82,4 m

t = 7.9 m

maka luasan adalah : L = (82,4 x 7,9) : 2 = 325,875 m^2

Figure 3 Planned Turn Pad Area



The results of this calculation show that the minimum area of the turn pad is ±325.9 m², in accordance with the maneuvering requirements of the ATR 42-300 and ICAO standards.

4.3. Aircraft Wheel Load Analysis and Equivalent Annual Departure

The aircraft wheel load is calculated to determine the pressure received by the pavement. The load is calculated using the equation:

$$W = 0.95 \times MTOW \times \frac{1}{Number\ of\ wheels\ on\ the\ main\ gear}$$

With MTOW ATR 42-300 = 16,700 kg and dual wheel gear configuration (2 wheels on the main gear), we obtain:

ATR 42-300 Wheel Load = 0.95 x 16700 kg x ½
= 7932.5 kg

Next, the Equivalent Annual Departure (EAD) is calculated to determine the number of aircraft movements in equivalent form to the design aircraft. However, because only ATRs operate at Namrole Airport,
42-300,

Table 7 Equivalent Annual Departure ATR 42-300

No	Jenis Pesawat	Tipe Roda	MTOW	*Annual Departure*	*Eq. Annual Departure*	Beban Roda	Beban Roda Pesawat Terkritis	Log R_2	$(W1/W2)^{1/2}$	Log R1	Eq. Annual Departure
1	2	3	4	5	6	7	8	9	10	11	12
2	ATR 42-300	*Dual Wheel*	16.700	308	308	7933	7933	2,489	1	2,489	308.9

Therefore, the EAD value equals the actual number of departures, which is 309 movements/year (rounded). This calculation is important because it is used as the basis for determining pavement thickness using the FAA method and FAARFIELD software.

4.4. Pavement Thickness Planning

4.4.1. FAA Manual Pavement Thickness Calculation

With parameters:

- CBR subgrade = 6%
- CBR subbase = 30%
- MTOW = 16,700 kg (36,784 lb)
- Equivalent Annual Departure = 309

Using FAA AC 150/5320–6G, pavement thickness for dual-wheel-gear aircraft was determined using manual charts. Analysis results:

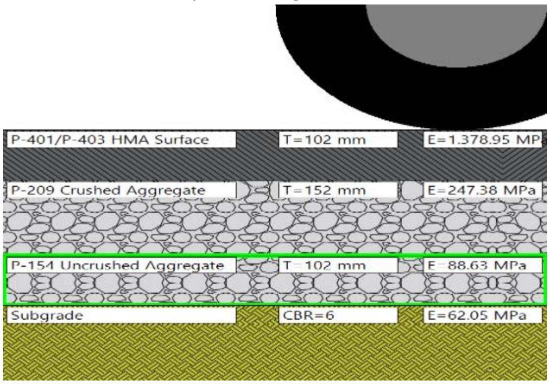
- Total thickness of flexible pavement = 16 inches (±41 cm)
- Surface layer thickness (asphalt) = 4 inches (10.16 cm)
- Base course thickness = 6 inches (15.24 cm)
- Subbase thickness = 12.2 inches (30.99 cm)
- Total construction thickness = 22.2 inches (56.39 cm)

4.4.2. Pavement Thickness Calculation Using FAARFIELD

Analysis with FAARFIELD (FAA Rigid and Flexible Iterative Elastic Layered Design) produces the following pavement thickness:

- Surface = 102 mm
- Base course = 152 mm
- Subbase = 102 mm
- Total construction thickness = 356 mm (35.6 cm)

Figure 4 Results of Pavement Thickness Analysis Using FAARFIELD



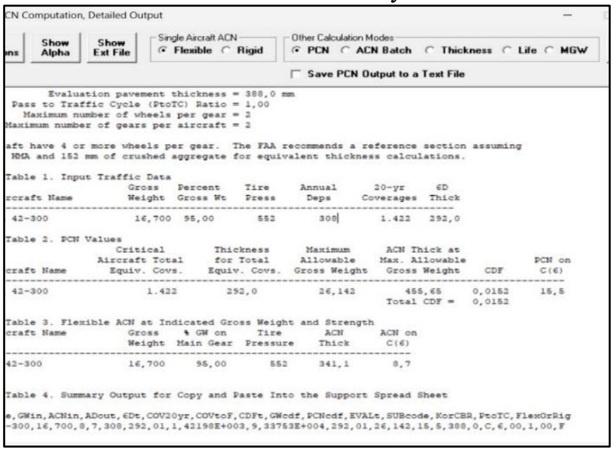
FAARFIELD's results are slightly lower than those of the manual method. This difference is understandable because FAARFIELD uses a layered elastic model based on numerical data, while the manual method uses conservative graphs.

5.5. PCN Value Evaluation Using COMFAA 3.0

The Pavement Classification Number (PCN) is an international parameter that indicates the pavement's ability to withstand aircraft loads. PCN values are calculated using COMFAA 3.0 software based on FAA AC 150/5335-5C.
With the input of FAARFIELD pavement thickness, 6% soil CBR, and ATR 42-300 aircraft data, the following is obtained:

PCN = 15.5 F/C/X/T
ACN ATR 42-300 = 8.7

Table 8 COMFAA 3.0 Analysis Results



Since PCN > ACN, the turn pad pavement is declared suitable for ATR 42-300 aircraft operations. The Cumulative Damage Factor (CDF) value = 0.0152 (<1) indicates that the pavement structure is still in a safe condition and has not experienced structural damage due to current traffic loads.

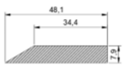
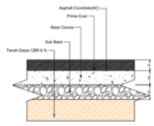
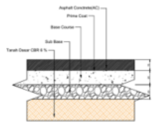
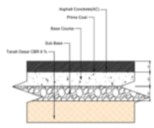
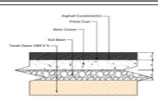
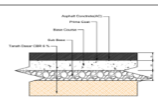
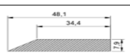
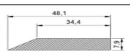
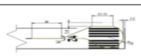
5.6. Comparison of Designed and Existing Pavement Thickness

Field measurements showed that the existing pavement was 35.6 cm thick, while the design required 55 cm. There was a 19.4 cm difference in elevation, necessitating an overlay or profiling to equalize the height and prevent disruption to aircraft operations in the turn pad area.

5.7. Turn Pad Area Planning Specifications

Bestek or what is also called the Technical Specification Book is a document compiled as a reference for implementing the construction of a turn pad area. Bestek for planning a turn pad area can be seen in the table below.

Table 8 Turn Pad Area Planning Bestek

NO	Job description	Volume
1	Measurement and Cleaning Work	L = 325,875 m2
		L = ((A+B) × T) : 2) L = ((48.1+34.4)x7.9) : 2 L = (82.5 × 7.9) : 2 L = 651.75 : 2 L = 325,875 m2
2	Regular Earth Excavation Work	Volume = 179,231 m3
		Area = 325,875 m2 Height = 55 cm = 0.55 m Volume = Area × Height =325.875×0.55 = 179,231 m3
3	Leveling and Land Removal Work	Volume = 179,231 m3
		Area = 325,875 m2 Height = 55 cm = 0.55 m Volume = Area × Height =325.875×0.55 = 179,231 m3
4	Sub Base Sirtu Layer Work	Volume = 65.175 m3
		Area = 325,875 m2 Height = 20 cm = 0.2 m Volume = Area × Height =325.875×0.2 = 65.175 m3
5	Soil Compaction Work for Base Course and Sub Base	Volume = 130.35 m3
		Area = 325,875 m2 Height = 40 cm = 0.4 m Volume = Area × Height =325.875×0.4 = 130.35 m3
6	Crushed Stone Work base course	Volume = 65.175 m3
		Area = 325,875 m2 Height = 20 cm = 0.2 m Volume = Area × Height =325.875×0.2 = 65.175 m3
7	Prime Coating 2kg/m2	L = 325,875 m2
		L = ((A+B) × T) : 2) L = ((48.1+34.4)x7.9) : 2 L = (82.5 × 7.9) : 2 L = 651.75 : 2 L = 325,875 m2
8	Asphalt work AC 60-70 average thickness 5 cm surface	L =325.875x3 =977.625 m2
		L = ((A+B) × T) : 2) L = ((48.1+34.4)x7.9) : 2 L = (82.5 × 7.9) : 2 L = 651.75 : 2 L = 325,875 m2
9	Painting/Marking	L = 25.8 m2
		L = Length x Width L = 172 x 0.15 L = 25.8 m2

5.8. Cost Budget Plan (RAB) Analysis

The RAB was prepared based on the Basic Activity Unit Price (HSPK) for the Namrole area in 2024 and PM 78 of 2014, with a total cost of Rp 524,900,000.00. The largest cost component comes from the AC 60–70 asphalt work with an average thickness of 5 cm, namely Rp 283.8 million (approximately 54% of the total cost).

Table 9 Recapitulation of RAB Turn Pad Area

No	Uraian pekerjaan	Satuan	Volume	Harga Satuan (Rp)	Jumlah Harga (Rp)
1	2	3	4	5	6
A	**PEKERJAAN PERSIAPAN**				
1	Pekerjaan pengukuran	m²	325.875	7,331.78	2,389,245.38
2	Pekerjaan Pembersihan	m²	325.875	2,840.00	925,485.00
B	**PEKERJAAN TANAH**				
1	Pekerjaan Galian Tanah Biasa	m³	179.231	122,395.90	21,937,170.71
2	Pekerjaan Perataan dan Buangan Tanah	m³	179.231	165,642.84	29,688,373.96
C	**PEKERJAAN STRUKTUR**				
1	Pekerjaan Pemadatan Tanah	m³	130.35	82,442.09	10,746,326.10
2	Pekerjaan Sirtu untuk Sub Base	m³	65.175	502,711.19	32,764,201.65
3	Perkerjaan Batu Pecah Untuk Base Course	m³	65.175	936,660.03	61,046,817.42
D	**PEKERJAAN ASPAL**				
1	Prime Coating 2kg/m2	m²	325.875	78,410.08	25,551,885.39
2	Pekerjaan Aspal AC 60-70	m²	977.625	290,339.62	283,843,271.78
E	**PEKERJAAN MARKA**				
1	Pengecatan/Marking	m²	25.8	151,717.76	3,914,318.11
				Jumlah	472,807,095.50
				PPN 11%	52,008,780.50
				Total	524,815,876.00
				Dibulatkan	524,900,000.00
	Terbilang : Lima Ratus Dua Puluh Empat Juta Sembilan Ratus Ribu Rupiah				

This cost breakdown ensures that the turn pad design can be implemented economically, scalably, and in accordance with safety standards.

5.8. Design Implications and Technical Evaluation

Based on the overall analysis, several important points were obtained:

- The 325.9 m² turn pad design complies with ICAO and KP 39/2015 standards for the ATR 42-300 (Code Letter B) aircraft.
- Pavement thickness of 41–56 cm is capable of withstanding aircraft loads, as evidenced by the PCN value being greater than the ACN.
- The difference in thickness between the existing and planned pavement (19.4 cm) needs to be addressed with appropriate construction methods so as not to interfere with aircraft operations.
- The RAB of IDR 524.9 million is a rational and proportional cost estimate for the planned scope of work.
- The combination of the FAA Manual, FAARFIELD, and COMFAA 3.0 methods provides complementary analysis results, improving design reliability and the basis for long-term maintenance planning.

Overall, this design will support increased aircraft operational safety, pavement service life, and service capacity at Namrole Airport as air traffic movements in the Maluku region increase.

5. CONCLUSIONS AND SUGGESTIONS

5.1 Conclusion

Based on the results of data processing, technical calculations, and analysis carried out in Chapter 4, the following conclusions can be drawn:

5.1.1 Turn Pad Area Dimensions

Referring to the Decree of the Director General of Civil Aviation Number 21 of 2023 and the Aerodrome Design Manual (Doc. 9157 Part 1), the planning of the turn pad at Namrole Airport, Maluku Province with the planned ATR 42-300 aircraft results in a trapezoidal turn pad dimension with:

- Length of the upper parallel side: 34.4 m
- Length of the lower parallel side: 48.1 m
- Trapezoid height: 7.9 m

From the results of the geometric calculations, the turn pad area was obtained as 325,875 m².

5.1.2 Pavement Thickness and Bearing Capacity Planning

Pavement thickness planning was carried out by adopting the Federal Aviation Administration (FAA) method using FAARFIELD software as an analysis tool, in accordance with Advisory Circular AC 150/5320–6G on Airport Pavement Design and Evaluation.

The calculation results show:

- Total pavement thickness: 35.6 cm (14.02 inches)
- PCN (Pavement Classification Number) value: 15.5
- CDF (Cumulative Damage Factor): 0.0152, which indicates that the pavement in the planning is still in the category of being suitable for use and is able to withstand aircraft traffic loads according to specifications.

5.1.3 Cost Budget Plan (RAB)

Referring to PM 78 of 2014 and the Basic Activity Unit Price (HSPK) of South Buru Regency in 2024, the budget plan for the construction of the turn pad area at Namrole Airport is estimated at IDR 524,900,000.00 (Five Hundred Twenty Four Million Nine Hundred Thousand Rupiah).

5.2 Suggestions

For the construction of the next turn pad, it is recommended that the thickness of the planned pavement be adjusted to the existing pavement to avoid differences.

Elevation and material selection are carried out in accordance with technical standards and operational aircraft loads. Future researchers should also review the FAA's manual calculation method to verify the results, while also considering the use of FAARFIELD software, which is more accurate and meets the latest FAA standards. Furthermore, airport requirements data should be updated periodically, as movement data and operational requirements can change annually.

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