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Feasibility Analysis of Runway, Taxiway and Apron Dimensions of Torea Airport in Fakfak Regency, West Papua Province

Muhammad Yunus[a,*], Ratna Septa Sari Tuhepaly[b], Ahmad Fitriadhy[c]

[a]Department of Civil Engineering, Polytechnic State of Fakfak. Email: muhammadyunus@polinef.id
[b]Department of Civil Engineering, Polytechnic State of Fakfak. Email: ratnasarituhepaly@gmail.com
[c]Programme of Maritime Technology, School of Ocean Engineering, University Malaysia Terengganu. Email: naoe.afit@gmail.com

Abstract

The development of transportation sector modes, especially air transportation modes, is currently experiencing very significant development. This is because the mode of air transportation in the form of aircraft can make people move very quickly, unlike land and sea transportation modes which require a longer time. In this regard, an airport that meets the requirements in terms of flight security and safety is needed. The study aimed was to analyze the dimensions of the runway, taxiway, apron and evaluate the feasibility of the runway, taxiway, apron dimensions at Torea Airport in Fakfak Regency, West Papua Province. From the results of the research conducted, it was found that the dimensions of the runway length of Torea Airport have met the minimum requirements set by the International Civil Aviation Organization (ICAO) in 2016 with a runway length of 1201.8 m Torea Airport but in terms of requirements for the type of aircraft ATR 72-600 does not meet the requirements. While for the standard dimensions of the runway width and the width of the runway shoulder of Torea Airport according to the Regulation of the Ministry of Transportation of the Directorate-General of Civil Aviation Number: KP 39 of 2015 concerning Technical and Operational Standards of Civil Aviation Safety Regulations.

Keywords: Airport; International Civil Aviation Organization (ICAO); modes of transportation; runway

1. Introduction

An airport is an area or area on land and or waters with certain boundaries that is used as a place for aircraft, in addition to landing and taking off, as well as a place for passengers to get on and off, loading and unloading goods, and a place for intra and intermodal transportation equipped with transportation facilities. aviation safety and security, as well as basic facilities and other supporting facilities [1, 2].

Along with flight fares in Indonesia that are increasingly affordable for the public, the increasing interest of the Indonesian people in using air transportation [1]. This is also what makes Indonesia experience very rapid development in the aviation industry [3].

Torea Airport is an airport that serves flights in the Fakfak Regency, West Papua Province. Not many flights depart from this airport, there is only one airline with one aircraft serving at the airport, namely Wings Air with ATR 72-600 aircraft [4].

Civil Aviation Safety Regulations – Part 139 (Manual Of Standard CASR - Part 139) Volume I, airports (aerodromes) are guidelines for airport operators so that every construction and operation of airports (aerodromes) can meet the technical and operational standards of airports that have been set determined by the Directorate General of Civil Aviation and as an effort to realize aviation security and safety [5, 6].

According to the Regulation of the Director-General of Civil Aviation No. KP 39 of 2015, airport safety is a vital link in aviation safety [6]. Airport safety is achieved by providing airport facilities and maintaining an airport environment that ensures the safety of aircraft operations [7-9]. By adhering to established standards and procedures and adopting a proactive safety management approach, airport operators can demonstrate that they have fulfilled their safety obligations to their passengers who are essentially a travelling public [10–12].

Torea airport facilities are currently far from good because the airport looks small and obstacles in the form of tall trees across the runway make it difficult for pilots to make the landing process [4]. Not to mention, to both ends of the runway and one side of the runway there are ravines. With such obstacles and gaps, the true aspect of flight safety is at stake. However, this aircraft continues to operate with several requirements, namely the cargo in the form of passengers and goods must not be optimal. However, this transportation restriction still has potential safety risks. The study aimed to analyze the dimensions of the runway, taxiway, apron and evaluate the feasibility of the runway, taxiway, apron dimensions at Torea Airport in Fakfak Regency, West Papua Province.

*Corresponding author. Tel.: +62-811-4212-748
Jalan TPA Imam Bonjol Atas Air Merah, Kelurahan Wagom Fakfak, Papua Barat, Indonesia, 98611

2. Literature Review

2.1. Airport definition

An airport is an area on land and/or waters with certain limits that are used as a place for aeroplanes to land and take off, boarding passengers, loading and unloading goods, and places for intra and inter-mode transportation, which are equipped with aviation safety and security facilities, as well as other facilities shops and other supporting facilities [13].

2.2. Airport facilities

Airport facilities have two types, namely basic facilities and supporting facilities. Both of these facilities are useful for organizing flight service activities. The following are the facilities at the airport:

a. Basic Airport Facilities
   According to the Regulation of the Directorate-General of Civil Aviation through SKEP/77/VI/2005, the main airport facilities are as follows [14] :
   1) Airside facilities
      a) Runway and runway markings
      b) Runway strip/runway end safety area
      c) Taxiway
      d) Apron
      e) Obstruction restriction facilities
      f) Drainage facilities
   2) Landside facilities
      a) Passenger terminal building
      b) Cargo terminal building
      c) Operational building facilities
      d) Roads and vehicle parking
b. Airport Support Facilities
   The following are facilities that support the needs for other activities at the airport :
   1) Hotel
   2) Restaurant
   3) Motor vehicle parking facilities
   4) General treatment facilities
   5) Warehousing facilities
   6) Aircraft repair facilities
   7) Hangar facilities
   8) Waste treatment facilities

2.3. Runway

a. Runway definition
   According to SKEP – 161 IX (Runway, Taxiway, and Apron Planning Instructions, 2003), a runway is a pavement used by aircraft to land (landing) or take off (take off) [14]. According to Horonjeff, the runway at an airport consists of structural pavement, shoulder, blast pad and runway end safety area [15].
b. Runway classification
   International Civil Aviation Organization divides the classification of airports based on the runway geometry available at an airport and the type of aeroplanes operating at the airport. ICAO classifies airports based on the Airplane Reference Field Length (ARFL) and the size of the aircraft (distance outside the main gear and wingspan) operating at the airport [9, 10] as shown in Table 1.

Table 1. Airport reference code

Reference Code Aerodrome				
Element Code 1		Element Code 2		
Code No.	Runway Length Reference for Aircraft use	Letter Code	Wingspan	Width of the distance between main wheels Outermost
1	< 800 m	A	< 15 m	< 4.5 m
2	800 m - 1.200 m	B	15 m - 24 m	4.5- 6 m
3	1.200 m - 1.800 m	C	24 m - 36 m	6 m - 9 m
		D	36 m - 52 m	9 m - 14 m
4	> 1.800 m	E	52 m - 65 m	9 m - 14 m
		F	65 m - 80 m	14 m - 16 m

Table 2. Wide taxiway standards by ICAO

Code Letter	Aircraft Classification	Wide Taxiway (m)	Minimum Clearance from Outer Side of Main Wheel with Taxiway Edge (m)
A	I	7.5	1.5
B	II	10.5	2.25
C	III	15^{A} 18^{B}	3^{A} 4.5^{B}
D	IV	18^{C} 23^{D}	4.5
E	V	25	4.5
F	VI	30	4.5

2.4. Taxiway

a. Taxiway definition
   According to Basuki, the taxiway serves as a way in and out of the aircraft from the runway to the apron and vice versa, or from the runway to the maintenance hangar [13]. Taxiways are arranged so that a plane that has just landed does not interfere with another plane that is taxiing, ready to head to the end of take-off. At many airports, the taxiway makes a right angle with the runway so that landing aircraft must be slowed to a very low speed before turning onto the taxiway. However, a taxiway designed for aircraft to turn at high speed off the runway, will reduce runway usage time.
b. Wide Taxiway
   Some of the requirements issued by ICAO in the geometric design of taxiways are as follows [8, 9] as shown in Table 2.

2.5. Apron

According to SKEP - 161 - IX Runway Planning Instructions, Taxiway and Apron, an apron is a certain part of an airport that is used to load/unload passengers to/from aircraft, loading and unloading goods or posts, refuelling, parking and maintenance aircraft. The apron is on the airside which is directly in contact with the terminal building, and is also connected to the taxiway leading to the runway [12]. The geometry of the apron is determined by the parking layout, the number and size of the gates and the geometry of the aircraft being served. The regulatory capacity in the apron is determined through the following parameters:

a) Fasteners on underground transport (parking lots, main roads).
b) Passenger management (number of check-in counters).
c) Management of goods (number of shelters and capacity of support systems).

Table 3. Wings clearance

Code (letter)	Free Distance
A	3.0 m
B	3.0 m
C	4.5 m
D	7.5 m
E	7.5 m
F	7.5 m

d) Passport check, security check, check before boarding (size of waiting room and the number of shelters).

As analysis for the apron, ICAO issued the following requirements for wing clearances as shown in Table 3.

2.6. Aircraft dimensions and size

The dimensions of the aircraft that need to be known include (Fig. 1):

1) Wingspan, is the distance or wingspan that is used to determine the width of the taxiway, the distance between taxiways, the size of the apron, the size of the hangar.
2) Length, is the length of the fuselage used to determine the width of the taxiway (bend), the width of the exit R/W, T/W, the size of the apron, the size of the hangar.
3) Height, is the height of the aircraft used to determine the height of the hangar door, as well as installation in the hangar.
4) Wheel/Gear Tread, is the distance between the main wheels from axle to axle which is used to determine the turning radius of the aircraft.
5) Wheel Base, is the distance between the main wheel (main gear) and the front wheel of the aircraft (nose gear) which is used to determine the T/W exit radius.
6) Outer Main Gear Wheel Span (OMGWS), is the distance between the outermost main wheels, where this value determines the Reference Code Letter.
7) Tail Width, is the rear wing width used to determine the area of the appron.

3. Research Methodology

3.1. Time and place of research

This research was conducted at Torea Fakfak Airport, Jl. Yos Sudarso Fakfak, Pariwari District, Fakfak Regency, West Papua Province. The research time is carried out from March-May 2021. The existing conditions at Torea Fakfak Airport can be seen in Fig. 2.

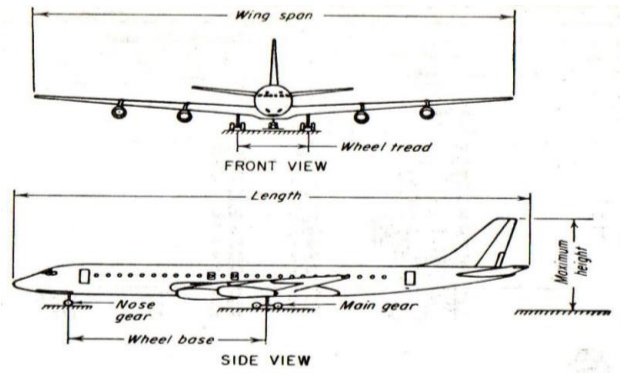

Figure 1. Aircraft characteristics components

Figure 2. General view from the Torea Fakfak airport

3.2. Data collection technique

The data collection carried out in this study used the direct observation method in the field. The data was obtained in the form of primary data and secondary data.

a. Primary Data
   Primary data is data taken directly in the field, using the direct observation method which will obtain data on the existing condition of Torea Airport, Fakfak Regency. The data obtained is survey data conducted for 1 week with the following survey steps:
   1) Prepare the tools used, namely preparing stationery, roll meter and push meter.
   2) Requesting permission from Torea Fakfak UPBU (Airport Implementing Unit) for data collection.
   3) The survey was conducted on the airside (runway, taxiway, and apron) of Torea Airport, Fakfak Regency during weekdays.
   4) The survey was conducted by measuring the dimensions of the runway, taxiway, and apron at Torea Airport, Fakfak Regency. The data collection is carried out as follows:
      a) Length of runway, taxiway and apron
      b) Width of runway, taxiway and apron
   5) Direct field observations are carried out carefully by taking into account the existing condition.
b. Secondary Data
   Secondary data is data obtained from related parties, while secondary data needed include:
   1) Data on temperature, the surface slope at the Torea. Airport location.
   2) Data on the dimensions of the existing runway, taxiway, and apron at Torea Fakfak Airport.
   3) Collecting secondary data in the UPBU office of Torea Fakfak Airport.

3.3. Data analysis techniques

Data analysis techniques used in this study with the following stages:

a) Sketching drawings and dimensions of Torea airport conditions according to the results of measurements and observations in the field.
b) Analyze the dimensions of the existing runway, taxiway, and apron at Torea Fakfak airport according to the results of the sketch drawing.
c) Evaluating the feasibility of the dimensions of the existing runway, taxiway, and apron at Torea Fakfak airport using ICAO (International Civil Aviation Organization) standards.

d) Provide recommendations for the feasibility of the dimensions of the existing runway, taxiway, and apron at Torea Fakfak airport using ICAO (International Civil Aviation Organization) standards.

4. Results and Discussion

4.1. Results

4.1.1. The existing condition of measurement results

Data on the existing condition of Torea Fakfak Airport obtained from the results of direct measurements carried out at Torea Fakfak Airport obtained the data in Table 4.

4.1.2. Airport existing condition

The data on the existing condition of Torea Fakfak Airport obtained from the Torea Fakfak Airport Operator Unit includes general airport data and data on the existing condition of the airport. These data can be seen in Table 5 and Table 6.

Table 4. Measurement data at Torea airport

No.	Air Facilities	Results
	Runway Dimension	
1.	- Length	1201.8 m
	- Wide	30 m
	Taxiway Dimension	
2.	- Length	53 m
	- Wide	18 m
	Appron Dimension	
3.	- Length	110 m
	- Wide	63

Table 5. Technical data of aircraft type ATR 72-600

No.	Description	Aircraft Technical Characteristics Data
1.	Referensi Kode	3C
2.	Aeroplane references field length (ARFL)	1290 m
3.	Wingspan	27.05 m
4.	Outer Main Gear Wheel Span (OMGWS)	4.10 m
5.	Length	27.16 m
6.	Maximum Take-Off Weight (MTOW)	22800 Kg

Aircraft ATR 72-600 characteristics data

For data on the characteristics of the ATR 72-600 type aircraft serving flights at Torea Airport, Fakfak Regency, obtained from the 2015 General Air Transportation Regulation which can be seen in Table 5.

As for the grouping of airports and aircraft classes according to the 2015 General Regulation of Air Transportation, it is shown in Table 6.

4.2. Discussion

4.2.1. Runway

- *Runway Length*

Torea Airport in Fakfak Regency is grouped into 3C group (ADC) with a runway length of between 1200 m – 1800 m and a wingspan of aircraft that can operate at Torea Airport (Table 7-8), Fakfak Regency between 24 m – 36 m. From the results of the research that has been carried out, a comparison of the runway length data obtained from measurements and data obtained from the Torea Airport Implementation Unit (UPBU) can be seen in Table 9 and Fig. 3.

Table 6. Airport grouping and aircraft class

Airport Group	No. Code	*Aeroplane Reference Field Length* (ARFL)	Letter Code	Wingspan
A (*Unattended*)	1	≤ 800 m	A	≤ 15 m
B (AFIS)	2	800 m ≤ p ≤ 1200 m	B	15 m ≤ | ≤ 24 m
	3	1200 m ≤ p ≤ 1800 m	C	24 m ≤ | ≤36 m
C (ADC)			D	36 m ≤ | ≤52 m
	4	≤ 1800 m	E	52 m ≤ | ≤ 65 m
			F	64 ≤ | ≤80 m

Table 7. Torea airport general data

No.	Description	Airport General Data
1.	Airport Names	Torea
2.	City / Regency	Fakfak
3.	Manager Name	Directorate General Air Transportation
4.	Airport Status	Class III (UPT)
5.	Distance and Directions to Nearest City/Airport	± 7 km
6.	Airport Reference Coordinates	02˚ 55’ 11.5” S / 132˚ 15’ 42” E
7.	Elevation	446 feet Msl
8.	Temperature	32˚ C
9.	Types of Air Traffic Services	AFIS
10.	Operating Hours	H/S 06.00 - 16.30 WIT

Table 8. Torea airport existing condition data

No.	Air Facilities	Existing Data
1.	Dimension Strip	
	- Length	1260 m
	- Wide	60 m
2.	Runway	
	a. Runway	10 – 28
	b. Designation/Number/Azimuth	02˚ 55’ 11.5” S 132˚ 15’ 42.2” E
	c. Dimension	
	- Length	1200 m
	- Wide	30 m
	d. Turning Area	Exist
	e. Long Slope	1 %
	f. Transverse Slope	1 %
	g. Surface Type	Asphalt Hotmix
	h. Strenght	Dsh 8
	i. Pavement Clasification Ind (PCI)	-
	j. Flatness (Profil)	-
	k. Skid Resistance (Violence)	-
	l. Marking	
	- Runway Designation Marking	Exist
	- Runway Center Line Marking	Exist
	- Runway Edge Marking	Exist
	- Threshold Marking	Exist
	- Touchdown Marking	Exist
	- Aiming Point Marking	Exist
	- Exit Guidance Line Marking	Exist
3.	Taxiway	Exist
	a. Dimension	
	- Length	60 m
	- Wide	19 m
	b. Long Slope	0.8 %
	c. Transverse Slope	1 %
	d. Surface Type	Asphalt Hotmix
	e. Strenght	Dsh 8
	f. Rapid Exit Taxiway	
	- Minimum turning radius	R 15
	- The angle of intersection between the rapid exit and the runway	R 15
	g. Marking	
	- Taxiway Center Line Marking	Ada
	- Runway Holding Position Marking	Ada
	- Taxiway Guidance Marking	Ada
	- Taxiway Edge Marking	Ada
4.	Apron	
	a. Dimension	
	- Length	73 m
	- Wide	64 m
	b. Long Slope	0.50 %
	c. Transverse Slope	0.50 %
	d. Surface Type	Asphalt Hotmix
	e. Strenght	Dsh 8
	f. Marking	
	- Apron Edge Marking	Exist
	- Apron Guidance Marking	Not Exist
	- Parking Stan Position Marking	Not Exist
5.	Fillet : (Round/Radius) R:	
	a. Runway with Taxiway	Exist
	b. Taxiway with Appron	Exist
6.	Overrun (Stopway)	Exist
	a. Dimension	
	- Length	60 m
	- Wide	30 m
	b. Long Slope	-
	c. Transverse Slope	-
	d. Surface Type	-
	e. Strenght	-

7.	Runway Strip	
	a. Dimension	1260 m
	- Length	60 m
	- Wide	
	b. Long Slope	-
	c. Transverse Slope	-
	d. The First 3m outward from the runway	Grass
8.	Runway and Safety Area (RESA)	Not Exist
	a. Dimension	
	- Long	45 m
	- Wide	85 m
	b. Long Slope	-
	c. Transverse Slope	-
9.	Obstacle Limitation Surface	
	a. Take off Runway 10 and Approach area 28	
	b. Take off Runway 28 and Approach area 10	
	c. Obstacle transitional surface	30%

Tablel 9. Runway length comparison based on research results

No.	Description	Results
1.	Torea Airport Implementation Unit (UPBU)	1200.0 m
2.	Existing Measurement	1201.8 m

Tabel 10. Standard runway length comparison of Torea airport

Torea Airport Runway Length	ICAO Standard	Aircraft ATR 72-600 Standard
1201.8 m	1200 – 1800 m	1290 m

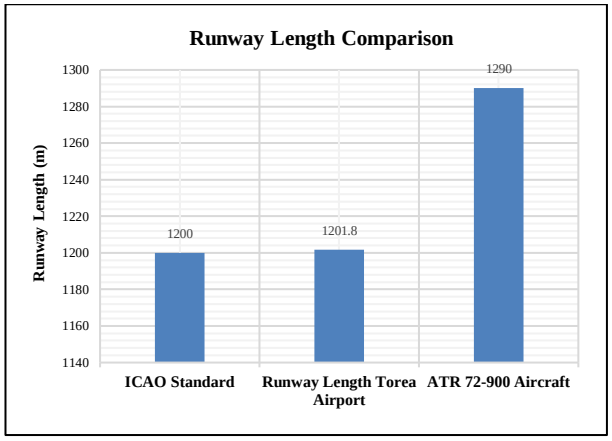

Figure 3. Runway length comparison of Torea airport

From Table 10 and Fig. 3, it can be seen that the length of the runway at Torea Airport in Fakfak Regency has met the minimum standard requirements set by the International Civil Aviation Organization (ICAO) in 2016 which is 1200 m. Meanwhile, according to the Regulation of the Ministry of Transportation of the Directorate General of Civil Aviation Number: KP 39 of 2015 concerning Technical Standards and Operations of Civil Aviation Safety Regulations which regulates the minimum standard limit for the length of the runway for the type of aircraft ATR 72-600 is 1290 m, so that if we analyze that the length of the Torea airport runway does not meet the minimum standard requirements and poses a risk to flight safety and security factors, especially for ATR 72-600 aircraft.

- *Runway Wide*

For data on the comparison of runway wide obtained from the results of measurements in the field and from the Torea Airport Implementation Unit (UPBU), which can be seen in Table 11 and Fig. 4.

From Table 11 and Fig. 4, it can be seen that the width of the runway at Torea Airport in Fakfak Regency has met the minimum standard requirements set by the International Civil Aviation Organization (ICAO) in 2016 which is 30.0 m (Table 12).

Table 11. Comparison of runway wide

No.	Description	Result
1.	Torea Airport Implementation Unit (UPBU)	30.0 m
2.	Existing Measurement	30.0 m

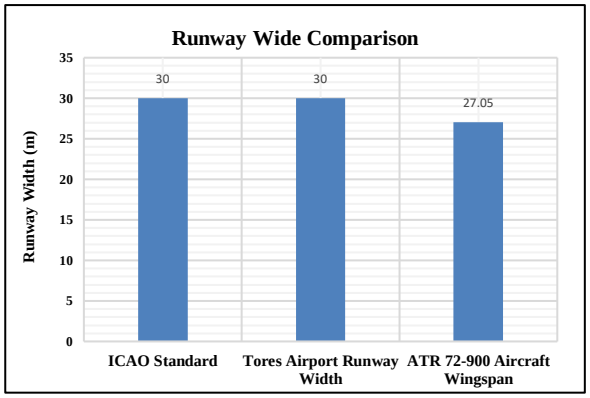

Figure 4. Runway wide comparison of Torea airport

Table 12. Standard runway shoulder dimensions according to ICAO

Code Letter	Aircraft Classification	Runway Shoulder Wide
A	I	3 m
B	II	3 m
C	III	6 m
D	IV	7.5 m
E	V	10.5 m
F	VI	12 m

Meanwhile, according to the Regulation of the Ministry of Transportation of the Directorate General of Civil Aviation Number: KP 39 of 2015 concerning Technical Standards and Operations of Civil Aviation Safety Regulations where it is regulated regarding the wingspan for the type of aircraft ATR 72-600 is 27.05 m (Ministry of Transportation, 2015), so that If we analyze it, the runway width of Torea Airport meets the minimum standard requirements for flights, especially for ATR 72-600 type aircraft operating at Torea Airport in Fakfak Regency. When the upper structure load is not working.

- *Runway Shoulder*

For the feasibility analysis of the runway shoulder at Torea Airport in Fakfak Regency, refer to the International Civil Aviation Organization (ICAO) standard in Annex 14 Vol I (2016) as seen in Table 9, where the dimensions of the runway shoulder are for the ATR 72-600 aircraft type. which has a 3C reference code is 6.0 m.

From the results of research conducted for the condition of the runway shoulder width of Torea Airport, it is obtained a comparison of the runway shoulder width according to ICAO standards and the existing condition of the runway shoulder width of Torea Fakfak Airport which can be seen in Table 13 and Fig. 5.

4.2.2. Taxiway

- *Taxiway Dimension*

The taxiway wide of Torea Fakfak Airport is 18 m, based on the ICAO standard in Annex 14 Vol I (2016), the taxiway width for the ATR 72-600 aircraft type which has a reference code 3C is 18 m. So, it meets the standards for use by ATR 72-600 aircraft as shown in Table 14 and Table 15.

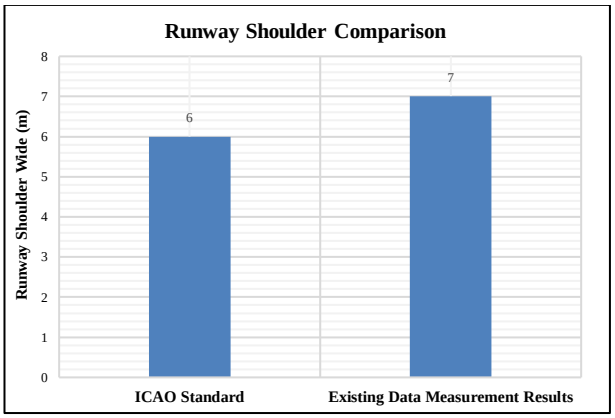

Figure 5. Runway shoulder wide comparison of Torea airport

Tabel 13. Runway shoulder-width comparison

No.	Description	Results
1.	Existing Measurement	7.0 m
2.	Standard ICAO	6.0 m

Table 14. Taxiway dimensión of ICAO Standard

Code Letter	Aircraft Classification	Taxiway Wide (m)
A	I	7.5
B	II	10.5
C	III	15^{A} 18^{B}
D	IV	18^{C} 23^{D}
E	V	25
F	VI	30

Table 15. Taxiway dimensión comparison of Torea airport

No.	Description	Result
1.	ICAO Standard	18.0 m
2.	Existing Measurement	18.0 m

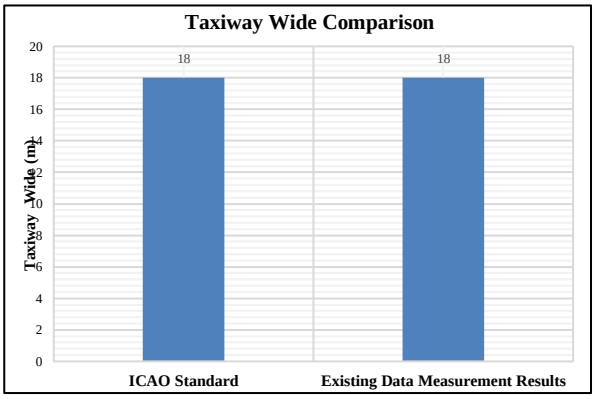

Figure 6. Taxiway dimensión comparison of Torea airport

From the results of the above analysis, a comparison of stopway dimensions according to ICAO standards and the existing condition of the runway width of Torea Fakfak Airport can be seen which can be seen in Fig. 6.

- *Taxiway Shoulder*

The taxiway shoulder width of Torea Fakfak Airport is 7 m, based on the ICAO standard in Annex 14 Vol I (2016), the runway width for the ATR 72-600 aircraft type which has a 3C reference code is 25 m. So, it does not meet the standards for use by ATR 72-600 aircraft as shown in Table 16 and Table 17.

Table 16. Taxiway shoulder of ICAO Standard

Code Letter	Aircraft Classification	Minimum Width of Taxiway Shoulder on Straight Section
A	I	25 m
B	II	25 m
C	III	25 m
D	IV	38 m
E	V	44 m
F	VI	60 m

Table 17. Taxiway shoulders comparison of Torea airport

No.	Description	Result
1.	ICAO Standard	25.0 m
2.	Existing Measurement	7.0 m

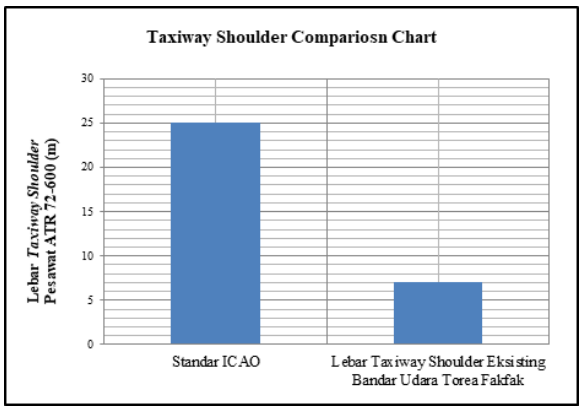

Figure 7. Taxiway shoulder wide comparison of Torea airport

From the results of the above analysis, a comparison of the width of the taxiway shoulder according to ICAO standards and the existing condition of the runway width of Torea Fakfak Airport which can be seen in Fig. 7.

4.2.3. Appron

The length of the apron at Torea Fakfak Airport which has a nose-in parking type of aircraft parking is 110 m and the width is 66 m, based on the ICAO standard in Annex 14 (2016), the length of the apron for the type of aircraft ATR 72-600 which has a reference code 3C is 95 m and the width is 45 m. So, it meets the standards for use by ATR 72-600 aircraft as shown in Table 18, Table 19 and Fig. 8.

Table 18. Apron dimensión of Torea airport

No.	Description	Result Measurement
1.	Apron Length	110.0 m
2.	Apron Wide	66.0 m

Table 19. Apron dimension comparison of Torea airport

No.	Description	ICAO Standard	Existing Measurement
1.	Length Apron	95 m	110 m
2.	Wide Apron	45 m	66 m

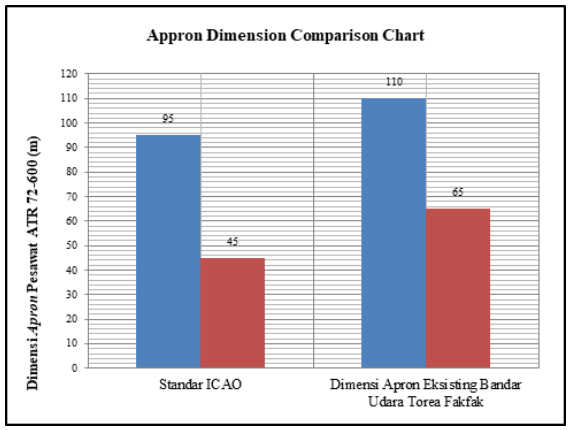

Figure 8. Apron dimension comparison of Torea airport

5. Conclusion

From the research results, it can be concluded that the length of the runway at Torea Fakfak Airport has not met the eligibility requirements for dimensions for ATR 72-600 aircraft because ATR 72-600 aircraft must land and take off at an airport whose type of air traffic service is C (ADC) with ARFL 1290 m, while Torea Fakfak Airport has a type of air traffic service that is B (AFIS) with a runway length (ARFL) of 1201.8 m and a runway width of Torea. The Torea Fakfak Airport Taxiway which has a width of 18 meters meets the standard for use by the ATR 72-600 aircraft type, the ICAO standard for the width of the taxiway which has a 3C reference code is 18 meters. The length of the apron at Torea Fakfak Airport which has a nose-in parking type of aircraft parking is 110 m and the width is 66 m, based on the ICAO standard in Annex 14, the length of the apron for the ATR 72-600 aircraft type which has a 3C reference code is 95 m and width is 45 m.

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