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PARALLEL TAXIWAY FLEXIBLE PAVEMENT PLANNING AT ADI SOEMARMO INTERNATIONAL AIRPORT SOLO MIDDLE JAVA

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Abstract: Based on the airport master plan listed in KP 408 in 2017, the author calculated predictions in the next 20 years related to volume characteristics and peak times, namely at peak passenger hours and aircraft movements. Then plan critical aircraft for forecasting needs and planning for parallel taxiway needs. This study describes how to design an ideal construction structure for flexible pavement planning using the results of pavement thickness using FAARFIELD software and the results of PCN and ACN values using COMFAA software. The results of the several methods used can be used as a reference of flexible pavement planning for the need making parallel taxiways in the calculated planning year. Based on the analysis carried out on the parallel taxiway flexible pavement design at Adi Soemarmo Airport, Solo, it was found that the results of aircraft movements during peak hours in 20 years, the plan resulted in 16 movements in 2040 on the basis of calculations using existing aircraft, aircraft type B737-800 and the results of the strength plan. Pavement using aircraft type A330-300 which produces a PCN value of 85 and an ACN value of 74. Based on this analysis, it is concluded that Adi Soemarmo International Airport, Solo, is on the requirements for making parallel taxiways because it is already at the standard 16-20 movement when peak hours and qualified PCN-ACN values because PCN > ACN values.

Keyword: *Aircraft Movements, COMFAA, FAARFIELD, Pavement Thickness*

Introduction

With the prediction of the recovery of flight conditions at Adi Soemarmo Solo International Airport after the Covid-19 pandemic, PT Angkasa Pura I Adi Soemarmo Solo Branch needs to anticipate the readiness of airport infrastructure. Based on the KP 408 document of 2017, that there is already a master plan that has been made for the development of airport infrastructure at Adi Soemarmo Solo International Airport. This is what is interesting for authors because they can plan and know how much it is necessary for Adi Soemarmo Solo International Airport to develop airport infrastructure, especially taxiways, to support aircraft movements during flight operations. Currently, the Alpha taxiway and Bravo taxiway at Adi Soemarmo Solo

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International Airport can only facilitate critical aircraft, namely Boeing 737-900ER aircraft for domestic flights during the Covid-19 pandemic that occurred in 2019 - 2022 and Airbus A330-900Neo aircraft if there is a Hajj flight.

Parallel Taxiway

Broadly speaking, a parallel taxiway is a taxiway that is almost the same or even equal to the length of a runway in an airport, its function is to reduce runway occupancy time, especially for aircraft services that will take off in order to reduce the time for taxiing holding, so that the runway can be used by other aircraft. Parallel taxiway also has positive values or advantages compared to taxiway types in general which are in terms of operating time. Several things need to be considered more deeply, especially in the area of the plot planned as parallel taxiway land.

Forecasting

Forecasting is a collection of variables that then the value is estimated in the time to come. If the predictions are done correctly and correctly, it can change our habits for the better. This is because the performance in the past will continue to repeat at least in the relatively close future. (Murahartawaty, 2009). Forecasting can also be seen from seasonal events, traffic trends and irregular events for short-term forecasts assuming that similar phenomena will continue in the following year (Persadanta, 2021).

FAARFIELD

FAARFIELD software is a program for calculating the thickness of a flexible or rigid pavement which is carried out by calculating using an application. The determination of the thickness of a pavement can be seen in the standards set in KP 14 of 2021 concerning Technical Specifications for Airport Airside Facility Work. FAARFIELD (Federal Aviation Administration Rigid and Flexible Iterative Elastic Layered Design) is a computer software used as a thick design of flexible and rigid pavements on airport runways. FAARFIELD can also be as a thick design of bending or rigid pavement

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overlays. The calculation procedure and thickness design in this program is based on the FAA-AC method No: 150/5320-6E.

COMFAA

The COMFAA program is one of the computer software that is useful as a tool for calculating Aircraft Classification Number (ACN) and calculating tools Pavement Classification Number (PCN) Comfaa Software is then varied using Cummulative Damage Factor (CDF), then the combined load of several aircraft operating at the airport. The impact caused by this combined traffic is equated to the largest leveling of aircraft. Then when it is equivalent, the PCN allowance can cover the impact of all aircraft traffic proportionally. This COMFAA software adopts the calculations that have been detailed as stated in the latest standard published by the FAA in 2014 which is Adsivory Circular/AC 150/5335-5C.

Method

Data Collection

a. Through literature studies, authors use literature sources and other data that are closely related to problems that are compiled as a theoretical basis in research.
b. Through observation, the author conducted a direct review of the field when conducting FieldWork Practices at Adi Soemarmo Solo International Airport to see firsthand the events, locations and data needed for thesis research.
c. Collecting aircraft data and critical aircraft data at Adi Soemarmo Solo International Airport.
d. Conduct forecasting at Adi Soemarmo Solo International Airport for the next 20 years to find out the right planning year for parallel taxiway needs.
e. The calculation of the pavement thickness plan using the FAA method is by using FAARFIELD software. Determination of PCN value with COMFAA software.

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Discussion and Result

Linear Regression

Table 1 Results of Processing the Number of Existing Passengers

YEAR	X	X^2	NUMBER OF PASSENGERS (Y)	XY	Y^2
2015	1	1	1.459.077	1.459.077	2.128.905.691.929
2016	2	4	2.108.505	4.217.010	4.445.793.335.025
2017	3	9	2.657.49	7.972.47	7.062.263.730.064
2018	4	16	2.610.537	10.442.148	6.814.903.428.36
2019	5	25	1.564.586	7.822.930	2.447.929.351.396

(Source : Author analysis)

Based on the table above, a calculation equation is obtained that can be written as follows:

A simple linear regression equation model is as follows:

Y = a +bx

Where:

Y = *Response variable* or Variable Result (dependent)

X= *Predictor* variable or Causal Factor variable (Independent)

a= Constant

b = Regression coefficient/magnitude of *response* generated by the predictor variable

The values of values and a and b can be calculated using the formula below:

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Table 2 Kostanta Results (a) and Coefficients (b)

$a = \frac{(\sum y)(\sum x^2)-(\sum x)(\sum xy)}{n(\sum x^2)-(\sum x)^2}$ $= \frac{(10.400.147)(5)-(15)(31.913.641)}{5(55)-(15)^2}$ $= \frac{(572.010.835)-(478.704.615)}{(275)-(225)}$ $= \frac{(93.306.220)}{(50)} = 1.866.124$	$b = \frac{n(\sum xy) - (\sum x)(\sum y)}{n(\sum x^2) - (\sum x)^2}$ $= \frac{5(31.913.641)-(15)(10.400.197)}{5(55)-(15)^2}$ $= \frac{(159.568.205)-(156.002.955)}{(275)-(225)}$ $= \frac{(1.565.250)}{(50)} = 71.305$

(Source : Author analysis)

From the results of the equation obtained from calculations with the linear regression method that has previously been calculated, it is obtained as follows table:

YEAR	PASSANGER PER YEARS	PASSANGER IN PEAK HOURS	AIRCRAFT IN PEAK HOURS
2020	2,293,954	1147	10
2021	2,365,259	1183	10
2022	2,436,564	1218	10
2023	2,507,869	1254	10
2024	2,579,174	1290	11
2025	2,650,479	1325	11
2026	2,721,784	1361	11
2027	2,793,089	1397	12
2028	2,864,394	1432	12
2029	2,935,699	1468	12
2030	3,007,004	1504	13
2031	3,078,309	1539	13
2032	3,149,614	1575	13
2033	3,220,919	1610	13
2034	3,292,224	1646	14
2035	3,363,529	1682	14
2036	3,434,834	1717	14
2037	3,506,139	1753	15
2038	3,577,444	1789	15
2039	3,648,749	1824	15
2040	3,720,054	1860	16

(Source : Author analysis)

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Based on the results of passengers and aircraft movements during peak hours in the 2020-2040 plan year, the results are obtained that in 2040 the movement of aircraft at Adi Soemarmo Solo International Airport is 16 aircraft movements, this is the conclusion that in that year it has become a requirement according to standards for carrying out the manufacture of parallel taxiways , namely the existence of 16-20 aircraft movements during peak hours in the planned year (Samosir et al., 2021).

Annual Departure

Based on aircraft movement data at Adi Soemarmo Solo International Airport in 2018, the movement of aircraft annual departures is as follows:

Table 3 Annual Departure Movements

Airplane	Aircraft Movement Per Day	Annual Departure
Boeing 737-900ER	4	3370
Boeing 737-800	4	2232
Airbus A320-200	7	2385
ATR 72-600	1	932

(Source : Author analysis)

Aircraft Load Calculation

For the main landing gear, which is on the fuselage, it is 95% because the main landing gear on the aircraft is the main fulcrum of the entire load of the aircraft and the nose gear that accommodates a load of 5% of the entire aircraft load. Therefore, it is necessary to calculate the MTOW (Maximum Take Off Weight) of the type of aircraft that has been operating or the type of aircraft that is already in operation or the type of aircraft that is existing at Adi Soemarmo Solo International Airport. Then furthermore, the load protection of each wheel of the operating aircraft can be carried out, namely by:

$$Wheel\ Load = 0{,}95\ x\ MTOW\ x\ \frac{1}{Jumlah\ Main\ Landing\ Gear}$$

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a. B737-900E

Wheel Load = 0,95 x 85.366 x $\frac{1}{4}$ = 20.274 kg

b. A330-300

Wheel Load = 0,95 x 230.900 x $\frac{1}{4}$ = 54.838 kg

The calculated wheel load is the aircraft load on the main landing gear that is already in operation or existing aircraft and aircraft that are used as a reference for calculating the thickness of the pavement in the next stage.

Pavement Thickness Calculation Results Using FAARFIELD

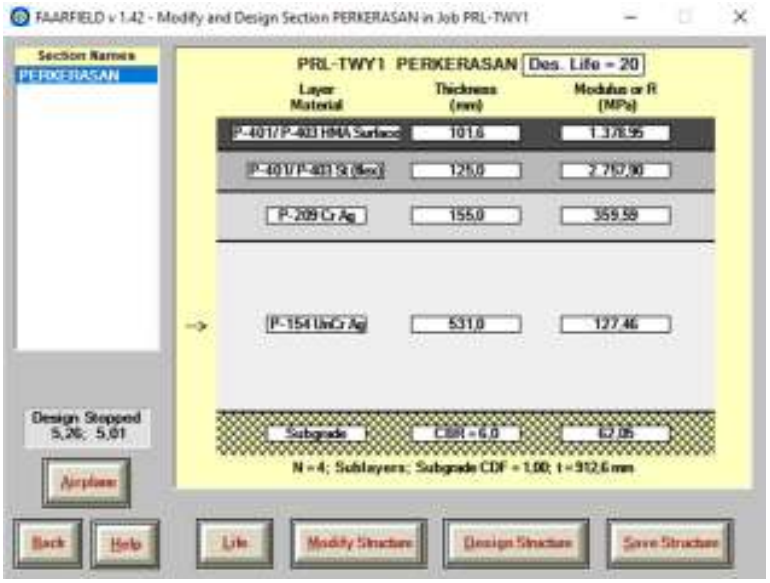

Figure 1 Pavement Thickness Results

Table 4 Faarfield Calculation Bold Results

Pavement coating	Pavement layer thickness (mm)	Pavement layer thickness (cm)
Permukaan (*surface course*) *Hot Mix Asphalt Pavement P-401*	101,6	10
Top Foundation (*Base Course) Chrushed Aggregate Base*	212,3	21,2

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Course P-209		
Bottom Foundation (Subbase Course) Subbase Course P-154	515,8	51,6
Total	**829,7**	**82,8**

COMFAA Calculation Results

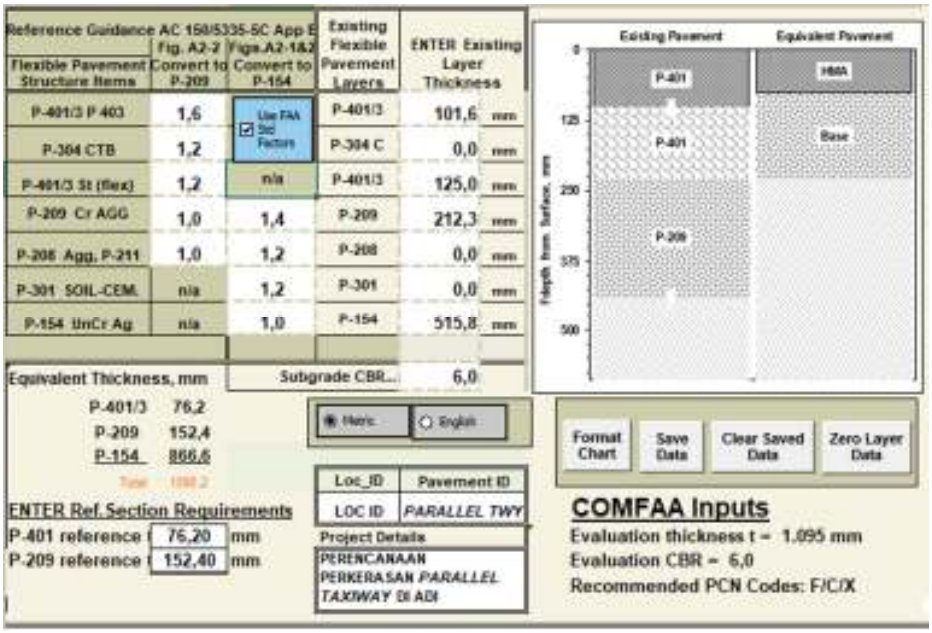

Figure 2 COMFAA Spreadsheet

No.	Aircraft Name	Gross Weight (lbs)	Percent GW on Gears	Tire Press. (kPa)	Annual Departures	No. of Tires on Gear	Number of Gears
1	A330-300 opt	233,900	95,70	1.450	1.365	4	2
2	B737-900 ER	85,366	94,58	1.517	3.370	2	2
3	B737-800	79,243	93,56	1.413	2.232	2	2
4	A320 Twin opt	78,400	92,80	1.440	2.385	2	2
5	D-75	34,019	95,00	758	932	2	2

Figure 3 COMFAA Airplane External List

In the analysis of passenger calculations during peak hours and aircraft movements during peak hours, only using Boeing 737-800 aircraft in order to see the final results in parallel taxiway planning which will be concluded in

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order to find out the right time (year) to make the planned parallel taxiway. Meanwhile, for the calculation of the load on the pavement, the assumption of an Airbus A330 – 300 type aircraft is used, the capacity and MTOW of the aircraft is greater than the aircraft that is already in operation. This assumption will support how thick and pavement strength results are related to PCN values and ACN values of excision aircraft and plans.

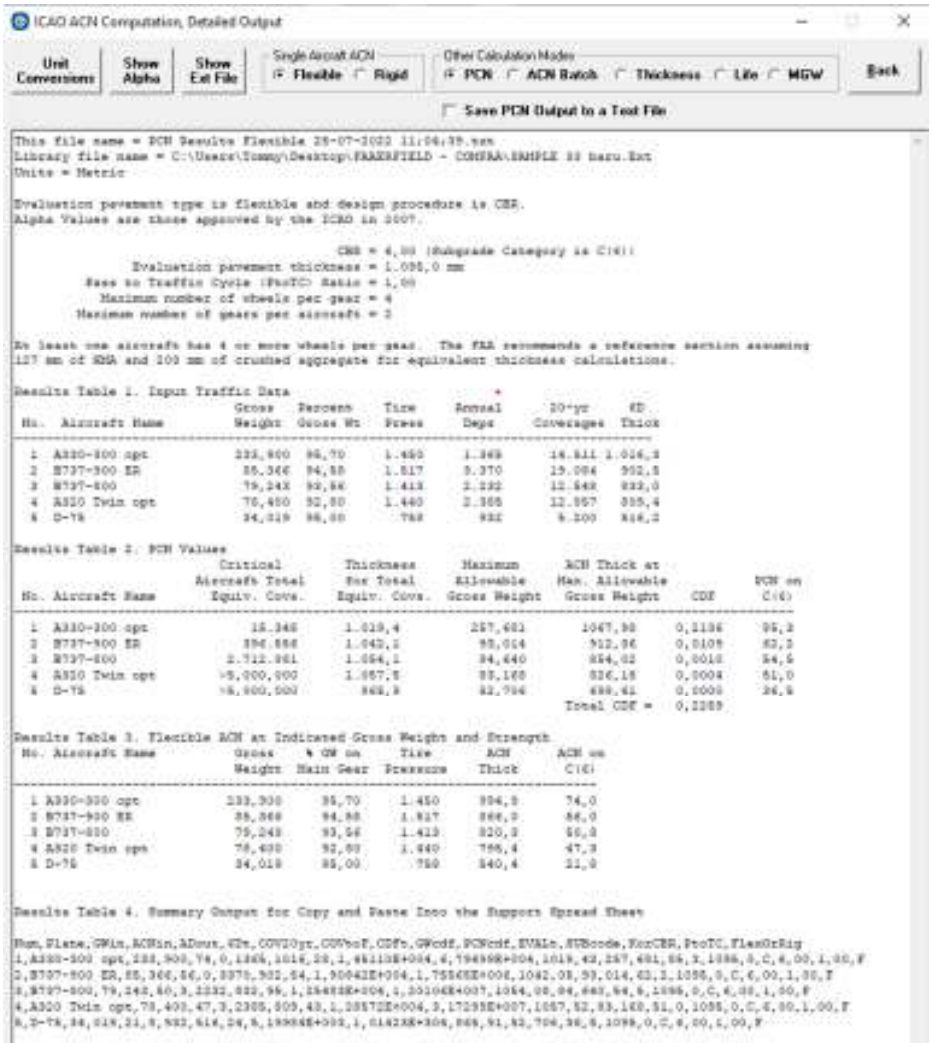

Figure 4 PCN – ACN Value Results

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Conclusion

Based on the results of the description of the analysis in the formulation of this thesis, it can be concluded that it is:

1. In calculating the forecasting for parallel taxiway planning at Adi Soemarmo Solo International Airport for 20 years from 20 years from 2020 - 2040 in the future, it was concluded that in 2040 there will be 16 aircraft movements during peak hours, this result has become a recommendation for the manufacture of *parallel taxiways* to support movement aircraft during flight operations because they meet the standards in adrm edition 11, namely there are at least 16 – 20 movements during peak hours.
2. The results of the structure planned using FAARFIELD and COMFAA software in the planned year 2020 – 2040 with a critical aircraft, namely the A330-300 with *subgrade* (CBR 6%). The total thickness of the pavement layer is 82.8 cm (*SubBase Course* 51.6 cm, *Base Course* 21.2 cm, and *Surface* 10 cm).
3. The thickness of the parallel taxiway pavement structure that has been planned for the next 2020 – 2040 plan year, obtained the PCN value of the critical aircraft type A330-300 is 85.3 ≈ 85, while the ACN value on the aircraft of this type is 74.0 ≈ 74. This can be interpreted to mean that the planning of this pavement structure is qualified due to the result of the VALUE of PCN>ACN and with the declaration of PCN which is 85 F/C/X/U.

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