



Planning of Rigid Pavement on Surface Level Heliport at Rahadi Oesman Airport Ketapang – West Kalimantan

Miguel Dos Santos^(✉) and Wiwid Suryono

Aviation Polytechnic of Surabaya, Surabaya, Indonesia
miguel dossantos272@gmail.com

Abstract. As long as Rahadi Oesman Airport is operating, but until now it does not yet have Surface Level Heliport facilities for take-off landing helicopters, so helicopters often take-off landing in the Apron section. With the condition of the Apron pavement being inadequate to carry the helicopter, there was damage in the form of holes in the Apron pavement. To reduce this damage and for the sake of flight safety which is written in SKEP 77 of 2015, Rahadi Oesman Airport is required to provide a surface level heliport. This final project is designed to convey how to plan Surface Level Heliport with pavement thickness according to international standards (Federal Aviation Administration) through FAA and FAARFIELD Manual calculations and calculate PCN values using COMFAA Software. From the calculation results obtained, there are 13 cm thick concrete slab or surface and 11 cm subbase, and have PCN 9.4 and ACN 3.5 values based on the most critical aircraft, namely BELL 412 with a maximum weight of 11,900 lbs and volume results for surface level heliport planning of $43 \times 43 \times 0.24 \text{ m}^3$.

Keywords: Surface Level Heliport · Rigid Pavement · FARFIELD · COMFAA · Rahadi Oesman Airport Ketapang – West Kalimantan

1 Introduction

Rahadi Oesman Airport (IATA code: KTG, ICAO code: WIOK) is a Class II airport managed by the UPBU of the Directorate General of Civil Aviation, located in Delta Pawan District, Ketapang Regency, West Kalimantan. Currently, Rahadi Oesman Airport has air side facilities, namely one runway with a runway length of 1400 m and a width of 30 m and an asphalt surface with a PCN value of 21 F/C/Y/T. Rahadi Oesman Airport also has 2 Taxiways namely A and Taxiway B with dimensions of 75 m long and 18 m wide, while the Apron has dimensions of length 224 and width 51 m and asphalt surface with PCN values of 21 F/C/Y/T. The airlines operating at the airport are Wings Air and Nam Air. This airport serves flight routes from Ketapang to Pontianak and Semarang.

In an effort to realize the provision of Ketapang Rahadi Oesman Airport facilities, one of which is the need for the availability of air side and land side facilities with adequate quality and quantity in accordance with the technical requirements and provisions issued

Table 1. Data Take-off Landing of Helicopters at Rahadi Oesman Airport Ketapang

| NO | ADEP | ADES | DATE OF FLIGHT | Air_code | F_Number | ACRegis ter | Type | PARKIN G NO |
|----|---------------------------------------|--------------------------------------|----------------|----------|----------|-------------|-------|-------------|
| 1 | WIKT | WIOK | 2021-02-02 | ARMY | HA5173 | HA5173 | B412 | 4 |
| 2 | WIOO | WIOK | 2021-02-15 | ARMY | HA5173 | HA5173 | B412 | 4 |
| 3 | WIOK | WAGI | 2021-02-15 | ARMY | HA5173 | HA5173 | B412 | 4 |
| 4 | WIOK | WIOO | 2021-02-19 | ARMY | HA5173 | HA5173 | B412 | 4 |
| 5 | 'SUKADANA(01 03' 14" S 109 40' 30" E) | WIOK | 2021-02-19 | POLICE | P1112 | P1112 | NBO | 1 |
| 6 | WIOK | PTALM(R 060 34NM) | 2021-02-20 | POLICE | P1112 | P1112 | NBO | 4 |
| 7 | LAMAN (01 26' 48,2" E 110 13' 31,9") | WIOK | 2021-02-01 | AFE | PKODC | PKODC | AS350 | 4 |
| 8 | WIOK | LAMAN (01 26' 48,2" E 110 13' 31,9") | 2021-02-01 | AFE | PKODC | PKODC | AS350 | 4 |
| 9 | WIOK | LAMAN (01 26' 48,2" E 110 13' 31,9") | 2021-02-01 | AFE | PKODC | PKODC | AS350 | 4 |
| 10 | WIOK | WIOK | 2021-02-01 | AFE | PKODC | PKODC | AS350 | 4 |
| 11 | LAMAN (01 26' 48,2" E 110 13' 31,9") | WIOK | 2021-02-01 | AFE | PKODC | PKODC | AS350 | 4 |



Fig. 1. Damage to the Surface Apron of Rahadi Oesman Airport, Ketapang

by the Directorate General of Civil Aviation which refers to international regulations FAA 2009 [1].

Ketapang’s Rahadi Oesman Airport has been operating for a long time but until now there is no helipad facility. Based on helicopter flight traffic data which can be seen in Table 1. The problem formulation of the problem is as follows:

Rahadi Oesman Airport has always been the Home Base for helicopters operating for extinguishing land fires that often occur every dry season in the district of Ketapang and its surroundings. In addition, there are also other operational activities that cause helicopters to frequently take-off landing in the Apron area. As a result, the pavement on the top layer of the airport arpon was severely damaged (Fig. 1).

According to the Regulation of the Minister of Transportation of the Republic of Indonesia Number 77 of 2015 article 3 paragraph 1 which reads “To support the safety of flight operations and airport services, every airport facility that is operated must meet the needs, technical and feasibility standards”. So in ensuring flight safety from all risks that may occur, the airport is obliged to provide Surface Level Heliport facilities which are planned to use rigid pavement [1–4].

In the Regulation of the Director General of Civil Aviation Number 215 of 2019 Technical and Operational Standards of Civil Aviation Safety Regulations Part 139 (Manual Of Standard Casr Part 139) Volume II Helicopter Landing and take-off Place (Heliport) explains that Heliport is a helicopter landing and take-off place in land (surface Level Heliport), on top of the building (elevated Heliport) on the offshore platform/ship (helideck), and shipboard [2]. Every construction and operation of a Heliport must be able to meet the technical and operational standards set by the Directorate General of Civil Aviation as well as an effort to realize flight safety. One of the determinants of the success of work in an airport job is determined in terms of planning.

Pavement planning that will be used is required to be able to accept and carry the helicopter's load on it. Due to the low maintenance costs and weight adjustment of cement or concrete materials, it shows a perfect system where all heavy loads from the helicopter are distributed evenly so that it is more durable, therefore the authors choose to use rigid pavement on the surface Level Heliport [5, 6].

This study aims to obtain the results of the calculation of the planned helicopter rigid pavement construction, with a carrying capacity that is able to serve the largest helicopter, namely the Bell 412 helicopter. The calculation method used is the FAA (Federal Aviation Administration) method at Advisory Circular No. 150/5320-6D “Airport Pavement Design and Evaluation”.

The problem formulation of the problem is as follows:

1. How to plan the Surface Level Heliport pavement thickness that can carry the largest type of Bell 412 helicopter with a maximum weight at Rahadi Oesman Airport Ketapang?
2. How to plan rigid pavement structure on Surface Level Heliport at Rahadi Oesman Airport Ketapang?
3. How to plan a Surface Level Heliport marking design?

2 Theoretical Basis

In order to facilitate the discussion regarding the design of rigid pavement for Surface Level Heliport at Rahadi Oesman Airport, Ketapang, a basic theory is needed that underlies the design of rigid pavement thickness and surface Level Heliport dimensions. With the aim of being able to assist in analysing and making it easier for readers.

2.1 Heliport

According to Annex 14 Volume II “Heliport” (fourth edition, 2013) regarding Heliport, it is stated that the definition of Heliport is: “An aerodrome or a defined area on a structure intended to be used wholly or in part for the arrival, departure and surface movement of helicopters.” Based on the description, it can be understood that; Heliport can be defined as an aerodrome or a specific area of a structure intended to be used for the arrival, departure and movement of helicopters on the surface.

Meanwhile, according to the Regulation of the Director General of Civil Aviation Number 215 of 2019 Technical and Operational Standards of Civil Aviation Safety Regulations Part 139 (Manual Of Standard Casr Part 139) Volume II Helicopter Landing and Take-off Places (Heliport) said that Heliport is a helicopter landing and take-off place. on land (surface Level Heliport), on top of buildings (elevated Heliport), on offshore platforms/ships (helideck) and shipboard Air Side Facilities.

According to PM 77 of 2015, Airport Facilities are all facilities used for airport and aviation operations, which consist of airport infrastructure and equipment and utilities.

2.2 Characteristics of Helicopters

To plan the Surface Level Heliport at the airport, according to the Federation Aviation Administration (2009) 150/5320-2c regarding “Heliport design”, helicopter specifications are needed to plan the infrastructure [3]. The characteristics of the helicopter include:

2.2.1 Third Level Heading

The weight of the helicopter is needed in planning the pavement thickness and surface strength of the Heliport. The Surface Level Heliport construction must be designed to withstand the shock load of the helicopter landing at maximum load. Besides being designed to withstand shock loads on helicopter landings, the construction must also withstand dead loads due to RON (Remain Overnight) aircraft staying or staying at the airport.

2.2.2 Size

The width and length of the helicopter affect the dimensions on the surface Level Heliport.

2.2.3 Dimensions of Surface Level Heliport

Affects the land area required at an airport.

Table 2 shows the characteristics of the largest helicopter designed to land on the Surface Level Heliport of Rahadi Oesman Airport Ketapang.

2.2.3.1. Rigid Construction Planning

Rigid construction is a concrete pavement design based on reinforced or non-reinforced concrete. The construction must be a mixture of cement, water, fine aggregate and coarse

Table 2. Planned Helicopter

| BELL 412 Plan Helicopter Specifications | | |
|--|----------------------|---------------|
| Description | Specification | |
| total length (D) | 49.6 ft | 15,11808 m |
| Helicopter Body Length | 43.0 ft | 13.13 m |
| Main Propeller Diameter (RD) | 46 ft | 14 m |
| Empty Weight | 6,789 lb | 3,079.439 kg |
| BELL 412 Plan Helicopter Specifications | | |
| Description | Specification | |
| Maximum Weight At Take-off (B) | 11,900 lb | 5,397.7492 kg |
| Crew | 1–2 peoples | |
| Passenger | 13 peoples | |
| Tall | 15 ft | 4.572 m |

aggregate with or without additives. The quality of concrete is expressed by the symbol K, for example K 300 which means concrete with a characteristic compressive strength of 300 kg/cm^2 . For the use of concrete classified as Concrete Pavement, the concrete must have a characteristic flexural strength of at least 42.2 kg/cm^2 at the age of 28 days when tested in accordance with ASTM C31, C 31 M [4] and when tested using a cube of $15 \times 15 \text{ cm}$, the minimum concrete strength is must be 400 kg/cm^2 at the age of 28 days, the concrete strength for 7 days must be $0.7 \times$ characteristic flexural strength. (Heru Basuki, Book Designing and Planning Airfields, p. 337).

The pavement is designed to carry traffic loads safely and comfortably and during the design life there will be no significant damage. To be able to fulfill these functions, cement concrete pavements must:

1. Reducing stresses that occur on the subgrade (due to helicopter loads) to the limits that the subgrade can still bear, without causing a difference in settlement/deflection that can damage the pavement.
2. Able to overcome the influence of swelling and shrinkage and a decrease in the strength of the subgrade, as well as the influence of weather and environmental conditions.

Cement concrete pavement is a structure consisting of continuous (non-continuous) cement concrete slabs without or with reinforcement, or continuously with reinforcement, located above the sub-base or subgrade layer.

In cement concrete pavement, the bearing capacity of the pavement is mainly obtained from the concrete slab. The nature, bearing capacity and uniformity of the subgrade greatly affect the durability and strength of cement-concrete pavements. Factors that need to be considered are compaction moisture content, density and changes in

water content during the service period. The subbase layer on cement concrete pavement is not is the main part that bears the burden, but is a part that functions as follows:

1. Controlling the effect of swelling and shrinkage of the subgrade.
2. Prevents intrusion and pumping at joints, cracks and edges of concrete slabs.
3. Provides steady and uniform support to the concrete slab.
4. As a working floor pavement during implementation.

Cement concrete slabs have properties that are quite stiff and stiff and can spread the load over a wide area and produce low stresses in the layers below. If a high level of comfort is required, the surface of the cement concrete pavement can be coated with a layer of asphalt mixture as thick as 5 cm [5], but by looking at the maintenance factor, only the cement concrete pavement surface remains.

2.2.3.2. FAA Manual Method

Planning the pavement thickness can be done by manual analysis using graphs for each layer based on the FAA-AC method No: 150/5320-6D (Fig. 2). The calculation begins with processing data first, such as subgrade strength data (CBR Subgrade), calculating the equivalent Annual Departure, determining flexural strength (tensile strength) which can then be projected into a graph for determining subbase thickness and concrete slab thickness, as shown in Fig. 3.

2.2.3.3. FAARFIELD Software

The FAA 150/5320-6G method using FAARFIELD (Federal Aviation Administration Rigid and Flexible Iterative Elastic Layered Design) software is a relative program for designing flexible and rigid pavement thicknesses on Heliport, Taxiway, and Apron runways. The thickness calculation and design procedure in this program is based on the FAA-AC method No: 150/5320-6G (Fig. 4).

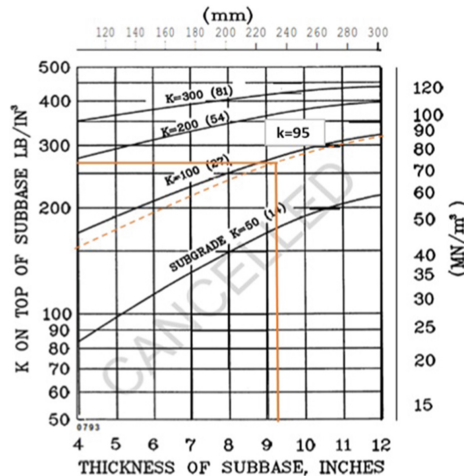


Fig. 2. Graph of Subbase Thickness Calculation (Doc AC No. 150/5320-6D Federal Aviation Administration, Sect. 3, rigid pavement design).

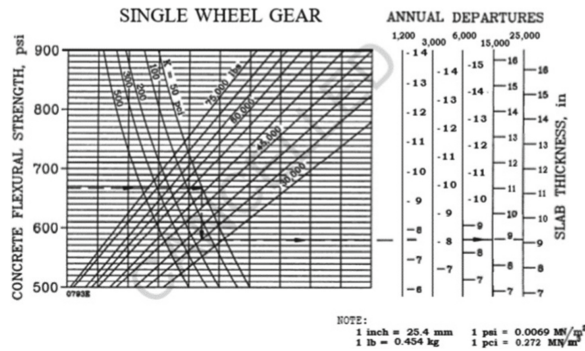


Fig. 3. Graph of Calculation of Concrete Slab Thickness (Doc AC No. 150/5320-6D Federal Aviation Administration, Sect. 3, rigid pavement design).

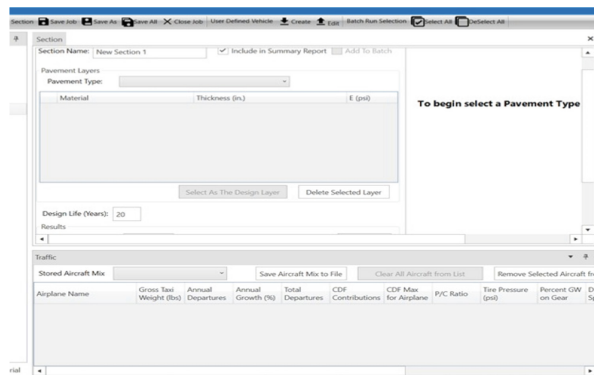


Fig. 4. FAARFIELD Application Display (Source: AC No: 150/5320-6G)

2.2.3.4. COMFAA Software Method

Determining the PCN value using the COMFAA program follows the principles and procedures detailed in the latest standard issued by the FAA in 2014 namely Advisory Circular/AC 150/5335-5C. The COMFAA program is a computer program with the aim of calculating the Aircraft Classification Number (ACN) and calculating the Pavement Classification Number (PCN). The COMFAA [7] program was developed with the concept of Cumulative Damage Factor (CDF), namely by calculating the combined effect of several aircraft (combined aircraft) operating at the airport. While the helicopter uses the maximum allowed gross weight and the following is a display of the program used to determine the maximum allowable gross weight value (Fig. 5).

2.2.3.5. SAP2000

SAP stands for System Application And Product In Data Processing. In general, SAP is one of the largest ERP (Enterprise Resource Planning) applications in the world commonly used by programmers. This software is used to develop and support an organization in carrying out its activities efficiently and effectively related to IT. A wide variety of companies have used it because of its obvious benefits.

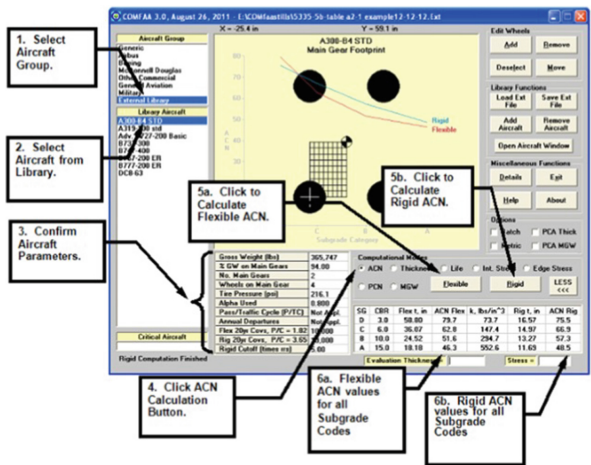


Fig. 5. Program COMFAA (Source: AC 150/5335-5C)

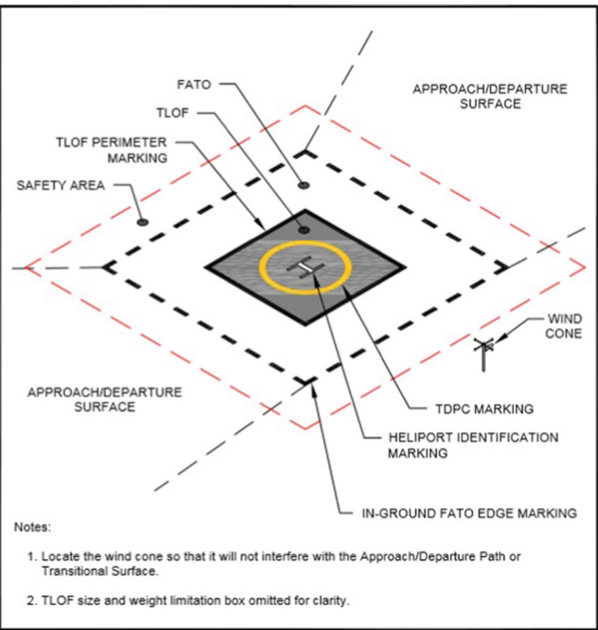


Fig. 6. Heliport Design (AC 150/5390-2C).

2.2.3.6. Heliport Marking Design

In the Federal Aviation Administration (2009) 150/5320-2c on Heliport Design describes this design standard assumes that there will be no more than one helicopter in the final approach and take-off area (FATO) and associated safety areas if there is a need for more than one area, touchdown and take-off (TLOF) in Heliport (Fig. 6).

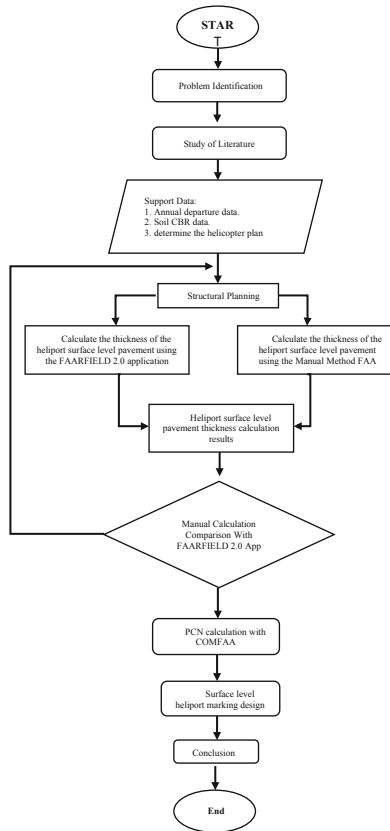


Fig. 7. Research Flowchart.

3 Research Methods

The Thinking Framework is a temporary explanation of a symptom that is the object of the problem. This thinking framework is prepared based on a literature review and relevant or related research results, the framework for thinking about a problem can be seen in Fig. 7.

4 Results and Discussion

4.1 Calculation of Planned Dimensions of Surface Level Heliport

By analyzing the problems above, the Surface Level Heliport that will be designed must serve the largest helicopter, namely the BELL 412 helicopter so that the damage to the parking stand section of the apron does not happen again [6]. Because there is no Surface Level Heliport at Rahadi Oesman Airport Ketapang so this development plan it is very necessary to build it so that it can meet the standardization of air side facilities and aviation safety.

Table 3. Planned Helicopter Type

| BELL 412 Plan Helicopter Specifications | | |
|---|---------------|---------------|
| Description | Specification | |
| total length (D) | 49.6 ft | 15,11808 m |
| BELL 412 Plan Helicopter Specifications | | |
| Description | Specification | |
| Helicopter Body Length | 43.0 ft | 13.13 m |
| Main Propeller Diameter (RD) | 46 ft | 14 m |
| Empty Weight | 6,789 lb | 3,079.439 kg |
| Maximum Weight At Take-off (B) | 11,900 lb | 5,397.7492 kg |
| Crew | 1–2 peoples | |
| Passenger | 13 peoples | |
| Tall | 15 ft | 4.572 m |

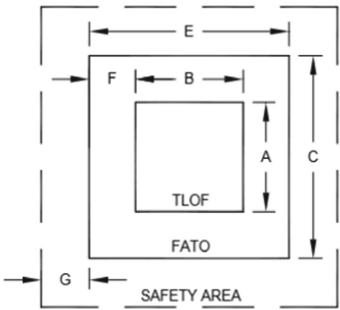


Fig. 8. Helicopter Movement Area (AC. No. 150/5320-2)

For this reason, the following will calculate the dimensions of the Surface Level Heliport construction plan at Rahadi Oesman Airport Ketapang which will be made based on the largest type of helicopter that will operate (Table 3).

4.2 Critical Helicopter Type that Will Operate

From the data obtained for the BELL helicopter type 412 has different parking space requirements depending on which will operate at Rahadi Oesman Airport Ketapang – West Kalimantan (Fig. 8).

Table 4. Relationship of TLOF/FATO safety areas and minimum dimensions (AC. No. 150/5390-2)

| DIM | ITEM | VALUE |
|-----|--|------------|
| A | Minimum TLOF Length | 1 RD |
| B | Minimum TLOF Width | 1 RD |
| C | Minimum FATO Length | 1 ½ D |
| D | Minimum FATO Width | 1 ½ D |
| E | Minimum separation between the Parameters of the TLOF dan FATO | ¾ D – ½ RD |
| F | Minimum Safety Area Width | |

4.3 Calculation of Annual Departure

After obtaining the most critical and largest helicopter types, the next step is to calculate all the annual departures of helicopters operating at Rahadi Oesman Airport Ketapang – West Kalimantan converted into critical aircraft landing gear types (Table 4). This is done as if there is only one type of helicopter operating at Rahadi Oesman Airport Ketapang – West Kalimantan.

This equivalent Annual Departure calculation will be projected into a pavement equivalent thickness graph later. The following is the equivalent annual departure calculation (RI) for helicopters operating at Rahadi Oesman Airport Ketapang – West Kalimantan (Table 5).

$$\text{LogRI} = (\text{LogR2} * \left(\frac{W1}{W2}\right)^{\left(\frac{1}{2}\right)}) \quad (1)$$

$$R1 = 10^{\text{Log} \text{LogR2} \left(\frac{W1}{W2}\right)^{\left(\frac{1}{2}\right)}} \quad (2)$$

1. Bell 412 $\text{LogR1} = \text{Log } 53 (11.900/11900)^{1/2} = 53$
2. AS 350 $\text{Log R1} = \text{Log } 28 (4960/11900)^{1/2} = 18$

After getting the R1 value from each helicopter, the next step is to add up the totals so that the total equivalent Annual Departure for all helicopters is 81 which will be projected into the pavement thickness graph.

Table 5. Equivalent Annual Departure

| Airplane type | Gear type | | | Annual Departure | MTOW (pounds) | Annual Dep Konv | Wheel Load | Plane Wheel Load | Equivalent Annual Departure |
|---------------|-----------|---|-------|------------------|---------------|-----------------|------------|------------------|-----------------------------|
| | From | To | Konv. | | | R2 | W2 | W1 | R1 |
| AS-350 | Skid | Dual Wheel | 1 | 28 | 11.900 | 28 | 11.900 | 11.900 | 28 |
| BELL 412 | Skid | Dual Wheel | 1 | 53 | 4.960 | 53 | 4.960 | 11.900 | 53 |
| TOTAL | | | | 81 | | | | | 81 |
| W2 | : | Wheel load is calculated assuming 95% is supported by the main landing gear, dual wheel has 2 wheels then = $MTOW \times 0.95 \times 1/4$ | | | | | | | |
| W1 | : | Critical/largest aircraft wheel load | | | | | | | |

4.4 Calculation of Annual Departure Calculation of Surface Level Heliport Pavement Thickness Manually (FAA Method)

4.4.1 Subgrade

The value of the foundation modulus on rigid pavement is expressed as the reaction modulus of the subgrade, where the results of the modulus will be plotted onto the subbase thickness graph contained in AC 150/5320-6D (FAA method). The formula for converting the CBR value to the soil reaction modulus is as follows:

$$K = \left[\frac{1500 \times 25}{26} \right]^{0.7788} = 288.5854$$
$$K = 289 \text{ pci} \tag{3}$$

where :
K= Subgrade Reaction Modulus

The data obtained obtained a minimum CBR of 6% field soil according to the PCN value at Rahadi Oesman Airport Ketapang, which is 21 F/C/Y/T.

4.4.2 Subbase

After obtaining the value of the subgrade reaction modulus (k), which is $K = 95 \text{ pci}$, then the thickness of the subbase can be determined by plotting on the subbase thickness graph. With the condition that the Subbase CBR value 25%, then 25% Subbase CBR is used. The following is the calculation of the Subbase value:

$$K = \left[\frac{1500 \times 25}{26} \right]^{0.7788} = 288.5854 \tag{4}$$

The projected value of K Subgrade = 95 pci and K Subbase = 289 pci on the graph can be seen in Fig. 9.

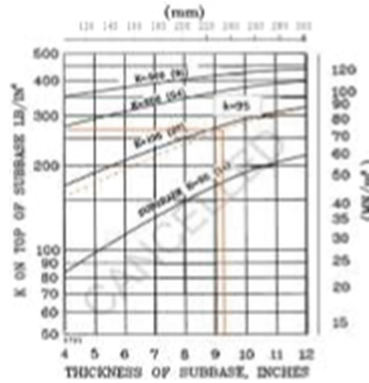


Fig. 9. Subbase thickness calculation graph (Doc AC No. 150/5320-6D Federal Aviation Administration, Sect. 3, rigid pavement design).

The projection results on the subbase thickness graph according to Doc AC No.150/5320-6D obtained a minimum subbase thickness of 9.2 in. or 23.37 cm rounded up to 24 cm to provide a safety value in planning the thickness of the subbase. Concrete slabs Need to be projected several values into graph of the calculation of the thickness of the concrete slab to determine the thickness of the concrete slab or concrete slab on rigid pavement (ASTM C78).

$$MR = K \times \sqrt{(f_c')} \quad (5)$$

where:

MR: Flexural Strength

K = Constant (8, 9, 10)

Fc' = compressive strength of concrete (psi)

It is planned that the value of K = 9 and the quality of the concrete used is K-450 = 450 kg/cm² then the flexural strength value can be obtained.

So:

$$\begin{aligned} MR &= K \times \sqrt{(f_c')} \\ MR &= 9 \times \sqrt{6400} \\ MR &= 720 \text{ psi} \end{aligned} \quad (6)$$

After getting the value of the Modulus of Rupture or the modulus of collapse or flexural strength of 720 psi, it is rounded up to 750 psi and then entered into the graph for each helicopter, the value of the flexural strength of K, MTOW and annual departures. The following can be seen in Fig. 10.

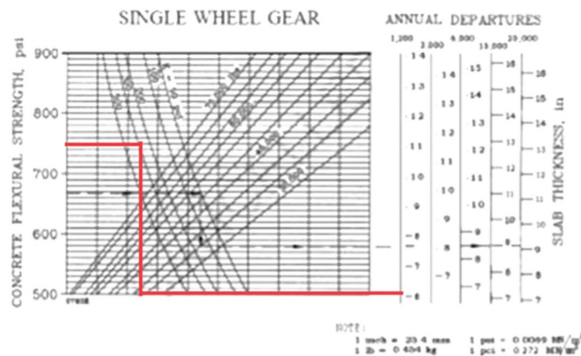


Fig. 10. Surface thickness calculation graph (Doc AC No. 150/5320-6D Federal Aviation Administration, Sect. 3, rigid pavement design)



Fig. 11. Pavement Thickness Plan

Because using concrete quality k-450 which has been 28 days, the flexural strength value of 750 psi is chosen which is then drawn at the K Subbase value of 289 pci, after that draw a line to the MTOW value of the planned helicopter, then draw the line again to the pavement thickness value according to the equivalent Annual Departure is 81. By using this method, the thickness of the concrete slab or concrete slab is 6 in. or 15.24 cm = 16 cm.

After calculating the pavement thickness plan at the Surface Level Heliport with the subgrade bearing capacity (CBR) taken from the minimum value at Rahadi Oesman Airport, Ketapang, which is 6%. Therefore, the pavement thickness values are obtained as follows:

- Thickness of concrete slab = 6 in. or 16 cm (fs: 750 pci).
- Subbase thickness: 9.2 in. or 24 cm (K: 289 pci).

And the next is the result of the planning drawing of the Surface Level Heliport pavement thickness using the FAA method (Fig. 11).

Table 6. Minimum layer thickness for rigid pavement structures

| Layer Type | FAA Specification Item | Maximum Aircraft Gross Weight Operating on Pavement, lbs (kg) | | |
|------------------------------|---|---|---|---|
| | | <60,000 (27,215) | < 100,000 (45,360) | ≥ 100,000 (45,360) |
| Rigid Surface ² | P-501, Cement Concrete Pavement | 6 in (150 mm) ² | 6 in (150 mm) ² | 6 in (150 mm) ² |
| Drainable Base (When Used) | P-407 ⁵ , P-307 | | 6 in (150 mm) when used | 6 in (150 mm) When used |
| Stabilized Base ³ | P-401 or P-403; P-304; P-306 | Not Required | Not Required | 5 in (125 mm) |
| Base ⁴ | P-209, P-207, P-208, P-210, P-211, P-212, P-213, P-219, P-220 | Not Required | 6 in (150 mm) | 6 in (150 mm) |
| Subbase ⁵ | P-154 | 6 in (100 mm) | As needed for frost or to create working platform | As needed for frost or to create working platform |

4.5 Calculation of Surface Level Heliport Pavement Thickness Using FAARFIELD

FAARFIELD is a good iterative process for pavement design, in this case is rigid pavement on the Heliport Level surface. After the subgrade and Annual Departure data are available, then FAARFIELD is used to plan the pavement according to the following steps:

4.5.1 Create a New Job

Click the “New Job” tab, then copy the Section Name “New Rigid” into the created job.

4.5.2 Determination of the Structure Used

Go to the “Structure” tab, then modify and specify the type of structure to be used on rigid pavements. Table 6 shows table of materials that can be used in planning.

| Pavement Structure Information by Layer | | | | | |
|---|---------------------------|-----------------|----------------|--------------------|-------------------|
| No. | Type | Thickness mm | Modulus MPa | Poisson's Ratio | Strength R MPa |
| 1 | P-501 PCC Surface | 125.0 | 27579 | 0.15 | 5.2 |
| 2 | P-154 Uncrushed Aggregate | 101.6 | 89 | 0.35 | 0 |
| 3 | Subgrade | 0 | 62 | 0.4 | 0 |

| Airplane Information | | | | |
|----------------------|--------|-----------------|----------------------|--------------------|
| No. | Name | Gross Wt. kg | Annual Departures | % Annual Growth |
| 1 | S-5 | 2250 | 28 | 0 |
| 2 | S-12.5 | 5798 | 53 | 0 |

| Additional Airplane Information | | | | |
|---------------------------------|--------|---------------------|-------------------------|--------------|
| No. | Name | CDF Contribution | CDF Max for Airplane | P/C Ratio |
| 1 | S-5 | 0.00 | 0.00 | 6.21 |
| 2 | S-12.5 | 0.00 | 0.00 | 3.94 |

Fig. 12. Pavement Thickness Results Using FAARFIELD

For Subbase use item P-154 and not use stabilized base due to the design helicopter weight <12,500 kg and item P-501 (Portland Cement Surface) or PCC as rigid pavement (surface). For strength of Subgrade or subgrade based on airport data Rahadi Oesman has a CBR value of 6%, then the value of K can be found in the following way using the equation obtained from AC No. 150/5320-6G:

$$K: 28,6926 \times \text{CBR } 0.7788$$
$$K: 28,6926 \times 60.7788$$
$$K: 115.822 \text{ pci}$$
$$K: 116 \text{ pci}$$

(7)

4.5.3 Annual Departure Data

Select the “Airplane” tab to enter data for operating aircraft and their MTOW and also enter Annual Departure for each type of aircraft.

4.5.4 Annual Departure Data

After all data is entered, namely aircraft data, Annual Departure, type of pavement to be used, and the strength of the existing subgrade (Fig. 12). Then the thickness of the planned pavement can be calculated by the application.

The calculation results by the FAARFIELD application can be seen in Fig. 13.

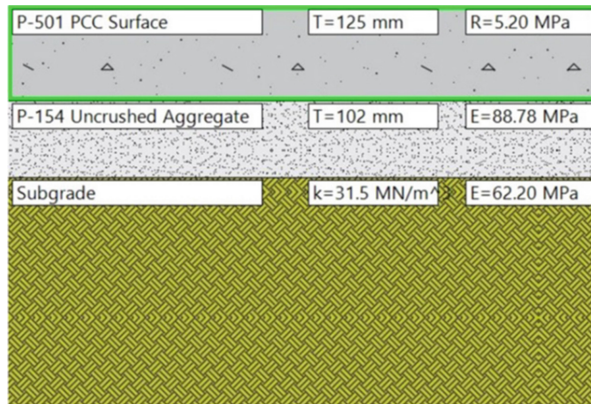


Fig. 13. The Calculation Result FAARFIELD

5 Conclusion

Based on the data that has been analyzed and calculated, it can be concluded the following results:

The results of the calculation of the Surface Level Heliport pavement thickness using the FAA, FAARFIELD and COMFAA MANUAL methods used in the Surface Level Heliport construction plan are as follows:

| Description | Planning Method | |
|---------------------|---------------------|-------------------|
| | MANUAL FAA & COMFAA | FAARFIEL & COMFAA |
| Surface Coating | 16 cm | 13 cm |
| Subbase Layer | 24 cm | 11 cm |
| Subgrade Coating | CBR 6% | CBR 6% |
| PCN Value | 17 | 9.4 |
| ACN Value | 3.5 | 3.5 |
| Max.All Gross Weigh | 27.649 t | 14.847 t |

In the comparison results between the FAA & COMFAA Manual and FAARFIELD & COMFAA methods, the FAARFIELD & COMFAA method was chosen because the calculation is more efficient in using materials to plan the Heliport surface level.

The results of the Surface Level Heliport marking plan can be seen in the image below with a volume dimension of 43 m × 43 m × 0.24 m.

References

1. O. Rejeb et al., "Parametric analysis and new performance correlation of the surface conventional rigid pavement temperature," *Case Studies in Construction Materials*, vol. 16, Jun. 2022, doi: <https://doi.org/10.1016/j.cscm.2022.e00923>.

2. B. H. Cho and B. H. Nam, "Concrete composites reinforced with graphene oxide nanoflake (GONF) and steel fiber for application in rigid pavement," *Case Studies in Construction Materials*, vol. 17, Dec. 2022, doi: <https://doi.org/10.1016/j.cscm.2022.e01346>.
3. S. A. P. Rosyidi, N. I. M. Yusoff, N. N. Ismail, and M. R. M. Yazid, "Integrated time-frequency wavelet analysis and impulse response filtering on SASW test for rigid pavement stiffness prediction," *Ain Shams Engineering Journal*, vol. 12, no. 1, pp. 367–380, Mar. 2021, doi: <https://doi.org/10.1016/j.asej.2020.05.006>.
4. A. Talkeri and A. U. Ravi Shankar, "Alkali activated slag-fly ash concrete incorporating precious slag as fine aggregate for rigid pavements," *Journal of Traffic and Transportation Engineering (English Edition)*, vol. 9, no. 1, pp. 78–92, Feb. 2022, doi: <https://doi.org/10.1016/j.jtte.2021.05.001>.
5. I. Bulakh et al., "Architecture of Air Transport Medicine Facilities," *Civil Engineering and Architecture*, vol. 10, no. 5, pp. 1840–1853, Sep. 2022, doi: <https://doi.org/10.13189/cea.2022.100511>.
6. E. Feldhoff and N. Metzner, "Examining legal requirements for a ground infrastructure at airfields as part of an automated, emission-free airfreight transport chain," in *Transportation Research Procedia*, 2021, vol. 52, pp. 461–468. doi: <https://doi.org/10.1016/j.trpro.2021.01.054>.
7. A. Rahmawati and F. Rahmawati, "Runway Pavement Strength Evaluation of Yogyakarta International Airports with COMFAA 3.0 Software," *International Journal of Integrated Engineering*, vol. 14, no. 4, pp. 350–359, 2022, doi: <https://doi.org/10.30880/ijie.2022.14.04.027>.
8. Asroni, Ali. (2010). *Balok Dan Pelat Beton Bertulang*. Yogyakarta, Indonesia: Graha Ilmu.. Elissa, "Title of paper if known," unpublished.
9. Charles, B., Djuniati, S., Sandhya vitri, A. (2016). *Analisis Perencanaan Struktur Perkerasan Runway, Taxiway, dan Apron Bandara Sultan Syarif Kasim II Menggunakan Metode FAA*. Jurnal Jom FTEKNIK Volume 3 No.2.

Open Access This chapter is licensed under the terms of the Creative Commons Attribution-NonCommercial 4.0 International License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits any noncommercial use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.

