Redesign Runway Strip With Evaluate The Geometry, Cut and Fill-In, and CBR at Mopah Airport

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Abstract. Mopah airport has one runway that is supported by an apron which is located at a distance of 472 m from touch down to the size of 18,560 m². Apron between the runway with two lines connected to the taxiway. One of the airside facilities Mopah Merauke airport is the runway strip that serves as a countermeasure state of emergency when the air out of the runway failure when landing or taking off. The objective of this study is to redesign the runway strip by evaluating geometric, cut and fill and CBR in Merauke Mopah Airport using KP. 39 in 2015, KP. 93 The year 2015 and KP. 576 in 2011. The data taken is the carrying capacity of the soil and ground elevation using test equipment Theodolite and Dynamic Cone Parameter. Results of testing the design of the runway strip Merauke Mopah Airport with dimensions of the runway with a length of 2500 m and a width of 45 m with the code type "4.C", obtained the runway strip width of 150 m plan right side and the left side of 150 m. CBR value of research in getting 9.93% which comply with minimum CBR value that is 6%, and a transverse slope of the runway strip elevation plan by 0.8%, to meet the slope of the runway strip elevation plan of each cross-section the importance of the volume of cut and fill with amounting to 174,205.00 m³ to 3008.80 m³ excavation and embankments.

1. Introduction
This The airport is an airport that is used for landing and takeoff of aircraft, up and down passengers or loading and unloading cargo, and equipped with flight safety facilities such as runway strip or area of a rectangle that is flattened clean without objects disturbing to support equipment maintenance and in an emergency when the aircraft out of the runway[1][2].

Aerodrome (airport) in Merauke namely Mopah Airport has one runway that is supported by an apron which is located at a distance of 472 m from touch down to the size of 18,560 m². Runway with apron taxiway connected by two lines namely taxiway A and B are in the middle of the runway at taxiway size A = 23 m x 189 m and taxiway B = 25.5 m x 175 m so that the plane will take off, landing and had to spin out in runway to get to the apron.

Air transport safety is a trending topi because of the high rate of air accidents are slipping up out of the runway and into the area of the runway strip. The incident has become a benchmark for designing a safer airport that the airport is equipped with side air facilities are following standards KP. 39 and KP. 93 - 2015. Thus, it will minimize the possibility of a victim of the situation failed landing and take off. [3][4][5].
One of the airside facilities Mopah Merauke airport is the runway strip. Runway strip is very important at a given airport is vital for the function of flight safety in anticipation of a failed state that is landing or taking off when the aircraft out of the runway. Runway strip must be able to support and provide a place for the emergency landing when the aircraft out of the runway and the other function is to runoff catchment areas of rainwater so that no water ponding in the area of the runway [6].

2. Literature review

2.1. Regulation

Regulation of the Ministry of Civil Aviation, namely KP. 39 in 2015 and KP. 93 The year 2015 which longitudinal slope has been determined following the type of runway. Mopah Airport did not have data measuring the ground elevation of the runway strip and test data CBR (California Bearing Ratio) runway strip of land in the area, for it can be used as reference standards of airport design [7].

2.2. Runway strip

The width of the runway strip has been determined in accordance with KP 39 2015 the values listed in Table 1.

| Aerodrome reference code | The width of the runway strip |
|--------------------------|------------------------------|
| Layout ab                | 60 m                         |
| 2c                       | 80 m                         |
| 3 (if the runway width 30m) | 90 m                     |
| 3.4 (if the runway width 45m or more) | 150 m                |

a. Runway strip can be reduced up to 30 m depending on the limits applied to aircraft operational small.

b. Runway strips used at night require a runway strip with a minimum width of 80 m

Source: [8].

The slope of the transverse Runway Strip must not exceed:

- If the Code Number runway is 2 or 4 to 1.5% and no greater than 2.5%.
- If the Code Number runway is 1 or 2 to 1.5% and no greater than 3%.

The code runway strip can be seen in table 2.

| Information | 4 | 3 | 2 | 1 |
|-------------|---|---|---|---|
| The minimum distance end of the runway or stop the way | 60 m (200 ft) | 60 m (200 ft) | 60 m (200 ft) | 60 m (200 ft) |

Continued table 2

| Information | 4 | 3 | 2 | 1 |
|-------------|---|---|---|---|
| The width of the runway strip for grounding instrument | 300 m (1000 ft) | 300 m (1000 ft) | 150 m (500 ft) | 150 m (500 ft) |
The width of the strip foundation for non-instrument runway

| 150 m (500 ft) | 150 m (500 ft) | 80 m (260 ft) | 60 m (200 ft) |

The width of the area leveled for non-instrument runway

| 150 m (500 ft) | 150 m (500 ft) | 80 m (260 ft) | 60 m (200 ft) |

The slope area in averaging for areas that averaged (%)

| 1.5 | 1.75 | 2 | 2 |

Source: [9]

In planning the runway strip heap, bearing a strong influence subgrade pavement thickness. The higher the strength of the support the land, then the required pavement thickness thinner to withstand traffic loads. The carrying capacity of the foundation soil (subgrade) is influenced by soil type, density, moisture content, and others [10]

3. Research methods and sites

3.1. Research methods

This study was designed based on the provisions of the Regulation of the Ministry of transportation, namely KP. 39 In 2015, KP. 93 - 2015 and KP. 576 in 2011.

Field CBR value generally used for planning additional layer (overlay). The equipment used in the testing is the CBR mould, mechanical jacks, digger, and water pass. CBR testing can be performed directly on the spot by placing the truck on the inspection hole and install the CBR mechanical jack [11]

Table 3. Specifications subgrade CBR value for the runway strip

| No. | Category subgrade | CBR value | Interval value of CBR | Code |
|-----|-------------------|-----------|-----------------------|------|
|     |                   | Subgrade (%) | Subgrade (%)         |      |
| 1   | High              | 15         | CBR > 13              | A    |
| 2   | Medium            | 10         | 8 < CBR < 13          | B    |
| 3   | Low               | 6          | 4 < CBR < 8           | C    |
| 4   | Ultra low         | 3          | CBR < 4              | D    |

The scope of work includes the measurement of "Transverse Survey, Center Line Survey, Profile levelling cross-sectional survey and survey of existing services" on location in the scope of work. Cross Section Leveling must be carried out perpendicular to the direction "centerline" predetermined for each measurement area at intervals of 3 m along the "centerline" in order to get an accurate superelevation.

Long Section Leveling along the direction perpendicular to the "centerline" elevation/level should be measured every 5 m intervals for pavement work ", and the work of other structures such as drainage, fencing, hoarding and others that the measure should not be more than 50 m intervals [12]

3.2. Research Sites

The location study was conducted in Merauke Mopah Airport, and can show on the pictures as follows:
3.3. Elevation Data, CBR and Dimensions
For existing runway strip elevation data and taking field CBR data using the following method:

The width, length and slope of the runway strip can be seen in Table 4.

| Secondary Data Types       | How Data Collection                                                                 |
|----------------------------|-------------------------------------------------------------------------------------|
| a. dimensions runway       | Dimensions runway in the acquisition of office UPBU Mopah Merauke                   |
| b. Layout and facilitates  | Runway layout the data obtained from the office UPBN Mopah Merauke                   |
| the airside Mopah          |                                                                                     |
| Merauke                    |                                                                                     |

Table 4. Table collection of secondary data
4. Results and discussion

4.1. Dimensions runway strip

The design of the runway strip is done by using the method in the form of air transportation ministry's regulations, namely KP 39-2015 and KP 93-2015, on technical standards and operation of civil aviation safety regulations, in order to design a runway strip. The results of measurements of length and width dimensions Merauke Mopah Airport can be shown as follows:

![Figure 4. Runway length and width dimensions](image)

Dimensions runway 2500 m x 45 m, it can be concluded runway length based on the table or equations in chapter II page 14 Table 2.1 then the length of the runway belonging to the code number 4 is L> 1800 in the mean length of a runway more than 1800 m, the width of the runway of the equation in chapter II, page 14, table 2.2, the classified code number 4 and the code letter “C” is the runway width of 45 m. Then the draft plan of the runway strip according to the transportation ministry's decision KP 39 - 2015 is a 150 m wide strip of runway left, and 150 m from the right edge of the runway.

4.2. Basic land capability CBR

To get the data of CBR, using a DCP (Dynamic Cone Penetrometer), the data obtained by direct measurements at the study site with a sample of some of the soil sample points with a predetermined distance of between one point with another point is 50 meters.

| Amount | Cumulative Collision | Penetration (mm) | Cumulative Penetration | DN | Log CBR | CBR Titik |
|--------|----------------------|------------------|------------------------|----|---------|-----------|
| 0      | 0                    | 110              |                        |    |         |           |
| 5      | 5                    | 165              | 55                     |    |         |           |
| 5      | 10                   | 265              | 155                    | 13.65 | 1.32   | 21.04     |
| 5      | 15                   | 340              | 230                    |    |         |           |
| 5      | 20                   | 383              | 273                    |    |         |           |
4.3. Results of data processing elevation (Elevation Existing)
Implementation of a runway measuring strips covering the general survey, mapping and plotting the geometric design of the field specifically to get a detailed elevation, boundaries of the runway strip, which are translated into the measurement data table. The existing elevation is obtained using a theodolite with direct measurements at the sites.

Examples of existing elevation measurement point calculation sta 0 + 000 right-I as follows:

4.3.1. Correction threads include:

- Yarn over
  \[ BA = 1585 + (1585-1473) \]
  \[ BA = 1697 \text{ mm} \]

- Central thread
  \[ BT = \frac{1597+1473}{2} \]
  \[ BT = 1585 \text{ mm} \]

- Correction Distance
  \[ BB = 1585 - (1697-1585) \]
  \[ BB = 1473 \text{ mm} \]

4.3.2. Correction Distance:

\[ \text{Slope} = \frac{1597+1473}{1000} \times 100 \]

Slope = 22.4 mm
Flat = 22.4 x Sin α 90
Flat = 22.4 m

4.3.3. Looking for a height difference (m):

\[ \frac{1222-(1585+0)+(22.4x1000)x0}{1000} \]

= - 0.333 m

4.3.4. Correction Distance:

= Elevation of the ground surface (GPS) - high difference
= 3,000 m - 0.333 m
= 2.667 m
4.4. CBR Field Representation

The results of the CBR field have been obtained; it can be classified as follows: CBR 6% as much as 1 point, CBR 8% as much as 4 points, CBR 9% as much as 6 points, CBR 10% by 2 points, CBR 11% as much as 3 points, CBR 12% as much as 15 points, CBR 13% as much as 31 points, CBR 14% as much as 28 points, CBR 15% as much as 11 points, CBR 16% by 5 points, so it can be concluded:

| CBR | The same amount or the representing | Percent (%) of the same or greater |
|-----|-----------------------------------|----------------------------------|
| 6   | 106                               | $\frac{106}{100} \times 100 = 100\%$ |
| 8   | 105                               | $\frac{105}{100} \times 100 = 99.06\%$ |
| 9   | 101                               | $\frac{101}{100} \times 100 = 95.26\%$ |
| 10  | 95                                | $\frac{95}{100} \times 100 = 95.00\%$ |
| 11  | 93                                | $\frac{93}{100} \times 100 = 93.00\%$ |
| 12  | 90                                | $\frac{90}{100} \times 100 = 90.00\%$ |
| 13  | 75                                | $\frac{75}{100} \times 100 = 75.00\%$ |
| 14  | 44                                | $\frac{44}{100} \times 100 = 44.00\%$ |
| 15  | 16                                | $\frac{16}{100} \times 100 = 16.00\%$ |
| 16  | 5                                 | $\frac{5}{100} \times 100 = 5.00\%$  |

For CBR graph cumulative and can show on a graph as follows:

![CBR graph](image)

**Figure 5. CBR graph elected**
Results of the draft runway strip of the dimensions of the runway with a length of 2500 m and a width of 45 m, it can be concluded that the type runway in Merauke Mopah Airport is type "4.C", for the results of the runway strip width type of plan is 150 meters on the right and 150 meters left side, for a transverse slope elevation plan or plans of 0.8%, then cut and fill calculation results can be inferred to excavation work to generate elevation plan, then the volume obtained by 174,205.00 M3 and to work pile, to produce elevation plan obtained volume amounted to 3008.80 M3, with the dimensions of the runway strip the standards to be met CBR CBR is 6%, from fieldwork to get 9.93% CBR chosen field, then meet the existing standards.

4.5. Results cubication Cut and Fill Volume
From the results of existing elevation and elevation design plan by taking the slope - the slope of 0.8%, then count each cross-section has a slope that is not uniform in the state of the field is necessary to cut and fill activities, for calculation can be summarized as follows and in the dust on the attachment backing up the volume calculation:

| No. | Information                        | Subtotal (m³) |
|-----|------------------------------------|---------------|
| 1   | Sub excavation work                |               |
|     | The right side of the runway strip | 7932.13       |
|     | The left side of the runway strip  | 166,272.88    |
|     | A total volume of excavation       | 174,205.00    |
| 2   | Sub total embankment work          |               |
|     | The right side of the runway strip | 14177.93      |
|     | The left side of the runway strip  | 16830.88      |
|     | The total volume of excavation     | 31008.00      |

5. Conclusion
Results of the draft runway strip of the dimensions of the runway with a length of 2500 m and a width of 45 m, it can be concluded that the type runway in Merauke Mopah Airport is type "4.C", for the results of the runway strip width type of plan is 150 meters on the right and 150 meters left side, for a transverse slope elevation plan or plans of 0.8%, then cut and fill calculation results can be inferred to excavation work to generate elevation plan, then the volume obtained by 174,205.00 M3 and to work pile, to produce elevation plan obtained volume amounted to 3008.80 M3, with the dimensions of the runway strip the standards to be met CBR CBR is 6%, from fieldwork to get 9.93% CBR chosen field, then meet the existing standards.

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