CONSTRUCTION PLANNING OF INSPECTION ROAD USING FLEXIBLE PAVEMENT STRUCTURE AT KOMODO AIRPORT LABUAN BAJO EAST NUSA TENGGARA

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ABSTRACT
Komodo Airport is an airport located in Komodo District, West Manggarai District, East Nusa Tenggara Province. Komodo Airport, which is categorized as a Class II Airport, has a runway with a length of 2650 m. The unavailability of these inspection road facilities was also noticed by the Region 4 Airport Authority when carrying out routine visits to check airside and landside facilities at Komodo Airport. Currently, inspection activities are carried out directly within the runway area, which causes some FOD (Foreign Object Debris) caused by the inspection vehicle itself. The construction of the Inspection Road is located in the movement area, so the MOWP (Method of Working Plan) document must be included in order to keep airport operations running during construction. The pavement structure on the inspection road has a total pavement thickness of 2.42 meters with the inspection road being 2890 meters long and 5 meters wide. Budget Plan The required costs are Rp. 9,080,825,000.00 (Says nine billion eighty million eight hundred twenty five thousand rupiah).

Keywords: *Road Inspection, Pavement Design Manual, Pavement Structure, Method of Working Plan.*

1. INTRODUCTION

Komodo Labuan Bajo Airport Service Unit is located in Komodo District, West Manggarai Regency, East Nusa Tenggara Province (NTT). Geographically located at coordinates 08º29’12.40”S 119º53’14.44”E. Previously, in 1986 this airport was called Mutiara II Airport, which was a pioneering airport for the Ruteng regional government which could only be entered by Trinoter aircraft. In 1993, this airport was handed over to the Ministry of Transportation which is managed by the Air Transportation Directorate, then changed its name to Komodo Labuan Bajo Airport.

In accordance with Ministerial Regulation 39 of 2019 concerning National Airport Arrangements, an airport is a certain area on land and/or waters which functions as a place for aircraft to take off and land, departure and disembarkation of passengers, loading and unloading of goods, as well as domestic transportation. Intermodal transportation that provides transportation with flight safety equipment, basic equipment and other auxiliary equipment. With these regulations, it means that airports must have adequate safety and security supporting facilities. In order to support safety and security, regular inspection activities are needed on all airport components. Based on the Aerodrome, 2022 Komodo Airport Aerodrome Manual, Komodo Airport has a runway 2,650 m long with a width of 45 m. The existing condition is that there is currently no inspection road available at Komodo Airport, which is presented in Figure 1.2, namely land covered with wild plants.

The number of flights at Komodo Airport is quite dense, however it is not supported by one of the aviation security facilities, namely inspection roads. The unavailability of these inspection road facilities was also noticed by the Region 4 Airport Authority when carrying out routine visits to check airside and landside facilities at Komodo Airport. According to SKEP 347/XII/99, 1999 concerning Standards for design and/or engineering of airport facilities and equipment, inspection roads are built around airports and are used for routine inspections of airport facilities. These roads are also used by emergency vehicles such as PKP-PK fire extinguishers ...

Inspection activities are currently carried out directly in the airside facilities area and the terminal entrance access road and around the airport, so that sometimes during inspections several FODs are found coming from operational cars passing on the runway. Seeing the importance of these facilities, Komodo Airport needs to build an inspection road. Because if continuous inspections are carried out in the runway area, inspection activities can only be carried out when there are no flights. Anticipating this, an inspection road must be built, so that if something unexpected happens suddenly during a flight, the inspection can still be carried out without disrupting flight activities.

Planning for the construction of this inspection road, which takes into account the thickness of the road pavement layer, generally uses the 2017 Pavement Design Manual No.02/M/BM/2017 method, but along with technological developments, this method was developed into the 2024 Road Pavement Design Manual.

The method itself was created by the Ministry of Public Works for use in Indonesia. The pavement used in the inspection road development plan is flexible pavement.

The inspection road is planned to be 2,890 m long and 5 m wide. Apart from taking into account the thickness of the inspection road, this research also calculates the planned budget for the construction of the inspection road and, if the construction is carried out in a limited airport security area, then according to the Directorate General of Civil Aviation, PR 21 of 2023, if there is work that has the potential to disrupt operational at the airport, then this work project must be implemented based on the appropriate planning method, namely by issuing a MOWP (Method of Working Plan) document.

The purpose of building the inspection road is expected to support airport operational activities and improve aviation security facilities at BandariiUdara KomodoiiLabuan Bajo. From the description that has been explained, the final assignment title that can be appointed is **"INSPECTION ROAD CONSTRUCTION PLANNING USING FLEXIBLE PAVEMENT STRUCTURE IN BANDAR UDARA KOMODO LABUANiBAJO NUSA TENGGARA TIMUR"**

2. CONCEPTUAL DEFINITIOON

A. Airport

According to Law no. 1 of 2009 concerning Aviation, an airport is an area that provides facilities for taking off and landing aircraft, as well as supporting safety, security and flight operations. Law no. 15 of 1992 and Presidential Decree No. 70 of 2001 also defines airports as airports used for aviation activities and as transit points between modes of transportation.

1. Land Side (Landside)
   Referring to Minister of Transportation Decree No. 47 of 2002, the land side is an area that is not directly connected with flight operations.
2. Air Side (Airside)
   Based on the Decree of the Minister of Transportation No. 47 of 2002, the air side is a non-public area that requires security checks for access. Airside amenities include:
   a. Runway: The runway for landing and takeoff of aircraft (SKEP 161/2003).
   b. Taxiway: A road connecting aircraft from the runway to the apron.
   c. Apron: Aircraft parking area, place to board/unload passengers, cargo and maintenance.
   d. Inspection Road: Path around airport boundaries for routine inspection of facilities (SKEP 347/1999).

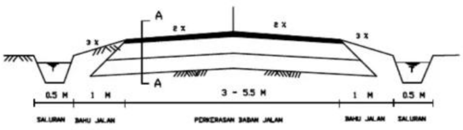

Figure 2.1 Inspection Road

(Source:SKEP 347 / XII / 1999)2

Flexible pavement structures in excavations consist of several layers designed to distribute traffic loads effectively to the subgrade. Starting from the surface layer, AC-WC (Asphaltic Concrete Wearing Course) functions as a wear layer, followed by AC-BC (Asphaltic Concrete Binder Course) which acts as an intermediate layer, and AC-Base (Asphaltic Concrete Base Course) as a foundation layer. Below that is CTB (Cement Treated Base) which strengthens the foundation with cement, followed by Class A and B LFA which are aggregate foundation layers. The compacted subgrade becomes the basis of the structure, supported by a support layer which functions to minimize the effect of the soil on the entire pavement. This construction ensures that the inspection road is able to safely and efficiently support and spread traffic loads.

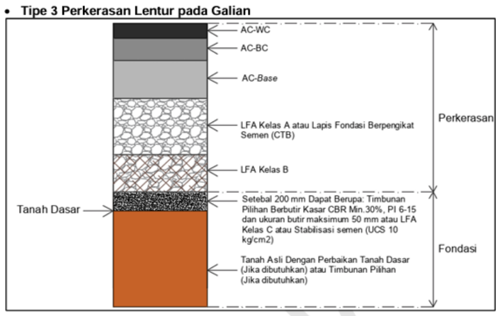

Figure 2. 2 Structure of the Pavement Layers in the Excavation (Source: Ministry of General Affairs and Public Housing: Highways, 2024)

B. Planning Inspection Roads

Flexible pavement planning for inspection roads includes all layers starting from the base soil, subbase layer, top foundation layer, to the surface layer, using the Road Pavement Design Manual No.02/M/BM/2024. This method was chosen because it is commonly used in journals to determine the thickness of pavement and was created by the Ministry of Public Works, so it is suitable for application in Indonesia. The planning stages for the thickness of new road pavement follow the guidelines of this manual.

1. Plan Age

Table 2.1 Planned Age of New Road Pavement (UR)

Jenis Perkerasan	Elemen Perkerasan	Umur Rencana (tahun)(1)
Perkerasan lentur	Lapisan aspal dan lapisan berbutir(2).	20
	Lapis Fondasi jalan	40
	Semua perkerasan untuk lokasi yang tidak dimungkinkan pelapisan ulang (*overlay*), seperti: jalan perkotaan, *underpass*, jembatan, dan terowongan	
	Lapis Fondasi Berpengikat Semen, *Cement Treated Based* (CTB)	
Perkerasan kaku	Lapis fondasi atas, lapis fondasi bawah, lapis beton semen, dan fondasi jalan	
Jalan tanpa penutup	Semua elemen (termasuk fondasi jalan)	10

(Source: Ministry of Public Works and Public Housing; Highways, 2024)

a. If it is considered_difficult_to use the above plan age, another plan age can be used, but analysis must be carried out first with discounted lifecycle costs which can show that the plan age can_provide the lowest discounted lifecycle cost.

b. The design age must take into account the capacity of the road.

2. Traffic Volume Analysis

In pavement structure analysis, traffic data is an important parameter for calculating the traffic load over the design life. First year traffic volumes are determined from traffic projections for the survey year. Traffic surveys, which are carried out 7 x 24 hours or based on previous surveys, are used for analysis. The Indonesian Road Capacity Manual (MKJI) helps determine the LHRT (Annual Average Daily Traffic) and traffic volume during rush hours. If there is any doubt in the data, an independent survey should be conducted for validation, and no data manipulation is permitted.

3. Traffic Growth Factors

Factors that influence traffic increases are based on series growth data (historical growth data) or correlation formulations with other relevant or applicable growth factors. If the data is not available then the following table can be used (Ministry of Public Works and Public Housing; Directorate General of Highways, 2024).

Table 2. 2 Factors for Traffic Growth Rate (i) (%)

	Jawa	Sumatera	Kalimantan	Rata-rata Indonesia
Arteri dan perkotaan	4,80	4,83	5,14	4,75
Kolektor *rural*	3,50	3,50	3,50	3,50
Jalan desa	1,00	1,00	1,00	1,00

The planned lane is a traffic lane with the dominance of commercial vehicles such as trucks and buses. The traffic load on this lane is calculated in standard cumulative axle loads (ESA) by taking into account the direction distribution factor (DD) and the commercial vehicle lane distribution factor (DL). For two-way streets, DD is usually 0.50. Traffic loads are converted to ESA using the Equivalent Load Factor (VDF), and axle load calculations must be made accurately through surveys or data from weighbridges. CESAL measures the total axle load over the design life taking into account VDF, LHR, DD, and DL.

C. Road Paving

Road pavement consists of a mixture of aggregate and binding material, such as asphalt or cement, to support the load of vehicles. According to Sukirman (1999) in research by Bamher (2020), there are two types of pavement construction: Rigid Pavement: Using a layer of concrete with or without steel reinforcement, placed on top of the subgrade to support the wheel load. The quality of the concrete determines the strength of the road. Flexible Pavement: Using asphalt as a binder, with a layer that absorbs and distributes traffic loads to the ground. The choice of pavement type depends on the traffic volume, design age, and foundation condition, with consideration of the lowest cost over the plan life.

Table 2.6 Selection of Pavement Structure

Struktur Perkerasan	Bagan Desain	ESA5 (juta) dalam 20 tahun				
		0 - 1	1 - 4	4 - 10	>10 – 30	>30
AC modifikasi	3, 3A, 3B	-	-	-	-	2
AC dengan CTB					2	-
AC Modifikasi dengan CTB					-	2
AC dengan lapis fondasi agregat	3, 3A, 3B	-	1, 2	1, 2	2	-
HRS tipis di atas lapis fondasi agregat	4	2	2	-	-	-
Burda atau Burtu dengan lapis fondasi agregat	5	3	3	-	-	-
AC/HRS dengan lapis fondasi *Soil Cement*	6	2	2	-	-	-
AC/HRS dengan lapis fondasi agregat dan perbaikan tanah dasar (dengan stabilisasi semen)	7	2	2			
Perkerasan kaku dengan lalu lintas berat	8	-	-	-	2	2
Perkerasan kaku dengan lalu lintas rendah	8A	-	-	1, 2	-	-
Perkerasan tanpa penutup (Japat dan jalan kerikil)	9	1	-	-	-	-

D. Calculation of the RAB Cost Budget Plan

According to Firmansyah (2011), the cost budget plan, also known as RAB, is a calculation of the amount of costs required for materials and wages, as well as other costs related to implementing a development project. Through the cost budget plan, it is hoped that the project will run effectively and efficiently, so that funds are calculated carefully. The unit price used in planning the inspection road at Komodo Airport in Labuan Bajo uses the district unit price. West Manggarai in 2022 with the employment coefficient using PM 78 in 2014.

E. Method of Working Plan (MOWP)

Decree of the Director General of Civil Aviation Number PR 21 of 2023 regulates Technical and Operational Standards for Civil Aviation Safety Regulations Part 139, which states that work that disrupts aircraft operations must be completed using the Method of Working Plan (MOWP). Instructions for compiling a MOWP include:

1. Title Page: Each MOWP must be given a reference number consisting of the Aerodrome identification in AIP Indonesia (location indicator), two digits of the last year and the MOWP number assigned by the Mainland Aerodrom Operator. MOWPs issued to the same Mainland Aerodrome must be numbered sequentially in the order in which they were issued. The MOWP number, issue date, date and amendment number are written at the top right corner of the title page. In addition to indicating the location of the work, the title should contain a brief description of the project, for example "[Aerodrome name]: Runway repairs 04/22". The title page must include a list of the parts of the MOWP and indicate the MOWP approval date, MOWP start and end dates, and work completion date.

2. Work Information: Contains a summary of the entire scope of work and an explanation of the Aerodrome facilities impacted by the work. Include the date of planning and start of work implementation, the amount of time required for each stage, and the time required to complete the work. "The actual date and time during which the work is carried out will be informed via NOTAM, which is issued no less than 48 hours before the work is carried out."
3. Aircraft Operation Restrictions: This MOWP section must have a format that allows aircraft operators to create their own publications. It should also allow aircraft operators to obtain references and information about operational impacts on them. Additionally, researchers must provide an explanation of each restriction, as well as what types of aircraft are affected by the restriction. Includes planned NOTAM (Notice To Airman) with complete sentences related to Aerodrome work must be included in the MOWP. This point also explains several rules, namely:
    a. Work Stages
       At each stage of work, any restrictions on aircraft operations in the Movement Area and Approach and Take Off Area must be recorded and shown in the form of a drawing. If the work to be carried out is complex, a table must be prepared showing the limits applicable to each stage of the work and to each type of Aircraft operation. This table should contain the start and finish dates of each phase of work, and should also have a description column to note details of special constraints. In addition, pilots must be provided with NOTAMs for information before the flight.
    b. Markings, Signs and Lights
       Drawings attached to the MOWP shall show the arrangements used to install, change, and remove markings, turf, and lights in work areas and other areas affected by work activities at the Aerodrome.
    c. Emergency Situations and Extreme Weather
       The MOWP should explain in every detail the special arrangements that will be implemented during work in case of emergency or extreme weather if it occurs.
    d. NOTE
       In the MOWP, full sentences for all planned NOTAMs relating to Aerodrome work must be included.
4. Job Organization Restrictions (Contractor): The MOWP must restore all restrictions and requirements for organizations (contractors) carrying out work at the Aerodrome to normal operational safety standards. This point explains several rules, namely:
    a. Workers and Equipment
       Special statements must be made when workers and equipment are required to leave the Movement Area for certain Aircraft operations. Example: "All workers and their equipment must immediately leave Runway 04/22 for Aircraft operations larger than CASA 212."
    b. Access
       The drawing attached to the MOWP must show the route to and from the work area, as well as the procedures for entering the work area located in the Movement Area.
    c. Management and Regulation of Aerodrome Works
       The Mainland Aerodrome Operator is responsible for ensuring that work at the Aerodrome is carried out in accordance with the standards stated in PR 21 of 2023. During the implementation of work at the Mainland Aerodrome, the organizer must appoint someone in writing as a work safety officer (WSO). Persons, vehicles, goods and equipment required to carry out the work shall not enter the movement area or remain there except for use in the work.
    d. Time Limited Work
       If normal Aircraft operations are not disrupted, work at the Land Aerodrome can be carried out as time-limited work. The movement area may be returned to normal safety standards in no more than 30 minutes, including the removal of any obstructions caused by the work. Except for a NOTAM issued no less than 24 hours before the start of work, which provides the date and time of work commencement as well as the time required to return to normal safety standards, a person is prohibited from starting work that takes more than 10 minutes to return the movement area to normal safety standards and move obstacles.
5. Administration: Names of project contacts and safety officers.
6. Authorization: Statement that the work must comply with the MOWP, validity period, and signature of the relevant authority.
7. Images: A visual reference for each stage of the job.
8. Distribution List: Includes all relevant parties, such as project managers, WSO, AVSEC, and aircraft operators.

Examples of MOWPs from several airports show that the rules in PR 21 of 2023 must be strictly followed in carrying out work at airports.

3. RESEARCH METHODS

In planning inspection road construction using flexible pavement structures, the following planning flow is obtained:

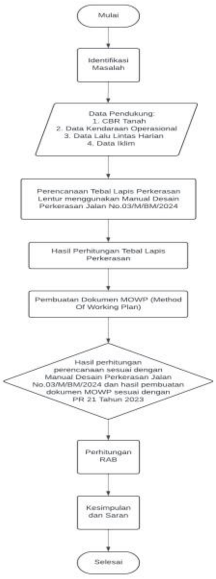

Figure 3.1 Research Method Flow Chart

A. Methods Used

Indonesia's aviation industry is developing rapidly, with the addition of airlines and flight routes in various cities. To support aviation activities at Komodo Labuan Bajo Airport, adequate infrastructure is required, including inspection roads that function to monitor and maintain security areas. Currently, inspections are still carried out directly at the airside without any special inspection roads.

B. Data Collection

Data for this planning was obtained from various sources, such as soil CBR from On the Job Training activities, MOWP content based on PR 21 of 2023, operational vehicle data from the Aerodrome Manual and direct observations, as well as daily traffic and rainfall data from BMKG West Manggarai. The unit price of wages and materials uses the 2024 West Manggarai Regency standard costs and PM 78 of 2014.

C. Pavement Thickness Plan:

Pavement thickness calculations are carried out based on the Road Pavement Design Manual No.02/M/BM/2024, which includes calculations of LHR, traffic volume, traffic growth, and standard axle cumulative loads. The results of these calculations were then verified in accordance with SKEP/347/XII/1999.

D. MOWP Document Preparation:

The MOWP document is prepared based on the PR 21 of 2023 regulation, covering all the content required for development planning.

E. Budget Plan Calculation:

After the pavement has been planned, a cost budget (RAB) is prepared to determine the need for workers and materials with reference to unit prices in 2022 and PM 78 of 2014.

4. RESULTS AND DISCUSSION

A. Manual Methods for Road Pavement Design No.02/M/BM/2024

Calculation of the thickness of flexible pavement (Flexible Pavement) for the construction of the Komodo Airport inspection road using the Road Pavement Design Manual Method No.02/M/BM/2024. The following are the steps to determine the thickness plan for the inspection road:

1. Traffic Information

In table 4.1 is a recapitulation of data from daily traffic inspections at BandarrUdara Komodo which was taken during on-the-job training activities, and traffic data collection was carried out for 1 week, from the beginning of airport operational hours until the operational schedule was completed.

Table 4.1 Recapitulation of Daily Traffic Data

Time	Pick Up	Hilux (Avsec)	Hilux (AMC)	Hilux (PKP-PK)
06.00-09.00	1	1	1	1
10.00-12.00	0	1	0	0
13.00-15.00	1	1	1	0
16.00-18.00	1	1	1	0
19.00-21.00	1	1	0	0
Total	**4**	**5**	**3**	**1**
Average	**4**	**3**	**5**	**1**

Average daily traffic data is used to calculate the number of vehicles that pass through the inspection road. Recapitulation of LHR data for each type of vehicle is adjusted to the number of vehicles passing through the inspection road. Table 4.2 shows the LHR size of each vehicle.

Table 4. 2 Number of Vehicles that Pass the Inspection Road

No.	Vehicle Number	Vehicles/Week Number	Vehicles Average/Day (LHR)
1.	Pickup	28	4
2.	Hilux (Avsec)	35	3
3.	Hilux (AMC)	21	5
4.	Hilux (PKP-PK)	7	1
Total		**91**	**13**

2. Construction calculation plan:

The inspection road at Komodo Airport is planned with flexible pavement for a service life of 20 years, according to the 2024 Pavement Design Manual. This road is categorized as a village road because of low traffic. The traffic load calculation uses the ESA formula, with a directional distribution (DD) factor of 0.5 and a lane distribution (DL) of 100%.

3. Traffic Growing:

Traffic growth is determined at 3% per year for developed areas. Using the equation R=((1+(0.01xi))〗^UR-1)/0.01xi, an R value of 0.67 is obtained.

4. Load Equivalent Factor (VDF):

The VDF value is determined for the classification of passing vehicles, with the type of vehicle entering classification 4.

5. Cumulative Equivalent Single Axle Load(CESAL)
Calculation of the cumulative standard axle load (CESA 4) based on the equation ESATH - 1 = (∑LHRJK x VDFJK) x 365 x DD x DL x R, results in ∑CESA4 of 111.27 CESA 4.

B. Pavement Thickness Calculation Stages

Based on table 2.6, the choice of pavement structure is determined after obtaining the Equivalent Single Axle (ESA) calculation.

1. Determining CBR Values

The CBR value of the land was obtained from the Labuan Bajo Komodo Airport. The next calculation of the CBR value uses the percentile method in accordance with the 2024 Pavement Design Manual. For percentile, the formula in Excel is used and the CBR amount is multiplied by 0.1. So that the CBR percentile result is obtained.

2. Determining the Design Pavement Thickness

According to the calculations, CESAL4 was obtained at 111.27 ESA4. The type of pavement that can be selected for use is design 3B, in accordance with table 2.6. Layer thickness is determined by chart from design 3B in the following table.

Table 4.3 Pavement Design Charts with Improved Subgrade Cement Stabilization

	STRUKTUR PERKERASAN[1]		
	SC1	SC2	SC3
	Beban Sumbu 20 tahun pada lajur desain ($ESA4 \times 10^6$)		
	< 0,1	0,1- 0,5	> 0,5 – 4
	Ketebalan lapis perkerasan (mm)		
HRS WC, AC WC	50*		
Lapis Fondasi Agregat Kelas A	160	220	300
Lapis Fondasi Agregat Kelas B	110	150	200
Stabilisasi tanah asli hingga mencapai CBR ekuivalen 6%	160	200	260

* 50 mm berlaku untuk HRS dan AC-WC (pada desain 2x50 tumbukan *marshall*)

Based on this table, the foundation layer thickness is determined as below:

a. AC – WC: 50 mm
b. Class_A Aggregate Foundation Layer: 220 mm.
c. Class_B aggregate foundation layer: 150 mm.
d. Stabilization of the original soil to reach the equivalent CBR of 6%: 200 mm

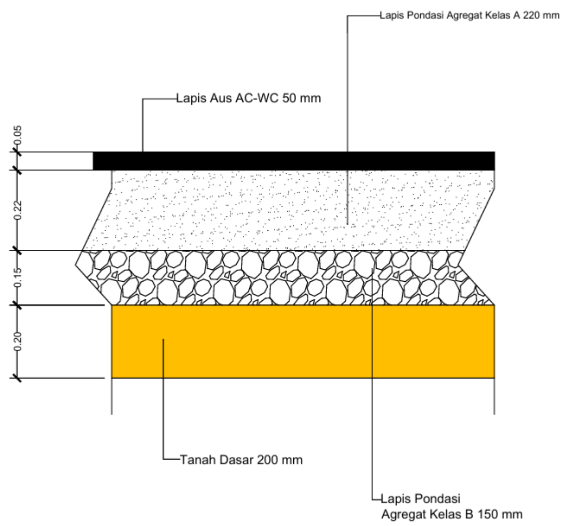

Figure 4. 1 Longitudinal section of the flexible pavement of the inspection road

3. Determine the Foundation of the Plan

Foundations are determined by looking at how big the CBR of the soil is. The CBR value of the soil that has been calculated is 7%, so according to table 2.7, if the CBR value of the soil is more than 6%, there is no need to make improvements to the soil before work is carried out.

C. Calculation of Planned Costs

Calculation of the cost budget plan begins when you have obtained the layer thickness results from the 2024 Pavement Design Manual method. The RAB is calculated referring to PM 78 of 2014 and the HSPK of West Manggarai Regency for the 2022 Fiscal Year. The RAB calculation results are obtained for the details of the cost budget calculation as in the attached attachment.

Table 4.4 Cost Budget Plan

RENCANA ANGGARAN BIAYA					
	PEKERJAAN	: PERENCANAAN PEMBANGUNAN PERKERASAN LENTUR JALAN INSPEKSI			
	LOKASI	: BANDAR UDARA KOMODO LABUAN BAJO NUSA TENGGARA TIMUR			
	TAHUN ANGGARAN	: 2024			
NO	URAIAN KEGIATAN	VOLUME	STN	HARGA SATUAN (Rp)	JUMLAH HARGA (Rp)
I	PEKERJAAN PERSIAPAN				
1	Direksi Keet	96	m^2	Rp 2,219,871.56	Rp 213,107,669.76
2	Papan nama proyek	1.00	ls	Rp 3,681,579.16	Rp 3,681,579.16
3	Pengukuran	14450	m^2	Rp 6,389.24	Rp 92,324,489.10
4	Pembersihan	14450	m^2	Rp 18,340.00	Rp 265,013,000.00
					Rp 574,126,738.02
II	PEKERJAAN PERKERASAN				
1	Galian Tanah	2890	m^3	Rp 79,409.90	Rp 229,494,611.00
2	Urugan dan Pemadatan Tanah	2890	m^3	Rp 103,488.22	Rp 299,080,969.67
3	Lapis Pondasi (Agregat Kelas A)	3179	m^3	Rp 558,407.32	Rp 1,775,176,883.63
4	Lapis Pondasi (Agregat Kelas B)	2167.5	m^3	Rp 495,477.32	Rp 1,073,947,100.20
5	Prime Coat AC 60/70 (2,5 kg/m^2)	1445	m^2	Rp 727,739.48	Rp 1,051,583,548.60
6	Tack Coat AC 60/70 (1,5 kg/m^2)	1445	m^2	Rp 682,156.60	Rp 985,716,287.00
7	Laston Lapis Aus AC-WC	722.5	m^3	Rp 3,008,686.51	Rp 2,173,776,000.73
8	Mobilisasi dan Demobilisasi	1.00	ls	Rp 18,019,574.60	Rp 18,019,574.60
					Rp 7,606,794,975.44
JUMLAH					Rp 8,180,921,713.46
PPN 11%					Rp 899,901,388.48
JUMLAH TOTAL					Rp 9,080,823,101.94
DIBULATKAN					Rp 9,080,825,000.00
TERBILANG					
SEMBILAN MILYAR DELAPAN PULUH JUTA DELAPAN RATUS DUA PULUH LIMA RIBU RUPIAH					

D. Calculation of Planned Costs

The preparation of the MOWP document refers to the PR 21 of 2023 regulation. The MOWP document consists of several aspects of regulations for implementing project work that may disrupt flight operations. The following is the MOWP document:

MOWP NO. : 1
DATE OF ISSUE : 1 MARCH 2024
AMMANDEMENT : 0
DATE OF AMMANDEMENT : 1 MARCH 2024

METHOD OF WORKING PLAN

AERODROME : KOMODO AIRPORT
DESCRIPTION : INSPECTION ROAD CONSTRUCTION

DATE
Date of Approval of MOWP : 1 March 2024
Date of Commencement works : 1 March 2024
Date of Completion of Works : -
Date of Expiry of MOWP : -
Date of Revision Ammend 1 : -

CONTENT :
1. Change Sheet
2. Job Information
3. Restrictions on Aircraft Operations
4. Restrictions on Work Organization
5. Administration
6. Authority
7. List of Attachments
8. Distribution List

Table 4.5 Table of change points

No.	Change Points	Change Contents
1	Work Area	1. Carrying out excavations on the side of the apron and runway 35-17. 2. Resurfacing work on the apron and runway 35-17 side pavement. 3. 3. Work to construct inspection roads on the apron and runway 35-17.
2	(General Changes)	Changes in the implementation time duration up to the specified month.
3	Time of Implementation	Working hours refer to the NOTAM issued 1 day before work starts.
4	Working Hours	1. NOTAM area for construction of inspection road on the side of apron and runway 35-17. 2. For a period of time up to the specified project schedule.
5	NOTAM	Accessibility to the airside 1. The path of workers gathering at the fire station and checked by avsec officers. 2. The path of heavy equipment through the north door of the fire station through the road to the runway and then to the work area.
6	Access	The project implementation is carried out by PT.
7.	Project Implementer	Organizational structure on page 11
8.	Communication Channel	There are changes and replacements of personnel: 1. Work Safety Officer of Komodo Labuan Bajo Airport. 2. Work Safety Officer from the project implementer.
9.	MOWP Validity Period	MOWP is valid until the specified month.
10.	MOWP Preparation and Approval	Changes in Personnel who review MOWP documents with the implementing party.
11.	List of Attachments	Changes in the number and contents of the attachment list.

Construction work carried out in the Komodo Airport area, Labuan Bajo, requires special attention to operational safety as well as tight coordination with various related parties. The construction of the 2,890 meter long and 5 meter wide inspection road has a direct impact on movement area facilities, especially the runway and apron. Therefore, the issuance of a NOTAM (Notice to Air Men) at least 48 hours before work starts is crucial to provide information to airlines regarding the construction implementation schedule. Apart from that, all work must be carried out in accordance with the Method of Working Plan (MOWP) and under the strict supervision of the Work Safety Officer (WSO) appointed by the Airport. Every member of the work organization is obliged to comply with safety and security directives, including control of vehicles and heavy equipment used in the project area. Strict regulation of access, signs, markings, aerodrome lights, as well as protection of electrical services and water supply networks is an integral part of the entire implementation of this work. These efforts ensure that construction projects run smoothly without disrupting flight safety and airport operations.

Administration of Inspection Road construction work at Komodo Labuan Bajo Airport is strictly regulated to ensure the safety of flight operations. This project is led by the Head of Komodo Airport as Project Manager, with full support from the Work Safety Officer (WSO) whose task is to ensure that all construction activities comply with Civil Aviation Safety Regulations (CASR) Part 139 and Manual of Standards (MOS) Part 139 Aerodromes. WSOs have important responsibilities, including ensuring the safety of flight operations, coordinating with Air Traffic Control (ATC), and ensuring the issuance of NOTAMs in accordance with MOWP requirements. They must also monitor conditions on site, ensure unserviceability signs are installed correctly, and check that vehicle routes and excavations are carried out to standards. If there is damage or an incident that could potentially compromise flight safety, the WSO must immediately report it to ATC and the aerodrome operator. During the work, the WSO must also ensure that all vehicles and heavy equipment do not interfere with aircraft operations, as well as that the work area is safe from Foreign Object Debris (FOD) before being returned for flight operations. These overall responsibilities highlight the important role of the WSO in maintaining the highest safety standards in the airside area during the implementation of this construction project.

1. Publication

This Method of Working Plan is prepared in accordance with Section 10:11, Manual Of Standard (MOS) Part 139 Aerodromes. Work operations must be carried out in accordance with this MOWP document.

2. Changes to the MOWP Document

Any changes to the contents of the MOWP document must go through the approval of the person responsible for airport operations and the person responsible for carrying out the work and will be included as an amendment.

3. Time Limits Apply

This Work Plan Method (Method of Working Plan) is valid until the completion of work in accordance with the implementation contract, unless amended or reviewed in this MOWP document.

To provide a visual reference for each stage of the work, drawings must be attached. In addition, drawings must include special information such as work areas, aircraft restrictions, location of radio navigation aids, actual location of visual aids and markings, information about heights and locations of critical obstacles, fixed locations of taxiways, access points, storage areas for materials and equipment , and the location of electrical lines and control cables that may be faulty.

Figure 4. 3 Mobilization path and material disposal location
(Source: Google Earth, accessed May 14, 2024)

Figure 4. 4 Layout of the project requirements
(Source: Google Earth, accessed May 14, 2024)

The MOWP document distribution list in the Inspection Road construction project at Komodo Labuan Bajo Airport involves various parties who play an important role in ensuring the safety and smooth operation of flights. This document must be distributed to the Land Aerodrome Operator, including the project manager or Commitment Officer (PPK), Work Safety Officer (WSO), and Aviation Security Personnel (AVSEC) if any. In addition, contractors acting as project managers, work administrators or consultants, as well as the Director General must also receive this document. Aviation Accident Relief and Fire Fighting (PKP-PK), Air Traffic Services (ATS), Aircraft Operators using Land Aerodrome, and Fixed-base operators are also included in the distribution list. Distribution of this document is very important to ensure that all relevant parties have the information necessary to maintain safety and efficiency during construction work.

The attachment that accompanies this MOWP document includes Table 4.5, which contains a list of worker attendance. This table plays an important role in ensuring accountability and effective supervision during the implementation of the Inspection Road development project at Komodo Airport. This attendance register helps in monitoring the attendance of each worker involved, ensures that all personnel working on the project site are properly recorded, and provides proof of presence required for administrative and safety purposes. Thus, this table becomes an integral part of the document that supports the implementation of the project systematically and in accordance with established procedures.

Table 4.5 Worker Attendance List

WORKERS ATTENDANCE LIST

Day/Date :
Contractor :
Location : Komodo Labuan Bajo Airport
Time :

No	Name	Agency/Company	Position/Title	TTD
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				

12				
13				
14				

The construction of an inspection road using a flexible pavement structure at Komodo Airport in Labuan Bajo, East Nusa Tenggara, involves a multifaceted approach that integrates site analysis, design considerations, construction techniques, and ongoing maintenance. This process begins with a thorough site analysis and geotechnical investigation, crucial for tailoring the pavement structure to local conditions. Given the tropical climate of East Nusa Tenggara, it is imperative to assess soil properties and drainage conditions accurately. The soil characteristics, including its type and bearing capacity, directly influence the pavement design, while the region's high temperatures and humidity levels necessitate specific material choices to ensure long-term performance.

Following the site analysis, the design of the flexible pavement must address both material selection and structural composition. High-quality asphalt mixes suited for the local climate are essential, as they must withstand both the mechanical stresses and environmental conditions. The choice of aggregates also plays a pivotal role; durable, weather-resistant aggregates will enhance the pavement's resistance to wear and degradation. The structural design of the pavement typically involves a layered approach, including subgrade, sub-base, base course, and surface course. Each layer must be designed according to the anticipated load and soil conditions, with appropriate thickness and strength to ensure stability and performance.

Effective construction planning and quality control are critical for achieving a durable pavement. The installation of each layer should follow best practices, including proper compaction and ensuring adequate bonding between layers. Rigorous quality control measures, such as material testing and thickness verification, are necessary to maintain high standards throughout the construction process. Additionally, environmental considerations should be integrated into construction practices. Sustainable methods, such as recycling asphalt and minimizing waste, can mitigate the impact on the local ecosystem and contribute to a more eco-friendly project.

Once the pavement is constructed, ongoing maintenance and inspection are essential for preserving its functionality. Establishing a routine inspection schedule allows for the early detection of issues such as cracks or surface wear, which can be addressed promptly to prevent further damage. A well-defined maintenance plan should include regular tasks like crack sealing and surface cleaning to extend the pavement's lifespan. Furthermore, preparing for emergency repairs is crucial to address any significant damage quickly, ensuring the road remains safe and operational.

Project management and coordination with stakeholders also play a vital role in the success of the construction project. Effective communication with local authorities and stakeholders ensures compliance with regulations and addresses any concerns that may arise. Keeping the local community informed about construction activities, schedules, and potential disruptions helps to minimize inconvenience and foster a positive relationship with the public. Additionally, careful budget management and adherence to the construction timeline are essential to avoid cost overruns and ensure timely project completion.

CONCLUSION

Based on the analysis and calculations carried out in the previous chapter, the conclusions obtained include the following.

1. Site plan analysis was carried out during On the Job Training, that the site plan for the inspection road construction will be 2890 meters long with a road width of 5 meters. The inspection road will be built close to the airport runway and close to the airport perimeter fence, so that it can facilitate operational activities in terms of maintenance and security of the airport even during aircraft operational hours.
2. Inspection road pavement structure planning calculations using flexible pavement structure types with reference to the 2024 Pavement Design Manual, with results including:
   a. AC WC : 50 mm.
   b. Class A Aggregate Foundation Ply: 220 mm.
   c. Class B aggregate foundation layer: 150 mm.
   d. Stabilization of the original soil to reach the equivalent CBR of 6%: 200 mm
3. The results of the thick layer shop drawings for the inspection road can be seen in chapter 4 and the attachment.
4. The Method of Working Plan document was prepared by adapting PR 21 of 2023 regulations in chapter 4 with a comparison using the Airport MOWP Document that was previously published.
5. The standard price of goods refers to the 2024 West Manggarai Regency Work Unit Price, the budget plan for the costs required for the construction of the inspection road is IDR 9,080,825,000.00 (Spelled out nine billion eighty million eight hundred twenty-five thousand rupiah).

To achieve more optimal results in planning the construction of the inspection road at Komodo Labuan Bajo Airport, there are several suggestions that need to be considered. First, considering that the last CBR (California Bearing Ratio) data was taken in 2014, it is recommended that airport managers double-check to obtain the latest and more accurate CBR data, in order to maximize calculations in planning. Second, managers can also carry out studies or recalculations using alternative methods, thereby enabling comparisons of planning results that are more appropriate to field conditions. Apart from that, further analysis of the geometric design also needs to be taken into account so that the inspection road construction plan is more in line with actual conditions in the field. Lastly, it is recommended that the contents of the Method of Working Plan (MOWP) document be adjusted to the specific needs of the project, so that work implementation can run more effectively and efficiently.

REFERENCES

[1] AERODROME MANUAL 2022 Bandara Komodo, UPBU Komodo (2022).

[2] Amaludin, A. H. (2017). *Analisis Perbandingan Tebal Perkerasan Lentur Antara Metode Aashto 1993 Dengan Metode Manual Desain Perkerasan 2017 (Studi Kasus: Jalan Lingkar Luar Barat Kota Surabaya)*, 1–10.

[3] Ardiansari, A. B. (2022). *Perencanaan Jalan Inspeksi Di Bandar Udara Naha.* Politeknik Penerbangan Surabaya. 1–80.

[4] Bamher, B. G. (2020). *Analisis Tebal Perkerasan Lentur Menggunakan Metode Manual Desain Perkerasan Jalan 2017 Pada Proyek Jalan Baru Batas Kota Singaraja-Mengwitani, Buleleng*. 1–44.

[5] Firmansyah, A. Y. A. (2013). *Rancang Bangun Aplikasi Rencana Anggaran Biaya Dalam Pembangunan Rumah*, 1–263.

[6] KM 47 Tahun 2002 Tentang Sertifikasi Operasi Bandar Udara, Kementrian Perhubungan 1 (2002).

[7] Manual Desain Perkerasan Jalan 2017, Kementrian PUPR 31 (2017).

[8] Manual Desain Perkerasan Jalan 2024, Kementrian PUPR 31 (2024).

[9] Method Of Working Plan Pekerjaan Apron, Bandar Udara Sumenep Madura (2020).

[10] Method Of Working Plan Perpanjangan Runway, Bandar Udara Sumbawa (2019).

[11] Method Of Working Plan Wilayah Sisi Udara, Bandar Udara Djalaludin Gorontalo (2023).

[12] Pedoman Tugas Akhir, PPSDMPU (2020).

[13] PM 39 Tahun 2019 Tentang Tatanan Kebandar Udaraan Nasional, Direktorat Jenderal Perhubungan Udara 1 (2019).

[14] Peraturan Presiden NO 70 Tahun 2001 Kebandarudaraan, Presiden Republik Indonesia 1 (2001).

[15] PR 21 Tahun 2023 Manual Of Standard CASR 139 Volume I Aerodrome Daratan, Udara.D.J.P 296 (2023).

[16] Prasetiyo, H., Poernomo, Y. C. S., & Candra, A. I. (2020). Studi Perencanaan Perkerasan Lentur dan Rencana Anggaran Biaya (Pada Proyek Ruas Jalan Karangtalun - Kaliwadir Kabupaten Tulungagung). *Jurnal Manajeman Teknologi dan Teknik Sipil*, *3*, 348–361.

[17] Purwadi, D. (2022). *Evaluasi Tebal Perkerasan Jalan Provinsi Berdasarkan Manual Desain Perkerasan (Mdp) 2017 (Studi Kasus : Jl. Laksamana R.E Martadinata Bandar Lampung, Lampung)*, 1–10.

[18] Sirait, Ferdian Okky Saputra, Supiyan, & Elvina, I. (2020). Perencanaan Tebal Perkerasan Lentur (Flexible Pavement) Menggunakan Metode Manual Desain Perkerasan Tahun 2017. *Teoritis dan Terapan Bidang Keteknikan*, *3*(2), 186–197.

[19] Surat Keputusan 161 IX 2003 Petunjuk Pelaksanaan Perencanaan/Perancangan Landasan Pacu,Taxiway,Apron, Direktorat Jenderal Perhubungan Udara (2003).

[20] Surat Keputusan 347/XII/99 Standar Rancang Bangunan dan/atau Rekayasa Fasilitas dan Peralatan Bandar Udara, Direktorat Jenderal Perhubungan Udara 1 (1999).

[21] Standar Harga Satuan Kab.Manggarai Barat (2022).

[22] Undang-Undang No 1 Tahun 2009 Tentang Penerbangan, Direktorat Jenderal Perhubungan Udara (2009).

[23] Undang-Undang No 15 Tahun 1992 Tentang Penerbangan, Presiden Republik Indonesia (1992).