Ref. No. :- MIAL/CO/AERA-MYTP/2022/2 Dated: - 29th July 2022

The Secretary,
Airports Economic Regulatory Authority of India,
AERA Building, New Administrative Block,
Safdarjung Airport,
New Delhi – 110 003

Subject: - Need for Runway Overlay at Mangaluru International Airport Limited (MIAL)

Dear Sir,

As per DGCA requirement for a longer soft RESA at Rwy 6 end, there is a need to convert 120m of physical pavement at Rwy6 end, which formed part of TORA, TODA and ASDA of Rwy 6. As the declared distances of the Rwy at Mangaluru International Airport is getting reduced due to the conversion of Rwy pavement for soft RESA, there is a need for extension of Rwy towards Rwy 24end. Due to the steep terrain of the land outside the Airport boundary (a level difference of 60m is observed at the external road level from current threshold, 450m east), it was decided by the Operator to limit the Runway length to 2400m. SALS 420m is also not possible at both ends due to this terrain. SALS 360m is only provided on Rwy 6 end and after proposed extension of Rwy, the last two approach lights are going outside the current Airport Boundary. Therefore, a limitation of 300m is expected at Rwy 24 end as well.

MIAL wish to include centerline light as advised by safety committee (headed by Hon'ble Minister of Civil Aviation) in light of recent incident happened at Calicut Airport, as an improved guidance/ additional safety feature for Visual Aids, due to the reduced length of SALS for Rwy length of 2400m. As Mangaluru International Airport is a Code D complaint airport, with International and Cargo Operations during night hours, the proposal for centerline light adds value to the safety of the Runway.

Hence, a flexible overlay is proposed over the existing rigid Runway, to provide for the conduits for centerline lights. The conduit thickness of 50mm for the centerline light has to be freshly laid across the width of the Runway from the duct bank adjacent to Rwy shoulder. The chasing of existing Rigid pavement to conceal the conduits is not recommended as it may affect the life of the pavement. Therefore, it is proposed to have a minimum thickness of 60mm for the DBM layer for this purpose, apart from the upper SDAC and DAC layers.

The existing cross slope of the Runway is not uniform throughout and it varies between 0.7% to 1% at various chainages. While doing a flexible overlay, it is advisable to go for a higher cross slope of 1.5% for easy drainage of rainwater. This enhancement of slope will lead to a higher edge thickness of 39.75cm at the centre of the Rwy. As only 200mm thickness is required for the provision of centre light at the centre, it was decided to optimize the cross slope to 1.4%

so that the centre thickness will be limited to 37.5cm maximum and so as to enable establishment of new linkages to the parallel taxiway.

Due to the virtue of existing slope, in most locations the centerline thickness is in the range of 20-30cm. Minimum edge thickness of 12.5cm is provided at pavement edge, with min. thickness of 30mm for DAC and 35mmthk SDAC as elaborated in Pavement report Attached.

For Mangaluru International Airport Limited

Ashu Madan

(Authorized signatory)

Enclosed: - Annexure 1 – Pavement design report

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1. Pavement Design Approach Methodology

The Federal Aviation Administration (FAA) pavement design method outlined in Advisory Circular 150/5320-6G (2020) is used in the design of the Runway Extension 06-24, Overlay and taxiway pavements. The design approach was selected to warrant a structural life of 20 years flexible and rigid pavements. The selected design process was optimized with the aim to reduce maintenance requirements throughout the design life. The basic design principle is not the maximum load or ultimate load that the pavement can carry, rather the number of load repetitions that the pavement can sustain (fatigue principle).

In FAARFIELD, the airfield pavement design software, fatigue failure is expressed in terms of a cumulative damage factor (CDF). For a single airplane and constant annual departures, CDF can be expressed by the following equation:

$$CDF = \frac{(\text{Annual Departure}) \times (\text{Life in Years})}{\left(\frac{\text{Pass}}{\text{Coverage}}\text{ ratio}\right) \times (\text{Coverage to Failure})}$$

or,

$$CDF = \frac{\text{Applied Coverages Coverages}}{\text{to failure}}$$

When CDF = 1 it indicates that the pavement has used up all of its fatigue life. When CDF < 1, it means that the pavement has some life remaining and the value of CDF gives the fraction of the life used. When CDF > 1, it means that the pavement has exceeded its fatigue life.

A value of CDF greater than 1 does not necessarily mean that the pavement will no longer support traffic, but that it would have failed according to the definition of failure used in the design procedure, and within the constraints of uncertainties in material property assumptions etc.

2. Pavement design considerations

Flexible overlay over rigid pavement is proposed for Rwy 06-24 for the purpose of incorporating inset light fittings as well as slope correction of the existing PQC surface. Fiber glass grid layer is introduced as the interface layer after scarifying the existing surface of PQC layer. Existing rigid pavement crust consists of the following composition.

Existing pavement layers	***Thickness***
PQC	*380mm*
WMM	*150mm*

Table - Existing Pavement crust for Runway 06-24

As per PCN evaluation done with the help of VMHFWD of AAI at Mangalore Airport in 2014 for New Runway 06-24 the value is 80/R/B/W/T (Report attached).

The type of pavement adopted for runway overlay is given in the table below:

Sl. No.	Facility	Pavement /Overlay Type Selected for Design
1.	Recarpeting of Rigid Runway 06/24	Flexible overlay over existing Rigid

Table -2 Pavement Selected for Runway overlay

3.1 Design using FAARFIELD

Pavement design is done using the computer program FAARFIELD2.0.7. FAARFIELD uses layered elastic and three-dimensional finite element-based design procedures for new and overlay designs of flexible and rigid pavements respectively.

3.2 Design Input Parameters

3.2.1 Pavement Life

Design Life in FAARFIELD refers to structural life. Structural life for design is related to the total number of load cycles a pavement structure will carry before it fails. Flexible Pavement is designed for a structural life of 20 years.

3.2.2 Subgrade Strength

The subgrade strength used for the pavement design was derived from the Geotechnical Investigation report furnished by MIAL team. As per the conclusion & suggestions given in geotechnical report it is mentioned to consider design CBR value as 8%. However from the Geotechnical report it was observed that out of 18 test pits, TP nos 10 to 18 were taken adjacent to the Rwy 06-24 for which the CBR test values are tabulated below. CBR value of 10 is considered in FAARFIELD input.

Test pit no.	CBR value
10	17.6 %

11	*7%*
12	*20%*
13	*23.4%*
14	*16.7%*
15	*10.5%*
16	*16.8%*
17	*18.7%*
18	*10.4%*

3.2.3 Air Traffic Type and Frequency

The anticipated aircraft fleet mix considered for pavement design is as follows:

Category	*Aircraft type*
Code C	***A320-200,A321-200, A321 neo, Bombardier Q400, B737-800***

As per the details of Traffic volumes and annual departures collected from MIAL, traffic fleet mix has been derived as follows:

YEAR (FY)	DOM ATM	INTL ATM	TOTAL ATM	DEPARTURE		CAP - 17 ATM/HOUR FOR FY 2040 (NACO - MP)			FLEET MIX
OPERATIONS WILL START FROM FY2024						DESIGN LIFE - 20 YEARS			AS PER NACO
						NO ANNUAL GROWTH CONSIDERED	DOM	FSC NB	10%
2024	11,639	4,053	15,692	7,846		PAVEMENT TYPE - FLEXIBLE		LCC NB	75%
2025	13,524	5,058	18,582	9,292		FOR 24 END LINK TWY, RWY EXTENSION		TURBOPROP	15%
2026	15,522	6,060	21,582	10,791		CBR - 15%	INTL	FSC WB	5%
2027	17,592	6,958	24,550	12,276		DESIGN TRAFFIC - 100%		LCC WB	5%
2028	19,687	7,815	27,502	13,752		FOR 06 END LINK TWY, APRON TAXILANE		FSC NB	15%
2029	21,652	8,661	30,313	15,157		CBR - 10%		LCC NB	75%
2030	23,045	9,376	32,421	16,211		DESIGN TRAFFIC - 100%			
2031	24,073	9,878	33,951	16,976				NB	87.50%
2032	25,128	10,393	35,521	17,761					50% of WB to NB
2033	26,216	10,925	37,141	18,571				TUROPROP	12.50%
2034	27,789	11,417	39,206	19,603					50% of WB to Turboprop
2035	29,457	11,930	41,387	20,694				NB	17,061
2036	31,224	12,467	43,691	21,846				TURBOPROP	2,438
2037	33,098	13,028	46,126	23,063					FLEET MIX
2038	35,083	13,614	48,698	24,349					AS PER KITCO
2039	37,013	14,176	51,189	25,595					
2040	39,049	14,761	53,809	26,905				A320 (NB)	35%
2041	41,196	15,370	56,566	28,284					
2042	43,462	16,004	59,466	29,733				B737 (NB)	35%
2043	45,853	16,664	62,516	31,258					
								Q400/ATR 72	30%
		ANNUAL AVG DEP		19,498					

Table -4- ATM FORECAST

3.2.4 Load

Pavements should be designed for the maximum anticipated takeoff weights of the airplanes in the fleet regularly operating on the section of pavement being designed.

3.2.5 Landing Gear Type and Geometry

Gear type and configuration dictate how airplane weight is distributed to a pavement and how the pavement responds to airplane loadings.

3.2.6 Tire Pressure

Tire pressure varies depending on gear configuration, gross weight, and tire size. For flexible pavements constructed with a high stability asphalt, tire pressures up to 1.75 MPa may be accommodated. Tire pressure has a negligible impact on rigid pavement design.

3.2.7 FAARFIELD Material Properties

In FAARFIELD, pavement layers are assigned a thickness, elastic modulus, and Poisson's ratio. The same layer properties are used in flexible and rigid analysis. Poisson's ratio is fixed for all materials and the elastic moduli are either fixed or variable depending upon the material.

Designed pavement cross sections (Faarfield outputs attached as annexure)are given in below table:

Table -5- Recommended Pavement overlay Design

RECOMMENDED PAVEMENT OVERLAY DESIGN			
Material Type	***Layer Item***		***Thickness (mm)***
	FAA	***Indian***	
1. Pavement Overlay for RWY 06-24 (Flexible overlay over rigid)			
Hot Mixed Asphalt Surface	*P-401*	*DAC/SDAC*	*125 (50+75)*
Flexible Stabilised Base	*P-403*	*DBM*	*100*
Total Thickness			***225***

ANNEXURE- 1
FAARFIELD SECTION REPORT

Federal Aviation Administration FAARFIELD 2.0 Section Report

FAARFIELD 2.0.7 (Build 09/14/2021)

Job Name: AMIAL Rwy overlay

Section: HMA on Rigid rwy

Analysis Type: HMA on Rigid

Last Run: Thickness Design 2022-02-11 13:00:44

Design Life = 20 Years

Total thickness to the top of the subgrade = 631mm

Pavement Structure Information by Layer

No.	Type	Thickness mm	Modulus MPa	Poisson's Ratio	Strength R MPa
1	P-401/P-403 HMA Overlay	100.6	1379	0.35	0
2	P-501 PCC Surface	380.0	27579	0.15	4.5
3	P-209 Crushed Aggregate	150.0	269	0.35	0
4	Subgrade	0	100	0.4	0

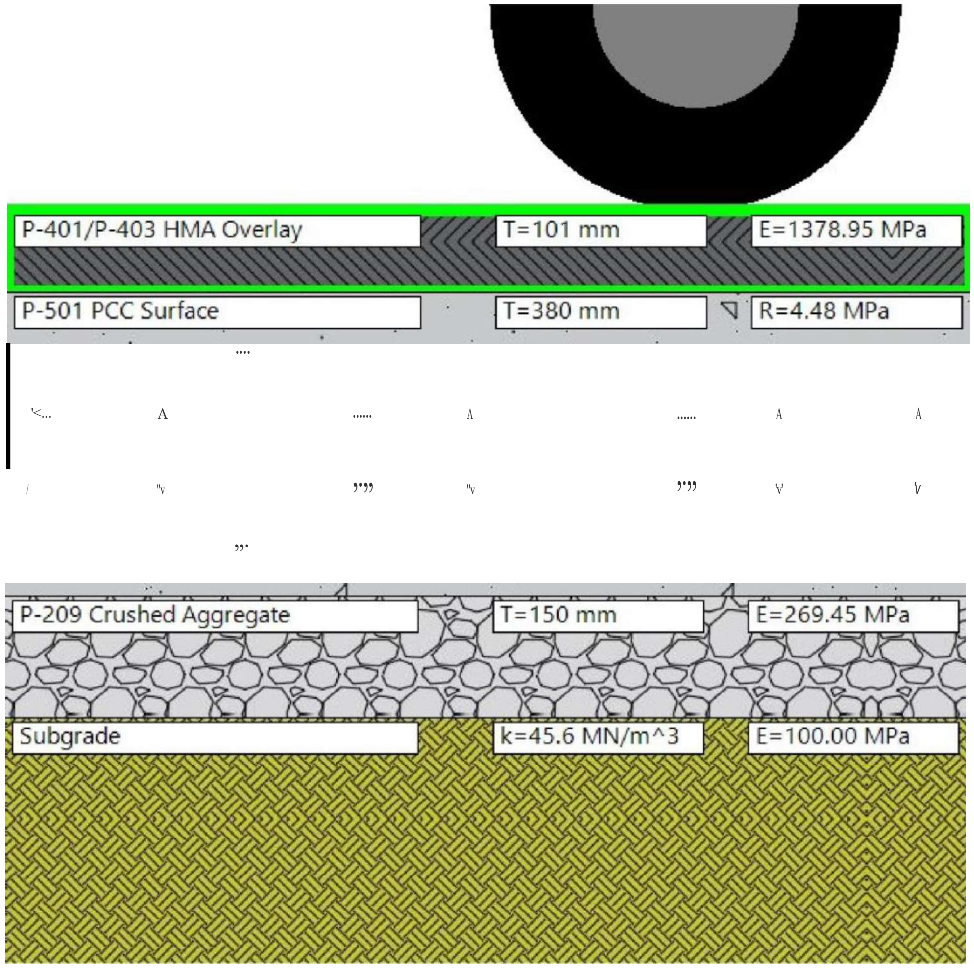
Airplane Information

No.	Name	Gross Wt. kg	Annual Departures	% Annual Growth
1	A321-200 opt	93900	6824	0
2	Bombardier CL-604/605	21863	2925	0
3	B737-800	79242	6824	0
4	Q400/Dash 8 Series 400	29347	2925	0

Additional Airplane Information

No.	Name	CDF Contribution	CDF Max for Airplane	P/C Ratio
1	A321-200 opt	0.00	0.00	0
2	Bombardier CL-604/605	0.00	0.00	0
3	B737-800	0.00	0.00	0
4	Q400/Dash 8 Series 400	0.00	0.00	0

User Is responsible For checking frost protection requirements.



P-401/P-403 HMA Overlay
T=101 mm
E=1378.95 MPa
P-501 PCC Surface
T=380 mm
R=4.48 MPa
P-209 Crushed Aggregate
T=150 mm
E=269.45 MPa
Subgrade
k=45.6 MN/m^3
E=100.00 MPa