Design of AC - 25 asphalt mixture proportioning on the taxiway of Shenzhen Baoan International Airport

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Abstract. According to the growing demand for air transport industry, an extension of the associated taxiway is required, so the Shenzhen Airport runway west of the taxiway expansion is imperative. Combined with the taxiway of Shenzhen Baoan International Airport, we design the lower layer type of AC-25 modified asphalt mixture ratio. We analysis from raw material selection, mixture gradation design and admixture added, and finally choose the excellent performance of asphalt mixture.

1. Introduction

In a survey of the airport, we find that Shenzhen Baoan International Airport is damaged on the taxiway, it serious impacts on the pavement service, and brings great trouble to the normal operation of the aircraft ; so we design the lower layer type of AC-25 modified asphalt mixture ratio, we analyze the lower layer type of AC-25 modified asphalt mixture ratio design and find he excellent performance of asphalt mixture to improve the performance of high temperature and water temperature of airport pavement.

2. Raw materials

2.1. Aggregate

There are 15-30mm, 10-20mm, 10-15mm, 5-10mm and 0-5mm aggregates, We teste the aggregate indexes in accordance with the relevant regulations , the test results are shown in table 1.

Table 1 The Coarse aggregate technical indicators

Test items		Test results	Technical requirements	Test method
Bulk specific gravity	15~30mm	2.690	—	T 0304
	10~20mm	2.721		
	10~15mm	2.808		
	5~10mm	2.659		
Apparent specific gravity	15~30mm	2.710	≥2.50	T 0304
	10~20mm	2.743		
	10~15mm	2.841		
	5~10mm	2.713		

From table 1, we can see all the technical indicators of the diabase coarse aggregate meet the specification requirements, and they can be used in the design and engineering.

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Table 2 The Coarse aggregate Particle gradation

mesh size (mm)	P(%)							
	10～30mm		10～20mm		10～15mm		5～10mm	
	Technical requirements	Test results	Technical requirements	Test results	Technical requirements	Test results	Technical requirements	Test results
31.5	90～100	100	—	100	—		—	
26.5	—	89.7	100	100	—	100	—	100
19	—	2.9	95～100	78.3	—	100	—	100
16	—	0.3	—	36	—	100	—	100
13.2	—	0.3	—	15.5	95～100	83.8	100	100
9.5	0～15	0.3	0～15	2.8	0～15	18.1	95～100	98.6
4.75	0～5	0.3	0～5	0.3	0～5	0.6	0～10	8.3
2.36	—	0.3	—	0.3	—	0.4	0～5	2.1
1.18	—	0.3	—	0.3	—	0.4	—	1.7
0.6	—	0.3	—	0.3	—	0.4	—	1.5
0.3	—	0.3	—	0.3	—	0.4	—	1.5
0.15	—	0.3	—	0.3	—	0.4	—	1.5
0.075	—	0.3	—	0.3	—	0.4	—	1.5

From table 2, we can see some passing rate of coarse aggregate can not meet the requirements of specification. We should strictly control the quality of the aggregate in the construction in order to make the passing rate and meet the specification requirements.

Table 3 The DIABASE FINE aggregate technical indicators

Test items	Technical requirements	Test results
		0~5mm
Apparent specific gravity(g/cm^3)	≥2.50	2.685
Sand equivalent(%)	≥60	81
Sturdiness(%)	≤12	5.3

Table 4 The DIABASE FINE aggregate Particle gradation

mesh size (mm)	P(%)	
	0～5mm	
	Technical requirements	Test results
9.5	100	100
4.75	85～100	100
2.36	40～70	82.0
1.18	—	53.6
0.6	—	36.9
0.3	—	27.1
0.15	—	22.8
0.075	0～15	18.7

From table 3 and 4, we can see some passing rate of diabase fine aggregate cannot meet the requirements of specification. We should strictly control the quality of the aggregate in the construction in order to make the passing rate and meet the specification requirements.

2.2. Filler

The filler is milled limestone powder, they all meet the technical requirements, and the test results are shown in table 5.

Table 5 The Mineral filler technical indicators

Test items		Technical requirements	Test results
Apparent specific gravity(g/cm^3)		≥2.50	2.881
Water content(%)		≤1	0.3
Particle gradation	＜0.6mm	100	100
	＜0.15mm	90～100	100
	＜0.075mm	75～100	99.3
Hydrophilic coefficient		≤1	0.8

From table 5, we can see filler technical indexes meets the specification requirements, it can be used in the design and engineering.

2.3. Asphalt

There are Maoming SBS modified asphalt, we test the asphalt indexes in accordance with the relevant regulations, they all meet the technical requirements (table 6).

Table 6 MAOMING SBS modified asphalt performance test results

Test items		Technical requirements	Test results
Penetration(25℃,100g,5s)(0.1mm)		40~70	53.5
Softening point(℃)		＞75	76.8
Ductility(5cm/min,10℃)(cm)		＞40	53.3
Equivalent softening point T_{800}(℃)		＞50	52
Equivalent brittle point$T_{1.2}$(℃)		＜-8	-12.6
Flash point(COC)(℃)		＞250	265
Density (25℃)(g/cm^3)		实测	1.032
Elastic recovery(15℃)		＞75	96
Filmy heating operational test163℃/5h	Mass loss(%)	＜1	0.2
	Penetration ratio(%)	＞70	66.9
	Ductility(10℃)(cm)	＞30	31.5

Test results show that the modified asphalt technology indexes meet the requirements.

2.4. Anti-rutting agent

Add 0.6% of the asphalt mixture quality anti-rutting agent can gain higher dynamic stability of mixture. Anti rutting agent basic indexes are testsd in table 7.

Table 7. Anti rutting agent basic indexes test results

Test items	Technical requirements	Test results
Density (g/cm^3)	0.9~1.1	0.96
Melt flow rate(190℃,2.16kg)(g/10min)	≥3	8
Water content(%)	≤2	0.6
Softening point(℃)	110~150℃	145

From table 7, we can see anti-rutting agent of all the indicators meet the technical requirements and it can be used in the design and engineering.

3. Mix design of AC-25 asphalt mixture

3.1. Aggregate gradation design

The mix design is adopted for the mineral aggregate gradation of skeleton dense structure. The matching is in table 8 and table 9.

Table 8 Ac-25 ratio of mineral aggregate gradation

specifications	10-30mm	10-20mm	10-15mm	5-10mm	0-5mm	Mineral powder
The percentage (%)	10	24	14	12	35	5

Synthetic mineral *aggregate gradation is shown in table and figure.*

Table 9 AC-25 mineral synthesis aggregate gradation

Mesh size (mm)		31.5	26.5	19	16	13.2	9.5	4.75	2.36	1.18	0.6	0.3	0.15	0.075
p (%)	upper	100	100	90	80	73	63	52	42	32	25	18	13	7
	lower	100	95	75	62	53	43	32	25	18	13	8	5	3
	middle	100	97.5	82.5	71	63	53	42	33.5	25	19	13	9	5
	synthetic	100	98.7	83.0	74.2	67.7	55.1	37.3	26.6	21.1	15.9	13.0	11.0	9.7

3.2. The determination of the optimum proportion

We select 5 asphalt aggregate ratio of Marshall test and calculate their physical indicators in order to determine the optimum proportion, the test results are shown in table 10 and figure 1.

Table 10 The Marshall test results of different asphalt aggregate ratio

Asphalt-aggregate ratio(%)	Theoretical density(g/cm^3)	Bulk density(g/cm^3)	VV(%)	VMA(%)	VFA(%)	MS(KN)	Flow value (0.1mm)
3.1	2.592	2.408	7.1	14.3	50.5	12.2	21.4
3.6	2.573	2.415	6.1	14.5	57.7	12.4	24.9
4.1	2.555	2.442	4.4	14.0	68.4	15.2	32.4
4.6	2.537	2.452	3.4	14.0	76.1	13.1	39.4
5.1	2.519	2.455	2.6	14.4	82.2	12.7	40.6
Technical requirements	—	—	3～5	≥12	55～70	＞8	20～40

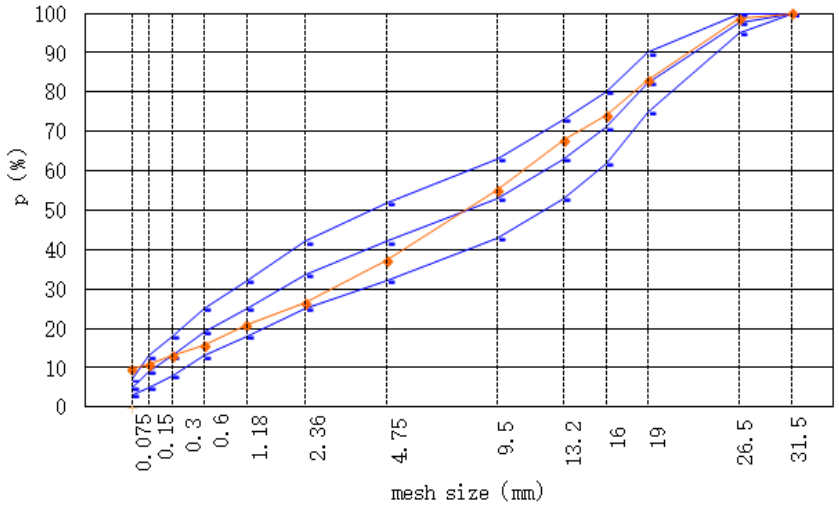

Figure 1. AC-25 grading curve

According to the requirements of the relevant specification, calculated the optimum proportion of 4.2%.

3.3. Road performance verification

we make road performance of verification AC-25asphalt mixture in the optimum asphalt aggregate ratio of 4.2%, the test results are shown in table 11.

Table 11 The Road performance verification test results

Test items	Test results	Technical requirements
MS(KN)	15.1	＞8
FL(0.1mm)	32.7	20～40
MSo(%)	93.3	≥80
TSR(%)	95.7	≥80
DS(time/mm)	17402	≥10000
Cw(mL/min)	No seepage	—

From the above test results, all the indexes can meet the requirements of related technologies in the optimum proportion 4.2%.

Adding anti-rutting agent quality of 0.6% asphalt mixture, dynamic stability of asphalt mixture arrives at 17402 times/mm, it meets the design requirements. we can see that the mixture has formed the skeleton dense structure from the profile of the specimen, it meets with the skeleton dense type AC asphalt mixture design intent.

4. Conclusion

For the analysis of AC - 25 mix proportion design of asphalt mixture, in order to improve the performance of asphalt mixture, we can adopt the following measures.

I) We should strictly control each index of the aggregate, all indicators are within the specification limits.

II) We should be reasonable to add additives, such as anti-rutting agent.

III) It is better to choose skeleton dense type of grading.

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