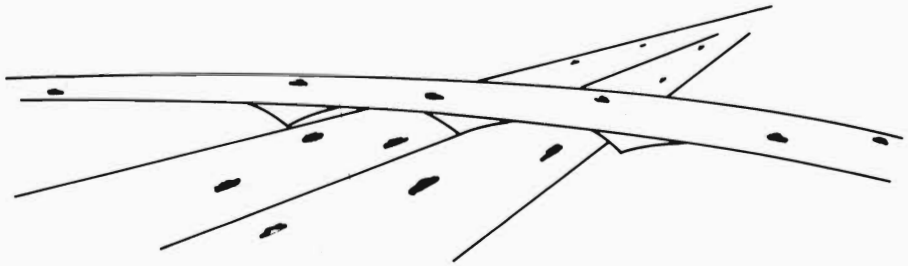

DEPARTMENTAL RESEARCH

Report Number: SS 15.6

DESIGN OF HOT MIX ASPHALTIC CONCRETE BY THE WEIGHT RATIO METHOD

TEXAS HIGHWAY DEPARTMENT

DESIGN HOT MIX ASPHALTIC CONCRETE

BY

THE WEIGHT RATIO METHOD

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DESIGNING HOT MIX ASPHALTIC CONCRETE

BY

THE WEIGHT RATIO METHOD

PURPOSE

The purpose of this report is to establish a method for adjusting current gradation specifications and to establish a fair bidding method for HMAC when using aggregates with wide differences in specific gravities.

DISCUSSION

The current specifications for HMAC were written for natural aggregates which have essentially the same specific gravities. Due to the introduction of lightweight aggregates, with the specific gravities varying from 1.10 to 2.00, present gradation specifications are not applicable. Equivalent mixes vary in weight as much as fifty percent. The heaviest mixes are favored when bidding by the ton.

The procedure explained in this report will correct for the variations in specific gravities for all aggregates without changing the present specifications. The gradation specifications and pay quantities are adjusted to one standard specific gravity.

DESIGN PROCEDURE

The mechanics of designing by the weight ratio method are the same as the procedure normally followed for a standard HMAC design (See Construction Bulletin, C-14 and Texas Test Procedures, Tex-200F). This procedure requires one additional calculation to correct for the variations in the specific gravities of the various mineral aggregates. To establish the

blend percentages for the aggregates which will meet the gradation specification, assume that all of the mineral aggregates have an equivalent specific gravity. After an acceptable gradation design is established, correct the blend percentages by adjusting the actual specific gravities of the aggregate to a standard specific gravity. For this report a standard specific gravity of 2.60 was selected. The adjusted gradation percentages are used to determine the actual gradation for plant control.

The calculations involved for this procedure are shown in Figures I, II and III. Figure I shows the calculations necessary to establish a gradation design which meets the specifications. Figure II shows the calculations necessary for correcting the variations in the specific gravities of the mineral aggregates. Figure III shows the calculations necessary to establish the design which will be used for plant control.

MEASUREMENT & PAYMENT

The current specifications for HMAC require that the asphalt and the aggregate be measured separately by the ton. Payment is based upon these two measurements.

To establish a fair bidding method for all aggregates, payment for the aggregates should be made for an equivalent ton based upon a standard specific gravity. The equivalent ton is based upon a ratio of a standard specific gravity and the actual specific gravity of the aggregate. The adjusted tons are calculated as follows:

$$\text{Adjusted Tons} = (\text{Actual Tons}) \frac{(2.60)}{(\text{Actual Specific Gravity})}$$

The actual specific gravity of the aggregate is obtained from the design for plant control.

HMAC DESIGN CONTROL WORKSHEET

(WEIGHT RATIO METHOD)

ITEM 340, TYPE D

Lab. No.	Materials	Producer	Pit	Sp. Gr.
18-71-2441	Lt. Wt. Aggr.	Texas Industries	Dallas Plant	1.228
18-71-2266	Limestone Scrns.	Texas Industries	Boonsville	2.650
18-71-2147	Concrete Sand	Lone Star	Kleberg	2.674
18-71-2146	Field Sand	Robertson Contr. Co.	Scoggins Pit	2.648
	Asphalt (AC-20)	American Petrofina	Mt. Pleasant	1.030

Percents Sieve Sizes	20.0% Field Sand		8.0% Conc. Sand		14.0% Scrns.		58.0% Lt. Wt.		100% Comb.	General Specs.
+ 1/2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1/2-3/8	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.1	0.1	0-5
3/8-4	0.0	0.0	0.4	0.0	2.0	0.3	63.8	37.0	37.3	20-50
4-10	0.0	0.0	4.1	0.3	25.0	3.5	33.6	19.5	23.3	10-30
+ 10	0.0	0.0	4.5	0.3	27.0	3.8	97.6	56.6	60.7	50-70
10-40	2.8	0.6	29.0	2.3	45.0	6.3	1.5	0.8	10.0	0-30
40-80	59.2	11.8	61.0	4.9	10.0	1.4	0.3	0.2	18.3	4-25
80-200	36.1	7.2	5.0	0.4	7.0	1.0	0.2	0.2	8.8	3-25
-200	1.9	0.4	0.5	0.1	11.0	1.5	0.4	0.2	2.2	0-6
Total	100.0	20.0	100.0	8.0	100.0	14.0	100.0	58.0	100.0	

HMAC GRADATION CONVERSION WORKSHEET

(CORRECTION FOR SPECIFIC GRAVITY)

ITEM 340, TYPE D

Standard Specific Gravity - 2.600

Materials	Design %	Sp. Gr.	Corrected Ratio	Plant %
Lt. Wt. Aggr.	58.0	1.228	27.376	39.0
Limestone Scrns.	14.0	2.650	14.266	20.3
Concrete Sand	8.0	2.674	8.224	11.7
Field Sand	20.0	2.648	20.360	29.0
TOTAL	100.0	--	70.226	100.0

$$\text{Corrected Ratio} = (\text{Design \%}) \left(\frac{\text{Sp. Gr.}}{\text{Std. Sp. Gr.}} \right)$$

$$\text{Plant Control Percents} = \frac{\text{Individual ratios (100)}}{\text{Sum of Ratios}}$$

HMAC PLANT CONTROL WORKSHEET

(WEIGHT RATIO METHOD)

ITEM 340, TYPE D

Lab. No.	Materials	Producer	Pit	Sp. Gr.
18-71-2559	Lt. Wt. Aggr.	Texas Industries	Dallas Plant	1.228
18-71-2266	Limestone Scrns.	Texas Industries	Bonnsville	2.650
18-71-2147	Concrete Sand	Lone Star	Kleberg	2.674
18-71-2146	Field Sand	Robertson Constr. Co.	Scoggins Pit	2.648
	Asphalt	American Petrofina	Mt. Pleasant	1.030

PLANT CONTROL DESIGN

Percents Sieve Sizes	29.0% Field Sand		11.7% Conc. Sand		20.3% Scrns.		39.0% Lt. Wt.		100% Comb.	Mix Design	Design Tol.
+ 1/2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0
1/2-3/8	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	± 5
3/8-4	0.0	0.0	0.4	0.0	2.0	0.4	56.5	22.0	22.4	20.3	± 5
4-10	0.0	0.0	4.1	0.5	25.0	5.1	37.0	14.5	20.1	18.2	± 5
+ 10	0.0	0.0	4.5	0.5	27.0	5.5	93.6	36.5	42.5	38.5	± 5
10-40	2.8	0.8	29.0	3.4	45.0	9.1	4.9	1.9	15.2	13.8	± 3
40-80	59.2	17.2	61.0	7.1	10.0	2.0	0.7	0.3	26.6	24.1	± 3
80-200	36.1	10.5	5.0	0.6	7.0	1.4	0.4	0.2	12.7	11.5	± 3
-200	1.9	0.5	0.5	0.1	11.0	2.3	0.4	0.1	3.0	2.7	± 3
Total	100.0	29.0	100.0	11.7	100.0	20.3	100.0	39.0	100.0	90.6	
									Asphalt	9.4	± 0.5

Asphalt Content	Actual Sp. Gr.	Theo. Sp. Gr.	% Density	% Stability	Cohesiometer Values
8.4	1.592	1.697	93.8	51	301
9.1	1.595	1.686	94.6	49	278
9.7	1.609	1.676	96.0	49	331
10.4	1.612	1.667	96.7	52	381