ATT-61/95 AGGREGATE PROPORTIONING

1.0 SCOPE

This procedure describes the methods used to proportion aggregates.

2.0 EQUIPMENT

calculator
Data Sheet: Aggregate Proportioning Chart, MAT 6-57.

3.0 PROCEDURE

If the percent proportions of two aggregates are known, their combined gradation can be determined using:

a) The Aggregate Proportioning Chart as per section 3.1.1, or

b) Through calculations as per section 3.1.2.

Section 3.2 deals with verifying or determining the percent split of a coarse and fine aggregate stockpile with the use of the Aggregate Proportioning Chart.

3.1 Determining Combined Gradations

3.1.1 Using Aggregate Proportioning Chart

1. Enter on the Aggregate Proportioning Chart the average grading of the coarse and fine stockpiles, the gradation limits and the percent proportions given by the contractor in the appropriate tables on the right side of the form, as shown in Figure 1.

2. For aggregate A (coarse), use the percent scale shown on the left side of the chart to plot the percent passing the 80 µm sieve.

3. For aggregate B (fine), plot on the right side of the chart the percent passing the 80 µm sieve.

4. Join the two points with a straight line.

5. Repeat steps 2 and 3 above for each of the remaining sieves.

6. Plot the minimum and maximum aggregate gradation specifications on the corresponding sieve line.

7. Join the gradation specification limit points on the right side of the chart, as shown in Figure 2. This is usually the maximum specification line.

8. Join the gradation specification limit points on the left side of the chart. This is usually the minimum specification line.

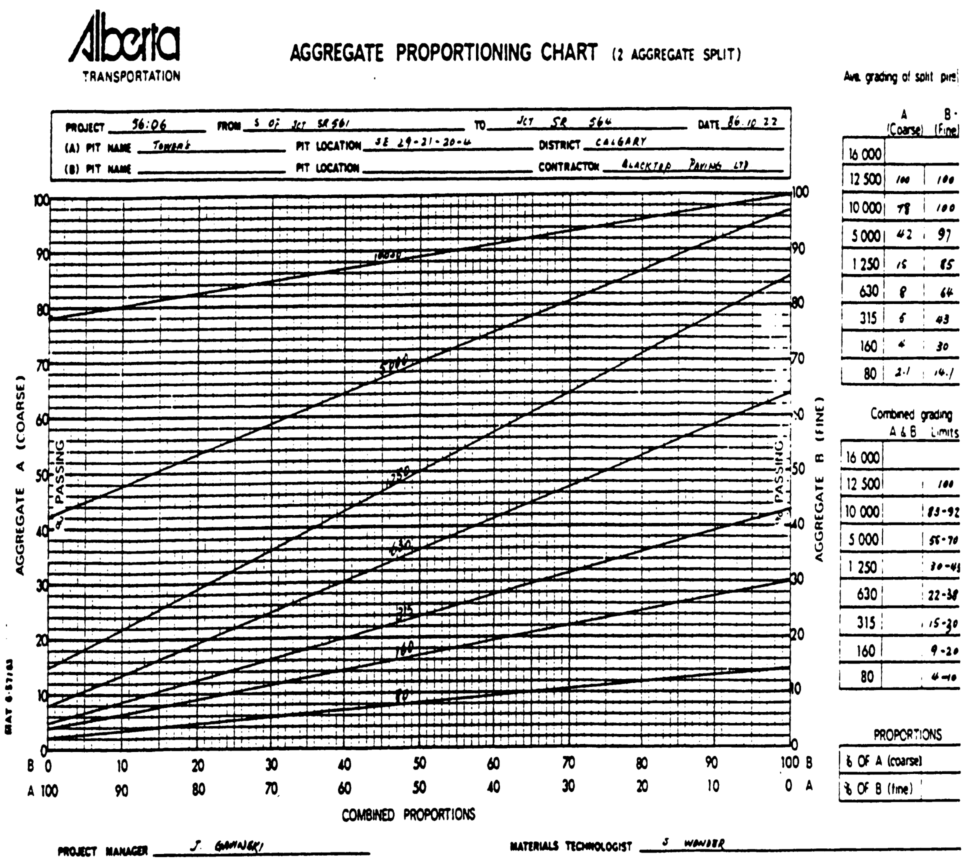

FIGURE 1

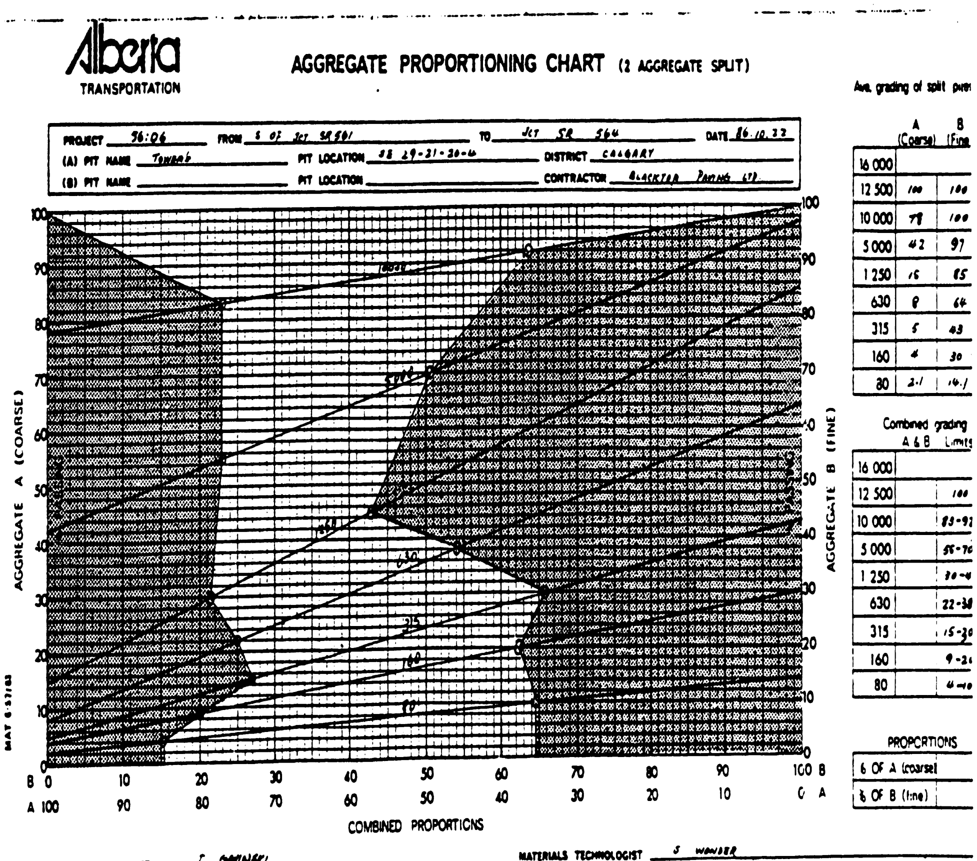

FIGURE 2

NOTE: The darkened area(s) outside the gradation specification lines are outside the limits of the gradation specifications.

9. Use the scale of the combined proportions shown at the bottom of the chart and draw a vertical line through the chart at the given proportions. An example is shown in Figure 3.

10. Pick off the chart, the combined grading for each sieve size as follows:

    a) Proceed along the vertical line to where it intercepts each sieve line.

    b) Then proceed horizontally to the edge of the chart and read the combined percent passing for that sieve.

11. Record the combined grading for each sieve in the appropriate table on the right side of the chart.

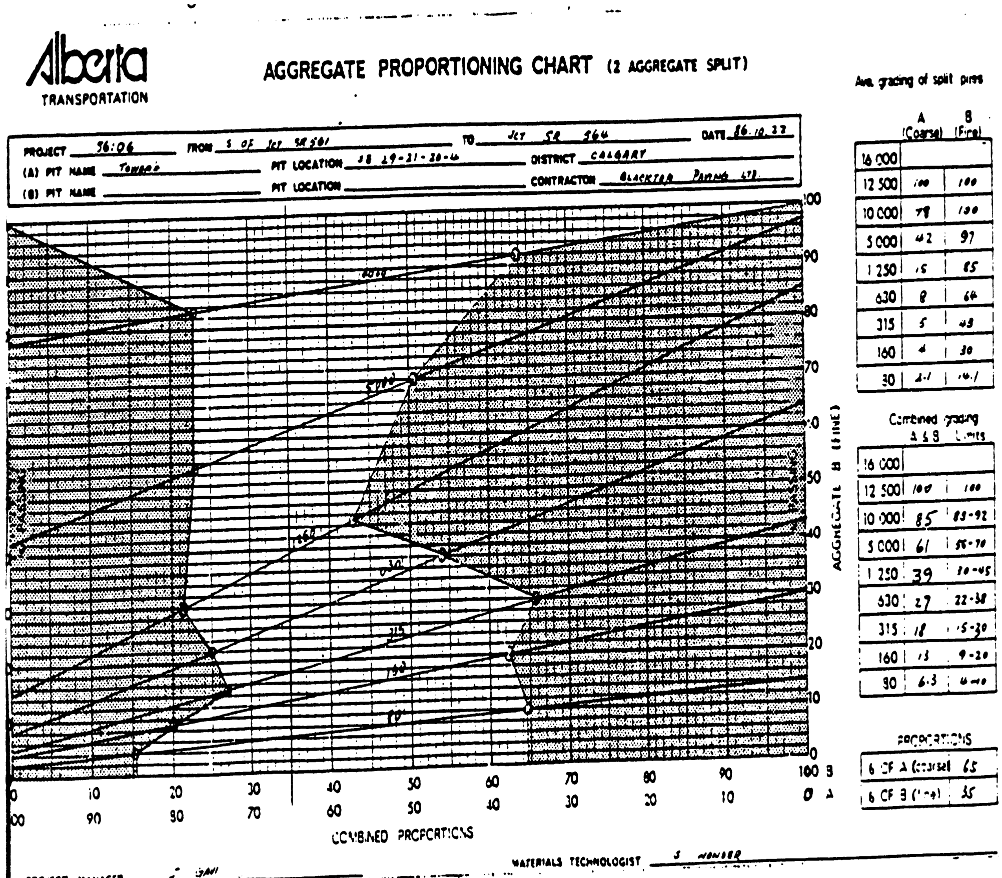

FIGURE 3

3.1.1.1 Addition of Blend Sand

If after completing section 3.1.1 the combined gradation of a split stockpile cannot meet the specifications limits, as shown in Figure 4, blend sand is often added to the aggregate.

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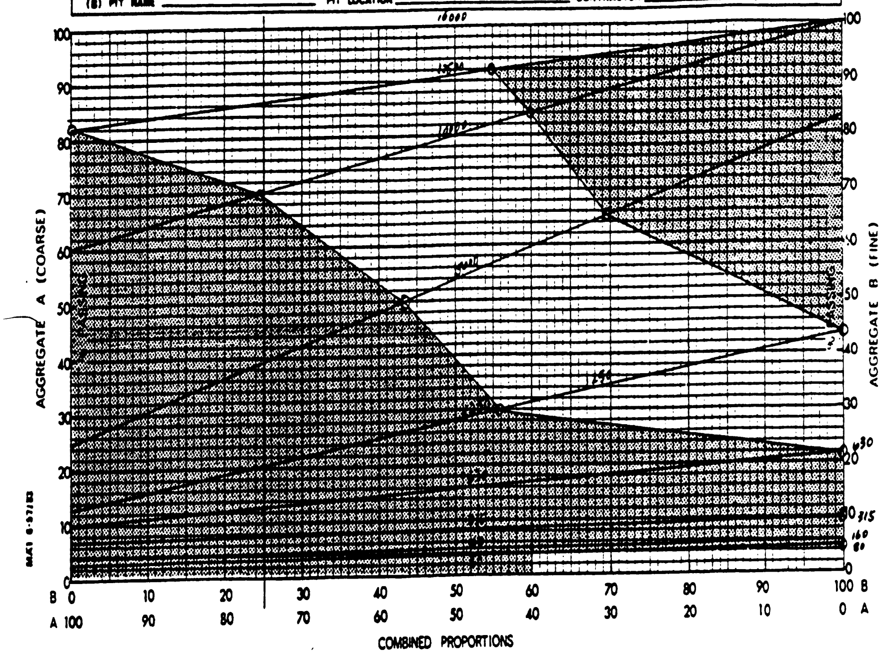
AGGREGATE PROPORTIONING CHART (2 AGGREGATE SPLIT)

PROJECT 40:30 FROM WILDKAY RIVER TO ALTA. RESOURCES DATE 86.10.22
(A) PIT NAME TWELVE MILE CREEK PIT LOCATION SW 10-53-27-5 DISTRICT EDSON
(B) PIT NAME PIT LOCATION CONTRACTOR BEDROCK CONSTRUCTION



Ave. grading of split p

	A (Coarse)	B (Fine)
16 000	100	
12 500	82	100
10 000	60	100
5 000	26	83
1 250	13	44
630	10	22
315	7	10
160	4	6
80	2.6	4.8

Combined gradin

	A & B	Lim
16 000		100
12 500	87	80-92
10 000	70	70-84
5 000	39	50-65
1 250	21	30-45
630	13	22-38
315	8	15-30
160	5	9-20
80	3	6-10

PROPORTIONS

% OF A (coarse)	75
% OF B (fine)	25

PROJECT MANAGER I. M. GOOD MATERIALS TECHNOLOGIST B. DONE

FIGURE 4

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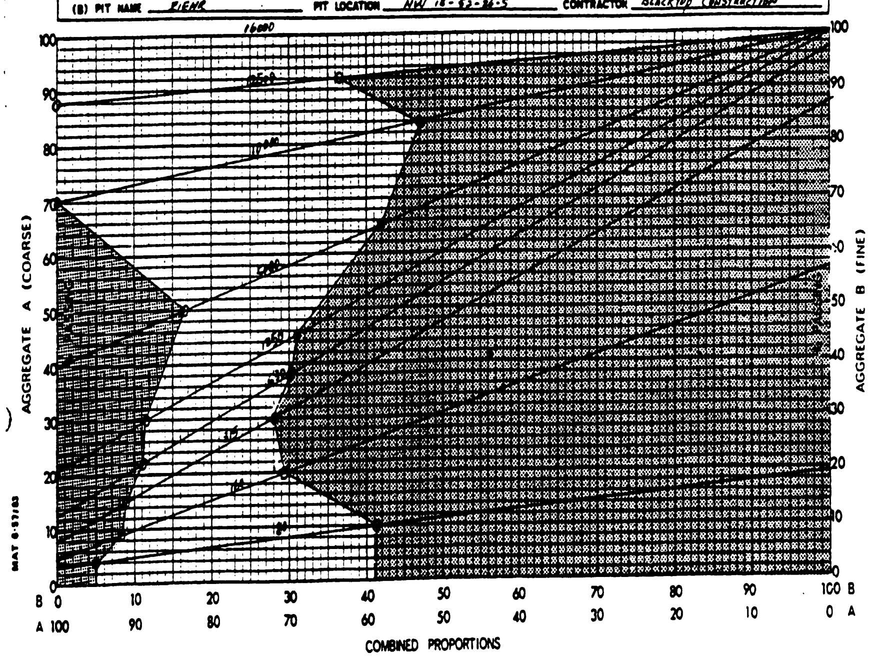
AGGREGATE PROPORTIONING CHART (2 AGGREGATE SPLIT)

PROJECT 40:30 FROM WILDWAY RIVER TO ALTA RESOURCES DATE 86.10.22
(A) PIT NAME TWELVE MILE CREEK PIT LOCATION SE 10-53-27-5 DISTRICT EDSON
(B) PIT NAME RIEHR PIT LOCATION NW 18-52-26-5 CONTRACTOR BLACKTOP CONSTRUCTION



Ave. grading of split pit

	A (Coarse)	B (Fine)
16 000	100	
12 500	87	100
10 000	70	100
5 000	39	100
1 250	21	100
630	13	97
315	8	87
160	5	57
80	3	19.4

Combined grading

	A & B	Limits
16 000		100
12 500	90	80-9
10 000	76	70-8
5 000	52	50-65
1 250	37	30-45
630	30	22-38
315	24	15-30
160	15	9-20
80	6.5	4-10

PROPORTIONS

% OF A (coarse)	80
% OF B (fine)	20

PROJECT MANAGER I. M. GOOD MATERIALS TECHNOLOGIST B. DONE

FIGURE 5

In order to determine the proper proportion of blend sand required to bring the combined gradation within specifications:

1. Determine the average gradation of the sand to be used. Record the percent passing the corresponding sieve as Average Grading of Split Piles, column "B" (Fine), on a second Aggregate Proportioning Chart as shown in Figure 5.

2. Transfer the combined grading (which did not meet specifications) from the previous chart to column "A" (Coarse).

3. Enter the specification limits on the Combined Grading Limits column.

4. Repeat steps 2 to 7 of Section 3.1.1.

5. Draw a vertical line slightly to the left of centre of the area outlined by the specifications band.

   NOTE: The location of the vertical line used to determine the % proportions is subject to the cost, hauling and availability of the blend sand.

6. Pick off the chart, the combined grading for each sieve size as follows:

   a) Proceed along the vertical line to where it intercepts each sieve line.

   b) Then proceed horizontally to the edge of the chart and read the combined percent passing for that sieve.

7. Record the combined grading for each sieve in the appropriate table on the right side of the chart.

8. Extend the line through both "Combined Proportions" scales "A" and "B" shown at the bottom of the graph.

9. Pick off the percentage at which the vertical line intersects scale "B" and record as "% of B (Fine)". This is the percent of blend sand required to be added to the split stockpile so that its gradation will meet the specifications.

10. Pick off the percentage at which the vertical line intersects scale "A" and record as "% of A (Coarse)". This is required percent of the combined coarse and fines stockpiles.

11. Multiply the original percent proportions given by the contractor by the combined percent proportions obtained in step 10 above and divide the result by 100. The result is the percent of coarse and percent of fines required from each stockpile for the combined coarse, fines and blend sand to meet specifications.

    ie. Original percent split of coarse = 60%

    Original percent split of fine = 40%

    Combined percent proportion required = 88%

Since, only 88% of the combined coarse and fine aggregate will be used, the original percent split of coarse and fine material will be reduced as follows:

% Coarse = 0.88 x 60% = 53%

% Fine = 0.88 x 40% = 35%

Therefore, the design split will be 53% coarse, 35% fines and 12% blend sand.

3.1.2 Calculation Method

The gradation of the combined aggregate can also be calculated using the known percent proportions and the average grading of the fine and coarse stockpiles. The procedure is as follows:

1. Obtain average gradation of the fine and the coarse stockpiles using the sieve analysis results obtained during splitting and crushing operations.

2. Obtain from the crushing contractor the percent split, that is, the proportion of aggregate crushed for each pile in relation to the total material produced in both piles.

   ie. Total aggregate crushed = 60 000 tonnes
   Weight of coarse aggregate = 33 000 tonnes
   Weight of fine aggregate = 27 000 tonnes

   The proportions of each aggregate is calculated as follows:

$$\%\ Coarse = \frac{33000}{60000} \times 100\% = 55\%$$

$$\%\ Fines = \frac{27000}{60000} \times 100\% = 45\%$$

3. For the "Coarse" stockpile, determine the proportioned percent passing each sieve using the formula:

$$Proportioned\ \%\ Passing\ Sieve = \frac{\%\ Split\ of\ Coarse\ Agg \times Ave.\ \%\ Passing\ Sieve}{100\%}$$

4. For the "Fines" stockpile, calculate the proportioned percent passing each sieve as follows:

$$Proportioned\ \%\ Passing\ Sieve = \frac{\%\ Split\ of\ Fine\ Aggregate \times Ave.\ \%\ Passing\ Sieve}{100\ \%}$$

5. Add the result of step 3 to the result of step 4 obtained in the corresponding sieve size. The resulting percentage is the gradation of the two stockpiles if combined at the given proportions. To aid in the calculations, a table may be set up as follows:

Stockpile	Sieve Size (µm)	12 500	10 000	5 000	1 250	630	315	160	80
Coarse	A. Average % Passing	100	83	39	23	21	19	13.9	6.1
	B. Coarse % split	55	55	55	55	55	55	55	55
	C. Proportioned % $\frac{(AB)}{100}$	55.0	45.7	21.5	12.7	11.6	10.5	7.7	3.4
Fine	D. Average % Passing 100	100	87	49	28	7	5.7	3.6	
	E. Fines % Split	45	45	45	45	45	45	45	45
	F. Proportioned % Passing $\frac{(DE)}{100}$	45.0	45.0	39.2	22.1	12.6	3.2	2.6	1.6
	G. Combined Gradation (C+F)	100.0	90.7	60.7	34.8	24.2	13.7	10.3	5.0

6. Compare the combined gradation for each sieve size to the gradation specification limits to verify if the combined gradation is acceptable.

3.2 Verifying the Split

The Aggregate Proportioning Chart can also be used to verify the percent proportions of the Coarse and Fine stockpiles given by the contractor. The procedure is as follows:

1. Obtain the average gradation of the coarse and fine stockpiles using the crusher sieve analysis results available to date.

2. Obtain the average combined gradation of the aggregate pit using previous Weekly Gradation Reports on file for the particular pit or previous MST design gradations.

   NOTE: Sometimes there is more than one pit with the same name. When obtaining this data, ensure the location also matches.

3. Repeat steps 1 to 5 of Section 3.1.1.

4. Plot the combined grading for each sieve along each respective sieve line as shown in Figure 6.

5. Draw a vertical line through the 5 000 µm sieve point.

6. Extend the line through both "% combined proportions" scales A and B, shown at the bottom of the graph.

7. Obtain the proportion of the coarse and fines stockpiles required to meet the combined gradation as follows:

   a) Pick off the percentage at which the vertical line intersects scale "B", and record as "% of B" (fine)".

   b) Pick off the percentage at which the vertical line intersects scale "A" and record as "% of A" (coarse)".

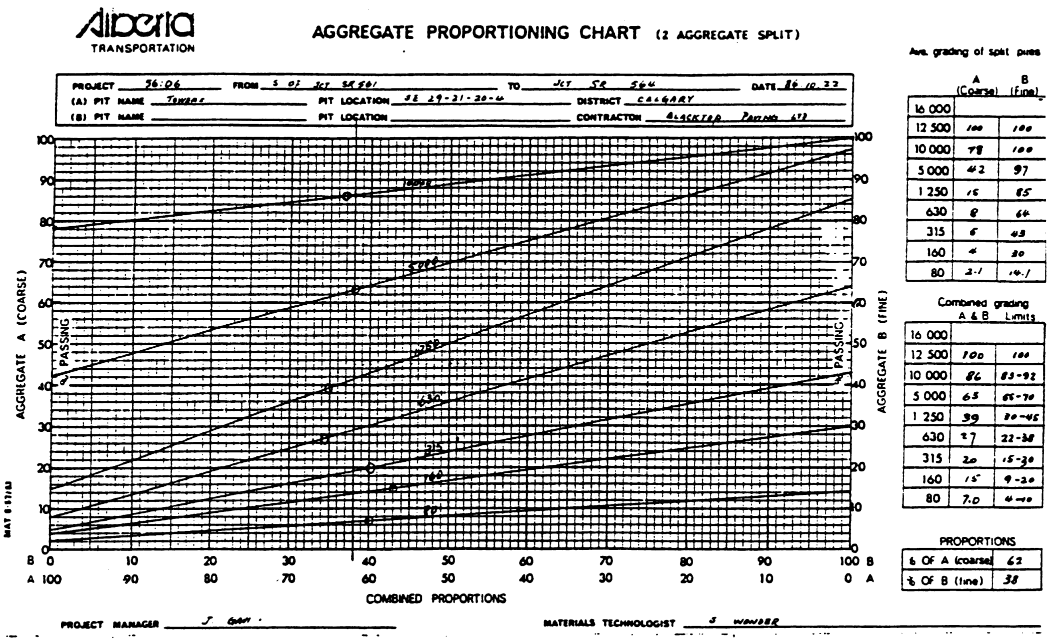


FIGURE 6

8. Compare the percent proportions from the chart to the proportions given by the Contractor.

3.3 Designation 1 Aggregate

For designation 1 aggregates, the contract specifies the approximate percent passing the 5 000 µm sieve of the combined aggregate. It also may specify the approximate percent of blend sand required to bring the combined aggregate to within gradation limits. In this case:

1. Plot on the Aggregate Proportioning Chart the percent passing the 5 000 µm sieve of the coarse stockpile on the left side of the chart.

2. Plot on the right side of the chart the percent passing the 5 000 µm sieve of the fines stockpile.

3. Join the two points with a straight line. Label the line as "5 000 µm sieve".

4. Plot on the vertical scale the specified percent passing the 5 000 µm sieve and proceed horizontally until it intercepts the "5 000 µm sieve" line.

5. Then proceed vertically to the bottom of the chart through the "Combined Proportions" scale.

6. Pick off the bottom scale the percent of coarse and the percent of fines required from each stockpile for the combined aggregate to meet the specified percent passing the 5 000 µm sieve.

7. Calculate the combined percent passing each other sieve as described in Section 3.1.2, steps 1, 3, 4 and 5 using the percent split determined in step 6 above.

8. If blend sand is required, verify the specified percent of blend sand as described in Section 3.1.1.1. If required, adjust the percent of blend sand, as the specified percentage is only approximate.

9. Compare the combined gradation to the design limits. If within the limits, have the contractor adjust the speed of each cold feed bin so that the plant will produce the desired proportions.

10. Check the proportions of the split as follows:

    a) Determine the speed in rev/min of each bin.

    b) Plot on the calibration graph the speed of each bin and pick off the graph the dry aggregate production rate in t/h of each bin.

    c) Calculate the total dry aggregate production rate by adding up the outputs obtained from the graph.

    d) Determine the percent split of each bin using formula:

$$\%\ Split = \frac{Dry\ Aggregate\ Production\ Rate\ of\ Bin}{Total\ Dry\ Aggregate\ Production\ Rate}$$

11. Obtain a cold feed sample of the combined aggregate as per ATT-38, and perform a wash sieve analysis test on the sample as per ATT-26.

12. Compare the gradation of the sample to the gradation limits of the design.

13. If required, adjust the specified <u>approximate</u> percent passing the 5 000 µm sieve and repeat steps 4 to 13.

4.0 HINTS AND PRECAUTIONS

1. The percent split may be determined at any time during crushing, using the average combined gradation obtained during the time period in question, i.e. day, week, etc.

2. If changes to proportions are necessary to meet specifications, the contractor must be informed. This may require the crushing contractor to over-crush in order to meet contract quantities.

3. If the proportions have been changed, the new combined gradation can be obtained at the point where the new % proportion line intersects each sieve line.