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CALCULATIONS PERTAINING TO GRADINGS AND SPECIFIC GRAVITIES

A. SCOPE

This test method contains the procedures and examples to illustrate (1) acceptable methods for adjusting and combining gradings and (2) methods of correcting for differences in specific gravities.

Samples, as received in the laboratory, can seldom be tested without some adjustment of gradings. These adjustments are usually necessary in order to meet specification grading requirements or to obtain a suitably graded sample for a particular test.

B. REFERENCES

ASTM C 127 – Density, Relative Density (Specific Gravity), and Absorption of Coarse Aggregate
ASTM C 128 – Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregate
ASTM C 136 – Sieve Analysis of Fine and Coarse Aggregates

C. GRADING ADJUSTMENTS ON SINGLE SAMPLES

Adjustment #1: Single sample with all the material retained on a designated sieve (oversized material) to be wasted ("wasted" is the term used for removing material that will not be used).

It is necessary to waste the oversized portion of the "as received" material in order to bring the grading into specifications.

Procedure: In order to compute the "as used" grading, increase to 100 % the "as received" percent passing the size on which the sample is to be scalped ("scalped" is the term used for removing or separating material on a particular sieve), and increase the "as received" percent passing of the other sizes in the same proportion.

Example: Assume an aggregate which has a grading with 90 % passing the ¾ in. sieve and the sample has to be scalped on the ¾ in. sieve. The "as used" grading is calculated as follows:

Sieve Size	As Received Percent Passing	Calculations	As Used Percent Passing *	Specified Limits Percent Passing
1½ in.	100	--	--	--
1 in.	95	--	--	--
¾ in.	90	--	100	100
⅜ in.	80	$\frac{100}{90} \times 80 = 88.89$	89	85-100
No. 4	70	$\frac{100}{90} \times 70 = 77.78$	78	70-90

*The percentages of material passing the sieve sizes smaller than the No. 4 sieve are computed in the same manner.

Adjustment #2: Single sample with the portion of the material passing a designated sieve to be wasted.

It is necessary to waste a portion of the "as received" material in order to bring the grading into specifications.

Procedure: In order to compute the "as used" grading, reduce the portion of the "as received" percent passing the sieve size on which the sample is to be reduced to the percentage required and adjust all other gradings.

Example: Assume an aggregate which has a grading as shown in the table below, and it is necessary to reduce the percent passing the No. 4 sieve from 70 % to 60 % and adjust all other gradings in order to conform to specifications. The "as used" grading is calculated as follows:

Sieve Size	As Received Percent Passing	Calculations	As Used Percent Passing *	Specified Limits Percent Passing
¾ in.	100	100	100	100
⅜ in.	90	$60 + (90 - 70)\left[\frac{100-60}{100-70}\right] = 86.67$	87	85-100
No. 4	70	60	60	52-68
No. 8	55	$\frac{60}{70} \times 55 = 47.14$	47	45-60

*Sizes smaller than the No. 8 sieve are computed in the same manner as for the No. 8 sieve.

It is generally desirable to know what percentage of the total sample is to be wasted.

Calculations: The following method may be used. Consider a unit amount of material:

Let: W = Percent of the total sample to be wasted

P_1 = "As received" percent passing No. 4 sieve

P_2 = "As used" percent passing No. 4 sieve

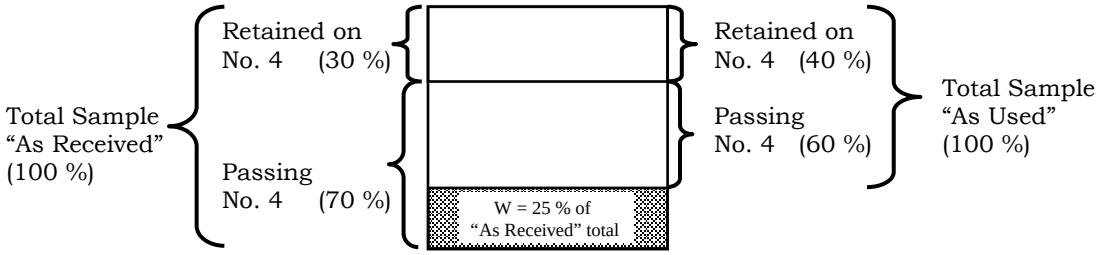
Then:

$$W = \frac{P_1 - P_2}{100 - P_2} \times 100$$

$$= \frac{70 - 60}{100 - 60} \times 100$$

= 25 % of total sample wasted

This relationship can be diagrammed as follows:



Adjustment #3: Single sample with a portion of the material retained on a designated sieve to be wasted.

It is frequently necessary to increase a portion of the "as received" material in order to bring the grading into specifications.

Procedure: In order to compute the "as used" grading, waste a portion of the "as received" percent retained on the sieve size on which the sample is to be increased and adjust all other gradings.

Example: Assume an aggregate which has a grading as shown in the table below and it is necessary to waste enough of the material retained on the No. 4 sieve to increase the percent passing the No. 4 sieve from 70 % to 80 % and adjust all other gradings in order to conform to specifications. The "as used" grading is calculated as follows:

Sieve Size	As Received Percent Passing	Calculations	As Used Percent Passing *	Specified Limits Percent Passing
¾ in.	100	100	100	100
⅜ in.	90	$80+(90-70)\left[\frac{100-80}{100-70}\right]=93.33$	93	90-95
No. 4	70	80	80	72-88
No. 8	40	$\frac{80}{70}\times 40=45.71$	46	42-52

*Sizes smaller than the No. 8 sieve are computed in the same manner as for the No. 8 sieve.

It is generally desirable to know what percentage of the total sample is to be wasted.

Calculations: The following method may be used. Consider a unit amount of material:

Let: W = Percent of the total sample to be wasted

R_1 = "As received" percent retained on No. 4 sieve

R_2 = "As used" percent retained on No. 4 sieve

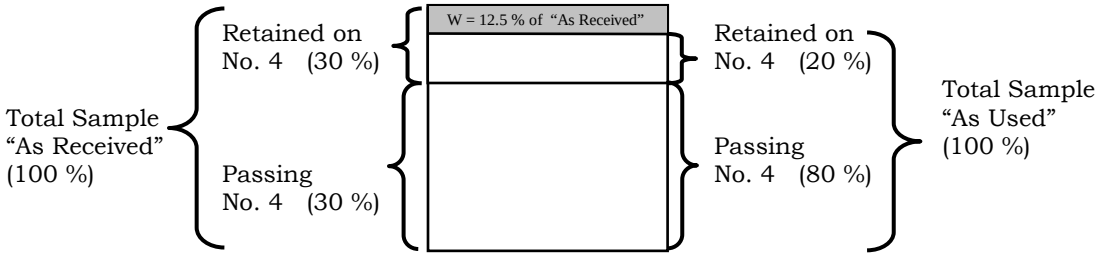
Then:

$$W = \frac{R_1 - R_2}{100 - R_2} \times 100$$

$$= \frac{30 - 20}{100 - 20} \times 100$$

= 12.5 % of total sample wasted

This relationship can be diagrammed as follows:



Adjustment #4: Single sample with all of the material passing a designated sieve to be wasted.

It is necessary to waste the portion of the "as received" material passing a designated sieve in order to bring the grading into specifications.

Procedure: In order to compute the "as used" grading, waste all of the "as received" material passing the designated sieve size (i.e., Percent passing designated sieve = 0 %) and adjust all other gradings.

Example: Assume an aggregate which has a grading as shown in the table below and it is necessary to waste all material passing the No. 4 sieve in order to conform to specifications. The "as used" grading is calculated as follows:

Sieve Size	As Received Percent Passing	Calculations	As Used Percent Passing*	Specified Limits Percent Passing
¾ in.	100	100 – 53 = 47	100	100
½ in.	82	82 – 53 = 29	62	60-80
⅜ in.	73	73 – 53 = 20	43	20-50
No. 4	53	53 – 53 = 0	0	0
No. 8	37	--	--	--
No. 16	24	--	--	--
No. 30	15	--	--	--

* All sieves must be adjusted to 100 % retained on the No. 4 sieve size.

Adjustments:

The passing ¾ in. sieve material is held at 100 % [+].
([+] This is the top-size sieve and will continue to be 100 % passing.)

The passing No. 4 sieve material is reduced to 0 [++].
([++] All material passing No. 4 is wasted.)

All other sieves must be reduced by the same percentage and adjusted proportionately as follows:

½ in. sieve: Reduce by 53: 82 - 53 = 29

$$\text{Proportion}: \frac{47}{100} = \frac{29}{X}$$

$$X = \frac{29 \times 100}{47}$$

$$X = 62$$

⅜ in. sieve: Reduce by 53: 73 – 53 = 20

$$\text{Proportion}: \frac{47}{100} = \frac{20}{X}$$

$$X = \frac{20 \times 100}{47}$$

$$X = 43$$

Adjustment #5: Single sample with a portion passing a designated fine sieve size to be wasted.

It is necessary to waste a portion of the "as received" material passing the designated fine sieve in order to bring the grading into specifications.

Procedure: In order to compute the "as used" grading, waste a portion of the material passing the designated fine sieve size of the "as received" material and adjust all other gradings.

Example: Assume an aggregate which has a grading as shown in the table below and it is necessary to reduce the percent retained on the No. 200 sieve from 10 % to 7 % in order to conform to specifications. The "as used" grading is calculated as follows:

Sieve Size	As Received Percent Passing	Waste Percent Passing	Proportion to 100 Percent	Specified Limits Percent Passing
¾ in.	-	-	-	100
½ in.	100	100 - 3 = 97	100	95-100
⅜ in.	83	83 - 3 = 80	82	75-90
No. 4	55	55 - 3 = 52	54	50-67
No. 8	43	43 - 3 = 40	41	35-50
No. 16	35	35 - 3 = 32	33	-
No. 30	28	28 - 3 = 25	26	15-30
No. 50	22	22 - 3 = 19	20	-
No. 100	16	16 - 3 = 13	13	-
No. 200	10	7	7	4-7

Adjustments:

The passing No. 200 sieve material is reduced by 3 (10-7). Therefore, all larger sieves must be reduced by 3.

The ½ in. sieve material is adjusted to 100 % to conform to the "as received" ½ in. sieve.

All other sieves must be reduced by the same percentage and adjusted proportionately as follows:

⅜ in. sieve: Reduce by 3: 83 - 3 = 80

$$\text{Proportion}: \frac{97}{100} = \frac{80}{X}$$

$$X = \frac{80 \times 100}{97}$$

$$X = 82.47$$

No. 4 sieve: Reduce by 3: 55 – 3 = 52

$$\text{Proportion}: \frac{97}{100} = \frac{52}{X}$$

$$X = \frac{52 \times 100}{97}$$

$$X = 53.61$$

Field Adjustment for #5: To waste the passing No. 200 sieve size, a field sample will need to be large enough to account for the waste. In most cases, the waste will be made from material passing the No. 4 sieve which has been separated when processed and graded.

Example: Assume 10,000 g of material, graded from coarse to fine, will be required for the tests and passing No. 200 sieve material equivalent to 3 % of the sample must be wasted from the total sample.

Procedure:

1. Determine the total amount of material before wasting:

$$\frac{10000\ g}{\left(\frac{100-3}{100}\right)} = 10309\ g$$

2. Determine the amount of material passing No. 200 sieve to be screened out of the total sample:

   10309 – 10000 = 309 g

3. Determine the amount of material passing No. 4 sieve that will be needed before screening out the passing No. 200 material.

   54 % of the 10,000 g needed for testing is passing the No. 4 sieve, or
   0.54 × 10000 = 5400 g of passing No. 4 material will be needed after wasting

   ∴ 5400 + 309 = 5709 g of the passing No. 4 material will be the amount necessary to obtain before screening out the passing No. 200 material.

NOTE: In most instances it should be possible to remove the passing No. 200 material by dry sieving; however, when large quantities are to be removed, it will probably be necessary to employ washing.

Adjustment #6: Single sample with a portion retained on a designated sieve (oversized material) to be wasted, but the fine materials (passing the No. 4 sieve) are to remain in the "as received" proportioned.

Procedure: In order to compute the "as used" grading, waste all "as received" material retained on the top sieve size of the "as used" gradation and hold the percentage of material passing the No. 4 sieve constant. Intermediate sieves are proportioned in the same ratio as the original grading.

The percentage of material passing the No. 4 sieve is held constant and the percentage passing the 1 in. sieve is equated to 100 %. The intermediate sizes, between the 1 in. and No. 4, are proportioned in the same ratio as the original grading.

Example: Assume an aggregate which has a grading as shown in the table below. It is necessary to remove the material retained on the 1 in. sieve size in order to conform to coarse grading specifications. But, the fine gradings are to be held constant, and the intermediate sizes (between the 1 in. and No. 4) are proportioned in the same ratio as the original grading. The "as used" grading is calculated as follows:

Sieve Size	As Received Percent Passing	Calculation	Adjusted Grading Percent Passing	Specified Limits Percent Passing
1½ in.	100	--	--	--
1 in.	90	--	100 *	100
¾ in.	80	60 + [(20 x 40)/30)] = 87	87	85-95
⅜ in.	70	60 + [(10 x 40)/30)] = 73	73	65-80
No. 4	60	--	60 **	50-65

* The material retained on the 1 in. sieve is wasted. Therefore, the percent passing the 1 in. sieve is 100 %.
** The No. 4 sieve percentage is held at 60 % to the "as received" No. 4 sieve.

Calculations:

All other sieves must be adjusted proportionately as follows:

¾ in. sieve: As received – Retained on No. 4 and Passing 1 in. = 30 %
As received – Retained on No. 4 and Passing ¾ in. = 20 %
Adjusted – Retained on No. 4 and Passing 1 in. = 40 %
Adjusted – Retained on No. 4 and Passing ¾ in. = 40 %

$$\text{Proportion :} \quad \frac{X}{40} = \frac{20}{30}$$

$$X = \frac{20 \times 40}{30} = 26.67$$

⅜ in. sieve: As received – Retained on No. 4 and Passing 1 in. = 30 %
As received – Retained on No. 4 and Passing ¾ in. = 10 %
Adjusted – Retained on No. 4 and Passing 1 in. = 40 %
Adjusted – Retained on No. 4 and Passing ¾ in. = 40 %

$$\text{Proportion :} \quad \frac{X}{40} = \frac{10}{30}$$

$$X = \frac{10 \times 40}{30} = 13.33$$

D. GRADING ADJUSTMENTS ON MULTIPLE SAMPLES

Adjustment #7: Combining two or more samples.

Procedure:

1. Determine the proportion of each sample to use.

2. Proportion each sample's grading.

NOTE: Each sample must have the same top size sieve. This may require using place holders with 100 % passing for these sieve sizes.

3. Add the individual proportioned samples for the "combined" grading.

4. Adjust combined gradings to meet specification requirements.

NOTE: The proportion of each sample to use generally depends upon the specification requirements. It is usually quicker to use the trial method for arriving at the proportions. An experienced operator can usually determine the proportions in the first or second trial.

Example: Determine the gradings for a ¾ in. top-size mixture that is a combination consisting of 80 % of Sample A and 20 % of Sample B. The "as used" grading is calculated as follows:

Sieve Size	As Received Percent Passing		Proportioned Grading		Combined Percent Passing *	As used Percent Passing **	Specified Limits Percent Passing
	Sample A	Sample B	80 % of Sample A	20 % of Sample B			
1 in.	100	100	80	20	100	--	--
¾ in.	90	100	72	20	92	100	100
⅜ in.	80	95	64	19	83	90	85-95
No. 4	70	90	56	18	74	80	75-85

* Combined Percent Passing = 0.80 × (Sample A) + 0.20 × (Sample B)
** Adjust gradings as demonstrated in Adjustment #1 above.

Adjustment #8: Removing and crushing oversize from "as received" sample and recombining with uncrushed material.

Procedure: The gradings are considered individually; i.e., crushed and uncrushed. Each grading is then proportioned as to its relative percentage of the original sample and recombined. The grading of the combined sample may need to be adjusted to conform to specification requirements.

Example: Determine the combined grading for a ¾ in. top-size mixture that is a combination consisting of the uncrushed material that passed the ¾ in. sieve in the "as received" material and the oversized "as received" material that was scalped on the ¾ in. sieve and crushed to passing the ¾ in. sieve. The combined grading is calculated as follows:

Sieve Size	Original Sample Percent Passing	Oversize Crushed Percent Passing	Proportioning *	Combined Sample (Original + Crushed)
2 in.	100	--	--	--
1½ in.	80	--	--	--
1 in.	70	--	--	--
¾ in.	54	100	100 x .46 = 46	54 + 46 = 100
⅜ in.	45	56	56 x .46 = 26	45 + 26 = 71
No. 4	39	35	35 x .46 = 16	39 + 16 = 55
No. 8	37	20	20 x .46 = 9	37 + 9 = 46
No. 16	34	15	15 x .46 = 7	34 + 7 = 41
No. 30	20	11	11 x .46 = 5	20 + 5 = 25
No. 50	16	9	9 x .46 = 4	16 + 4 = 20
No. 100	10	8	8 x .46 = 4	10 + 4 = 14
No. 200	4	4	4 x .46 = 2	4 + 2 = 6

* Each crushed sieve value is proportioned by 46 % because 46 % of the "as received" material was retained on the ¾ in. sieve, scalped and crushed.

Adjustment #9: Wasting material from the uncrushed portion of a sample in which the oversize is crushed.

Procedure: When an adjustment is necessary to produce a specified grading from a sample that has had the oversize crushed, the wasted material should be taken from the uncrushed portion of the aggregate, if the combined (crushed + uncrushed) material will meet the material properties of the specification. This will change the proportions of crushed and uncrushed, and an adjustment is necessary.

Example: From a sample having 50 % uncrushed "as received" and 50 % crushed oversized "as received" material, it is necessary to waste a portion of the total sample equivalent to 25 % in order to conform to the grading requirement. This 25 % is to be removed from the uncrushed portion and it is desired to obtain the proportions of crushed and uncrushed after this material has been wasted.

Calculations: The following method may be used. Consider a unit amount of material:

Let:
W = Percent of the total sample to be wasted
X = Original percent uncrushed
X_1 = Final percent uncrushed
Y = Original percent crushed
Y_1 = Final percent crushed

We know that:

$$X + Y = 100 \quad \text{and} \quad X1 + Y1 = 100$$

Also:

$$\frac{100 - W}{100} = \frac{X - W}{X_1}$$

Then:

$$X_1 = \frac{X - W}{100 - W} \times 100$$

Also:

$$\frac{100 - W}{100} = \frac{Y}{Y_1}$$

Then:

$$Y_1 = \frac{Y}{100 - W} \times 100$$

Substituting into the above equation,

$$X_1 = \frac{50 - 25}{100 - 25} \times 100 = \frac{25}{75} \times 100 = 33\ \%$$

Also:

$$Y_1 = \frac{50}{100 - 25} \times 100 = \frac{50}{75} \times 100 = 67\ \%$$

The final grading will contain 33 % uncrushed and 67 % crushed material.

Adjustment #10: Wasting a portion of the passing No. 200 sieve material from a combined sample of natural and crushed material.

Procedure: Blend the as received natural and crushed material as outlined in Adjustment #8. Waste the required portion passing the No. 200 sieve as outlined in Adjustment #5. Proportionately adjust sample to equal 100 %.

Example: Determine the combined grading for a ¾ in. top-size mixture that is a combination consisting of the uncrushed material that passed the ¾ in. sieve in the "as received" material and the oversized "as received" material that was scalped on the ¾ in. sieve and crushed to passing the ¾ in. sieve. The combined grading is calculated as follows:

Sieve Size	As Received Percent Passing		Combined Percent Passing	Adjust to Wasting 3 % of Passing No. 200	Proportion to 100 %	Final		
	Natural Material	Crushed Material				Percent Natural Material	Percent Crushed Material	Final Grading
1 in.	--	--	--	--	--	--	--	--
¾ in.	--	--	--	--	--	--	--	--
½ in.	79	21	100	97	100	78	22	100
⅜ in.	69	14	83	80	82	68	14	82
No. 4	48	7	55	52	54	47	7	53
No. 8	39	4	43	40	41	37	4	41
No. 16	32	3	35	32	33	30	3	33
No. 30	25	3	28	25	26	23	3	26
No. 50	19	3	22	19	20	16	3	19
No. 100	14	2	16	13	13	11	2	13
No. 200	8	2	10	7	7	5	2	7

To screen out and waste the passing No. 200 for testing, the waste should be made from the uncrushed material passing the No. 4 sieve size whenever possible.

1. Determine the total amount of material needed to meet testing requirements:

No. of Tests	Test	Quantity
3	Stabilometer specimens	3600 g
2	Moisture vapor susceptible specimens	2400 g
2	Swell specimens	2000 g
	Additional material for CKE, SE, etc.	1000 g
	Total material needed	9000 g

2. Determine the total amount of material before wasting:

$$\frac{9000\ g}{\left(\frac{100-3}{100}\right)} = 9278\ g$$

3. Determine the amount of material passing No. 200 sieve to be screened out of the total as received sample:

   9278 – 9000 = 278 g

4. Determine the amount of material passing No. 4 sieve that will be needed before screening out the passing No. 200 material.

   48 % of the 9000 g needed for testing is passing the No. 4 sieve, or
   0.48 x 9000 = 4320 g of passing No. 4 material will be needed after wasting

   Therefore: 4320 + 278 = 4598 g of the passing No. 4 material will be the amount necessary to obtain before screening out and wasting 278 g of the passing No. 200 material.

E. CORRECTION FOR VARIATION IN SPECIFIC GRAVITY OF MINERAL AGGREGATE

Grading analyses and grading limits of aggregates are generally expressed as a percentage "by weight" of the total passing each sieve size. However, this method is correct only when the aggregates are of uniform specific gravity. To correctly show particle size distribution, it is necessary to consider the grading analysis from a "by volume" basis. Consequently, when the variation in specific gravity between the fine and coarse material exceeds 0.20, it is necessary to compensate for this variation to obtain a batch weight that will produce the proper volumetric proportions. This is accomplished by use of the average specific gravity of the aggregate.

Adjustment #11: Blending stockpiles with different specific gravities in the proper proportions to conform to specified grading limits.

Procedure:

1. Combine the as received natural and crushed material in "by weight" proportions as outlined in Adjustment #8 that will produce a grading conforming to the specified limits irrespective of the specific gravities.

2. Adjust "by weight" proportions to "by volume" proportions.

3. Waste the required portion passing the No. 200 sieve as outlined in Adjustment #5.

4. Proportionately adjust sample to equal 100 %.

Example: Assume two stockpiles of aggregates that will be used for producing hot mix asphalt. One stockpile contains the passing No. 4 aggregates having a specific gravity of 2.73 and the other contains the retained No. 4 aggregates having a specific gravity of 2.32, a difference of 0.41. These stockpiles are to be blended in the proper proportions to conform to specified grading limits. The following table demonstrates the effect this 0.41 variation in specific gravity has upon the volumetric proportions of the mixture:

Sieve size	Specification Grading limits	(1) "By Weight" Blend of Stockpiles Conforming to Specification Limits Percent Passing	(2) Corrected to "By Volume" Percent Passing	(3) "By Volume" Grading Adjusted to Specifications Percent Passing	(4) Final "By Volume" Grading Percent Passing
¾ in.	100	100	100	100	100
⅜ in.	60-75	65	62	67	64
No. 4	50-65	51	47	54	50
No. 8	37-50	38	35	40	37
No. 16	--	29	27	31	29
No. 30	18-28	19	18	21	19
No. 50	--	14	13	15	14
No. 100	--	9	8	9	8
No. 200	3-8	4	4	5	5

Note: Specific gravity, coarse = 2.32
Specific gravity, fine = 2.73

Calculations:

Formulae and calculations in Stages (1) through (4) in the table are as follows:

Let:

$$G_A = \frac{100}{\left[\frac{P_{W1}}{G_1} + \frac{P_{W2}}{G_2}\right]}$$

$$P_V = \frac{P_W G_A}{G}$$

Where: G = Specific gravity of aggregate
G_A = Average specific gravity of aggregate
P_W = Percent of sample by weight
P_V = Percent of sample by volume

(1) Combine the retained No. 4 and passing No. 4 stockpiled materials in "by weight" proportions that will produce a grading conforming to the specified limits irrespective of the specific gravity. The grading, as shown under (1) represents proportions "by weight" of 49 % and 51 %, respectively, of the retained No. 4 and passing No. 4 stockpiled materials.

(2) With the difference of 0.41 in specific gravity, the next step is to determine whether or not a "by volume" grading produced from material batched "by weight" from the grading will conform to the grading limits.

Grading corrected to "by volume."

$$\text{Average specific gravity}: G_A = \frac{100}{\left[\frac{P_{W1}}{G_1} + \frac{P_{W2}}{G_2}\right]} = \frac{100}{\left[\frac{49}{2.32} + \frac{51}{2.73}\right]} = 2.51$$

$$\text{Percent retained on No. 4}: \frac{P_W G_A}{G} = \frac{49 \times 2.51}{2.32} = 53\ \%$$

$$\text{Percent passing No. 4}: \frac{P_W G_A}{G} = \frac{51 \times 2.51}{2.73} = 47\ \%$$

Change remainder of grading in proportion to the change from 51 % to 47 % on the passing No. 4, for example:

$$\text{Percent passing No. 4:} \quad 47 + (65 - 51)\left[\frac{100-47}{100-51}\right] = 62\ \%$$

$$\text{Percent passing No. 8:} \quad \frac{47}{51} \times 38 = 35\ \%$$

(3) However, when the grading is corrected to "by volume" by means of the average specific gravity of the aggregate, it is found to be out of grading limits on the No. 4 and No. 8 sieves. The correction to "by volume" changed the percentage passing the No. 4 sieve from 51 % to 47 % with other amounts passing the various sieves changing proportionately.

Therefore, to produce a grading conforming to specification limits from these materials, it is necessary to arbitrarily adjust the "by weight" proportioning of the stockpiles. For this adjustment, the percentage "by weight" is changed from 51 % to 54 % with other amounts passing the various sieves changed proportionately.

(4) Change the arbitrarily adjusted "by weight" grading in (3) to "by volume." With this correction, the 54 % "by weight" amounts to 50 % "by volume," with other amounts passing the various sieve sizes changed proportionately.

Grading corrected to "by volume."

Average specific gravity : $$G_A = \frac{100}{\left[\frac{P_{W1}}{G_1} + \frac{P_{W2}}{G_2}\right]} = \frac{100}{\left[\frac{46}{2.32} + \frac{54}{2.73}\right]} = 2.52$$

Percent retained on No. 4 : $$\frac{P_W G_A}{G} = \frac{46 \times 2.52}{2.32} = 50\ \%$$

Percent passing No. 4 : $$\frac{P_W G_A}{G} = \frac{54 \times 2.52}{2.73} = 50\ \%$$

Change remainder of grading in proportion to the change from 54 % to 50 % as in (2) above.

F. PRECAUTIONS

No adjustment to gradings should be made in the laboratory that cannot be economically duplicated in the field. The limitations of the screening plants, crushers, hot plants, and mixers should be taken into consideration when making adjustments.

G. SAFETY AND HEALTH

It is the responsibility of the user of this test method to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use. Prior to handling, testing or disposing of any materials, testers must be knowledgeable about safe laboratory practices, hazards and exposure, chemical procurement and storage, and personal protective apparel and equipment.

Caltrans Laboratory Safety Manual is available at:

http://www.dot.ca.gov/hq/esc/ctms/pdf/lab_safety_manual.pdf

End of Text
(California Test 105 contains 14 pages)