

Method of Test for Sieve Analysis

1. Scope:

This test is for determining sieve analysis of subbase, base course, mineral aggregate (Surface course materials), concrete aggregates, fillers, and similar materials.

2. Apparatus:

- 2.1 Scale or balance having the capacity to weigh any sample which may be tested utilizing this procedure and readable to the nearest 0.1 gram.
- 2.2 Sieves. Standard square opening, conforming to ASTM E 11.
- 2.3 Drying oven capable of maintaining a temperature of $230^{\circ} \pm 9^{\circ}\text{F}$.
- 2.4 Pans, scoops, brushes, etc., for handling materials.
- 2.5 Unit weight bucket.
- 2.6 Mechanical sieve shaker.

3. Procedure:

Surface Course Materials:

- 3.1 Obtain a sample in accordance with SD 201. The sample shall be large enough to provide specimens for all required testing.
- 3.2 Reduce the sample to the size of the specimen needed for testing by splitting or quartering in accordance with SD 213.
- 3.3 Minimum sample size.

NOTE: Nominal maximum size of particle is denoted by the smallest sieve opening listed below, through which 90% or more of the sample being tested will pass.

Nominal maximum size of particle	Minimum wt. of sample (Grams)
#4	500
3/8"	1000
1/2"	2500
3/4"	5000
1"	10000
1 1/2"	15000
2"	20000
2 1/2"	35000
3"	60000
3 1/2"	100000
4"	150000

- 3.4 The sample shall be dried to a constant weight at a temperature of $230^{\circ} \pm 9^{\circ}\text{F}$ or in accordance with SD 108. Frequent stirring will expedite the drying procedure.

NOTE: Cool until the container can be handled comfortably with bare hands and the operation of balance or sieves on which sample is placed are not affected by heat convection from material/pan.

- 3.5 Determine loose weight, if required, in accordance with SD 205.
- 3.6 Weigh the sample and record the weight in the "Original dry sample weight" box of the DOT-3 worksheet to the nearest 0.1 gram.
- 3.7 Assemble a series of sieves that will furnish the information required by the specifications covering the material to be tested. Nest the sieves in order of decreasing size of opening from top to bottom and include a pan below the last sieve.
- 3.8 Pour the sample into the top sieve of the nest. Agitate the sieves by hand or on a mechanical shaker for a sufficient period of time, established by trial or checked by measurement on the actual test sample, to meet the criterion for adequacy of sieving.

NOTE: The adequacy of sieving can be checked by the hand method. Hand sieving is done by using an individual sieve with a cover and pan while rotating and tapping the sieve approximately two times per second for one minute. The end point for sieving is when not more than 0.5% by weight shall pass that sieve.

- 3.9 Remove any dirt adhering to the + #4 material. This can be accomplished by dumping the material from each individual sieve into a flat pan and rubbing it with a soft pine or rubber covered block. After the dirt has been removed, pour the contents of the pan back onto the sieves and complete the shaking.

An alternate method is to place the material retained on an individual sieve in a cement sample can. With the lid in place, agitate the aggregate using a circular motion. The material is then reintroduced to the sieve and sieved by hand.

- 3.10 Weigh the material retained on each sieve and the material in the pan to the nearest 0.1 gram and record the weights on the worksheet. Tabulate the total for these weights. The tabulated total should check within 0.3% of the "Original dry sample weight." If it does not, a backup sample shall be tested.
- 3.11 In the coarse sieve series, the weight retained on a sieve in kg at the completion of sieving shall not exceed the product of 2.5 times the sieve size opening in millimeters times the effective sieving area in m^2 . In the fine sieve series (Openings smaller than #4) the weight retained on any sieve shall not be greater than 4 g/in.^2 (See Chart 1 below). If any sieve is overloaded, make a notation on the gradation sheet and sieve the material retained on that sieve by hand in split portions until the adequacy of sieving requirement is met. Prevent the occurrence of any further overloading of sieves by using one of the following:

insert an additional sieve with an opening size in between the overloaded sieve size and the next larger size in the sieve set, start with a smaller sample size to prevent the sieve from being overloaded, split the sample into two or more portions to sieve separately, or use a set of sieves having a larger frame size and providing greater sieving area. Sieve a sufficient amount of time so that the adequacy of sieving is met for all sieve sizes. Try approximately 10 minutes if using a mechanical sieve shaker, and increase the time if the adequacy of sieving is not met for all sieve sizes.

Sieve opening size (Inches)	Maximum amount of material that may be retained in grams			
	8" dia. sieve	12" dia. sieve	13.8" x 13.8" sieve (14"x14" nominal)	14.6" x 22.8" sieve (16"x24" nominal)
4"	N/A	N/A	30,600	53,900
3 1/2"	N/A	15,100	27,600	48,500
3"	N/A	12,600	23,000	40,500
2 1/2"	N/A	10,600	19,300	34,000
2"	3,600	8,400	15,300	27,000
1 1/2"	2,700	6,300	11,500	20,200
1"	1,800	4,200	7,700	13,500
3/4"	1,400	3,200	5,800	10,200
5/8"	1,100	2,700	4,900	8,600
1/2"	890	2,100	3,800	6,700
3/8"	670	1,600	2,900	5,100
1/4"	450	1,100	1,900	3,400
#4	330	800	1,500	2,600
#6 thru #200	200	470	900	1,500

Chart 1

- 3.12 Calculate the percentage of material retained on each sieve to the nearest 0.1% by dividing the weight of the retained material by the "Original dry sample weight" determined in 3.6.
- 3.13 Determine the accumulative percent passing each sieve by subtracting the retained percentage for the top sieve from 100.0 and continue subtracting the retained percentage for each sieve from the previous sieves accumulative passing percentage.
- 3.14 If the sample being tested requires a result for percentage of crushed particles, perform the test in accordance with SD 211 using a portion of the aggregate retained on the #4 sieve and above.

NOTE: If the material being tested requires a result for total - #200, the material from that test can be used to perform the percentage of crushed particles test.

- 3.15 If the sample being tested requires a result for percentage of particles less than 1.95 specific gravity for the + #4 sieve material, perform the test in accordance with SD 214 using a portion of the aggregate retained on the #4 sieve and above.

- 3.16 Using the material from the pan below the #4 sieve, split out samples in accordance with SD 213 to conduct the balance of the required testing. The number and size of samples to be split out will depend on the type of material being tested. Most surface course materials will require a sample to complete the fine portion of the sieve analysis and one for liquid limit/plastic limit/plasticity index. If you are testing uncoated mineral aggregate for asphalt concrete, a third sample will have to be split out for a particles less than 1.95 specific gravity test.

The samples split out for the fine portion of the sieve analysis and liquid limit/plastic limit/plasticity index must contain enough - #40 material to yield 100 grams. The less than 1.95 specific gravity test must obtain between 250 and 350 grams.

- 3.17 Weigh the sample to be used for the fine portion of the sieve analysis to the nearest 0.1 gram and record the weight on the "Weight before washing" line on the worksheet.
- 3.18 Place the sample in a pan and add enough water to cover it. Agitate the sample with sufficient vigor to result in complete separation of all particles finer than the #200 sieve from the coarser particles and bring the fine material into suspension. Pour the wash water containing the suspended and dissolved solids over a nest of 2 sieves. The lower sieve of the nest shall be a #200 and the upper shall be in a range of #8 to #16. Both of the sieves shall conform to the requirements of ASTM E 11. Repeat the process of adding water, agitating the sample, and pouring the water over the nest of sieves until the wash water is clear.
- 3.19 Dry the washed aggregate to a constant weight in an oven at $230^{\circ} \pm 9^{\circ}\text{F}$, as per SD 108 and weigh to the nearest 0.1 gram. Record this weight on the "Weight after washing" line of the worksheet.

NOTE: Cool until the container can be handled comfortably with bare hands and the operation of balance or sieves on which sample is placed are not affected by heat convection from material/pan.

Subtract the weight of the sample after washing, from the weight of the sample before washing and record the result on the "Loss from washing (- #200)" line and on the "Pan wash" line below the #200 sieve on the sieve analysis.

- 3.20 Assemble a series of sieves that will furnish the information required by the specifications covering the material being tested. Nest the sieves in order of decreasing size of opening from top to bottom and include a pan below the last sieve.
- 3.21 Pour the aggregate into the top sieve of the nest, place the nest of sieves on a mechanical shaker and shake for a sufficient period of time (A minimum of 10 minutes). Adequacy of sieving can be checked as outlined in 3.8 above. The quantity of material retained on any sieve at the completion of the sieving operation shall not exceed 4 grams per in² of sieve surface area. This amounts to 200 grams for an 8" diameter sieve.

- 3.22 Weigh the material retained on each sieve and in the pan and record the weights on the worksheet to the nearest 0.1 gram. Add the retained weights including the "Pan dry" and "Pan wash" quantities below the #200 sieve. Record this weight on the "Total" line at the bottom of the worksheet. This weight must be within 0.3% of the weight of the sample before washing. If it is not, a new sample shall be tested.

NOTE: Correct brush to use when cleaning sieves.

3/8" to #16 - steel #20 to #50 - brass #80 to > - paint

- 3.23 Complete the calculations for the fine sieves, beginning by dividing the initial sample weight derived in 3.17 above into the retained weights for each sieve and record the results on the worksheet to the nearest 0.1%. Next, multiply these retained percentages times the accumulative percentage passing the #4 sieve determined in 3.13 above and record the results on the worksheet again to the nearest 0.1%. Finally, determine the accumulative percentage passing each of these sieves by subtracting the retained percentage from the previous sieves accumulative passing percentage.
- 3.24 The percentage of material passing each sieve in the coarse and fines portion of the analysis may now be rounded and reported on the worksheet to the nearest whole number except the #200 sieve shall be reported to the nearest 0.1%.
- 3.25 Prepare the sample of material split out earlier as outlined in SD 207 for liquid limit/plastic limit/plasticity index. testing.
- 3.26 Perform the liquid limit and plastic limit in accordance with SD 207, calculate the plasticity index, and report the results on the sieve analysis worksheet.
- 3.27 If the sample being tested requires a result for percentage of particles less Than 1.95 specific gravity for the - #4 sieve material, perform the test on the 250 to 350 gram sample split out in 3.16 above in accordance with SD 208.

Process for determining total - #200 materials in asphalt concrete (excludes Class S):

- 3.28 Following completion of the coarse sieve analysis, combine all materials which were retained on #4 sieve and above and split out a sample for total - #200 testing in accordance with SD 213 which meets the requirements shown in the following table.

Nominal maximum size of particles	Minimum weight of sample, grams
#4	500
3/8"	500
1/2"	700
3/4"	1000
1"	1500

- 3.29 Weigh the sample to the nearest 0.1 g and record the weight as "Weight before washing" in the box labeled "(A)" below the coarse sieve area as shown on the enclosed example DOT-3 worksheet.
- 3.30 Place the sample in a pan and add enough water to cover it. Agitate the sample with sufficient vigor to result in complete separation of all particles finer than the #200 sieve from the coarser particles and bring the fine material into suspension. Pour the wash water containing the suspended and dissolved solids over a nest of 2 sieves. The lower sieve of the nest shall be a #200 and the upper shall be in a range of #8 to #16. Both of the sieves shall conform to the requirements of ASTM E 11. Repeat the process of adding water, agitating the sample, and pouring the water over the nest of sieves until the wash water is clear.
- 3.31 Following drying to a constant weight, weigh sample to nearest 0.1 g and record the weight as "Weight after wash" in the box labeled "(B)" below the coarse sieve area as shown on the enclosed example DOT-3 worksheet.
- 3.32 Calculate the percent passing the #200 Sieve (D) for the coarse aggregate by subtracting the "Weight after wash" (B) from the "weight before wash" (A) and dividing that result (C) by the "Weight before wash" (A). Multiply this result times 100. This is the percent - #200 for the coarse aggregate which must be recorded in the two boxes labeled "(D)" on the DOT-3 worksheet.

6.3	1/4		354.6	7.0	67.9	68	
4.75	#4	*	345.4	6.8	(F) 61.1	61	57-67
	Pan		3090.1	61.1			
	TOTAL		5055.1	100.0			
+ #4 Gradation Check:							
within 0.3% of original dry wt.				0.1%			
					D	wt. before washing (0.1%)	(A) 1069.3
					S	wt. after washing (0.1%)	(B) 1058.5
					T	loss from washing	(C) 10.8
					C	% - #200	(D) 1.01
					H		
					K		

- 3.33 To complete the calculations for the total - #200 material, four pieces of information are needed in the - #200 box at the lower left corner of the DOT-3 worksheet. You have already provided one of these in step 3.32 above, ((D) which is the percent passing the #200 sieve on the coarse aggregate sample wash). The other three are: (E) The percent passing the #200 sieve on the fine sieve analysis (This includes the washed and sieved portion), (F) The percentage of material that passed the #4 sieve during the sieve analysis and (G) The percentage of material that was retained on the #4 Sieve. The amount of material retained on the #4 sieve (G) can be determined by subtracting the percent passing the #4 sieve (F) from 100.
- 3.34 Complete the calculations by multiplying the percent - #200 on the coarse sieve aggregate (D) times the percent of material retained on the #4 sieve (G) and multiply the percent - #200 on the fine sieves (E) times the percent of material that passed the #4 sieve (F) and divide each by 100. The result obtained when adding these 2 values is the "Total - #200 material" for this sample.

Example:

The coarse sieve analysis had 61.1% passing the #4 sieve. 100.0% minus 61.1% passing = 38.9% retained on the #4 sieve.

1.01% passed the #200 sieve in the coarse aggregate sample that was washed (D) and 10.06% passed the #200 sieve on the fine sieve analysis (E).

PAN dry		2.5	52.5			wt. before washing (0.1g)	521.8
PAN wash		50.0	(E) 10.1	6.2		wt. after washing (0.1g)	471.8
TOTAL		521.5			loss from washing (- # 200)		50.0
Coarse (D) 1.01	x % Retain/Desig (G)	38.9	=	0.39	- #4 Gradation check:		
Chip	x % Retain/Design		=		within 0.3% of the		0.1
Fine (E) 10.06	x % Pass/Design (F)	61.1	=	6.15	wt. before washing		
Total/Combined - #200				6.5			

Calculations:

$$\text{Retained \#4 sieve (G) } 38.9\% \times \text{(D) } 1.01\% \text{ pass on coarse aggregate} = \frac{0.39}{100}$$

$$\text{Passing \#4 sieve (F) } 61.1\% \times \text{(E) } 10.06\% \text{ pass on fine sieve analysis} = \frac{6.15}{100}$$

$$0.39 + 6.15 = 6.54 \quad \text{or} \quad 6.5\% \text{ total minus \#200 for the sample.}$$

Coarse Aggregate for Concrete:

- 3.35 Obtain a sample in accordance with SD 201. The sample shall be large enough to provide specimens for all required testing.
- 3.36 Reduce the sample to the size of the various specimens needed for testing by splitting or quartering in accordance with SD 213. The number of specimens needed will depend on the testing required for the sample.

Most samples will require, as a minimum, a sieve analysis, material finer than #200 sieve and particles less than 1.95 specific gravity in coarse aggregate.

- 3.37 For the minimum size of samples for the various tests required, see 3.3 above for the sieve analysis, SD 206 for material finer than #200 sieve, SD 214 for particles less than 1.95 specific gravity in coarse aggregate and SD 218 for scratch hardness.

Coarse aggregate for lightweight concrete specimens shall consist of 0.1 ft³ or more of the material.

- 3.38 Perform the sieve analysis following the procedure outlined in 3.4, 3.6, 3.7, 3.8, 3.10, 3.11, 3.12, and 3.13 above. Coarse aggregate for concrete has a specification on the #8 sieve, so it will be necessary to add that sieve to the nest of sieves.

- 3.39 Using the samples split out in 3.36 above, perform the test for material finer than #200 sieve in accordance with SD 206, particles less than 1.95 specific gravity in coarse aggregate in accordance with SD 214 and scratch hardness of natural coarse aggregate in accordance with SD 218. Report the results of these tests on the worksheet in accordance with the guidelines provided by the applicable test procedure.

Fine Aggregate for Concrete:

- 3.40 Obtain a sample in accordance with SD 201. The sample shall be large enough to provide specimens for all required testing.
- 3.41 If the sample has free moisture on the particle surface, the entire sample may be dried or it may be split using a mechanical splitter with chute openings of 1 1/2" or more, to not less than 5000 grams and then dried.
- 3.42 Reduce the dried sample to the size of the various specimens needed for testing by splitting or quartering in accordance with SD 213. The number of specimens needed will depend on the testing required for the sample.

NOTE: If the sample received from the field does not have free moisture on the particle surface, it may be reduced to the various testing specimens by splitting or quartering in accordance with SD 213. It will, however, require drying before testing.

Most samples will require, as a minimum, a sieve analysis, inclusive of material finer than #200 sieve, and particles less than 1.95 specific gravity in fine aggregate.

The sample split out for the sieve analysis, inclusive of material finer than #200 sieve, must contain a minimum of 500 grams while the sample for the less than 1.95 specific gravity in fine aggregate test must contain between 250 and 350 grams.

The minimum sample specimen weight for the sieve analysis, inclusive of material finer than #200 sieve, for lightweight fine aggregate shall be as shown below:

Wt. of aggregate (lbs./ft ³)	Min. weight of test specimen (grams)
5 to 15	50
15 to 25	100
25 to 35	150
35 to 45	200
45 to 55	250
55 to 65	300
65 to 75	350

- 3.43 Perform the sieve analysis, inclusive of material finer than #200 sieve, in accordance with procedure outlined in 3.17, 3.18, 3.19, 3.20, 3.21, and 3.22 above.

Fine aggregate for concrete has a specification on the 3/8" and #4 sieve, so it will be necessary to add these sieves to the nest of sieves.

- 3.44 Calculate the percentage of material retained on each sieve to the nearest 0.1% by dividing the weight of the retained material by the weight of the sample before washing. Material passing #200 should be calculated to 0.01% and rounded to 0.1%.
- 3.45 Determine the accumulative percent passing each sieve by subtracting the retained percentage for the top sieve from 100.0 and continue subtracting the retained percentage for each sieve from the previous sieves accumulative passing percentage.
- 3.46 The percentage of material passing each sieve may now be rounded and reported on the worksheet to the nearest whole number except the #200 sieve shall be reported to the nearest 0.1%.

Process for determining Fineness Modulus (F.M.)

- 3.47 Samples of fine aggregate for concrete require a result for fineness modulus (F.M.). The sieves used for determination of F.M. are identified on the DOT-3 worksheet by an (*). Calculate the F.M. as follows:
 - A. Subtract the percentage passing (before rounding) the sieves designated by the (*) from 100.0 and record the result in the column titled F.M. After this has been accomplished on each sieve designated, total the results and divide by 100.
 - B. Report the result to the nearest 0.01%.

Example:

<u>Sieve Size</u>	<u>Percent Passing</u>	<u>100.0 Minus Percent Passing</u>
#4	99.8	0.2
#8	91.5	8.5
#16	67.8	32.2
#30	49.9	50.1
#50	21.5	78.5
#100	3.9	<u>96.1</u>
		Total 265.6

Fineness modulus (F.M.) = $\frac{265.6}{100}$ = 2.656 or 2.66

Process for Determining Combined Percentage of Material Passing the #200 sieve

- 3.48 The specifications for aggregates used in concrete require the combined mixture of fine and coarse aggregate be such that not more than a certain percent of the combined materials pass the #200 sieve.

To calculate this combined percentage of material passing the #200 sieve, multiply the percent passing the #200 sieve on the fine and coarse aggregate times the percentage of the sand and rock used in the mix according to the design mix, divide each of the results by 100 and then add them together.

Example:

1.65% passing #200 sieve on coarse aggregate.
0.95% passing #200 sieve on fine aggregate.
Coarse aggregate is 64.4% of total aggregate used in the mix.
Fine aggregate is 35.6% of total aggregate used in the mix.

Coarse aggregate	1.65%	x	64.4%	/	100	=	1.06%
Fine aggregate	0.95%	x	35.6%	/	100	=	<u>0.34%</u>
Combined - #200 sieve						=	1.40 or 1.4%.

The final percentage shall be recorded to the nearest 0.1%.

- 3.49 Perform the test for particles less than 1.95 specific gravity in fine aggregates in accordance with SD 208 and report the results on the worksheet.

Class S, Asphalt Surface Treatments and Miscellaneous Fine Aggregate:

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- 3.50 Obtain a sample in accordance with SD 201. The sample shall be large enough to provide specimens for all required testing.
- 3.51 Reduce the dried sample to the size of the various specimens needed for testing by splitting or quartering in accordance with SD 213. The number of specimens needed will depend on the testing required for the sample.
- 3.52 The minimum sample size shall be as outlined in 3.3 above.
- 3.53 If the sample being tested requires a result for flakiness index, perform the test in accordance with SD 203 using a portion of the aggregate retained on the #4 sieve and above.
- 3.54 If the sample being tested requires a result for percentage of crushed particles, perform the test in accordance with SD 211 using a portion of the aggregate retained on the #4 sieve and above.
- 3.55 If liquid limit/plastic limit/plasticity index is required by specifications, a sample of - #4 shall be obtained from a separate split. The sample split out for the liquid limit/plastic limit/plasticity index. must be of adequate size to produce at least 100 grams of - #40 sieve material.

- 3.56 The sample shall be oven dried to a constant weight at a temperature of $230^{\circ} \pm 9^{\circ}\text{F}$ or in accordance with SD 108.
- 3.57 Weigh the sample and record the weight in the "Weight before washing" line in the fine aggregate portion of the worksheet to the nearest 0.1 gram.
- 3.58 Perform wash as outlined in 3.18 above.
- 3.59 Dry the washed aggregate to a constant weight in an oven at $230^{\circ} \pm 9^{\circ}\text{F}$ as per SD 108 and weight to the nearest 0.1 gram. Record this weight on the "Weight after washing" line in the fine aggregate portion of the worksheet to the nearest 0.1 gram.
- 3.60 Subtract the weight of the sample after washing, from the weight of the sample before washing and record the result on the "Loss from washing (- #200)" line and on the "Pan wash" line below the #200 sieve on the sieve analysis.
- 3.61 Assemble a series of sieves that will furnish the information required by the specifications covering the material being tested. The use of 12" diameter sieves is recommended to prevent sieve overloading.
- 3.62 Pour the aggregate into the top sieve of the nest, place the nest of sieves on a mechanical shaker and shake for a sufficient period of time (A minimum of 10 minutes). Adequacy of sieving can be checked as outlined in 3.8 above. The quantity of material retained on any sieve at the completion of the sieving operation shall not exceed the amount listed in "Chart 1" of 3.11 above.
- 3.63 Weigh the material retained on each sieve and in the pan and record the weights on the worksheet to the nearest 0.1 gram. Add the retained weights including the "Pan Dry" and "Pan Wash" quantities below the #200 sieve. Record this weight on the "Total" line at the bottom of the worksheet. This weight must be within 0.3% of the weight of the sample before washing. If it is not, a new sample shall be tested.
- 3.64 Calculate the percentage of material retained on each sieve to the nearest 0.1% by dividing the weight of the retained material by the weight of the sample before washing. Material passing #200 should be calculated to 0.01% and rounded to 0.1%.
- 3.65 Determine the accumulative percent passing each sieve by subtracting the retained percentage for the top sieve from 100.0 and continue subtracting the retained percentage for each sieve from the previous sieves accumulative passing percentage.
- 3.66 The percentage of material passing each sieve may now be rounded and reported on the DOT-3 to the nearest whole number except the #200 sieve shall be reported to the nearest 0.1%.

4. Report:

4.1 Test results will be reported on form DOT-3 or DOT-68 (These forms do not apply to the Central Lab). Use of the DOT-68 is limited to the following:

- A. Concrete where 2 or more aggregate piles are being weighed during batching to meet a single gradation specification.
- B. Asphalt for mineral aggregate samples on projects utilizing a batch type mixing plant.

4.2 Calculations for the DOT-68 are determined as follows:

- A. Enter the “lbs./cu.yd.” of rock and chip from the Mix Design on lines (H) and (I).
- B. Divide the “lbs./cu.yd.” of the rock and chip by the “Total” to obtain the “Total Agg. %” for lines (H) and (I).

Mix Batch Ticket, lbs./cu. yd.; Total Agg %			
1" rock	1374.00	0.776	(H) (I)
Chip	396.00	0.224	
		0	
		0	
Total	1770.0	1.0	

- C. Split a separate sample of rock and chip for gradation and a separate sample of each for wash ensuring that you meet the minimum sample size as per 3.3 and SD 206.
- D. Perform the gradation for each and calculate as per 3.12 – 3.13.

1" rock				Chip			
Sample Wt.	(0.1g)	10312.3		Sample Wt.	(0.1g)	3098.8	
Sieve Size	Retained (0.1g)	% total ret.(0.1%)	% pass. (0.1%)	Sieve Size	Retained (0.1g)	% total ret.(0.1%)	% pass. (0.1%)
2				2			
1 1/2				1 1/2			
1 1/4				1 1/4			
1	0.0	0.0	100.0	1			
3/4	1431.6	13.9	86.1	3/4			
5/8	2964.8	28.8	57.3	5/8	0.0	0.0	100.0
1/2	1853.9	18.0	39.3	1/2	0.0	0.0	100.0
(J) 3/8	2095.4	20.3	19.0	3/8	104.8	3.4	96.6
1/4				1/4	1347.5	43.5	53.1
#4	1798.4	17.4	1.6	#4	935.3	30.2	22.9
#8	60.7	0.6	1.0	#8	616.2	19.9	3.0
Pan Dry	98.4			Pan Dry	90.5		
Pan Wash	0.0			Pan Wash	0.0		
TOTAL	10303.20			TOTAL	3094.30		

E. Calculate the "Gradation Check" as per 3.10.

Gradation Check==> 0.09

Gradation Check==> 0.15

F. Perform the wash as per SD-206 and calculate lines (K) and (M).

G. Multiply line (K) by "Total Agg %" from line (H) and enter in line (L) for "Bin adj. -200".

H. Multiply line (M) by "Total Agg %" from line I and enter on line (N) for "Bin adj. -200".

wt. before wash	3771.0	
wt. after wash	3728.2	
loss from wash	42.8	
% - #200==>	1.14	(K)
Bin adj. - 200==>	0.881	(L)

wt. before wash	2752.8	
wt. after wash	2707.1	
loss from wash	45.7	
% - #200==>	1.66	(M)
Bin adj. - 200==>	0.370	(N)

I. Add lines (L) and (N) and enter on line (O) for "Total Combined -200" for the Coarse Aggregate.

Composite Coarse Aggregate

Sieve Size	1" rock	Chip			Retained Total	Cumulative % Passing	Spec. Gradation	Job Mix Formula
2					0.0	100.0	100	
1 1/2					0.0	100.0	100	100-100
1 1/4					0.0	100.0	100	
1	0.0				0.0	100.0	100	95-100
3/4	10.8				10.8	89.2	89	
5/8	22.4	0.0			22.4	66.9	67	
1/2	14.0	0.0			14.0	52.9	53	25-60
3/8	15.8	0.8			16.5	36.4	36	
1/4		9.7			9.7	26.6	27	
# 4	13.5	6.8			20.3	6.4	6	0-10
# 8	0.5	4.5			4.9	1.4	1	0-5
Pan	0.7	0.7			1.4	0.1	0	
Total	77.6	22.4	0.0	0.0	99.9			

Total Combined - 200 ==> 1.25 (O)

J. The value from line (O) will then be carried to line (P) to calculate the "Total/Combined -200" with the Fine Aggregate.

Note: You must link the Fine Aggregate test with the Coarse Aggregate in MS&T for this calculation to occur.

K. You must enter the % of Fine Aggregate from the Mix Design on line (Q). Also enter the % of Coarse Aggregate from the Mix Design on line (P). The total of the column "% Retain/Design" must = 100.

L. Calculate the "Total/Combined - #200" as per 3.48

Coarse	1.25%	x % Retain/Design	58.00 =:	0.73	(P)
Chip		x % Retain/Design	=:		
Fine	1.45%	x % Pass/Design	42.00 =:	0.61	(Q)
04 Referenced		Total/Combined - #200		1.3	

M. To calculate the Composite Coarse Aggregate "Retained Total" multiply the "% total ret." from the respective sieve by the "Total Aggregate %" on the Mix Batch Ticket.

Example: (See line (J)) For 3/8 1" Rock multiply 20.3 x 0.776 = 15.75, round to 15.8, and 3/8 Chip multiply 3.4 x 0.224 = 0.76 round to 0.8,

NOTE: you will round these numbers to report on the form, but keep them at two decimal places to add in the next step.

Now add $15.75 + .76 = 16.51$, round to 16.5, this is your "Retained Total" for 3/8.

N. Calculate the "Cumulative % Passing" as per 3.13.

O. If the sample being tested requires a result for percentage of particles less than 1.95 specific gravity for the + #4 sieve material, perform the test in accordance with SD 214 using a portion of the aggregate retained on the #4 sieve and above.

5. References:

AASHTO T 27
ASTM E 11
SD 108
SD 201
SD 204
SD 206
SD 207
SD 208
SD 211
SD 213
SD 214
DOT-3
DOT-68
DOT-69

Sample ID 2203565
File No.

Sieve Analysis and P.I. Worksheet

DOT - 3 (Combined)
9-14

PROJECT PH 0066(00)15 COUNTY Aurora, Ziebach PCN B015

Charge to (If not above project)

Field No. 01 Date Sampled 03/10/2015 10:00 am Date Tested 03/10/2015 11:00 am

Sampled By Tester, One Tested By Tester, One Checked By Tester, Two

Material Type Base Course Source Richland Pit

Taken @ 180.5 tons Lot No. Sublot No.

Weight Ticket Number or Station Ticket #76427, Sta. 26+25 Lift 1 of 3

% moist. = (wet wt. - dry wt.) / dry wt. x 100 =

Sieve Size	F.M.	Retained	% total	% pass.	% pass.	Spec
mm	in	(.1g)	ret.(0.1%)	(0.1%)	(rounded)	Req.
100	4					
75	3					
62.5	2 1/2					
50	2					
37.5	1 1/2					
31.5	1 1/4					
25	1	0.0	0.0	100.0	100	100-100
19	3/4	167.6	2.3	97.7	98	80-100
16	5/8	240.6	3.3	94.4	94	
12.5	1/2	351.7	4.8	89.6	90	68-91
9.5	3/8	338.8	4.6	85.0	85	
6.25	1/4	625.2	8.5	76.5	77	
4.75	#4	586.2	8.0	68.5	69	46-70
Pan		5008.1	68.4			
Total		7318.2				

Sieve Size	retained	% total	% total X %	% pass.	% pass.	Spec
mm #	(.1g)	ret.(0.1%)	pa.#4(0.1%)	(0.1%)	(rounded)	Req.
3.35	6					
2.36	8	136.5	21.6	14.8	53.7	54
2.00	10	28.2	4.5	3.1	50.6	51
1.70	12					
1.18	16	67.1	10.6	7.3	43.3	43
0.850	20	62.7	9.9	6.8	36.5	37
0.600	30	75.8	12.0	8.2	28.3	28
0.425	40	61.4	9.7	6.6	21.7	22
0.300	50	55.6	8.8	6.0	15.7	16
0.180	80	34.4	5.4	3.7	12.0	12
0.150	100	4.8	0.8	0.5	11.5	12
0.075	200	10.6	1.7	1.2	10.3	10.3
PAN dry		1.7	95.1	10.3		631.9
PAN wash		93.4	15.1			538.5
TOTAL		632.20				93.4

Coarse	x % Retain/Design	= :	- #4 Gradation check:
Chip	x % Retain/Design	= :	within 0.3% of the
Fine	x % Pass/Design	= :	wt. before washing
Total/Combined - #200			0.1

Natural Sand	.00	Natural Fines	.00	Na. Rock	.00
Ma.Sand	.00	Filler	.00	Cr.Rock	.00
Cr.Fines	.00	Add Rock	.00		.00

Liquid Limit	L.L.	P.L.
a. can number	45	19
b. wt. can + wet soil (.01g)	29.87	28.34
c. wt. can + dry soil (.01g)	28.14	27.11
d. wt. of water (b - c) (.01g)	1.73	1.23
e. wt. of can (.01g)	19.92	20.17
f. wt. of dry soil (c - e) (.01g)	8.22	6.94
g. Liquid Limit (d/f x j x 100) (0.1)	21.2	N.P. <input type="checkbox"/>
h. Plastic Limit (d/f x 100) (0.1)	N.A.	17.7
i. P. I. (g - h) (0.1)	3.5	
Liquid Limit N.C. <input type="checkbox"/> (g. rounded)	21	N.A.
Plasticity Index (i. rounded)	4	
j. corr. # blows 26 22 = 0.9846, 23 = 0.9899, 24 = 0.9952		
25 = 1.0000, 26 = 1.0050, 27 = 1.0100, 28 = 1.0138		
wt. - #40 181.40 / wt. - #4 611.20 x % pass.#4 =	20.3	
(± 3.0% VARIABLE of Acc. % pass. (0.1%) on the #40)		
SPECIFICATION L.L.	0-25	
SPECIFICATION P.I.	0-6	

+ #4 % Particles less than 1.95 SP. GR.	
Specific gravity of solution (1.95 ± 0.01)	
wt. of lightweight particles (0.1 g)	
weight of + #4 material (0.1 g)	
% lightweight particles	
SPECIFICATION	

- #4 % Particles less than 1.95 SP. GR.	
Specific gravity of solution (1.95 ± 0.01)	
wt. of lightweight particles (0.1 g)	
weight of - #4 material (0.1 g)	
% lightweight particles	
SPECIFICATION	

Crushed Particles Test	
weight of crushed particles	447.0
weight of total + #4 sample	1015.9
percent of crushed particles	44
SPECIFICATION <input type="checkbox"/> 1 or more FF, min.	30-100

Figure 1

Sample ID 2203587

Sieve Analysis and P.I. Worksheet

DOT - 3 (Combined)

File No.

9-14

PROJECT PH 0066(00)15 COUNTY Aurora, Ziebach PCN B015

Charge to (If not above project)

Field No. 06 Date Sampled 03/11/2015 10:00 am Date Tested 03/11/2015 11:00 am

Sampled By Tester, One Tested By Tester, One Checked By Tester, Two

Material Type AGGREGATE COMPOSITE Source Jones Pit

Class E, Type 1 Lot No. 2 Sublot No. 1

Weight Ticket Number or Station Ticket # 76421, Sta. 165+55 Lt Lift 1 of 1

% moist. = (wet wt. 5235.1 - dry wt.) / dry wt. x 100 = 3.5

Sieve Size	F.M.	Retained	% total	% pass.	% pass.	Spec
mm	in	(.1g)	ret.(0.1%)	(0.1%)	(rounded)	Req.
100	4					
75	3					
62.5	2 1/2					
50	2					
37.5	1 1/2					
31.5	1 1/4					
25	1	0.0	0.0	100.0	100	0-100
19	3/4	30.3	0.6	99.4	99	97-100
16	5/8	159.7	3.2	96.2	96	
12.5	1/2	620.1	12.3	83.9	84	76-90
9.5	3/8	454.9	9.0	74.9	75	
6.25	1/4	354.6	7.0	67.9	68	
4.75	#4	345.4	6.8	61.1	61	57-67
Pan		3090.1	61.1			
Total		5055.1				
+ #4 Gradation Check:						
within 0.3% of original dry wt.			0.1			
				D	wt. before washing(0.1g)	1069.30
				u	wt. after washing (0.1g)	1058.50
				s	loss from washing	10.8
				t	% - #200	1.01
				c		
				h		
				k,		

Liquid Limit		L.L.	P.L.
a. can number			
b. wt. can + wet soil	(.01g)		
c. wt. can + dry soil	(.01g)		
d. wt. of water (b - c)	(.01g)		
e. wt. of can	(.01g)		
f. wt. of dry soil (c - e)	(.01g)		
g. Liquid Limit (d/f x j x 100)	(0.1)		N.P. <input checked="" type="checkbox"/>
h. Plastic Limit (d/f x 100)	(0.1)	N.A.	
i. P. I. (g - h)	(0.1)		
Liquid Limit	N.C. <input checked="" type="checkbox"/> (g. rounded)		N.A.
Plasticity Index	(i. rounded)		
j. corr. # blows	22 = 0.9846, 23 = 0.9899, 24 = 0.9952		
	25 = 1.0000, 26 = 1.0050, 27 = 1.0100, 28 = 1.0138		
wt. - #40	111.50 / wt. - #4	321.60	x % pass.#4 = 21.2
(± 3.0% VARIABLE of Acc. % pass. (0.1%) on the #40)			
		SPECIFICATION L.L.	0-25
		SPECIFICATION P.I.	0-0

Sieve Size	retained	% total	% total X %	% pass.	% pass.	Spec
mm #	(0.1g)	ret.(0.1%)	pa.#4(0.1%)	(0.1%)	(rounded)	Req.
3.35	6					
2.36	8	104.1	20.0	12.2	48.9	42-52
2.00	10					
1.70	12					
1.18	16	83.4	16.0	9.8	39.1	32-42
0.850	20					
0.600	30	113.3	21.7	13.3	25.8	26
0.425	40	33.2	6.4	3.9	21.9	14-24
0.300	50					
0.180	80	44.6	8.5	5.2	16.7	17
0.150	100					
0.075	200	90.4	17.3	10.6	6.1	6.1
PAN dry		2.5	52.5	6.2		521.8
PAN wash		50.0	10.1			471.8
TOTAL		521.50				50.0
		loss from washing (-#200)				

+ #4 % Particles less than 1.95 SP. GR.	
Specific gravity of solution (1.95 ± 0.01)	1.96
wt. of lightweight particles (0.1 g)	30.3
weight of + #4 material (0.1 g)	1921.4
% lightweight particles	1.6
SPECIFICATION	0.0-3.0

- #4 % Particles less than 1.95 SP. GR.	
Specific gravity of solution (1.95 ± 0.01)	1.96
wt. of lightweight particles (0.1 g)	5.2
weight of - #4 material (0.1 g)	304.1
% lightweight particles	1.7
SPECIFICATION	0.0-3.0

Coarse	1.01%	x % Retain/Design	38.90	0.39	- #4 Gradation check:
Chip		x % Retain/Design			within 0.3% of the
Fine	10.06%	x % Pass/Design	61.10	6.15	wt. before washing
		Total/Combined - #200	6.5		

Crushed Particles Test	
weight of crushed particles	786.4
weight of total + #4 sample	1008.9
percent of crushed particles	78
SPECIFICATION	2 or more FF, min. 70-100

Natural Fines	45.00	Cr.Fines	23.00	Na. Rock	17.00
Add Rock	15.00	Natural Sand	.00	Ma.Sand	.00
Filler	.00	Cr.Rock	.00		.00

Figure 2

Sample ID 2203609
File No.

Gyratory Aggregate Worksheet

DOT - 69
9-14

PROJECT PH 0066(00)15 COUNTY Aurora, Ziebach PCN B015
Field No. QC04 Date Sampled 03/12/2015 Date Tested 03/12/2015
Sampled By Tester, One Tested By Tester, One Checked By Tester, Two
Material Type AGGREGATE COMPOSITE Source Jones Pit
Class Q2 Lot No. 1 Sublot No. 4
Weight Ticket Number or Station # 50855, Sta. 625+15 Lift 1 of 1

% moist. = (wet wt. 8616.4 - dry wt.) / dry wt. x 100 = 3.9

Original Dry Sample Wt. (.1g) 8289.9

Sieve Size mm in	Retained (.1g)	% total ret.(0.1%)	% pass. (0.1%)	% pass. (rounded)	Spec Req.	Sand Equiv. Test Reading #1	Sand Rdg.	Clay Rdg.	S.E.	
50 2						Reading #2	3.1	6.6	47	
37.5 1 1/2							3.1	6.5	48	
31.5 1 1/4						Sand Equivalent Tests Results			48	
25 1						Fine Aggregate Angularity Test Results			41.8	
19 3/4	0.0	0.0	100.0	100	100-100	Flat and Elongated Particles Test Results				
16 5/8	7.3	0.1	99.9	100						
12.5 1/2	501.4	6.0	93.9	94	89-100					
9.5 3/8	890.3	10.7	83.2	83	79-93					
6.25 1/4	990.4	11.9	71.3	71						
4.75 #4	787.3	9.5	61.8	62						
Pan	5116.7	61.7	Dust wt. before washing(0.1g)		709.30					
Total	8293.4		wt. after washing (0.1g)		707.10					
+ #4 Gradation Check: within 0.3% of original dry wt. 0.04					loss from washing	2.2				
					% - #200	0.31				

Sieve Size mm #	retained (0.1g)	% total ret.(0.1%)	% total X % pa.#(0.1%)	% pass. (0.1%)	% pass. (rounded)	Spec Req.
3.35 6						+ #4 % Particles less than 1.95 SP. GR. Specific gravity of solution (1.95 ± 0.01) 1.95 wt. of lightweight particles (0.1 g) 19.1 weight of + #4 material (0.1 g) 1824.9 % lightweight particles 1.0 SPECIFICATION 0.0-3.0
2.36 8	187.7	29.8	18.4	43.4	43	
2.00 10						- #4 % Particles less than 1.95 SP. GR. Specific gravity of solution (1.95 ± 0.01) 1.95 wt. of lightweight particles (0.1 g) 3.2 weight of - #4 material (0.1 g) 302.4 % lightweight particles 1.1 SPECIFICATION 0.0-3.0
1.70 12						
1.18 16	137.2	21.8	13.5	29.9	30	Crushed Particles Test weight of crushed particles 651.7 weight of total + #4 sample 729.3 percent of crushed particles 89 SPECIFICATION 2 or more FF, min. 65-100
0.850 20						
0.600 30	112.0	17.8	11.0	18.9	19	Crushed Particles Test weight of crushed particles 651.7 weight of total + #4 sample 729.3 percent of crushed particles 89 SPECIFICATION 2 or more FF, min. 65-100
0.425 40	54.3	8.6	5.3	13.6	14	
0.300 50	42.7	6.8	4.2	9.4	9	Crushed Particles Test weight of crushed particles 651.7 weight of total + #4 sample 729.3 percent of crushed particles 89 SPECIFICATION 2 or more FF, min. 65-100
0.180 80						
0.150 100	35.0	5.6	3.5	5.9	6	Crushed Particles Test weight of crushed particles 651.7 weight of total + #4 sample 729.3 percent of crushed particles 89 SPECIFICATION 2 or more FF, min. 65-100
0.075 200	10.5	1.7	1.1	4.8	4.8	
PAN dry	4.8	49.2	4.8	wt. before washing (0.1g)		629.8
PAN wash	44.4	7.8		wt. after washing (0.1g)		585.4
TOTAL	628.60		loss from washing (-#200)			44.4

Coarse	0.31%	x % Retain/Design	38.20	=:	0.12	- #4 Gradation check: within 0.3% of the wt. before washing	0.2
Chip		x % Retain/Design		=:			
Fine	7.81%	x % Pass/Design	61.80	=:	4.83		
Total/Combined - #200			5.0				
Na. Rock	31.00	Cr.Fines	28.00	Natural Fines	25.00		
Osch Nat Fines	16.00	Natural Sand	.00	Ma.Sand	.00		
Filler	.00	Cr.Rock	.00	Add Rock	.00		

Figure 3

Comments: 12" sieves used

Weight of measure and glass plate		327.1
Weight of measure, glass plate & water		426.8
M = net mass of water		99.7
Water Temperature / Density	77F (25.0C)	997.03
V = volume of cylinder, mL		100.0

Dry - #4 bulk specific gravity (Gsb)	2.563	2.563	
Volume of cylinder, mL (V)	100.0	100.0	
Weight of cylinder, g (A)	183.0	183.0	
Wt. of cylinder + aggregate, g (B)	332.5	332.2	
Wt. aggregate, g (F=B-A)	149.5	149.2	
Uncompacted voids, (nearest 0.1%) $U = [(V - F / Gsb) / V] \times 100$	41.7	41.8	Average 41.8

Sieve Size	Total Sample Weight on Sieve	Weight of Tested Portion	Weight of Flat/ Elongated Particles	Percent Flat/ Elongated Individual Sieve	Percent Flat/ Elongated Weighted Average
50.0					
37.5					
25.0					
19.0					
12.5					
9.5					
4.75					

Total sample wt.

Percent flat and elongated particles in the total sample (weighted average) rounded

Figure 3A

Sample ID 2203613
File No.

Sieve Analysis and P.I. Worksheet

DOT - 3 (Coarse)
9-14

PROJECT PH 0066(00)15 COUNTY Aurora, Ziebach PCN B015

Charge to (If not above project)

Field No. 03 Date Sampled 03/12/2015 10:00 am Date Tested 03/12/2015 11:00 am

Sampled By Tester, One Tested By Tester, One Checked By Tester, Two

Material Type COARSE AGGREGATE Source Hills Materials, Rapid City Quarry
A-45, Bridge Lot No. Sublot No.

Weight Ticket Number or Station Lift of

% moist. = (wet wt. - dry wt.) / dry wt. x 100 =

Original Dry Sample Wt. (0.1g) 10414.8

Sieve Size	F.M.	Retained	% total	% pass.	% pass.	Spec
mm in	*	(.1g)	ret.(0.1%)	(0.1%)	(rounded)	Req.
100	4					
75	3					
62.5	2 1/2					
50	2					
37.5	1 1/2	0.0	0.0	100.0	100	100-100
31.5	1 1/4					
25	1	286.0	2.7	97.3	97	95-100
19	3/4	1720.7	16.5	80.8	81	
16	5/8	1098.7	10.5	70.3	70	
12.5	1/2	1407.0	13.5	56.8	57	25-60
9.5	3/8	* 1620.8	15.6	41.2	41	
6.25	1/4	2492.5	23.9	17.3	17	
4.75	#4	* 908.0	8.7	8.6	9	0-10
Pan						
Total						

Sieve Size	Total Sample Weight on Sieve	Weight of Tested Portion	Weight of Flat/ Elongated Particles	Percent Flat/ Elongated Individual Sieve	Percent Flat/ Elongated Weighted Average
mm in					
50.0	2				
37.5	1 1/2				
25.0	1				
19.0	3/4				
12.5	1/2				
9.5	3/8				
4.75	#4				

Total sample wt.
Percent flat and elongated particles in the total sample (weighted average) rounded

+ #4 Gradation Check: within 0.3% of original dry wt.
Dust loss from washing % - #200

+ #4 % Particles less than 1.95 SP. GR.	
Specific gravity of solution (1.95 ± 0.01)	1.96
wt. of lightweight particles (0.1 g)	0.1
weight of + #4 material (0.1 g)	1857.0
% lightweight particles	0.0
SPECIFICATION	0.0-1.0

Sieve Size	retained	% total	% total X	% pass.	% pass.	Spec
mm #	(.1g)	ret.(0.1%)	pa.#4(0.1%)	(0.1%)	(rounded)	Req.
3.35	6					
2.36	8	* 644.7	6.2	2.4	2	0-5
2.00	10					
1.70	12					
1.18	16	*				
0.850	20					
0.600	30	*				
0.425	40					
0.300	50	*				
0.180	80					
0.150	100	*				
0.075	200					
PAN dry		217.9	217.9			wt. before washing (0.1g) 3627.3
PAN wash		0.0	2.1			wt. after washing (0.1g) 3567.5
TOTAL		10396.30				loss from washing (-#200) 59.8

Crushed Particles Test	
weight of crushed particles	<input type="text"/>
weight of total + #4 sample	<input type="text"/>
percent of crushed particles	<input type="text"/>
SPECIFICATION	<input type="text"/> or more FF, min.

Coarse	1.65%	x % Retain/Design	64.40	=	1.06	- #4 Gradation check: within 0.3% of the wt. before washing <input type="text"/> 0.2
Chip		x % Retain/Design		=		
Fine	0.95%	x % Pass/Design	35.60	=	0.34	
03 Referenced		Total/Combined - #200	1.4			

Comments: 13.8" x 13.8" sieves were used. The 1/4 sieve was overloaded. 1/4 sieve was split in half and sieved by hand.

Figure 4

Sample ID 2203622

Sieve Analysis and P.I. Worksheet

DOT - 3 (Fine)

File No.

9-14

PROJECT PH 0066(00)15 COUNTY Aurora, Ziebach PCN B015

Charge to (If not above project)

Field No. 03 Date Sampled 03/12/2015 10:00 am Date Tested 03/12/2015 11:00 am

Sampled By Tester, One Tested By Tester, One Checked By Tester, Two

Material Type FINE AGGREGATE Source Birdsall S & G Wasta

A-45 Bridge Lot No. Sublot No.

Weight Ticket Number or Station Lift of

% moist. = (wet wt. - dry wt.) / dry wt. x 100 =

Original Dry Sample Wt. (0.1g)

Sieve Size	F.M.	Retained	% total	% pass.	% pass.	Spec
mm	in	(.1g)	ret.(0.1%)	(0.1%)	(rounded)	Req.
100	4					
75	3					
62.5	2 1/2					
50	2					
37.5	1 1/2					
31.5	1 1/4					
25	1					
19	3/4					
16	5/8					
12.5	1/2					
9.5	3/8	* 0.00	0.0	0.0	100.0	100
6.25	1/4					
4.75	#4	* 0.20	1.2	0.2	99.8	100

Pan						
Total						
+ #4 Gradation Check:			D wt. before washing(0.1g)			
within 0.3% of original dry wt.			u s wt. after washing (0.1g)			
			t c loss from washing			
			h k, % - #200			

Sieve Size	retained	% total	% total X %	% pass.	% pass.	Spec
mm #	(0.1g)	ret.(0.1%)	pa.#4(0.1%)	(0.1%)	(rounded)	Req.
3.35	6					
2.36	8	* 8.50	52.3	8.3		91.5
2.00	10					92
1.70	12					
1.18	16	* 32.20	149.0	23.7		67.8
0.850	20					68
0.600	30	* 50.10	112.8	17.9		45-85
0.425	40		79.4	12.6		49.9
0.300	50	* 78.50	99.3	15.8		37.3
0.180	80					21.5
0.150	100	* 96.10	110.6	17.6		22
0.075	200		18.4	2.9		3.9
PAN dry		0.9	6			1.0
PAN wash		5.1	1.0			1.0
TOTAL	2.66	629.00				629.4
						624.3
						5.1

Coarse	1.65%	x % Retain/Design	64.40	=:	1.06	- #4 Gradation check: within 0.3% of the wt. before washing
Chip		x % Retain/Design		=:		
Fine	0.95%	x % Pass/Design	35.60	=:	0.34	
03 Referenced		Total/Combined - #200			1.4	0.1

- #4 % Particles less than 1.95 SP. GR.	
Specific gravity of solution (1.95 ± 0.01)	1.95
wt. of lightweight particles (0.1 g)	1.6
weight of - #4 material (0.1 g)	274.3
% lightweight particles	0.6
SPECIFICATION	0.0-1.0

Figure 5

Sample Id 2203625
Mineral Aggregate

Sieve Analysis
Stationary Plant Mix

DOT - 68
9-14

Mix Batch Ticket	lbs./cu. yd.	Total Agg %
1" rock	1374.00	0.776
Chip	396.00	0.224
		0
		0
Total	1770.0	1.0

DRAFT

Test # 04
PCN/Project B015 PH 0066(00)15
Charge to (if not above project)
Sample Represents 1155.0
Date Sampled 03/13/2015
Date Tested 03/13/2015
Checked By Tester, Two

File Number
County Aurora, Ziebach
Cu. Yd. Class and Type COARSE AGGREGATE
Sampled By Tester, One
Tested By Tester, One

1" rock

Sample Wt. (0.1g)	Retained (0.1g)	% total (0.1%)	% pass. (0.1%)
2			
1 1/2			
1 1/4			
1			
3/4			
5/8			
1/2			
3/8			
1/4			
#4			
#8			
Pan Dry			
Pan Wash			
TOTAL	10303.20		

Gradation Check==>

wt. before wash 3771.0
wt. after wash 3728.2
loss from wash 42.8

% - #200==> 1.14
Bin adj. - 200==> 0.881

Chip

Sample Wt. (0.1g)	Retained (0.1g)	% total (0.1%)	% pass. (0.1%)
2			
1 1/2			
1 1/4			
1			
3/4			
5/8			
1/2			
3/8			
1/4			
#4			
#8			
Pan Dry			
Pan Wash			
TOTAL	3094.30		

Gradation Check==>

wt. before wash 2752.8
wt. after wash 2707.1
loss from wash 45.7

% - #200==> 1.66
Bin adj. - 200==> 0.370

Sample Wt. (0.1g)	Retained (0.1g)	% total (0.1%)	% pass. (0.1%)
2			
1 1/2			
1 1/4			
1			
3/4			
5/8			
1/2			
3/8			
1/4			
#4			
#8			
Pan Dry			
Pan Wash			
TOTAL	0.0		

Gradation Check==>

wt. before wash
wt. after wash
loss from wash

% - #200==>
Bin adj. - 200==>

Sample Wt. (0.1g)	Retained (0.1g)	% total (0.1%)	% pass. (0.1%)
2			
1 1/2			
1 1/4			
1			
3/4			
5/8			
1/2			
3/8			
1/4			
#4			
#8			
Pan Dry			
Pan Wash			
TOTAL	0.0		

Gradation Check==>

wt. before wash
wt. after wash
loss from wash

% - #200==>
Bin adj. - 200==>

Figure 6

Composite Coarse Aggregate

Sieve Size	1" rock	Chip	Retained Total	Cumulative % Passing	Spec. Gradation	Job Mix Formula
2			0.0	100.0	100	
1 1/2			0.0	100.0	100	100-100
1 1/4			0.0	100.0	100	
1	0.0		0.0	100.0	100	95-100
3/4	10.8		10.8	89.2	89	
5/8	22.4	0.0	22.4	66.9	67	
1/2	14.0	0.0	14.0	52.9	53	25-60
3/8	15.8	0.8	16.5	36.4	36	
1/4		9.7	9.7	26.6	27	
# 4	13.5	6.8	20.3	6.4	6	0-10
# 8	0.5	4.5	4.9	1.4	1	0-5
Pan	0.7	0.7	1.4	0.1	0	
Total	77.6	22.4	0.0	0.0	99.9	

Total Combined - 200 ==> 1.25

+ #4 % Particles less than 1.95 Specific Gravity

Specific gravity of solution (1.95 ± 0.01)
 wt. of lightweight particles (0.1 g)
 weight of + #4 material (0.1 g)
 % lightweight particles

Bin Adj. % lightweight particles

Composite % lightweight particles

SPECIFICATION maximum

0.0-1.0

Coarse	1.25%	x % Retain/Design	58.00	=	0.73
Chip		x % Retain/Design		=	
Fine	1.45%	x % Pass/Design	42.00	=	0.61
04 Referenced		Total/Combined - #200			1.3

Figure 6A

Flat and Elongated Particles

Rock Size	Sieve Size mm	Sieve Size inches	Total Sample Weight on Sieve	Weight of Tested Portion	Weight of Flat/ Elongated Particles	Percent Flat/ Elongated Individual Sieve	Percent Flat/ Elongated Weighted Average	
1*	50.0	2						
% of Rock	37.5	1 1/2						
	25.0	1						
	19.0	3/4	1431.6	1431.6	0.9	0.1	0.0	
	12.5	1/2	4818.7	809.3	6.7	0.8	0.4	
	9.5	3/8	2095.4	228.5	4.6	2.0	0.4	
	4.75	#4	1798.4	96.7	0.9	0.9	0.2	
	Total sample wt.		10144.1					
Percent flat and elongated particles in: 1*								1.0
Percent flat and elongated particles in Total Rock:								0.8

Rock Size	Sieve Size mm	Sieve Size inches	Total Sample Weight on Sieve	Weight of Tested Portion	Weight of Flat/ Elongated Particles	Percent Flat/ Elongated Individual Sieve	Percent Flat/ Elongated Weighted Average	
Chip	50.0	2						
% of Rock	37.5	1 1/2						
	25.0	1						
	19.0	3/4						
	12.5	1/2	0.0	0.0	0.0			
	9.5	3/8	104.8	75.0	0.0	0.0	0.0	
	4.75	#4	2282.8	40.8	1.1	2.7	2.6	
	Total sample wt.		2387.6					
Percent flat and elongated particles in: Chip								2.6
Percent flat and elongated particles in Total Rock:								0.6

Rock Size	Sieve Size mm	Sieve Size inches	Total Sample Weight on Sieve	Weight of Tested Portion	Weight of Flat/ Elongated Particles	Percent Flat/ Elongated Individual Sieve	Percent Flat/ Elongated Weighted Average	
	50.0	2						
% of Rock	37.5	1 1/2						
	25.0	1						
	19.0	3/4						
	12.5	1/2						
	9.5	3/8						
	4.75	#4						
	Total sample wt.		0.0					
Percent flat and elongated particles in:								0.0
Percent flat and elongated particles in Total Rock:								0.0

Combined Percent Flat and Elongated Particles for Total Rock:
 Rounded: 1
 Spec Max: 10

Figure 6B

Sample ID 2203643

Sieve Analysis and P.I. Worksheet

DOT - 3 (Fine)

File No.

9-14

PROJECT PH 0066(00)15 COUNTY Aurora, Ziebach PCN B015

Charge to (If not above project)

Field No. 04 Date Sampled 03/16/2015 09:00 am Date Tested 03/16/2015 10:00 am

Sampled By Tester, One Tested By Tester, One Checked By Tester, Two

Material Type FINE AGGREGATE Source Pete Lein & Sons, Wasta

1155.0 cuyd, RT. 2805.0 Lot No. Sublot No.

Weight Ticket Number or Station Belt Lift of

% moist. = (wet wt. - dry wt.) / dry wt. x 100 =

Original Dry Sample Wt. (0.1g)

Sieve Size mm in	F.M. *	Retained (.1g)	% total ret.(0.1%)	% pass. (0.1%)	% pass. (rounded)	Spec Req.
100 4						
75 3						
62.5 2 1/2						
50 2						
37.5 1 1/2						
31.5 1 1/4						
25 1						
19 3/4						
16 5/8						
12.5 1/2						
9.5 3/8	* 0.00	0.0	0.0	100.0	100	100-100
6.25 1/4						
4.75 #4	* 0.10	0.8	0.1	99.9	100	95-100

Pan Total D wt. before washing(0.1g) wt. after washing (0.1g)

+ #4 Gradation Check: within 0.3% of original dry wt. loss from washing % - #200

Sieve Size mm #	retained (0.1g)	% total ret.(0.1%)	% total X % pa.#4(0.1%)	% pass. (0.1%)	% pass. (rounded)	Spec Req.
3.35 6						
2.36 8	* 5.40	31.0	5.3	94.6	95	
2.00 10						
1.70 12						
1.18 16	* 27.30	128.2	21.9	72.7	73	45-85
0.850 20		96.5	16.5	56.2	56	
0.600 30	* 62.00	106.7	18.2	38.0	38	
0.425 40		89.1	15.2	22.8	23	
0.300 50	* 87.20	58.7	10.0	12.8	13	10-30
0.180 80		49.0	8.4	4.4	4	
0.150 100	* 96.80	6.9	1.2	3.2	3	2-10
0.075 200		10.6	1.8	1.4	1.4	
PAN dry	0.8	8.5		wt. before washing (0.1g)		585.7
PAN wash	7.7	1.5		wt. after washing (0.1g)		578.0
TOTAL	2.79	586.00		loss from washing (-#200)		7.7

- #4 % Particles less than 1.95 SP. GR.	
Specific gravity of solution (1.95 ± 0.01)	1.95
wt. of lightweight particles (0.1 g)	0.0
weight of - #4 material (0.1 g)	298.4
% lightweight particles	0.0
SPECIFICATION	0.0-1.0

Coarse	1.25%	x % Retain/Design	58.00 =	0.73	- #4 Gradation check: within 0.3% of the wt. before washing
Chip		x % Retain/Design	=		
Fine	1.45%	x % Pass/Design	42.00 =	0.61	
04 Referenced		Total/Combined - #200		1.3	

Figure 7

Sample ID 2203623
File No.

Sieve Analysis and P.I. Worksheet

DOT - 3 (Combined)
9-14

PROJECT PH 0066(00)15 COUNTY Aurora, Ziebach PCN B015

Charge to (If not above project)

Field No. 01 Date Sampled 03/13/2015 10:00 am Date Tested 03/13/2015 11:00 am

Sampled By Tester, One Tested By Tester, One Checked By Tester, Two

Material Type Type 2A Cover Aggregate Source Spencer Quarry

Taken @ 180.3 tons Lot No. Sublot No.

Weight Ticket Number or Station # 194, Sta 866+00 Lift of

% moist. = (wet wt. - dry wt.) / dry wt. x 100 =

Original Dry Sample Wt. (0.1g)

Sieve Size	F.M.	Retained	% total	% pass.	% pass.	Spec	Liquid Limit	L.L.	P.L.
mm	in	(.1g)	ret.(0.1%)	(0.1%)	(rounded)	Req.			
100	4						a. can number		
75	3						b. wt. can + wet soil	(.01g)	
62.5	2 1/2						c. wt. can + dry soil	(.01g)	
50	2						d. wt. of water (b - c)	(.01g)	
37.5	1 1/2						e. wt. of can	(.01g)	
31.5	1 1/4						f. wt. of dry soil (c - e)	(.01g)	
25	1						g. Liquid Limit (d/f x j x 100)	(0.1)	N.A. N.P. <input type="checkbox"/>
19	3/4						h. Plastic Limit (d/f x 100)	(0.1)	N.A. N.A.
16	5/8						i. P. I. (g - h)	(0.1)	
12.5	1/2						Liquid Limit N.C. <input type="checkbox"/> (g. rounded)		N.A.
9.5	3/8	*	0.0	0.0	100.0	100	Plasticity Index (i. rounded)		N.A.
6.25	1/4		235.5	19.2	80.8	81	j. corr. # blows <input type="checkbox"/> 22 = 0.9846, 23 = 0.9899, 24 = 0.9952		
4.75	#4	*	349.1	28.4	52.4	52	25 = 1.0000, 26 = 1.0050, 27 = 1.0100, 28 = 1.0138		
Pan							wt. - #40 / wt. - #4 x % pass.#4 =		
Total							(± 3.0% VARIABLE of Acc. % pass. (0.1%) on the #40)		

Specification L.L.
Specification P.I. 0-3

+ #4 Gradation Check: within 0.3% of original dry wt.

Sieve Size	mm	#	retained	% total	% total X	% pass.	% pass.	Spec	+ #4 % Particles less than 1.95 SP. GR.
			(0.1g)	ret.(0.1%)	pa.#4(0.1%)	(0.1%)	(rounded)	Req.	
3.35	6								Specific gravity of solution (1.95 ± 0.01)
2.36	8	*	518.3	42.2	22.1	10.2	10	0-28	wt. of lightweight particles (0.1 g)
2.00	10		44.6	3.6	1.9	6.6	7		weight of + #4 material (0.1 g)
1.70	12								% lightweight particles
1.18	16	*							SPECIFICATION
0.850	20								- #4 % Particles less than 1.95 SP. GR.
0.600	30	*							Specific gravity of solution (1.95 ± 0.01)
0.425	40		66.0	5.4	2.8	1.2	1	0-4	wt. of lightweight particles (0.1 g)
0.300	50	*							weight of - #4 material (0.1 g)
0.180	80								% lightweight particles
0.150	100	*							SPECIFICATION
0.075	200		12.2	1.0	0.5	0.2	0.2	0.0-3.0	
PAN dry			1.1	4.7	0.2			1228.5	Crushed Particles Test
PAN wash			3.6	0.4				1224.9	weight of crushed particles
TOTAL			1230.40					3.6	weight of total + #4 sample

loss from washing (-#200) 3.6
weight of crushed particles 582.6
weight of total + #4 sample 582.6
percent of crushed particles 100
SPECIFICATION 2 or more FF, min. 50-100

Coarse	x % Retain/Design	=:	- #4 Gradation check:	
Chip	x % Retain/Design	=:	within 0.3% of the	0.2
Fine	0.38% x % Pass/Design	=:	wt. before washing	
Total/Combined - #200				

Natural Sand	.00	Natural Fines	.00	Na. Rock	.00
Ma.Sand	.00	Filler	.00	Cr.Rock	.00
Cr.Fines	.00	Add Rock	.00		.00

Comments: 12" sieves were used. The #8 was split in two and shaken by hand. As per foot note #2, plasticity index was waived as not more than 4.0% of the material passed the #40 sieve.

Figure 8