

Preparing Base-Course Materials for Disturbed-Soil Indicator Tests

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There are two approved methods for preparing base-course materials for the disturbed soil indicator tests: (1) dry preparation of disturbed soil samples for test (AASHTO designation T-87-49) and (2) wet preparation of disturbed soil samples for test (AASHTO designation T-146-49 or T. H. D. No. 53).

This cooperative research study was undertaken to ascertain the differences that would be obtained in the end results of the disturbed soil indicator tests when one laboratory used the dry method and the other laboratory used the wet method of preparing the same sample for the disturbed-soil indicator tests.

In this cooperative research study which included caliche, shell, gravel and crushed stone base course materials, 17 samples were taken in three states: ten in Texas, five in Oklahoma, and two in Louisiana. The author supervised the digging and preparation of each sample at the site where each sample was taken, previous to the shipment of the samples to the laboratories. Four samples were prepared at each of the 17 sites. One sample so prepared was forwarded to each of the three laboratories. The fourth sample was kept for check purposes.

In the Texas State Highway Department laboratory the 17 different samples were prepared for the disturbed soil indicator tests by the wet method. In the Oklahoma State Highway Department laboratory and in the Louisiana State Highway Department laboratory the seventeen samples of base course materials were prepared for test by the dry method. Each laboratory then made the disturbed soil tests by the standard AASHTO methods. The results of the disturbed indicator tests of the seventeen samples of base course materials from each of the three state laboratories were assembled and arranged in a report by this author.

The results indicate the maximum difference between the methods of preparation in determining the liquid limit varied in this series of tests from 4 to 14 and the plasticity index varied from 3 to 14.

The test results indicate that wide variation may occur in the results of the liquid-limit test and the plasticity-index test, not only between the wet and the dry methods of preparation of the base course samples but also, to a lesser degree, between two laboratories using the same dry method of preparation.

● THE research reported in the following paragraphs was initiated and carried to conclusion for the purpose of measuring the maximum difference that is obtained in the soil constants of base-course-material samples when the given samples are prepared for the disturbed indicator soil tests by two different methods namely: (1) dry preparation of disturbed soil samples for test (AASHTO Designation T-87-49) and (2) wet preparation of disturbed soil samples for test (AASHTO Designation T-146-49, or T. H. D. No. 53).

Three state highway department soil laboratories cooperated with the writer in this base course material research study, namely, the Texas State Highway Department laboratory at Austin, Texas; the Oklahoma State Highway Department Laboratory at Oklahoma City, Oklahoma, and the Louisiana State Highway Department Laboratory at Baton Rouge, Louisiana.

Samples of base course materials were taken at 17 different locations in the three states by the author assisted by members of the soil laboratories of the state where the specific samples were taken. Ten samples were dug in Texas, five in Oklahoma, and two in Louisiana. At the outset of this research study, it was planned to select

samples of caliche, shell, and gravel base-course materials in the three states where samples were taken. The general location where each sample was taken is outlined in Figure 1. The specific location where each sample was taken as well as other pertinent data such as kind, depth, and age of base course and surface course, and present condition of surface course is outlined in Table 1.

The method of taking the samples was as follows: First the bituminous surface was

TABLE 1

Sample No	State	County	Kind of Base	Location	Base Depth	Type of Surface	Built	Surface Condition	Sub-grade
1	Tex	Reffugio	Shell	F. M. Highway 136, between Bayside and Woodsboro	6"	1" Single Bituminous Resurfaced 1949	1941	Good where sample was taken	Clay
2	Tex	Reffugio	Shell	F M. Highway 1039 4 mi. S of Woodsboro	5"	1" Single Bituminous	?	Poor Edge failures where sample was taken	Clay
3	Tex.	San Patricio	Caliche	U.S. Highway 50 in the business district of Mathis, Tex.	10"	1 1/4" Cold Uvalde Rock Asphalt	1947	very good	Clay
4	Tex	Bee	Caliche	State Highway 202-3 mi east of Beerville	7"	2" Caliche treated with emulsion 1/4" Seal Coat	1936	very good where sample was taken	Clay
5	Tex.	Bexar	Grav.	State Highway 346-3 mi North of Bexar-Atascosa Co line	10"	2" Uvalde Rock Asphalt	1930	Fair where sample was taken	Clay
6	Tex	Bexar	Grav.	2,000 feet North of Lackland Air Base Gate on loop No 13	12"	2 1/4" of Bituminous Concrete	1941	very good	Clay
7	Tex.	Bexar	Grav.	1,000 feet East of Kelly Field Overpass on loop No. 13	12"	2" of Bituminous Concrete	1939	very good	Clay
8	Okla	Pontotoc	Cr. Stone	2 1/2 mi South of Wye on State Highway No. 99	10"	2 1/4" Okla Rock Asphalt	1946	very good	Sand Clay
9	Okla	Murray	Cr. Stone	Platt National Park Highway 18-1/2 mile of Sulphur Okla gate	4"	2" Okla Rock Asphalt	1931	very good	Clay
10	Okla.	Carter	Grav	S end of Expressway-S Service road U S. 77 Ardmore, Okla	6"	2" Okla. Rock Asphalt	1948	Poor Surface Allgatorated	Clay
11	La.	Jeff.-Davis	Grav.	State Highway 105-0.3 mi South of Square in Welsh, La.	7"	Triple Bituminous	1946	very good	Sand
12	La	Calcasieu	Grav.	State route 240-1 1/4 mi. to intersection of U.S No. 90	7"	Triple Bituminous	1947	very good	Sand Clay
13	Tex	Hale	Caliche	1 1/2 mi. -North of Intersection F.M. 54 and F M. 400 on F.M. 400	10"	Double Bituminous Resealed 1950	1935	good where sample was taken	Clay
14	Tex.	Floyd	Caliche	U.S 70-7 mi. , East of Plainview and 0.4 mi East of Hale Co. line	9"	Double Bituminous Resealed 1950	1936	very good	Clay
15	Tex.	Crosby	Caliche	U.S. 62-1 mile South of Floyd-Crosby Co. line	7"	Double Bituminous Resealed 1949	1939	Good where sample was taken	Clay
16	Okla.	Kiowa	Grav	1 1/2 mile North of Snyder Oklahoma on U S. 183	6"	2" Okla. Rock Asphalt	1934	Poor Surface Allgatorated	Sand Clay
17	Okla.	Kiowa	Grav.	2 1/2 mi. South of Snyder Oklahoma on U S. 183	7"	2" Okla. Rock Asphalt	1935	very good	Sand Clay

carefully peeled from the surface of the base course, after which the base course surface was carefully broomed. Thereafter the compacted base course was picked loose with a pickaxe. Following this the loosened base course was shoveled into a soil sample

splitter and fell therefrom into steel buckets. Four bucketfuls were collected in this manner at the 17 different locations. After this the four bucketfuls were emptied into four different sacks.

The soil or base course sample splitter is shown in Figures 2 and 3. It consists of a hopper with bottom perforated in longitudinal sections which deliver into chutes alternately faced in opposite directions and delivering into two receiving pans. The soil or base course sample is poured into the riffle at the top, and is divided into two equal parts by means of the parallel troughs or chutes, the alternate ones emptying into the same pan. Thus the sample introduced into the hopper is divided into two equal parts, each part receiving an approximately equal fraction of mixture from all points in the hopper area. By subsequently passing through the sampler each of the first two portions obtained four separate samples are secured of substantially identical composition. This process may be continued to secure a representative sample of any desired size. The hopper and chutes are made of heavy rugged tin plate and are removably supported in a strong iron frame allowing space to insert receiving pans.

Thus four sacks of the same base course material was obtained from each hole dug in the surface of a bituminous pavement of known life and behavior at 17 different locations in the above mentioned states. These four sacks were marked Sample A, Sample B, Sample C, and Sample D. Thus after samples had been taken at the 17 different locations there were 17-A samples; 17-B samples; 17-C samples; and 17-D samples. Finally the 17 sacks of A samples were carried by the writer to the Texas Laboratory at Austin, Texas; the 17-B sacks of samples were carried to the Oklahoma laboratory at Oklahoma City, Oklahoma, and the 17-C sacks of samples were carried to the Louisiana laboratory at Baton Rouge, Louisiana. The 17-D sacks of samples were reserved in storage by the writer to be utilized at a later date in case any sample happened to get lost, or any check tests became necessary.

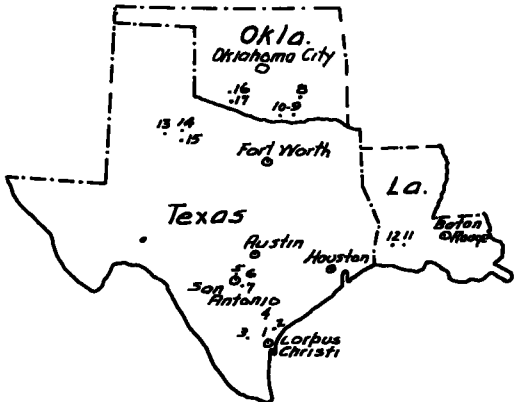


Figure 1. Base Course Material Research approximate locations where the 17 samples were taken.

The 17-A base course material samples were prepared for the disturbed soil indicator tests in the Texas laboratory at Austin, Texas, by the WET method of AASHO designation T-146-49 which is similar to method T. H. D. 53. The 17-B base course materials were prepared for the disturbed soil indicator tests in the Oklahoma laboratory at Oklahoma City, Oklahoma, by the DRY method or AASHO designation T-87-49. The 17-C samples were also prepared for the indicator tests in the Louisiana laboratory at Baton Rouge, Louisiana, by the DRY method AASHO designation T-87-49.

The laboratory procedure for preparing the base course material samples for the simple indicator soil tests by the DRY method (AASHO Designation T-87-49) is as follows:

Preparation of Test Samples

4(a) The base course sample as received from the field in the laboratory is dried thoroughly in air or by use of drying apparatus such that the temperature of the sample will not exceed 140F. After drying the aggregations are thoroughly broken up in a mortar with a rubber-covered pestle or suitable mechanical device in such a way as to avoid reducing the natural size of individual particles. Thereafter a representative test sample of the amount required to perform the tests is obtained by the method of quartering.

TABLE 2

Sample No.	Percent Passing																	
	-10 Lab.			-40 Lab.			-200 Lab.			-0.05 Lab.			-0.005 Lab.			-0.001 Lab.		
	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1	40	44	33	26	29	20	15	18	12	13	15	10	8	7	6	5	2	0
2	33	41	33	19	26	21	10	15	11	9	12	9	6	5	6	3	1	1
3	64	71	68	46	56	53	31	42	32	28	41	28	9	10	8	3	1	0
4	54	63	48	40	46	41	30	31	29	27	31	26	9	11	8	3	4	0
5	36	34	14	31	29	12	21	20	8	21	18	7	11	9	2	4	3	0
6	48	47	32	41	41	28	35	35	23	32	34	20	10	12	7	3	2	0
7	41	42	31	29	31	22	15	16	10	13	15	9	11	7	4	2	1	0
8	40	38	35	27	22	24	14	16	12	13	13	10	6	5	4	1	1	1
9	44	42	39	25	30	22	13	17	10	11	13	9	4	4	3	1	1	1
10	71	72	62	36	46	36	26	24	22	22	24	20	12	11	11	4	1	0
11	42	52	34	26	35	21	12	15	8	11	12	6	5	5	2	2	1	1
12	67	62	58	52	52	46	23	21	16	19	18	13	12	8	8	9	5	3
13	91	91	70	88	82	64	42	45	29	35	39	23	22	19	10	8	6	3
14	63	70	53	55	66	48	26	34	18	22	29	16	13	13	6	4	2	2
15	63	59	47	54	56	43	29	40	22	26	31	18	11	10	5	2	1	2
16	61	58	60	21	26	26	11	14	10	9	11	8	6	4	4	2	2	1
17	72	52	69	34	30	36	14	13	11	12	11	8	5	3	4	2	1	0



Figure 2.

4(b) The portion of the air-dried sample selected for purpose of mechanical analysis and physical tests is weighed and the weight recorded as the weight of the total sample uncorrected for hygroscopic moisture. The test sample is then separated into two portions by means of a 10 mesh sieve. The fraction retained on the No. 10 sieve is then ground in a mortar with a rubber-covered pestle or suitable mechanical device until the aggregations of soil particles are broken up into separate grains. The ground soil is then separated into two fractions by means of the No. 10 sieve.

4(c) The fraction retained on the No. 10 sieve after the second sieving is then set aside for use in the mechanical analysis of the coarse material.

5. The fractions passing the No. 10 sieve in both the sieving operations described

in section 4(b) is thoroughly mixed and by the method of quartering or the use of a sampler, a portion weighing approximately 115 grams for sandy soils, and approximately 65 grams for silt and clay soil, is selected for the mechanical analysis.

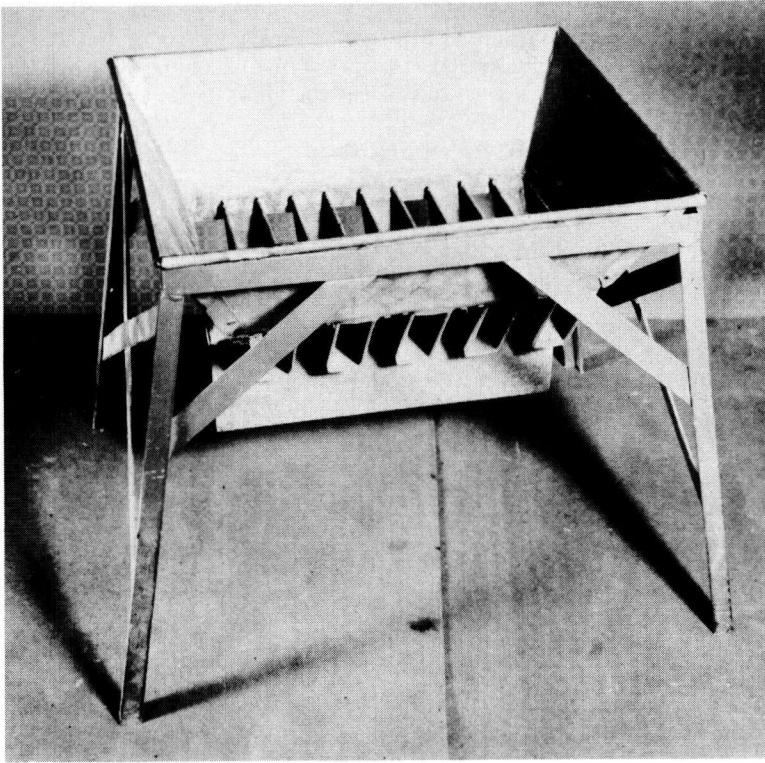


Figure 3.

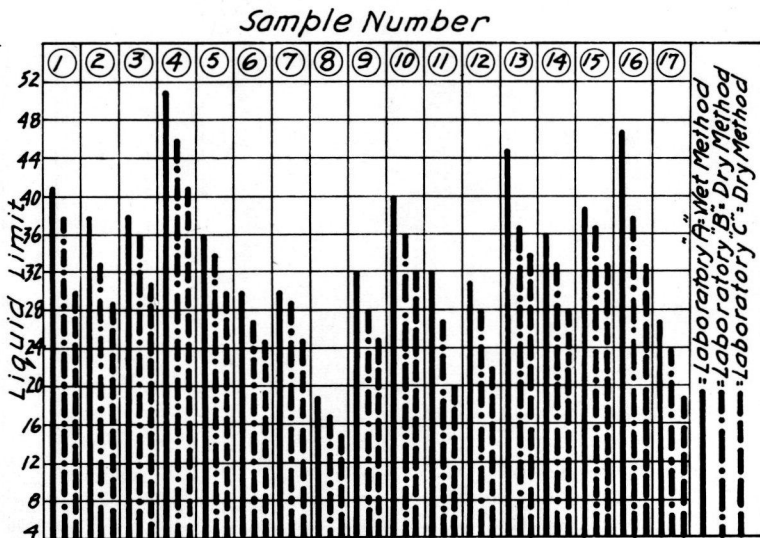


Figure 4.

Test Sample for Soil Constants

6. The remaining portion of the material passing the No. 10 sieve is then separated

into two parts by means of a No. 40 sieve. The fraction retained on the No. 40 sieve is then ground in a mortar with a rubber covered pestle or suitable mechanical device in such a manner as to break up the aggregation of soil particles without fracturing the individual grains. If the sample contains brittle fragments such as large flakes of mica, fragments of sea shells, etc., the grinding operation is done carefully and with just enough pressure to free the fragments from adhering particles of finer material. The ground soil is then separated into two fractions by means of the No. 40 sieve and the material retained on the No. 40 sieve and is reground as before. When repeated grind-

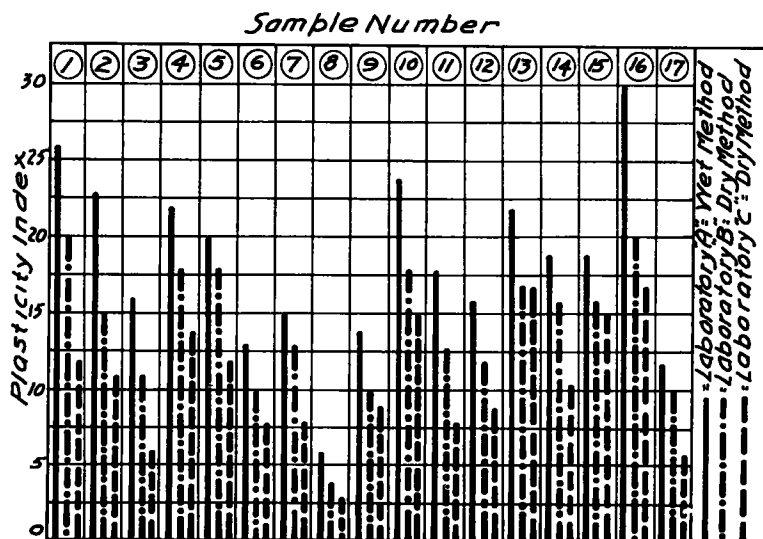


Figure 5.

TABLE 3

Sample Number	Liquid Limit		Plasticity Index		Ratio -200			0.05 to 0.005 Silt			0.005 to 0.001 Clay			less than 0.001 Colloids			Clay plus Colloids		
	Maximum Difference	Minimum Difference	Maximum Difference	Minimum Difference	-40			Lab.			Lab.			Lab.			Lab.		
					A	B	C	A	B	C	A	B	C	A	B	C	A	B	C
1	11	3	14	6	58%	62%	60%	5	8	4	3	5	6	5	2	0	8	7	6
2	9	5	12	8	53	58	52	3	7	3	3	4	5	3	1	1	6	5	6
3	7	2	10	5	67	75	80	19	31	20	6	9	8	3	1	0	9	10	8
4	10	5	8	4	75	67	71	18	20	18	6	7	8	3	4	0	9	11	8
5	6	2	2	2	68	69	67	10	9	5	7	6	2	4	3	0	11	9	2
6	5	3	3	3	85	85	82	23	22	13	7	10	7	3	2	0	10	12	7
7	5	1	2	2	52	52	45	2	8	5	9	6	4	2	1	0	11	7	4
8	4	2	2	2	52	73	50	7	8	6	5	4	3	1	1	1	6	5	4
9	7	4	4	4	52	57	45	7	9	6	3	3	2	1	1	1	4	4	3
10	8	4	6	6	72	52	61	10	13	9	8	10	11	4	1	0	12	11	11
11	12	5	5	5	46	43	38	6	7	4	3	4	1	2	1	1	5	5	2
12	9	3	12	4	44	40	35	7	10	5	3	3	5	9	5	3	12	8	8
13	11	8	5	5	48	55	45	13	20	13	14	13	7	8	6	3	22	19	10
14	8	3	3	3	47	52	38	9	16	10	9	11	4	4	2	2	13	13	6
15	6	2	3	3	54	71	51	15	21	13	9	9	3	2	1	2	11	10	5
16	14	9	10	10	52	54	38	3	7	4	4	2	3	2	2	1	6	4	4
17	8	3	2	2	41	43	31	7	8	4	3	2	4	2	1	0	5	3	4

ings produce only a small quantity of soil passing the No. 40 sieve, the material retained on the No. 40 sieve is discarded. The several fractions passing the No. 40 sieve obtained from the grinding and sieving operations above described are then thoroughly mixed together and set aside for use in the determination of the disturbed soil constants.

The laboratory procedure for preparing the base course material samples for the simple indicator soil tests by the WET method (AASHTO Designation T-146-49 or Texas Highway Department T. H. D. No. 53) is as follows:

SEPARATION OF SOIL BINDER FROM AGGREGATE

6. Weigh the air-dried sample and record the weight on the soil work card. Screen out all material that will easily pass 40 mesh sieve and save and identify the portion passing.

7. Immerse the retained portion from step 6 in a pan of clear water until all the binder material has slacked down or disintegrated, which may require from 2 to 24 hours. If the sample is immersed for only a few hours, extreme care should be taken to see that no lumps containing soil binder remain in the aggregate.

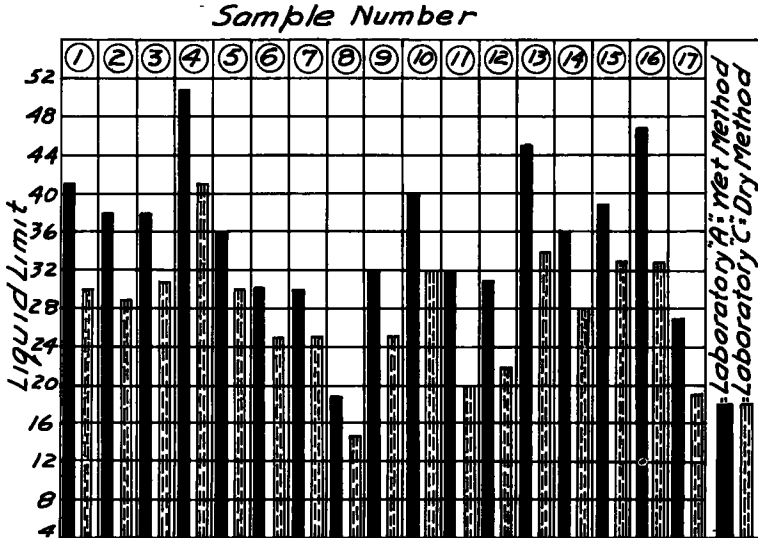


Figure 6.

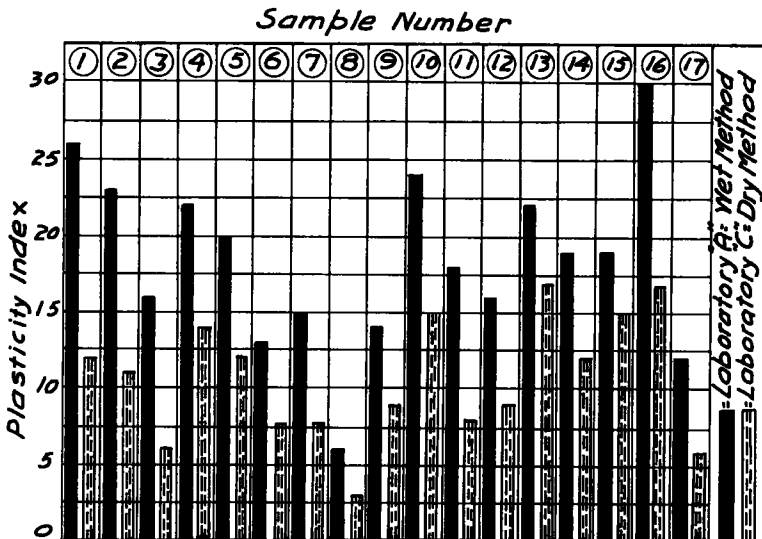


Figure 7.

8. The slacked material is then washed over a 40-mesh sieve. The empty 40-mesh sieve is set in the bottom of a milk pan and the surplus water from the sample poured into it. Enough additional water is added until the level of the water reaches a point approximately $\frac{1}{2}$ inch above the mesh in the sieve. Approximately one pound of the slacked material is placed in the water on the sieve and stirred by hand at the same

TABLE 4

Sample No.	L. L.	P. I.	F. M. E.	S. L.	L. S.	S. R.	Base Type	Class
1A	41	26	26	18	10.3	1.76	Shell	A-6
2A	38	23	23	20	8.4	1.73	Shell	A-6
3A	38	16	31	25	6.1	1.60	Caliche	A-4-7
4A	51	22	36	29	8.9	1.50	Caliche	A-7
5A	36	20	22	17	10.9	1.90	Gravel	A-6
6A	30	13	20	17	6.8	1.82	Gravel	A-2
7A	30	15	21	15	8.0	1.90	Gravel	A-2
8A	19	6	15	13	3.7	1.97	Cr. Rock	A-2
9A	32	14	21	17	7.4	1.81	Cr. Limest.	A-2
10A	40	24	21	15	11.8	1.86	Gravel	A-6
11A	32	18	18	15	8.5	1.84	Gravel	A-6-2
12A	31	16	20	18	7.0	1.80	Gravel	A-2-6
13A	45	22	26	16	13.1	1.81	Caliche	A-7
14A	36	19	24	17	9.2	1.77	Caliche	A-6-2
15A	39	19	26	19	9.2	1.73	Caliche	A-6-2
16A	47	30	25	16	14.1	1.87	Gravel	A-6
17A	27	12	18	15	6.4	1.88	Gravel	A-2

Percent Retained on

Sample No.	Round Opening					Square Mesh Screen					Grain Diam.			Soil Binder Sp.	Grav.	
	in inches					Sieve Numbers					in mm.					
	1½	1	¾	½	¼	10	20	40	60	100	200	0.05	.005			.001
1A	1	8	14	25	46	60	70	74	76	78	85	87	92	95	26	2.67
2A	7	14	22	40	52	67	77	81	82	83	90	91	94	97	19	2.66
3A	0	9	14	17	25	36	47	54	59	63	69	72	91	97	46	2.61
4A	0	6	11	16	31	46	57	60	62	65	70	73	91	97	40	2.62
5A	0	13	22	36	54	64	68	69	71	75	79	79	89	96	31	2.68
6A	1	11	19	30	44	52	56	59	61	62	65	67	90	97	41	2.67
7A	3	11	18	30	47	59	65	71	77	81	85	87	89	98	29	2.69
8A	6	17	25	35	49	60	67	73	78	82	86	87	94	99	27	2.68
9A	0	8	15	25	39	56	67	75	79	83	87	89	96	99	25	2.68
10A	0	0	3	5	11	29	52	64	68	71	74	78	88	96	36	2.61
11A	0	3	10	25	46	58	64	74	81	85	88	89	95	98	26	2.62
12A	0	2	10	19	28	33	35	48	57	69	77	81	88	91	52	2.66
13A	0	0	0	3	6	9	11	12	19	37	58	65	78	92	88	2.65
14A	9	14	17	21	29	37	42	43	49	59	74	78	87	96	55	2.67
15A	6	8	11	15	26	37	43	46	50	57	71	74	89	98	54	2.65
16A	3	21	28	32	39	51	71	79	84	87	89	91	94	98	21	2.72
17A	0	0	6	9	17	28	48	66	76	82	86	88	95	98	34	2.70

time the sieve is agitated up and down. If the material retained on the 40-mesh sieve contains lumps that have not slacked or disintegrated, but which can be crumpled or mashed between the thumb and finger so as to pass through the 40-mesh sieve, such lumps shall be broken and washed through the sieve to the binder pan. The reason for slacking or breaking all such lumps is that it is assumed that any such soft material in lumps will be broken down to binder size particles during the process of construction. When all the soil binder appears to have passed through the sieve, the sieve then is held above the soil and water in the pan and the material retained on the sieve is washed by pouring a small amount of clean water over it and letting the water run into the pan.

9. The material retained on the sieve is poured into another clean pan and another batch of the material with slacked binder placed on the 40-mesh sieve and washed as before. After the total sample has been washed, the pan containing all the soil binder

in the water is set aside and not disturbed for several hours, until all the soil binder has settled to the bottom of the pan and the water above the soil binder has become clear. All the clear water that is possible is then decanted or siphoned off the soil binder.

10. Dry the material retained on the 40-mesh sieve and dry-screen over the 40-mesh sieve, being careful to crumble or mash between the thumb and finger any soft material contained so that it will be included in the soil binder portion. It is necessary to dry-screen the washed retained material, even though it may not contain soft lumps, because there will be coarse-grained particles go through the 40-mesh screen which did not pass when covered with a film of water.

11. Combine all dry material passing the 40-mesh sieve and weigh.

12. Weigh the material retained on the 40-mesh sieve and record as "Wt. Retained on No. 40 Sieve."

TABLE 5

Sample No.	L. L.	P. I.	F. M. E. S. L.	Vol. Change	S. R.	Base Type	Class	
1-B	38	20	29	20	8.5	1.70	Shell	A-2-6(2)
2-B	33	15	29	21	13.0	1.67	Shell	A-2-6(1)
3-B	36	11	30	26	6.6	1.57	Caliche	A-6(2)
4-B	46	18	41	28	20.5	1.52	Caliche	A-2-7(2)
5-B	34	18	31	15	29.0	1.87	Gravel	A-2-6(1)
6-B	27	10	24	18	10.4	1.79	Gravel	A-2-4(0)
7-B	29	13	26	15	20.0	1.89	Gravel	A-2-6(1)
8-B	17	4	15	15	1.5	1.93	Cr. Rock	A-2-(0)
9-B	28	10	24	18	12.4	1.80	Cr. Limest.	A-2-4(0)
10-B	36	18	31	15	30.3	1.87	Gravel	A-2-6(2)
11-B	27	13	25	16	16.4	1.84	Gravel	A-2-6(1)
12-B	28	12	28	17	20.3	1.83	Gravel	A-2-6(1)
13-B	37	17	33	17	28.1	1.79	Caliche	A-6(5)
14-B	33	16	29	19	18.6	1.74	Caliche	A-2-6(2)
15-B	37	16	34	20	24.6	1.72	Caliche	A-6(4)
16-B	38	20	31	15	30.2	1.89	Gravel	A-2-6(1)
17-B	24	10	20	16	8.1	1.89	Gravel	A-2-4(0)

Percent Retained on

Sample No.	Square Opening					Square Mesh Screen						Grain Diam.			Soil Binder	Sp. Grav.
	in inches					Sieve Numbers						in mm.				
	1½	1	¾	½	# 4	10	20	40	60	100	200	.05	.005	.001		
1-B	0	4	7	14	39	56	-	71	-	-	82	85	93	98	29	-
2-B	0	5	8	15	41	59	-	74	-	-	85	88	95	99	26	-
3-B	0	4	5	9	20	29	-	44	-	-	58	59	90	99	56	-
4-B	0	0	4	9	26	37	-	54	-	-	69	69	89	96	46	-
5-B	0	9	14	28	57	66	-	71	-	-	80	82	91	97	29	-
6-B	2	9	14	25	45	53	-	59	-	-	65	66	88	98	41	-
7-B	0	7	14	26	49	58	-	69	-	-	84	85	93	99	31	-
8-B	6	13	18	32	52	62	-	78	-	-	84	87	95	99	22	-
9-B	0	8	17	28	46	58	-	70	-	-	83	87	96	99	30	-
10-B	0	0	3	5	13	28	-	54	-	-	76	76	89	99	46	-
11-B	0	3	5	15	40	48	-	65	-	-	85	88	95	99	35	-
12-B	0	7	10	21	34	38	-	48	-	-	79	82	92	95	52	-
13-B	0	0	1	3	7	9	-	18	-	-	55	61	81	94	82	-
14-B	6	10	15	19	26	30	-	34	-	-	66	71	87	98	66	-
15-B	0	0	8	14	32	41	-	44	-	-	60	69	90	99	56	-
16-B	0	3	25	33	42	53	-	74	-	-	86	89	96	98	26	-
17-B	0	0	6	16	32	48	-	70	-	-	87	89	97	99	30	-

TABLE 6

Sample No.	L. L.	P. I.	F. M. E.	S. L.	L. S.	S. R.	Base Type	Class
1-C	30	12	22	15	-	1.76	Shell	A-2
2-C	29	11	22	17	-	1.71	Shell	A-2
3-C	31	6	27	19	-	1.63	Caliche	A-2
4-C	41	14	30	23	-	1.54	Caliche	A-2-7
5-C	30	12	21	11	-	1.91	Gravel	A-2
6-C	25	8	18	15	-	1.80	Gravel	A-2
7-C	25	8	19	12	-	1.89	Gravel	A-2
8-C	15	3	13	10	-	1.94	Cr. Rock	A-2
9-C	25	9	17	16	-	1.81	Cr. Limest.	A-2
10-C	32	15	19	12	-	1.83	Gravel	A-2
11-C	20	8	13	13	-	1.84	Gravel	A-2
12-C	22	9	14	14	-	1.82	Gravel	A-2
13-C	34	17	19	14	-	1.81	Caliche	A-2-4
14-C	28	12	18	15	-	1.76	Caliche	A-2
15-C	33	15	20	17	-	1.71	Caliche	A-2
16-C	33	17	19	13	-	1.90	Gravel	A-2-4
17-C	19	6	15	13	-	1.89	Gravel	A-2

Percent Retained on

Sample No.	Square Opening					Square Mesh Screen						Grain Diam.			Soil Binder	Sp. Grav.
	in inches					Sieve Numbers						in mm.				
	1½	1	¾	½	# 4	10	20	40	60	100	200	.05	.005	.001		
1-C	4	12	-	32	56	67	-	80	-	85	88	90	94	100	20	2.67
2-C	3	12	-	34	56	67	-	79	-	85	89	91	94	99	21	2.66
3-C	2	5	-	13	24	32	-	47	-	60	68	73	92	100	53	2.61
4-C	1	4	-	18	40	52	-	59	-	66	71	74	92	100	41	2.62
5-C	2	16	-	44	76	86	-	88	-	90	92	93	98	100	12	2.68
6-C	3	16	-	40	62	68	-	72	-	74	77	80	93	100	28	2.67
7-C	2	10	-	32	59	69	-	78	-	86	90	91	96	100	22	2.69
8-C	4	16	-	38	58	65	-	76	-	84	88	90	96	99	24	2.68
9-C	2	12	-	31	51	61	-	78	-	86	89	91	97	99	22	2.68
10-C	0	2	-	8	22	38	-	64	-	74	78	80	89	100	36	2.61
11-C	1	4	-	24	58	66	-	79	-	88	92	94	98	99	21	2.62
12-C	0	4	-	22	38	42	-	54	-	75	84	87	92	97	46	2.66
13-C	3	5	-	8	17	30	-	36	-	58	71	77	90	97	64	2.65
14-C	4	15	-	29	42	47	-	52	-	72	82	84	94	98	48	2.67
15-C	2	6	-	20	46	53	-	57	-	68	78	82	95	98	43	2.65
16-C	0	13	-	30	42	50	-	74	-	86	90	92	96	99	26	2.72
17-C	0	2	-	10	21	31	-	64	-	82	89	92	96	100	36	2.70

13. Add the weights obtained in steps 11 and 12 for the "Wt. of Total Sample." This weight is used in the calculations, but should check reasonably close to the original weight (step 8) so as to be sure that all the sample is obtained.

Calculate, % Soil Binder= $\frac{\text{Wt. Passing No. 40 Sieve}}{\text{Wt. of Total Sample}}$ x 100

14. The material retained on the 40-mesh sieve is preserved for screen analysis, specific gravity, or any other test required.

PREPARATION OF SOIL BINDER

15. The soil binder portion will contain numerous lumps of soil particles, but none of the soil particles are larger than 40 mesh. Place the 40-mesh sieve on the 8½ inch

milk pan, and dry-screen out all of the material that will easily pass the screen.

16. If a pulverizer is available, the material retained (step 15) can be passed through the pulverizer with the jaw opening set slightly wider than 40-mesh in size.

If the pulverizer is not available, a portion of the material retained (step 15) shall be placed in the mortar and ground with the stone pestle until a majority of the lumps appears to be smaller than 40-mesh in size. This material is then placed on the 40-mesh sieve and the portion that will pass the sieve added to the portion passing from step number 15. Another portion of the retained material from step number 15 is placed in the mortar and the above operation repeated.

17. When the retained portion has been reduced down to approximately 100 or 150 grams, it is placed in the mortar and ground with the rubber covered pestle. This is to prevent the breaking up of any particles which might be larger than 40-mesh in size, and to separate the soil binder from these particles.

18. After all of the soil binder has been "prepared" to pass the 40-mesh sieve, it should be combined and stirred thoroughly to produce a uniform homogeneous mixture of all particles. This mixing can be expedited by screening the soil binder through a larger screen such as the $\frac{1}{4}$ inch screen.

DISCUSSION OF THE LABORATORY TEST RESULTS

The soil constants and the complete mechanical analysis including the hydrometer analysis of the seventeen "A" Base Course samples tested in the Texas Laboratory at Austin, Texas by the WET method of preparation for test are outlined in Table 4. Within the limits of the human equation all of the seventeen "A" samples were prepared for test strictly in accordance with specifications AASHTO T-146-49 which is similar to T. H. D. No. 53.

The soil constants and the complete mechanical analysis including the hydrometer analysis of the seventeen "B" Base Course samples tested in the Oklahoma Laboratory at Oklahoma City, Okla. by the DRY method of preparation for test are outlined in Table 5. Within the limits of the human equation all of the seventeen "B" samples were prepared for test strictly in accordance with specifications AASHTO Designation T-87-49.

The soil constants and the complete mechanical analysis including the hydrometer analysis of the seventeen "C" Base Course samples tested in the Louisiana Laboratory at Baton Rouge, La. by the DRY method of preparation for test are outlined in Table 6. Within the limits of the human equation all of the seventeen "C" samples were prepared for test strictly in accordance with specifications AASHTO Designation T-87-49.

The variations that were obtained in the Liquid Limit of the seventeen base course samples between Laboratory A (Texas), WET method, and Laboratory B (Oklahoma), DRY method, and Laboratory C (Louisiana), DRY method, are illustrated graphically in Figure 4.

The variations that were obtained in the Plasticity Index of the seventeen Base Course samples between Laboratory A (Texas) WET method, and Laboratory B (Oklahoma) DRY method, and Laboratory C (Louisiana) DRY method, are illustrated graphically in Figure 5.

The main, as well as the initial objective of this research study was to obtain the maximum possible difference in the soil constants. Inspection of Figures 4 and 5 indicate that the maximum difference in the Liquid Limit and the Plasticity Index test exists in all seventeen samples between the results of Laboratory A (Texas) WET method, and Laboratory C (Louisiana) DRY method. The results of Laboratory B (Oklahoma) DRY method are in all instances intermediate between these two. To show this maximum variation more clearly Figures 6 and 7 were introduced into this report.

The maximum variations in the Liquid Limit Test of the seventeen base course samples between the WET method of base course sample preparation of the Texas Laboratory (17-A samples), and the DRY method of base course sample preparation of the Louisiana Laboratory (17-C samples) are graphically outlined in Figure 6.

The maximum variations in the Plasticity Index Test of the 17 base course samples between the WET method of base course sample preparation of the Texas Laboratory (17-A samples) and the DRY method of base course sample preparation of the Louisiana

Louisiana Laboratory (17-C samples) are graphically outlined on Figure 7.

Table 2 summarizes mechanical analysis, including the hydrometer analysis of the percent passing the number 10, 40, 200 sieves and the 0.05, 0.005, and 0.001 mm of Laboratory A, WET method, and laboratory B, DRY method, and Laboratory C, DRY method of each of the seventeen samples.

Table 3 outlines numerically the maximum difference in each of the seventeen samples of the Liquid Limit and the Plasticity Index between the WET and the DRY method of sample preparation. This numerical maximum was obtained by subtracting the Liquid Limits and the Plasticity Indexes of Laboratory C from those of Laboratory A.

A minimum numerical difference in the Liquid Limits and Plasticity Indexes of the seventeen base course samples is also outlined in Column 2 and Column 4 of Table 3. This minimum difference was obtained by subtracting the Liquid Limits and the Plasticity Indexes of Laboratory B from Laboratory A. It will be seen from this numerical summary in Table 3 that the maximum difference in the Liquid Limit varies from 4 to 14; the maximum difference in the Plasticity Index varies from 3 to 14. Also the minimum difference in the Liquid Limit varies from 1 to 8; and the minimum difference in the Plasticity Index varies from 2 to 10.

Table 3 also outlines the ratio of the Minus 200 mesh sieve to the minus 40 sieve of each of the seventeen samples for all three laboratories namely Laboratory A, Laboratory B, and Laboratory C.

CONCLUSIONS

Wide differences are obtained in the disturbed soil constants of base course material samples prepared for test by the WET method (AASHTO Designation T-146-49 or T. H. D. No. 53) over the DRY method (AASHTO Designation T-87-49.) At this time the exact reason for this is obscure. It may possibly be due to the more active quality of the increased percentage of very fine intimate surface colloidal material that is obtained by the WET Method of sample preparation.

This research study also discloses that minor variations may arise in the soil constants of base course materials prepared for test by two different soil laboratories under the DRY Method specifications (AASHTO Designation T-87-49). The exact reason for this at this time is also obscure. It may possibly be due to the variation in the intensity of effort and the difference in length of time that a sample is pounded in the pestle between operators in the two laboratories.