Research Report
KTC-97-3

PERFORMANCE EVALUATION OF RECYCLED PCC PAVEMENT USED AS A CRUSHED STONE BASE AND DENSE GRADE AGGREGATE

by

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and

in cooperation with
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SI* (MODERN METRIC) CONVERSION FACTORS

APPROXIMATE CONVERSIONS TO SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
in.	inches	25.40000	millimeters	mm
ft	feet	0.30480	metres	m
yd	yards	0.91440	metres	m
mi	miles	1.60934	kilometres	km
		AREA		
in.^{2}	square inches	645.16000	millimetres squared	mm^2
ft^2	square feet	0.09290	metres squared	m
yd^2	square yards	0.83613	metres squared	m
ac	acres	0.40469	hectares	ha
mi^2	square miles	2.58999	kilometres squared	km^2
		VOLUME		
fl oz	fluid ounces	29.57353	millilitres	ml
gal.	gallons	3.78541	litres	l
ft^3	cubic feet	0.02832	metres cubed	m
yd^3	cubic yards	0.76455	metres cubed	m
		MASS		
oz	ounces	28.34952	grams	g
lb	pounds	0.45359	kilograms	kg
T	short tons (2000 lb)	0.90718	megagrams	Mg
		FORCE AND PRESSURE		
lbf	pound-force	4.44822	newtons	N
psi	pound-force per square inch	6.89476	kilopascal	kPa
		ILLUMINATION		
fc	foot-candles	10.76426	lux	lx
fl	foot-Lamberts	3.42583	candela/m	cd/m^2
°F				
	Fahrenheit temperature	5(F-32)/9	Celsius temperature	C

APPROXIMATE CONVERSIONS FROM SI UNITS

Symbol	When You Know	Multiply By	To Find	Symbol
		LENGTH		
mm	millimeters	0.03937	inches	in.
m	metres	3.28084	feet	ft
m	metres	1.09361	yards	yd
km	kilometres	0.62137	miles	mi
		AREA		
mm^2	millimetres squared	0.00155	square inches	in.
m^2	metres squared	10.76392	square feet	ft
m^2	metres squared	1.19599	square yards	yd
ha	hectares	2.47103	acres	ac
km^2	kilometres squared	0.38610	square miles	mi
		VOLUME		
ml	millilitres	0.03381	fluid ounces	fl oz
l	litres	0.26417	gallons	gal.
m^3	metres cubed	35.31448	cubic feet	ft
m^3	metres cubed	1.30795	cubic yards	yd
		MASS		
g	grams	0.03527	ounces	oz
kg	kilograms	2.20462	pounds	lb
Mg	megagrams	1.10231	short tons (2000 lb)	T
		FORCE		
N	newtons	0.22481	pound-force	lbf
kPa	kilopascal	0.14504	pound-force per square inch	psi
		ILLUMINATION		
lx	lux	0.09290	foot-candles	fc
cd/m^2	candela/m^2	0.29190	foot-Lamberts ^{2}	fl
		TEMPERATURE (exact)		
°C	Celsius temperature	1.8C + 32	Fahrenheit temperature	F

*SI is the symbol for the International System of units. Appropriate rounding should be made to comply with Section 4 of ASTM E380.

Rev. 12/93

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EXECUTIVE SUMMARY

Kentucky Highway Investigative Task No. 24, "Recycled Concrete Pavement", (SSP-059-7965) involved the use of Recycled/Crushed Portland Cement Concrete (RPCC) for use as Crushed Stone Base (CSB) on the Thomas More Parkway in Kenton County, Kentucky. The Parkway, which connects Dudley Road to South Loop Road in front of the Thomas More College campus, was the first roadway to be built in Kentucky using recycled Portland Cement Concrete for crushed stone base. The Kentucky Transportation Center was requested to evaluate the material's performance versus the normal limestone CSB and make appropriate recommendations. Both field and laboratory testing were required, along with annual visual surveys. In addition to the Thomas More Parkway, a portion of Interstate 275 was studied, where both RPCC and virgin limestone were used for DGA in adjacent sections. The adjacent sections were used for testing and evaluation of the RPCC CSB to compare its performance with regular limestone under similar conditions. In addition, RPCC samples were also collected from Interstate 75 and analyzed.

At this time, it appears that the RPCC CSB is performing equally to the limestone DGA under field conditions. Considerable breakdown of the recycled aggregate was observed under laboratory freeze-thaw conditions, but laboratory gradation tests show that the aggregate on the project is still within the specifications for both DGA and CSB. Due to this laboratory breakdown of the aggregate, it is recommended that FWD and gradation tests, and visual surveys be performed on the Thomas More Parkway and I-275 periodically. However, since field performance currently appears to be the same for DGA and RPCC, it is recommended that RPCC could continue to be used as a substitute for DGA, unless future distress data indicate otherwise.

INTRODUCTION

Kentucky Highway Investigative Task No. 24, "Recycled Concrete Pavement", (SSP-059-7965) involved the use of Recycled/Crushed Portland Cement Concrete (RPCC) for use as Crushed Stone Base (CSB) on the Thomas More Parkway in Kenton County, Kentucky. The Parkway, which connects Dudley Road to South Loop Road in front of the Thomas More College campus, was the first roadway to be built in Kentucky using recycled Portland Cement Concrete for crushed stone base. The Kentucky Transportation Center was requested to evaluate the material's performance versus the normal limestone CSB and make appropriate recommendations. Both field and laboratory testing were required, along with annual visual surveys. In addition to the Thomas More Parkway, a portion of Interstate 275 was studied, where both RPCC and virgin limestone were used for DGA in adjacent sections. The adjacent sections were used for testing and evaluation of the RPCC CSB to compare its performance with regular limestone under similar conditions. In addition, RPCC samples were also collected from Interstate 75 and analyzed.

HISTORY/CONSTRUCTION

Construction began on the Thomas More Parkway and a portion of Dudley Road in the Fall of 1992. The contractor for the project was the Eaton Asphalt and Paving Comapny of Covington, KY. The section of the Thomas More Parkway which was to be inspected began at the intersection of Dudley Road and the Thomas More Parkway (near station 186 + 50) and ended in front of the Thomas More campus at the intesection of the Thomas More Parkway and South Loop Road (Station 171 + 00). The section was approximately 472.44 meters(1550 feet) in length.

The Thomas More Parkway consists of three lanes: one for northbound, one for southbound traffic and one turning lane. The roadway consists of 36.83 centimeters (14 ½ inches) of RPCC crushed to Crushed Stone Base (CSB) specifications, followed by 14.605 cm (5 3/4 inches) of bituminous concrete base and 3.175 cm (1 1/4 inches) of bituminous concrete surface. The pugmill for the project was located in Sanfordtown. An illustration of the road's cross section is given in Figure 1. Site illustrations are given in Figures 2a and 2b .

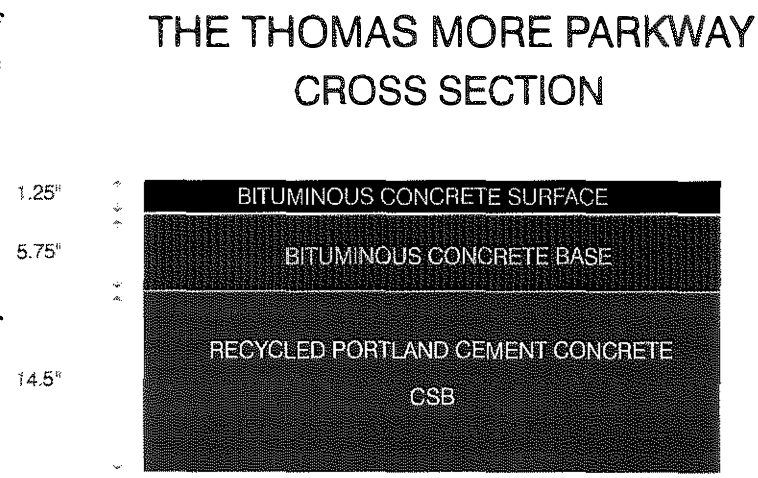


Figure 1. Cross Section of the Thomas More Parkway.

Figure 2a. Thomas More Parkway

Figure 2b. Thomas More Parkway

The section of Interstate 275 that was evaluated was renovated in 1994. The renovation consisted of two sections: one constructed with the conventional virgin limestone for DGA and one with RPCC for CSB. The section lengths were 109.73 meters (360 feet) and 140.2 meters (460 feet), respectively. The cross section of the roadway consisted of 27.94 cm (11 inches) of PCC followed by 10.16 centimeters (four inches) of asphalt-treated drainage blanket and 10.16 centimeters (four inches) of CSB. An illustration of the cross section is shown in Figure 3. This particular site was chosen so that DGA and CSB could be evaluated using practically the same surface layer and subbase. No gradation data were obtained on this site. Only Falling Weight Deflectometer (FWD) testing was performed.

CROSS SECTION OF INTERSTATE 275 USING RECYCLED ROADWAY CONCRETE FOR DENSE-GRADED AGGREGATE

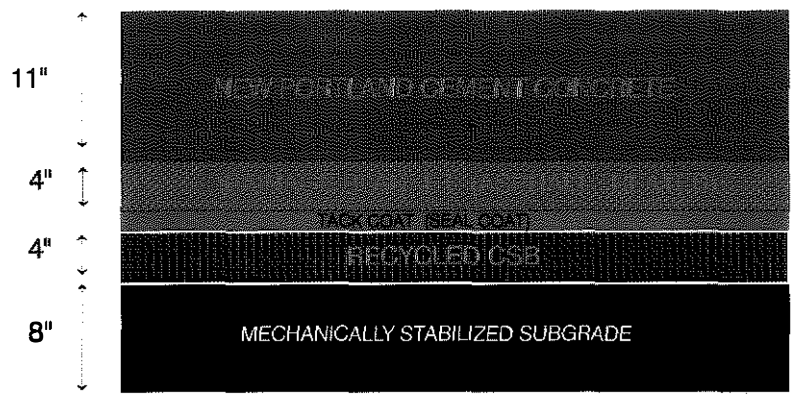


Figure 3. Cross Section of the I-275 Test Section

As mentioned previosly, RPCC CSB samples were also taken from Interstate 75 both before and after rolling. These samples, along with a sample of stockpiled virgin limestone DGA, were collected for comparing RPCC versus conventional DGA under freeze-thaw conditions.

LABORATORY TESTS

The major concern with using RPCC instead of the conventional virgin limestone for DGA and Crushed Stone Base (CSB) was that it would deteriorate more quickly. Since conventional DGA is composed of almost 100% limestone and RPCC CSB is composed of both gravel and hydrated Portland cement, a loss in stability was of concern. Two lab procedures were performed on the RPCC aggregate to determine its soundness. First, aggregate samples were collected during construction in 1992 and gradations were performed on them. Later, in 1996, aggregate samples were removed from the roadway and gradation tests were again performed. Both sets of data were evaluated, along with gradation data taken during construction by personnel of District 6 of the Kentucky Department of Highways. The results showed that some breakdown does occur, but the aggregate stays within the specification boundaries. The gradation breakdown of the three sets of data is shown graphically in Figure 4. To insure the accuracy of the sieve analysis, two gradation tests were performed on the same sample. The results were practically identical, indicating good repeatability. The results of the two-test method are shown graphically in Figure 5. The gradation results obtained by KTC, along with error analysis figures, are shown in Table 1. The RPCC aggregate was to be crushed and evaluated according to Crushed Stone Base specifications. However, the aggregate also falls within the acceptable values for dense-graded aggregate. This is shown in Figure 6.

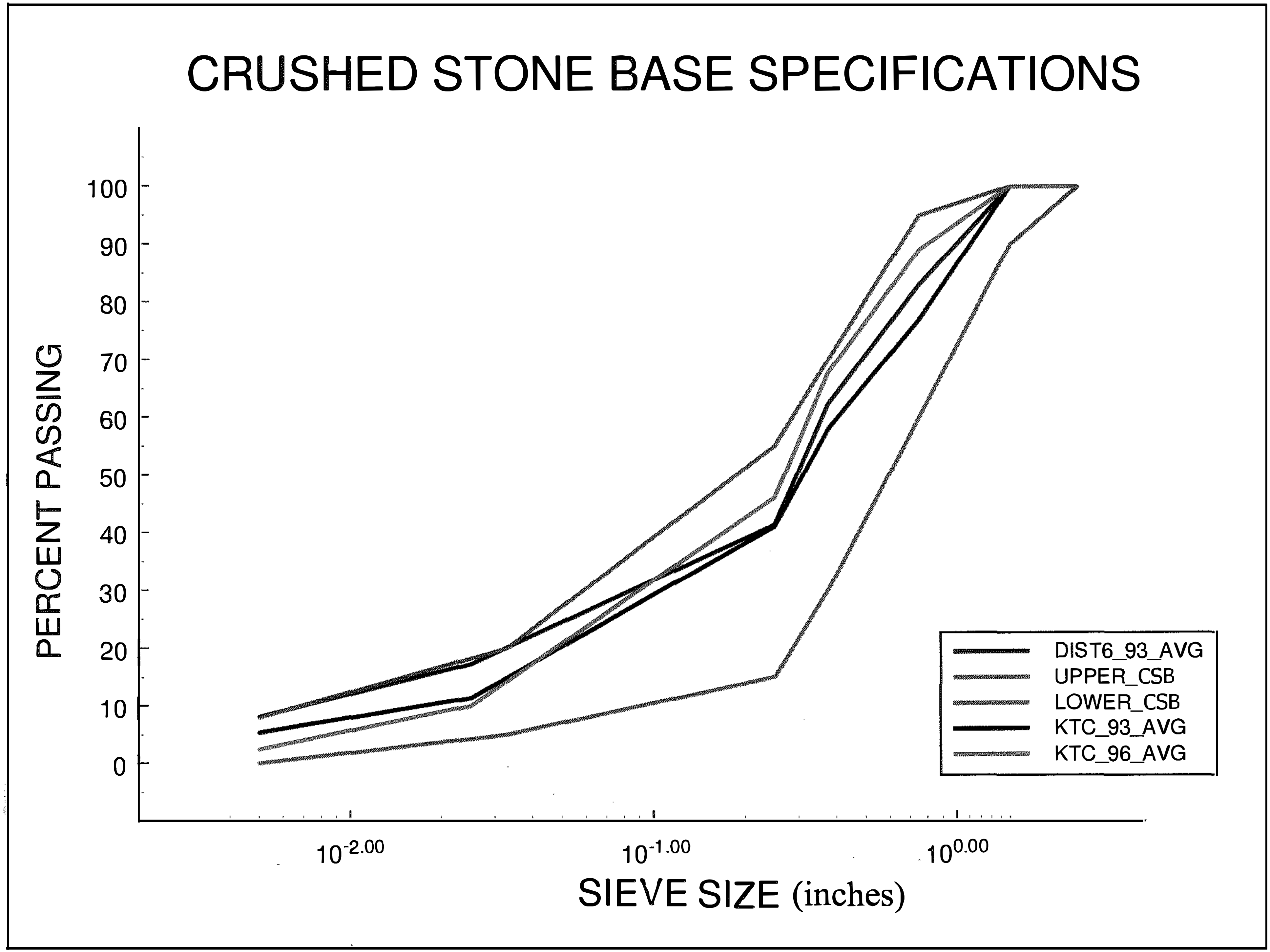


Figure 4, Recycled PCC CSB Percent Passing Averages and Crushed Stone Base Limits.

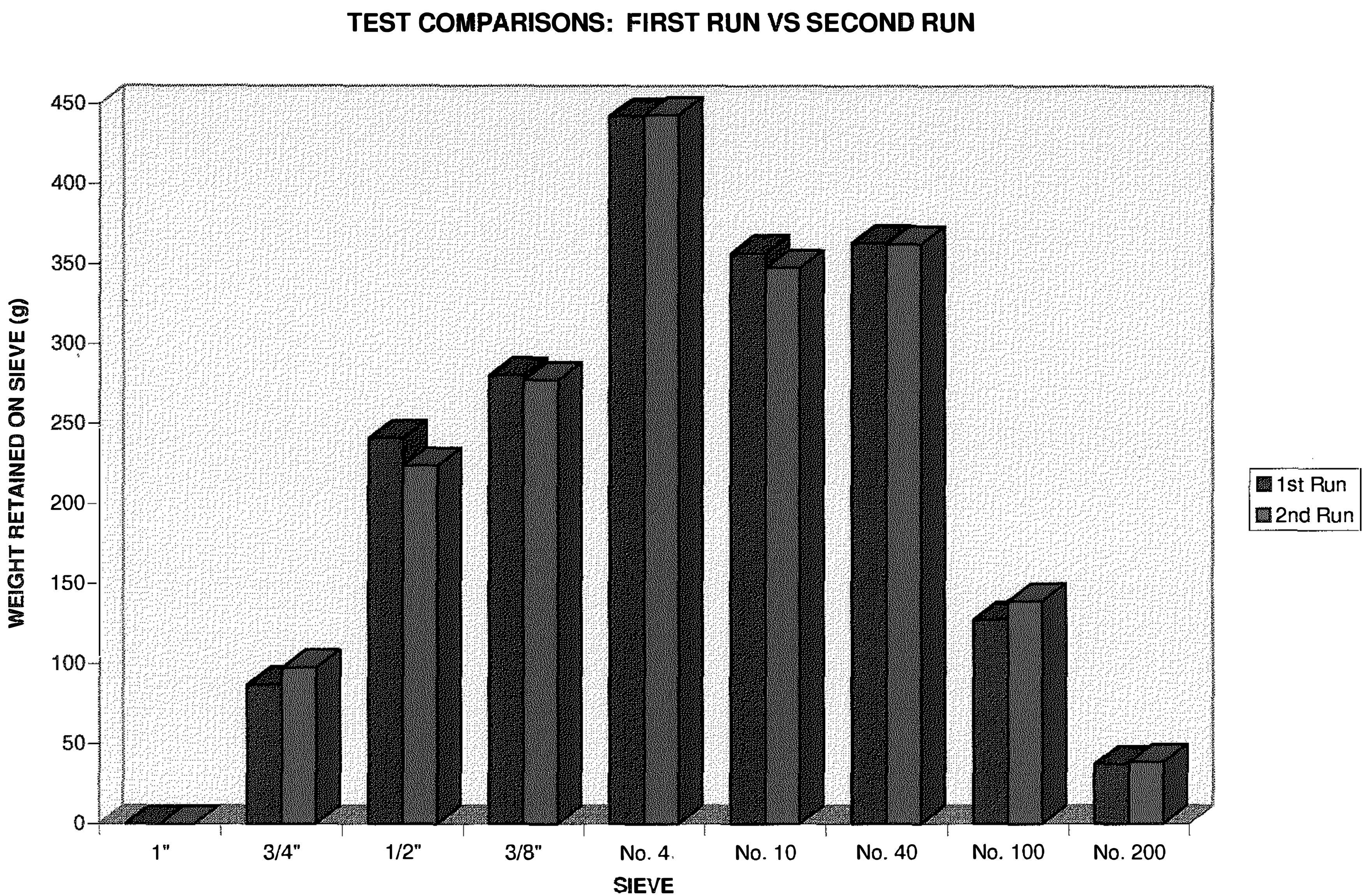


Figure 5, Gradation Test Comparisons: First Versus Second Run.

THOMAS MORE PARKWAY PERCENT RETAINED AVERAGES

sieve size	test 1	test 2	test 3	test 4	test 5(2K)	test 6(2691.55g)	% retained AVERAGE
			AVERAGES AFTER THE ANALYSIS OF 8691 GRAMS				
1"	5.903	7.717	0	0	4.522	2.698	**3.523**
3/4"	4.919	10.969	9.439	7.974	6.08	5.473	**7.095**
1/2"	11.567	12.778	8.844	8.733	7.821	16.221	**12.15**
3/6"	11.435	10.383	11.953	7.99	8.083	11.492	**10.58**
No.4	21.504	18.018	22.75	20.715	22.852	24.09	**23.01**
No. 10	16.763	15.168	19.324	20.193	19.938	16.409	**18.4**
No. 40	17.845	16.285	18.52	22.432	19.938	14.601	**18.2**
No. 100	5.956	4.758	5.158	6.774	6.121	4.649	**5.6**
No. 200	1.986	1.799	1.693	2.224	2.151	1.75	**1.97**
finer 200	2.122	2.125	2.319	2.965	2.496	2.616	**2.56**
			ERROR ANALYSIS				
sieve size	**deviation of test 1**	**deviation of test 2**	**deviation of test 3**	**deviation of test 4**	**deviation of test 5**	**deviation of test 6**	**average difference**
1"	2.376	4.19	3.52	3.526	0.995	0.828	2.57
3/4"	2.176	3.873	2.34	0.878	1.015	1.622	1.98
1/2"	0.583	0.627	3.306	3.417	4.329	4.071	2.72
3/8"	0.854	0.197	1.37	2.59	2.497	0.911	1.41
No.4	1.511	4.997	0.264	2.299	0.163	1.075	1.71
No.10	1.636	3.231	0.924	1.793	1.538	1.99	1.85
No.40	0.356	1.916	0.318	4.23	1.736	3.6	2.02
No.100	0.357	0.84	0.4401	1.175	0.522	0.949	0.71
No.200	0.008	0.178	0.284	0.247	0.174	0.227	0.19
finer 200	0.44	0.437	0.243	0.403	0.066	0.054	0.27

Table 1, Thomas More Parkway Percent Retained Averages and Deviations.

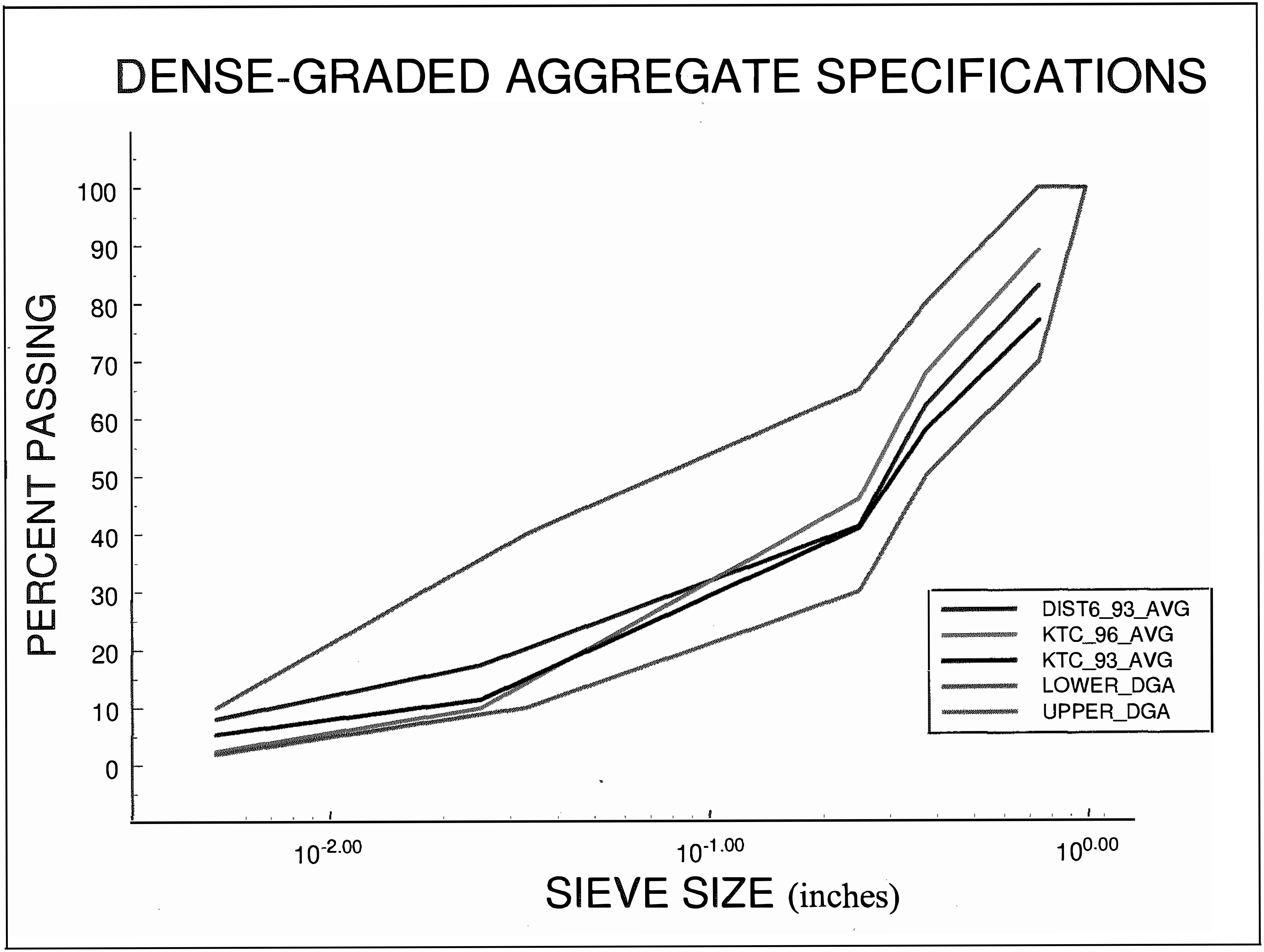


Figure 6, Recycled PCC CSB Percent Passing Averages and Dense-Graded Aggregate Limits.

Freeze-thaw testing was also performed on RPCC CSB used on the I-75 project. Samples from before and after field compaction were obtained, along with a control sample of conventional DGA from I-275. The three samples were then subjected to 50 freeze-thaw cycles. After 50 cycles, the DGA was then graded on a 4.76 millimeter (No. 4) sieve to determine the percent loss and breakdown due to the freeze-thaw process. The test confirmed that the RPCC aggregate deteriorated more quickly than conventional DGA as a result of freezing and thawing. Deterioration of the rolled and unrolled aggregate was comparable after completion of the freeze-thaw tests indicating that normal mechanical stress and handling does not cause significant breakdown of the RPCC aggregate. The results of this test are contained in Appendix A and are shown graphically in Figure 7.

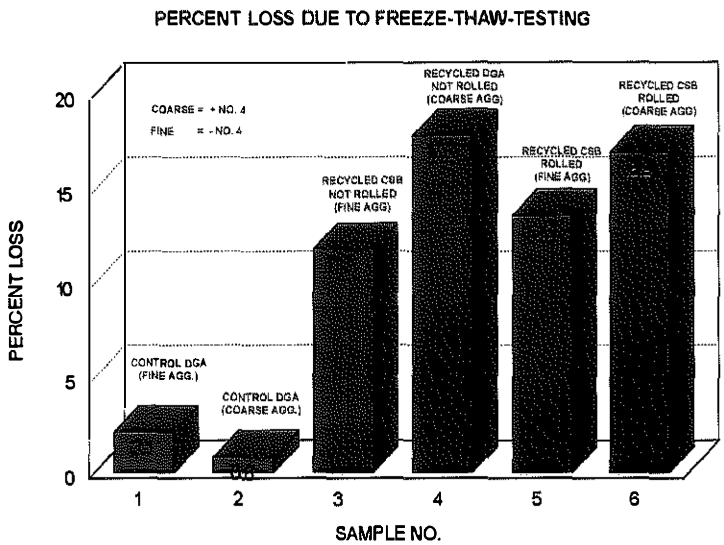


Figure 7. Percent Loss Due to Freeze-Thaw Testing

To estimate the number of freeze-thaw cycles that the aggregate will experience, a program developed at the University of Illinois at Urbana-Champagne and modified by Jack Deacon at the University of Kentucky(1) was used. The program uses factors such as temperature and direct sunlight to calculate the temperature at certain depths of asphalt and concrete pavement. In the past year, in Covington, Kentucky, pavement depths of 15.24 and 20.32 centimeters (six and eight inches) of asphalt pavement would have undergone seven and three freeze-thaw cycles, respectively. The Thomas More Parkway, which consisted of 17.78 centimeters (seven inches) of asphalt, would fall between those two figures. Portland cement concrete at a depth of 27.94 centimeters (11 inches) (the thickness of the I-275 section), would have experienced seven freeze-thaw cycles. However, the actual DGA in the I-275 roadway is also buried beneath an additional 10.16 centimeters (four inches) of asphalt drainage blanket. Therefore, it is likely that the DGA would have undergone even fewer freeze-thaw cycles. The number of freeze-thaw cycles both kinds of pavement underwent with respect to depth is shown graphically in Figure 8.

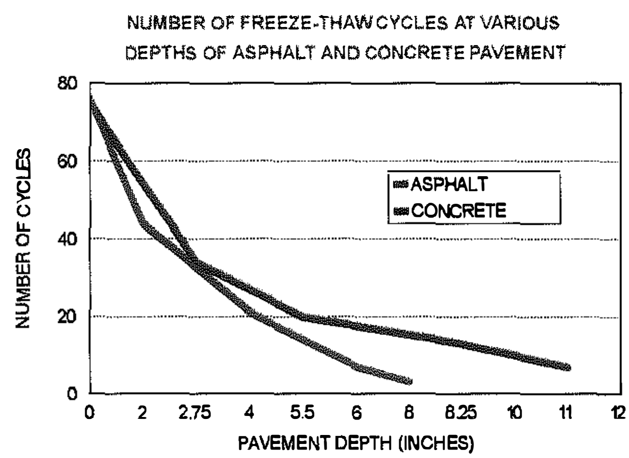


Figure 8. Number of Freeze-Thaw Cycles at Various Depths

The Center also performed specific gravity tests on the material which was recovered from the Thomas More Parkway. This was in order to test the claim of the contractor that the recycled material weighed 16% less than ordinary CSB. Two tests were run using a pycnometer at constant temperature. They yielded specific gravities of 2.66 and 2.61--only 1.5% and 3.4% less than conventional limestone at 2.70. A test was then run without making an effort to remove all air bubbles from the pycnometer. This test showed a specific gravity of 2.39 --about 11.5% lighter than the specific gravity of conventional limestone.

FALLING WEIGHT DEFLECTOMETER

Falling Weight Deflectometer tests were performed four times on the Thomas More Parkway: (1) on the aggregate base immediately before the bituminous layers were laid down, (2) just after the pavement was finished,(3) in 1994, (4) and in 1995. Tests were performed in both directions at 15.24- meter (50-foot) intervals. Three approximate load levels were applied at each station: 62.3 kN (14,000 lbs.), 48.9 kN (11,000 lbs.), and 35.6 kN(8,000 lbs.). Temperature readings were taken and considered when evaluating the results.

The FWD tests which were performed on I-275 were completed on the same day. Testing was performed on both the RPCC and conventional DGA sections at 6:30 AM, 10:00 AM, and 1:30 PM. A load of approximately 66.7 kN (15,000 lbs.) was used at each station twice.

The program used to evaluate the FWD field data and backcalculate the resilient modulus of the pavement and base layers was MODULUS 5.0. The program uses an iterative process to compute the moduli values. A problem with the calculation procedure is that a "unique" solution may not exist for the moduli values. Because of this, a four-layer roadway may be evaluated and two or more different sets of moduli values may be acceptable to MODULUS. Typically, however, only one set will be logical. Therefore, each moduli value must be scrutinized before it is considered as acceptable in evaluating the pavement and base properties of the roadway. All of the output data from MODULUS were evaluated and all illogical output were discarded. However, the amount of data discarded was nominal and did not significantly affect the accuracy of the evaluation.

On the Thomas More Parkway, testing was done on each station using three load levels---approximately 62.3kN (14,000 lbs.), 48.9kN (11,000 lbs.), and 35.6kN (8,000 lbs.). Moduli values from the four different testing dates for the aggregate base ranged from 206.85 to 482.65 Megapascals (30 to 70 ksi), typical for aggregate base, especially considering that asphalt pavement moduli is very dependent on temperature and direct sunlight, and temperatures varied over 30 degrees Fahrenheit between some tests. The moduli values for the northbound and southbound tests for each year are shown graphically in Figures 9 & 10. The averages for all three years combined in each direction is shown graphically in Figure 11. The moduli values for each test, along with standard deviation values, are given in Table 2.

On the section of I-275 that was tested, only loads of approximately 66.7kN (15,000 lbs.) were used. As the tests progressed throughout the day, the temperature increased, but concrete pavement is not affected by temperature as much as asphalt pavement. Moduli values for the conventional and recycled CSB sections were almost identical. Values ranged from approximately 406.8 to 448.18 Mpa (59 to 65 ksi) throughout both sections. The recycled CSB values were more consistent, showing values of 422.66, 415.77, and 424.04 Mpa (61.3, 60.3, and 61.5 ksi) at times of 6:30 AM, 10:00 AM, and 1:30 PM respectively. These values also fall within the typical range of moduli values for DGA. The moduli values at each station for the three tests are shown graphically in Figure 12. The moduli values for each section on each test, along with standard deviation values, are shown in Table 3.

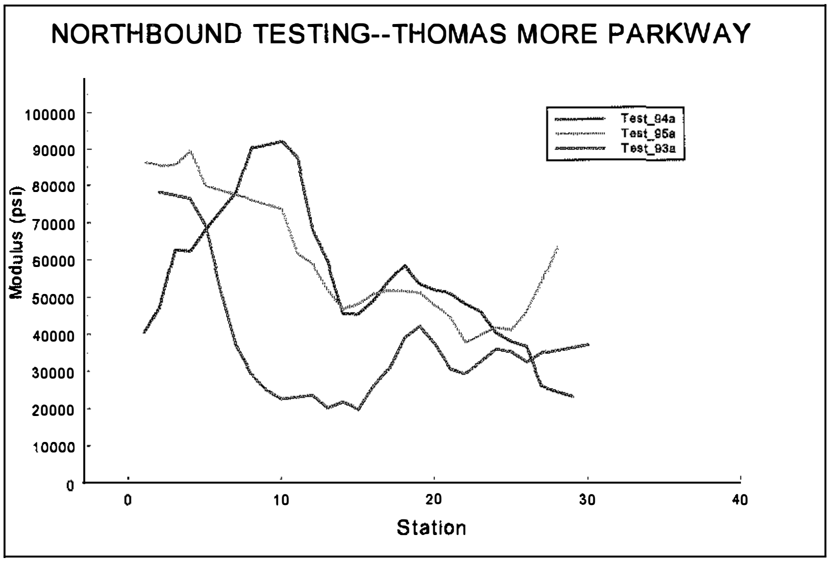


Figure 9. Falling Weight Deflectometer Testing, Thomas More Parkway, Northbound (1993-1995)

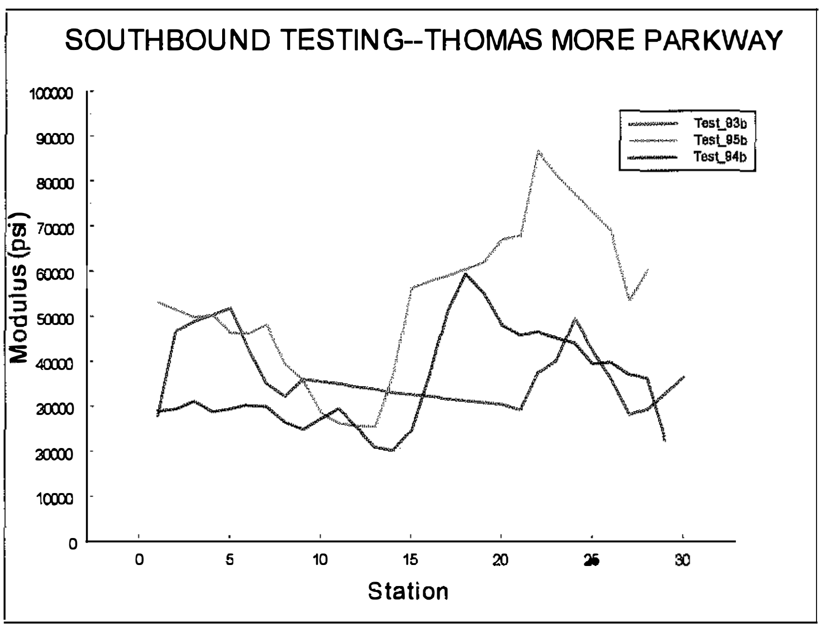


Figure 10. Falling Weight Deflectometer Testing, Thomas More Parkway, Southbound (1993-1995)

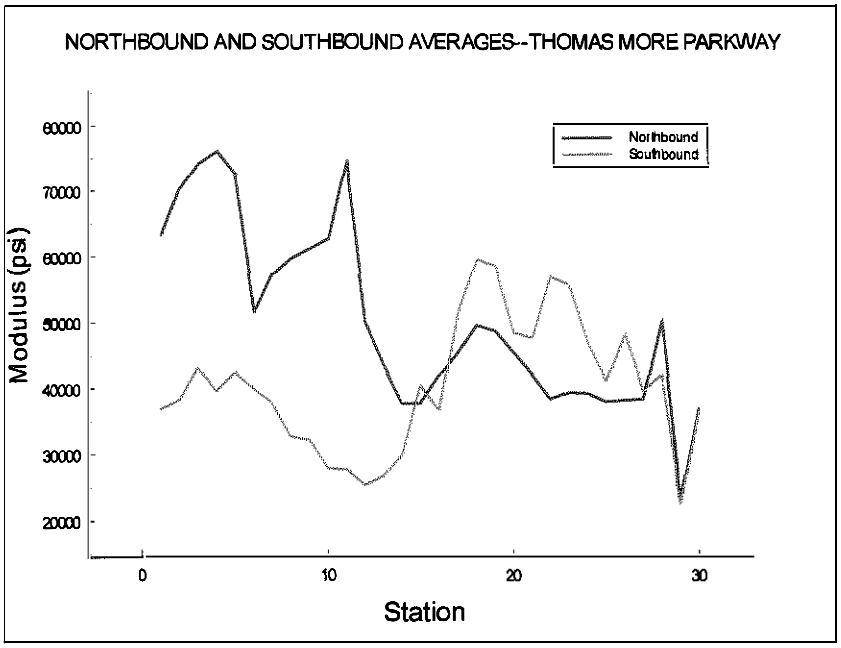


Figure 11. Falling Weight Deflectometer Testing, North and Southbound 3-Year Averages

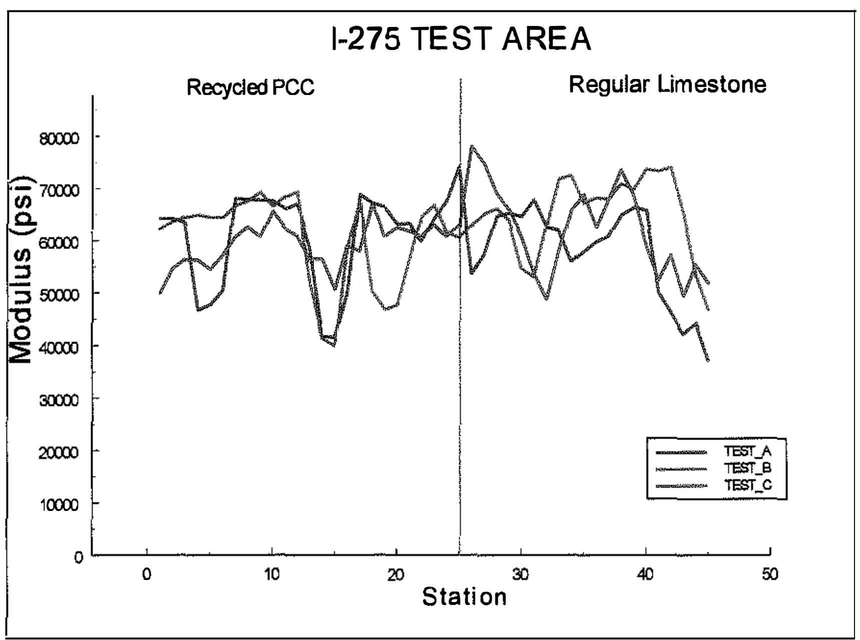


Figure 12. Falling Weight Deflectometer Testing, Interstate 275 (6:30 AM, 10:00 AM, 1:30 PM)

THOMAS MORE PARKWAY FWD DATA

	1993						1994						1995					
Northbound	Pavement (psi)	St. Dev	Base (psi)	St. Dev	Subgrade (psi)	St. Dev	Pavement (psi)	St. Dev	Base (psi)	St. Dev	Subgrade (psi)	St. Dev	Pavement (psi)	St. Dev	Base (psi)	St. Dev	Subgrade (psi)	St. Dev
15/14,000 lbs.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2515772	517677	53066	23676	50593	12344	784819	190339	58161	18556	45733	10670
12/11,000 lbs.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2416854	578616	60553	27737	51704	13191	763975	223976	62000	25616	44483	12924
9/8,000 lbs.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2302176	887699	69924	34029	53071	12376	801534	285245	55211	23092	46327	11144
Southbound																		
15/14,000 lbs.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3241012	569052	35402	20867	49738	23184	2539594	844358	54399	25357	47881	16921
12/11,000 lbs.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3332061	602239	29498	17231	61327	29081	2508350	604539	53132	28551	51722	17569
9/8,000 lbs.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	3253592	731053	32857	15238	49684	14268	1801702	669054	34909	18834	49375	18935

Table 2, Falling Weight Deflectometer Data, Thomas More Parkway.

INTERSTATE 275 TEST SECTION

RECYCLED PORTLAND CEMENT CONCRETE CSB VERSUS NORMAL LIMESTONE DGA

		Units of regular DGA	Standard Deviation	Units of recycled DGA	Standard Deviation
A	6:30 AM	59620	14383	61333	15839
B	10:00 AM	64918	15507	60257	18656
C	1:30 PM	60350	13881	61446	16686

Table 3, Falling Weight Deflectometer Testing, Interstate 275 Test Solutions

VISUAL SURVEY

As part of the project, Center personnel performed annual visual surveys on the Thomas More Parkway from Station 186 + 50 to Station 171 + 00. In 1996, bleeding was observed at Station 183 + 75. This area is depicted in Figure 13. In April 1998, longitudinal cracking in the wheel paths was noted in several areas. A station-by-station depiction of the site is contained in Appendix B.

Figure 13. Bleeding observed at Station 183+75.

CONCLUSIONS AND RECOMMENDATIONS

At this time, it appears that the RPCC CSB is performing equally to the limestone DGA under field conditions. Considerable breakdown of the recycled aggregate was observed under laboratory freeze-thaw conditions, but laboratory gradation tests show that the aggregate on the project is still within the specifications for both DGA and CSB. Due to this laboratory breakdown of the aggregate, it is recommended that FWD and gradation tests, and visual surveys be performed on the Thomas More Parkway and I-275 periodically. However, since field performance currently appears to be the same for DGA and RPCC, it is recommended that RPCC could continue to be used as a substitute for DGA, unless future distress data indicate otherwise.

REFERENCES

1. Dempsey, Herlache, Patel. The Climatic-Materials-Structural Pavement Analysis Program User's Manual. Federal Highway Administration Office of Engineering and Highway Operations Research and Developement. Department of Civil Engineering, University of Illinois at Urbana-Champagne, July 1983. (Modified by J. A. Deacon, University of Kentucky).

APPENDIX A
RESULTS OF FREEZE-THAW TESTING

I-275 DGA

SOUNDNESS TEST OF FINE AGGREGATE

SIEVE SIZE	ORIGINAL GRADATION (g)	ORIGINAL GRADATION (%)	WEIGHT BEFORE TEST (g)	WEIGHT AFTER TEST (g)	WEIGHT RETAINED ON DESIGNATED SIEVE (g)	% PASSING DESIGNATED SIEVE (g)	WEIGHTED % LOSS
#50 TO PAN	234.8	24.32656	N/A	N/A	N/A	N/A	N/A
#30 TO #50	76.5	7.925818	95.86	95.74	94.83	0.950491	0.075334
#16 TO #30	115.2	11.93535	100.24	100.1	98.96	1.138861	0.135927
#8 TO #16	226.8	23.49772	100.22	100.01	98.46	1.549845	0.364178
#4 TO #8	311.9	32.31455	100.22	100.02	95.15	4.869026	1.573404
TOTAL	965.2	100				TOTAL	2.148843

SOUNDNESS TEST OF COARSE AGGREGATE

SIEVE SIZE	ORIGINAL GRADATION (g)	ORIGINAL GRADATION (%)	WEIGHT BEFORE TEST (g)	WEIGHT AFTER TEST (g)	WEIGHT RETAINED ON DESIGNATED SIEVE (g)	% PASSING DESIGNATED SIEVE (g)	WEIGHTED % LOSS
1" TO 3/4"	138.5	20.11035	491.34	490.38	486.97	0.695379	0.139843
3/4" TO 1/2"	226.8	32.93161	670.11	667.77	665.14	0.393848	0.129701
1/2" TO 3/8"	70.7	10.26572	331.49	330.02	325.98	1.224168	0.12567
3/8 TO #4	252.7	36.69232	301.58	300.73	297.66	1.020849	0.374573
TOTAL	688.7	100				TOTAL	0.769787

I-75 PCCP
NOT-ROLLED

SOUNDNESS TEST OF FINE AGGREGATE

SIEVE SIZE	ORIGINAL GRADATION (g)	ORIGINAL GRADATION (%)	WEIGHT BEFORE TEST (g)	WEIGHT AFTER TEST (g)	WEIGHT RETAINED ON DESIGNATED SIEVE (g)	% PASSING DESIGNATED SIEVE (g)	WEIGHTED % LOSS
#50 TO PAN	135	26.07184	N/A	N/A	N/A	N/A	N/A
#30 TO #50	52.6	10.15836	100.35	99.84	92.12	7.732372	0.785482
#16 TO #30	61.9	11.95442	100.4	99.6	93.69	5.933735	0.709344
#8 TO #16	106.1	20.49054	100.41	100.4	86.28	14.06375	2.881737
#4 TO #8	162.2	31.32484	99.99	99.96	76.13	23.83954	7.467695
TOTAL	517.8	100				TOTAL	11.84426

SOUNDNESS TEST OF COARSE AGGREGATE

SIEVE SIZE	ORIGINAL GRADATION (g)	ORIGINAL GRADATION (%)	WEIGHT BEFORE TEST (g)	WEIGHT AFTER TEST (g)	WEIGHT RETAINED ON DESIGNATED SIEVE (g)	% PASSING DESIGNATED SIEVE (g)	WEIGHTED % LOSS
1" TO 3/4"	121	14.12067	502.75	499.36	418.21	16.2508	2.294722
3/4" TO 1/2"	213.1	24.86871	670.69	668.31	563.89	15.62449	3.885608
1/2" TO 3/8"	180.3	21.04096	331.49	329.59	258.83	21.4691	4.517305
3/8 TO #4	342.5	39.96966	302.08	300.94	247.09	17.89393	7.152144
TOTAL	856.9	100				TOTAL	17.84978

I-75 PCCP
ROLLED

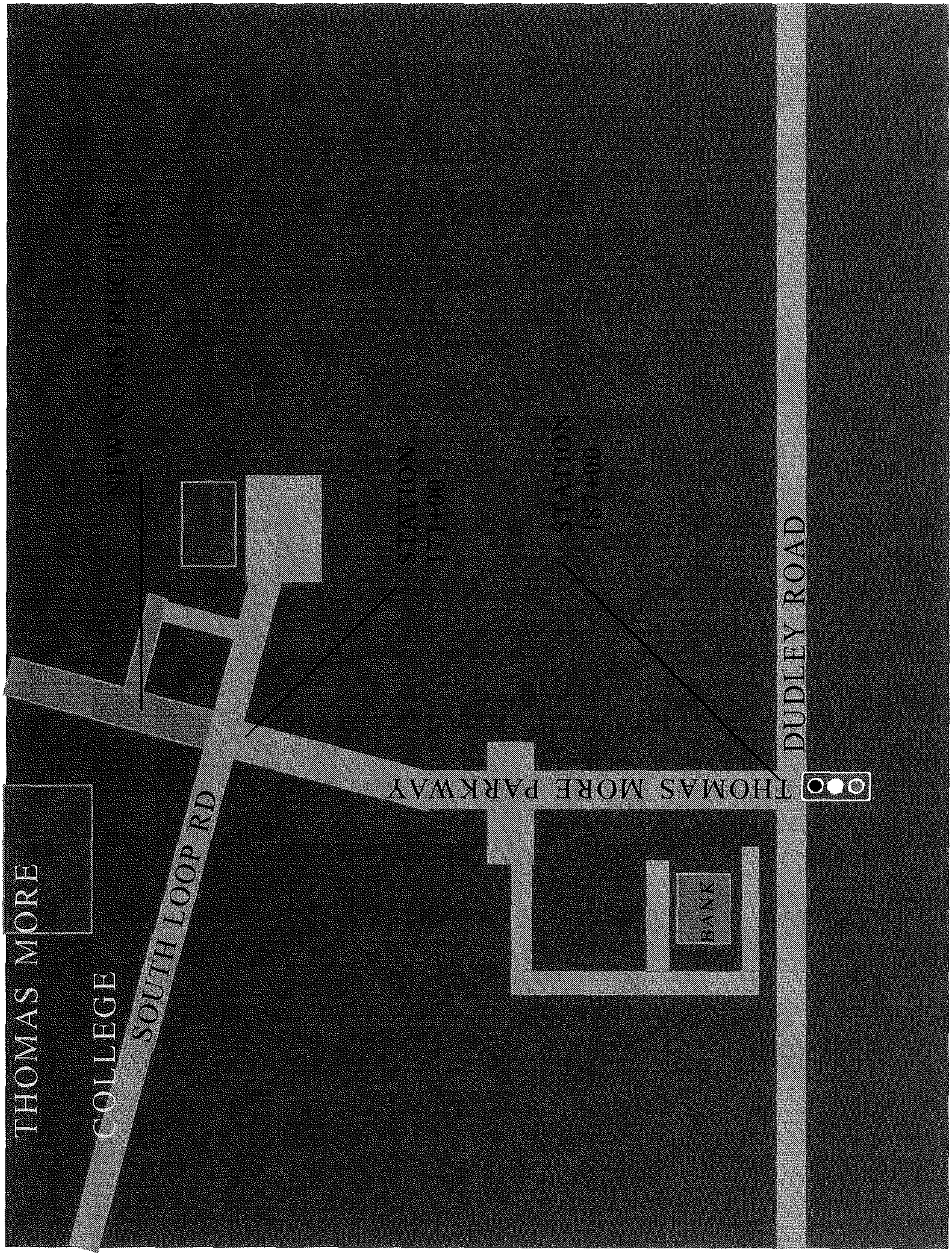
SOUNDNESS TEST OF FINE AGGREGATE

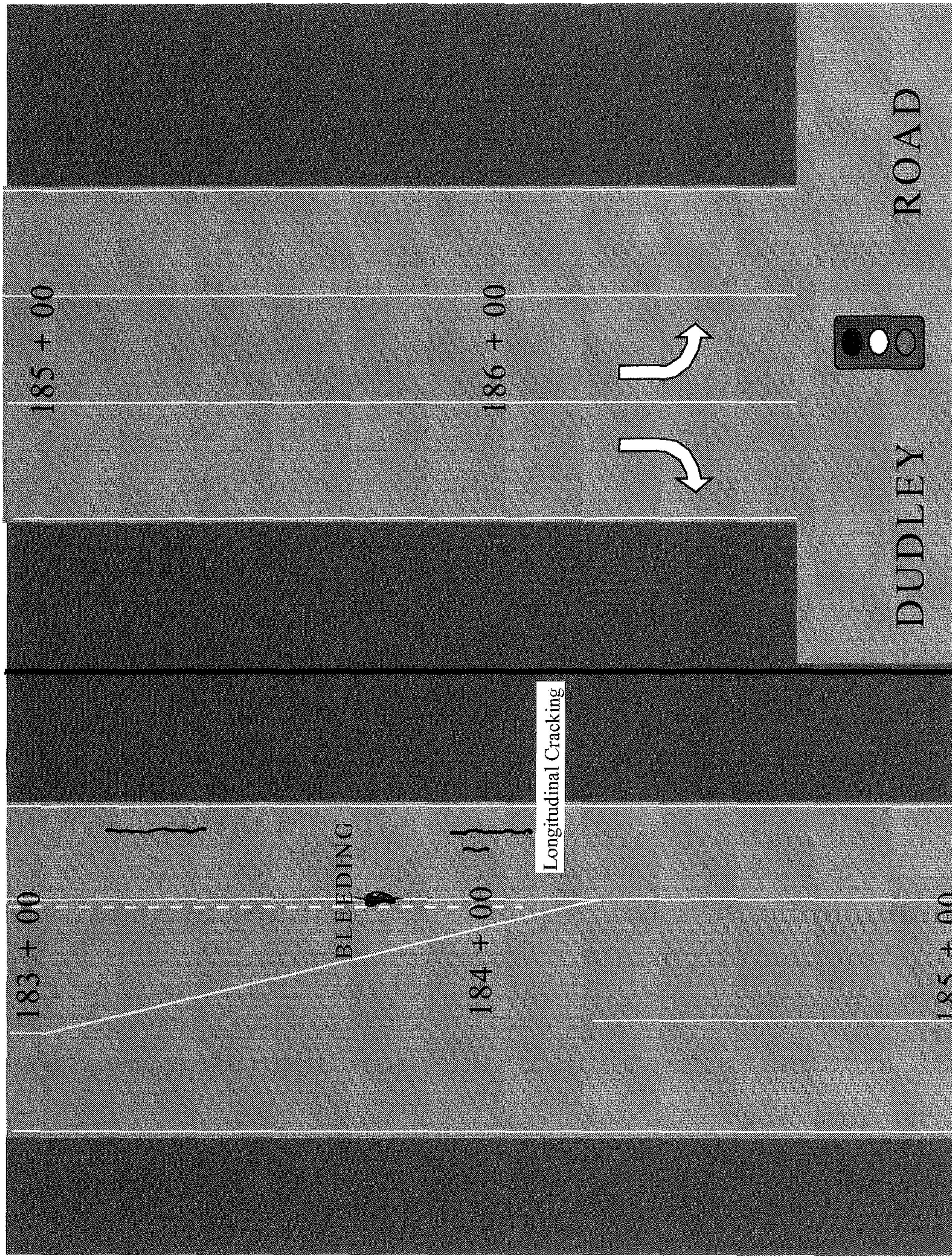
SIEVE SIZE	ORIGINAL GRADATION (g)	ORIGINAL GRADATION (%)	WEIGHT BEFORE TEST (g)	WEIGHT AFTER TEST (g)	WEIGHT RETAINED ON DESIGNATED SIEVE (g)	% PASSING DESIGNATED SIEVE (g)	WEIGHTED % LOSS
#50 TO PAN	127	28.38623	N/A	N/A	N/A	N/A	N/A
#30 TO #50	37.6	8.404113	100.04	99.58	84.47	15.17373	1.275217
#16 TO #30	44.6	9.968708	100.05	99.32	85.03	14.38784	1.434282
#8 TO #16	87.7	19.60215	100.11	99.53	87.01	12.57912	2.465778
#4 TO #8	150.5	33.6388	100.29	99.67	74.84	24.91221	8.380169
TOTAL	447.4	100				TOTAL	13.55545

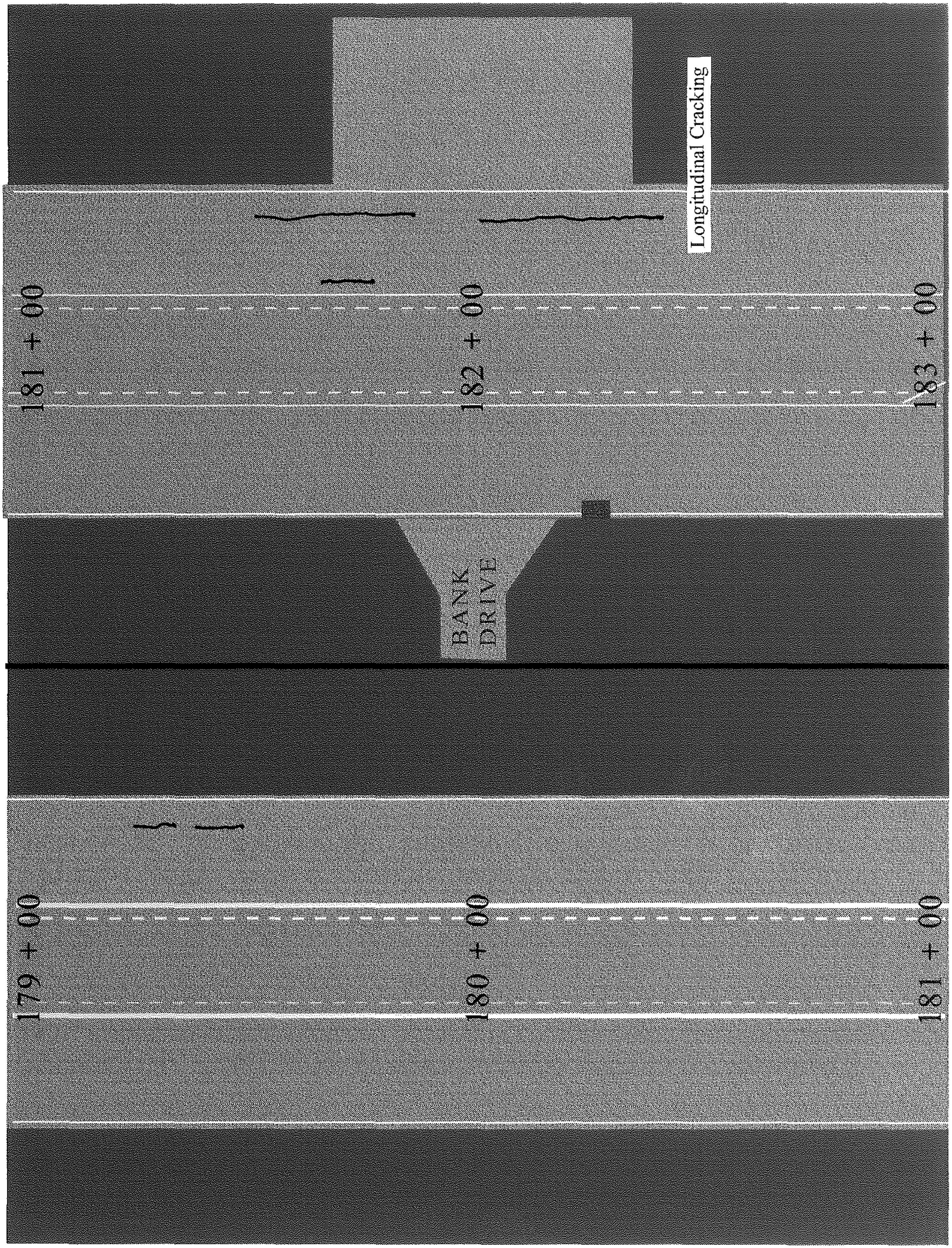
SOUNDNESS TEST OF COARSE AGGREGATE

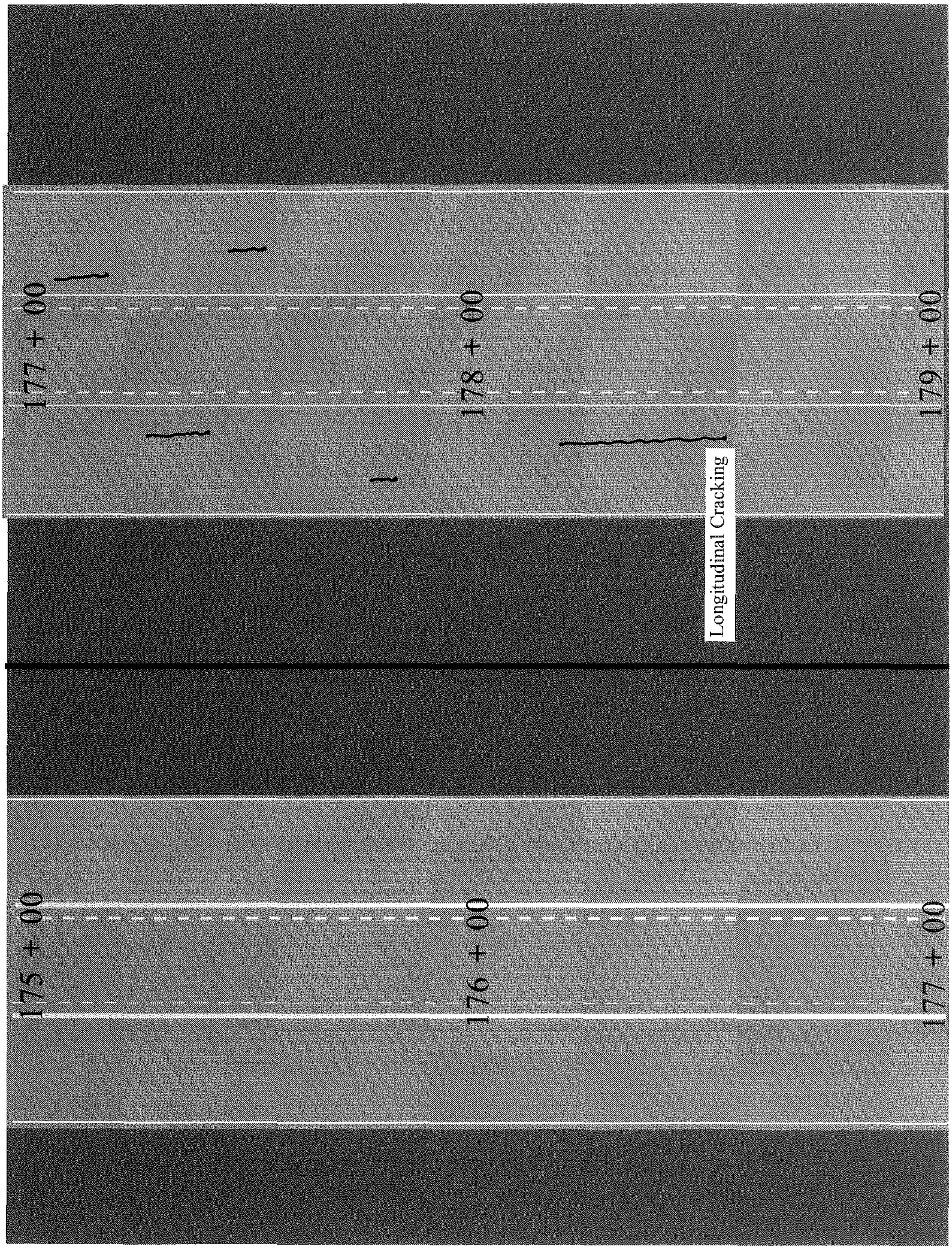
SIEVE SIZE	ORIGINAL GRADATION (g)	ORIGINAL GRADATION (%)	WEIGHT BEFORE TEST (g)	WEIGHT AFTER TEST (g)	WEIGHT RETAINED ON DESIGNATED SIEVE (g)	% PASSING DESIGNATED SIEVE (g)	WEIGHTED % LOSS
1" TO 3/4"	138.5	16.34025	391.79	389.51	332.39	14.66458	2.39623
3/4" TO 1/2"	201	23.71402	629.48	626.93	518.73	17.25871	4.092732
1/2" TO 3/8"	164.1	19.36055	329.93	328.43	279	15.05039	2.913838
3/8 TO #4	344	40.58518	301.25	299.07	244.15	18.36359	7.452898
TOTAL	847.6	100				TOTAL	16.8557

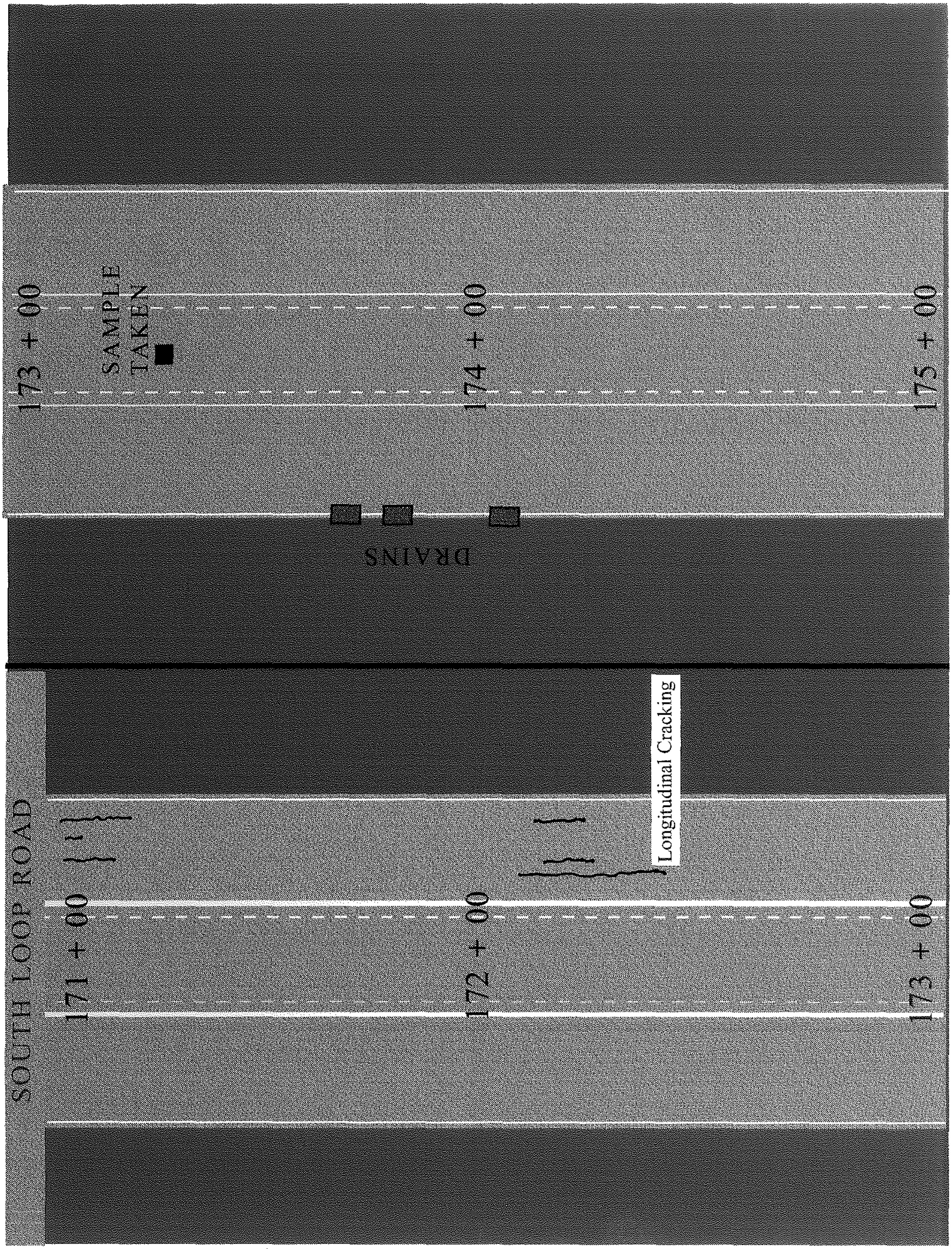
APPENDIX B
VISUAL SURVEY
THOMAS MORE PARKWAY


THOMAS MORE
COLLEGE
SOUTH LOOP RD
NEW CONSTRUCTION
STATION
171+00
STATION
187+00
THOMAS MORE PARKWAY
DUDLEY ROAD
BANK


183 + 00
BLEEDING
184 + 00
185 + 00
Longitudinal Cracking
185 + 00
186 + 00
DUDLEY ROAD


Longitudinal Cracking
181 + 00
182 + 00
183 + 00
BANK
DRIVE
179 + 00
180 + 00
181 + 00


177 + 00
178 + 00
179 + 00
Longitudinal Cracking
175 + 00
176 + 00
177 + 00


SOUTH LOOP ROAD
171 + 00
172 + 00
173 + 00
Longitudinal Cracking
173 + 00
SAMPLE
TAKEN
174 + 00
175 + 00
DRAINS