AN INTERIM REPORT ON THE A-B ROAD TEST PROJECT AND THE LOADED WHEEL TEST

by

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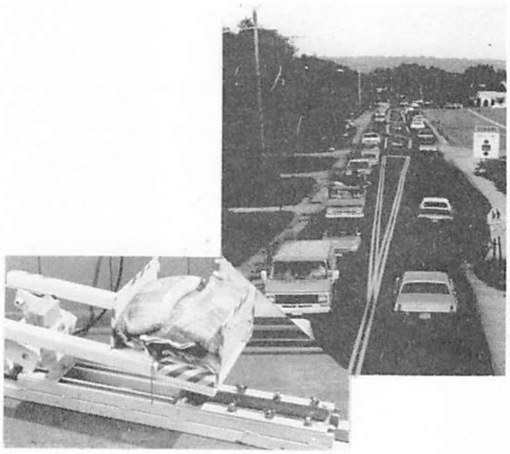

AN ISSA RESEARCH & DEVELOPMENT COMMITTEE REPORT FOR PRESENTATION AT THE 15TH ANNUAL CONVENTION OF THE INTERNATIONAL SLURRY SEAL ASSOCIATION.

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---- INTERIM REPORT ON THE A-B ROAD TEST PROJECT ----

Alexandersville-Bellbrook Road ("A-B Road"), West Carrollton, Ohio is a main, two-lane connector road between Interstate 75 and Ohio State Route 741. The road services a 12-month high school, a large paper mill (400 employees) a number of small industries, and commercial establishments, a large super market and about 30 homes. Adjacent to the school, there is an untravelled, paint stripe delineated island. Speed limits are 35 MPH except for the school zone which is restricted to 20 MPH during school hours. The traffic count is 19,000 ADT, 10% trucks.

On July 13, 1974, construction of a 14.3 pounds per square yard, quick-set, coarse type 2 (Xenia, Ohio Moraine) slurry seal was completed. The effective working length exceeded 4,000 feet. (6500 km) Widths varied from 22 to 34 feet . At each of 18 marked locations, samples of the aggregates and slurry were taken and meticulously analised for aggregate moisture, total mix moisture, AC content, dry and extracted gradations. The analysis was made the following December and January. Results are shown in table 1.

The Slurry mixtures as applied to the road were duplicated in the laboratory and subjected to a new traffic sumulating device, the "Loaded Wheel Tester (LWT)". Compaction Curves were drawn by a profilograph, Tackiness Points observed and Sand Adhesion measurements were made of the excess asphalt extruded to the specimen surface. We found that the compaction curves, tack points and sand adhesion values were all directly related to the Asphalt Cement content, and the number of LWT cycles as shown in Figure 1.

During the 13th Annual ISSA convention at Las Vegas, February 3-6, 1975, a report was given by Benedict titled "An Introduction to the Potential Uses of a Loaded Wheel Tester (LWT) for the Traffic Count Design of Slurry Seal". A description of the method of testing was presented along with a number of observations and hypotheses. Several critiques have been received and are summarized in the appendix. (Table 2)

On March 9, 1976, after 600 days of service and 11,400,000 vehicle passes on two lanes, Skid tests were run at each of 16 locat ions. Locations 1 and 18 had been overlaid with HMAC two months after the slurry construction. Figure 2 diagrams the results of the skid tests.

Skid numbers ranged from a high of 43 down to 17 where bleeding from excessively poured cracks occurs. The average of valid tests in the travelled roadway is SN_{40} = 36 @ 7.706% AC content. The average of the upper fiftieth percentile is SN_{40} = 39.1 @ 7.4% AC. The average of the lower fiftieth percentile is SN_{40} = 32.0 @ 8.1 % AC.

In the untravelled island, the skid numbers are from 66 to 71 and are representive of the initial numbers of the entire slurry project.

As of January 15, 1977, 17,000,000 accumulated 2-lane passes have occured and the condition appears nearly the same as in March. Hopefully, a second and final series of skid tests will be run and reported to our Atlanta convention in February, 1978.

Laboratory work on correlation and validation of the LWT method proceeds at Iowa State University, Ames, Iowa; Benedict Slurry Seal, Inc., Dayton, Ohio; and Composan, S.A., Madrid, Spain. The R & D committee has issued ISSA Technical Bulletin No. 109 describing the method to encourage others to participate in this research.

Questions and observations presented for discussion regarding the A-B Road Test and the LWT.

What is going on here?

1. Why do the asphalt contents vary?
2. Why do the skid numbers vary from theory in some cases?
3. What happened to the initial skid number? Compaction? Excess asphalt extruded? Matrix extruded? Equipment malfunction? Wear and polishing down to the matrix? Loss of macrotexture? Operator error? Thickness variation? Underlying variation in surface texture? Gradation variation? Laps causing thickness variation?

The LWT tack points in one set of experiments has found variations due to different aggregates; e.g.

19% emulsion in the Ohio Moraine gave tack points
equal to 22% emulsion in the Georgia Gneiss and
equal to 24% emulsion in the Spanish Silica

Gradation, quality of fines, percentage of fines, particle shape, crush resistance and aggregate interlock create more or less space or voids for asphalt. Greater void spaces may allow a greater variation in permissable asphalt content range.

Void Content is defined here as the space available for air, fines, fillers. . . . and asphalt.

Gradations coarser than type 2 or perhaps gap-graded may be less sensitive to asphalt content.

Some aggregates may be "void sensitive" depending on the relative quality and quantity of fines and percent retained on each sieve size.

Macrotexture is one necessary ingredient for adequate skid resistance. Loss of macrotexture occurs by the upward migration of the matrix or wear of the larger particles down to the matrix.

An exercise in logic:

a. Spread rates vary (See figure 3)
b. Void content varies with thickness (spread rate) and surface texture (See figure 4)
c. Surface voids and matrix voids vary in mono, multiple and minus-mono layers. (See figure 5)
d. Optimum asphalt content varies with void contents
e. Wear affects surface voids and depends on aggregate durability which in turn is related to percentage of coarse particles ($\pm$ 16) which in turn determines the void content. (See figure 6)

TEST RESULTS

MINERAL AGGREGATE SAMPLES

SAMPLE NO.

Sieve Size	1-2	3-4	5-6	7-8	9-10	11-12	13-14	15-16	17-18	Average
3/8"	100	100	100	100	100	100	100	100	100	100
No. 4	99	99	98	98	98	99	99	99	99	99
No. 6	89	90	87	86	85	87	89	88	88	88
No. 8	75	76	72	70	68	70	74	71	73	72
No. 10	68	68	66	63	62	63	67	65	66	65
No. 16	49	51	48	45	46	47	50	48	49	48
No. 30	34	35	33	31	32	33	35	33	35	33
No. 40	29	29	28	25	27	28	30	28	30	28
No. 50	24	25	23	22	23	23	26	24	25	24
No. 100	18	18	17	16	17	17	19	17	19	18
No. 200 (Washed & Sieved)	11.7	12.3	11.4	11.0	10.7	10.7	12.2	10.7	13.6	11.6
% Total Moisture	3.6	3.1	2.9	2.9	4.3	4.1	3.8	4.3	4.0	3.7 4.3 High 2.9 Low

EXTRACTED MINERAL AGGREGATE SAMPLES WITH TOTAL ASH

SAMPLE NO.

Sieve Size	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	Avg.
3/8"	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100
No. 4	98	98	99	98	98	98	98	97	99	98	99	98	99	99	99	99	99	99	98
No. 6	88	86	91	90	87	88	88	85	86	86	89	85	88	88	87	86	87	88	87
No. 8	73	72	76	76	71	72	72	70	69	69	72	69	73	73	73	69	70	73	72
No. 10	66	65	69	69	64	66	65	63	64	62	66	63	66	66	67	63	62	67	65
No. 16	49	49	52	53	49	49	49	47	49	47	50	48	51	51	52	48	46	50	49
No. 30	34	34	37	37	34	34	34	32	34	34	36	34	37	36	38	34	31	36	35
No. 40	30	29	32	32	30	29	29	28	30	29	31	30	32	32	34	30	26	32	30
No. 50	26	25	28	28	26	26	26	24	26	26	27	26	28	28	30	26	22	28	26
No. 100	21	20	22	23	21	21	21	20	21	21	22	21	23	23	25	21	17	23	21
No. 200 (Washed & Sieved)	16.5	16.7	17.6	18.4	17.3	17.0	16.9	15.9	17.2	17.5	18.2	17.1	19.0	18.6	20.1	17.3	12.4	18.1	17.3
% Total Moisture	18.6	17.5	17.8	18.4	17.7	16.2	17.4	17.3	18.6	18.4	18.7	17.9	18.3	18.2	20.6	19.8	18.1	17.9	18.2
																		High	20.6
																		Low	16.2
% Bitumen	9.1	8.3	9.3	7.8	7.9	8.0	7.3	8.4	8.0	7.5	8.6	7.0	7.6	7.0	8.4	7.5	6.2	5.2	7.7
																		High	9.3
																		Low	5.2

Table 1. A - B ROAD TEST GRADATIONS AND EXTRACTIONS

SUMMARY OF LWT CRITIQUES AND WRITTEN DISCUSSION

A. Herbert Southgate, Research Engineer Chief, Kentucky Bureau of Highways
   1. Investigate one way motion compared to reciprocating and allow time for recovery between cycles.
   2. Check 30 lbs. load x 10,000 cycles vs. 125 lb. load for 1,000 cycles.
   3. One 18-kip pass equals fatigur induced by 56, 9-kip loads.
   4. Particle shape may affect max allowable res. AC content.
   5. Stability in upper surfaces may be enhanced by use of emulsions formulated for high AC stabilities.
   6. Allow varying cure times and test for differences in particle orientation vs. ability to stop particle migration (ageing of the specimens).

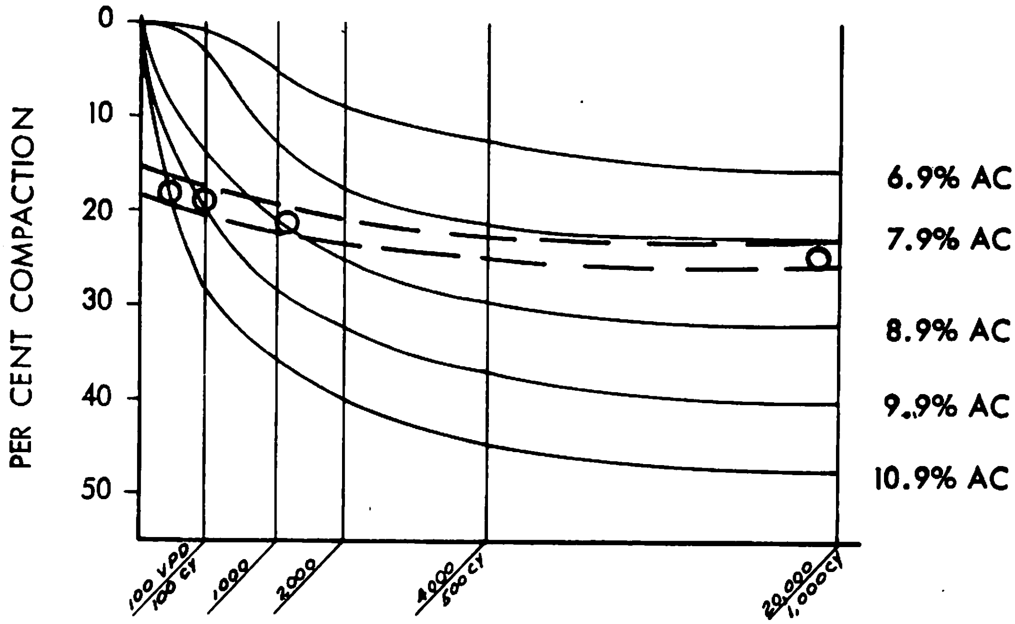
B. James A. Scherocman, Executive Director, Asphalt Paving Association of Indiana, Inc.
   1. Show clearly advantages of the LWT method.
   2. More info needed on establishment of tack point and why it comes about. State clearly why necessary to wet after tackiness starts.
   3. LWT is a way to correlate lab testing with field experiments.

C. Ben F. Kallas, Principal Engineer - Special Investigations Research Center, Asphalt Institute, College Park, Maryland.
   1. Good correlations between LWT and field required.
   2. Variables of temperature and loading most important. Should be studied before field correlations.
   3. Density and void analysis to develope void criteria.
   4. The few large variations in AC content with respect to flushing and ravelling makes the design more critical.

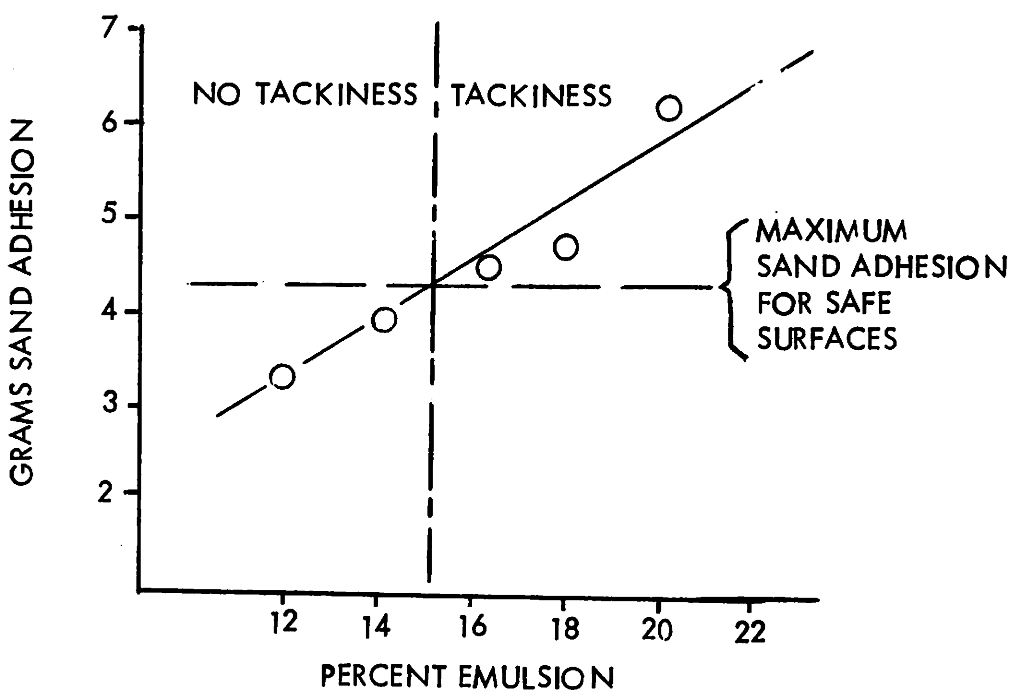
D. E. F. Fiock, 4209 Grim Avenue, Waco, Texas; Retired U.S. Bureau of Standards and Slurry Seal Technologist.
   1. Pressured Rubber will deform slurry until wholly and fully supported by the largest particles of aggregate.
   2. Reciprocating motion is foreign to tire-pavement interaction.
   3. Tack Point determination and measurement of excess asphalt by sand absorption (adhesion) is the most attractive feature of the test.
   4. Sees nothing specific in profilograms since compaction will stop when tire is supported by large aggregate. (?)
   5. Paragraph 3, 4 and 5 of page 5 are the real points of virture (Tack Point, visual flushing, sand adhesion) (uses 6-17 leaves him cold)
   6. May be glad that most observation were labeled "Hypotheses"!

E. W. R. Lovering, Division Paving Engineer, Asphalt Institure, Sacremento, California
   1. Combine LWT with WTAT. . . . should provide a good indication in asphalt content suitable for slurry seal.
   2. May require adjustment of load (too much?)

Table 2 CRITIQUES OF LWT METHOD

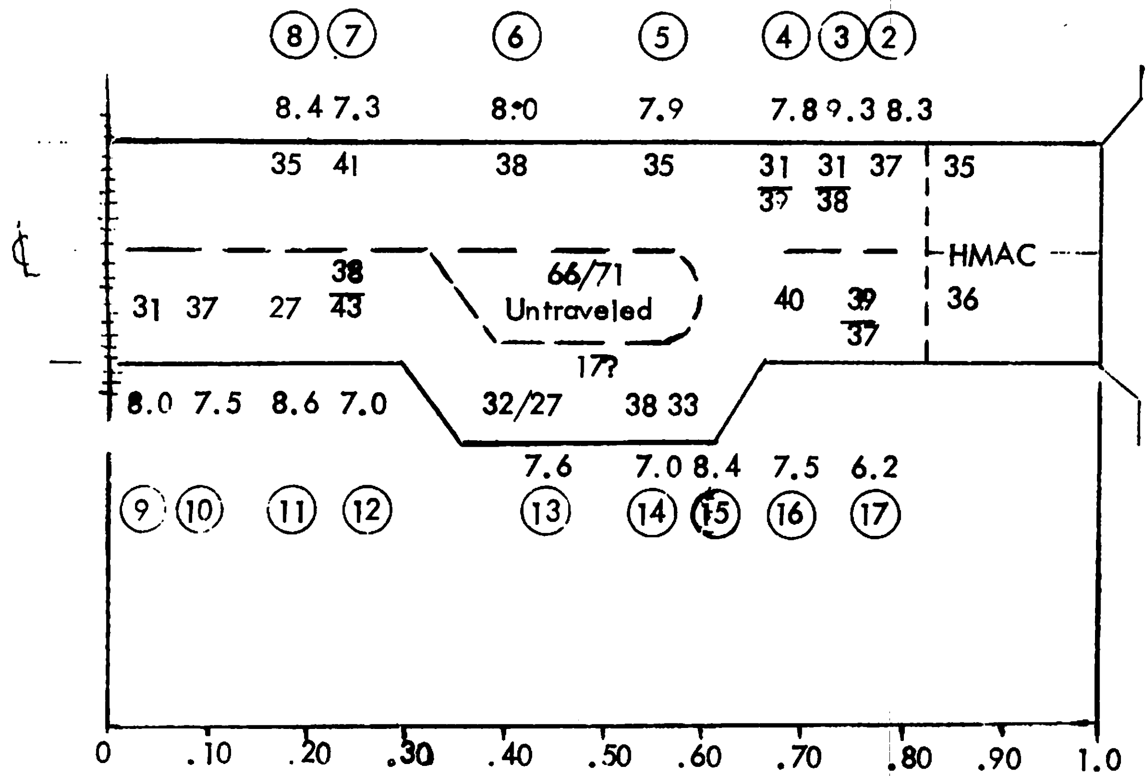


LWT COMPACTION & TACK-POINT CURVES



EXCESS EXTRUDED ASPHALT BY HOT SAND ADHESION

Figure 1. A-B ROAD TEST- LWT COMPACTION, TACK POINT AND SAND ADHESION



AVERAGE SN_{40}-36.0

Upper 50% average is SN_{40}- 32.0 @ 8.10%AC (33.1 @ 8.06)

Lower 50% average is SN_{40}- 39.1 @ 7.40%AC (39.7 @ 7.06)

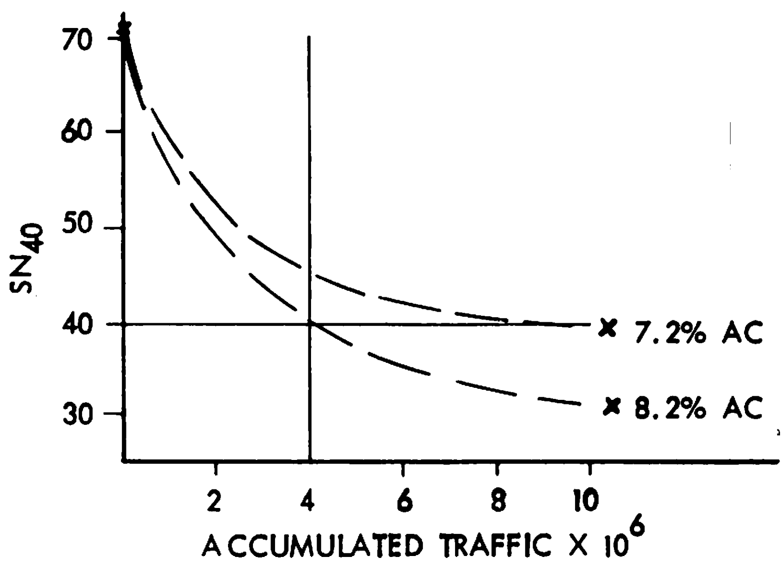


Figure 2. A-B ROAD TEST AFTER 11,000,000 VEHICLES – March 9, 1976

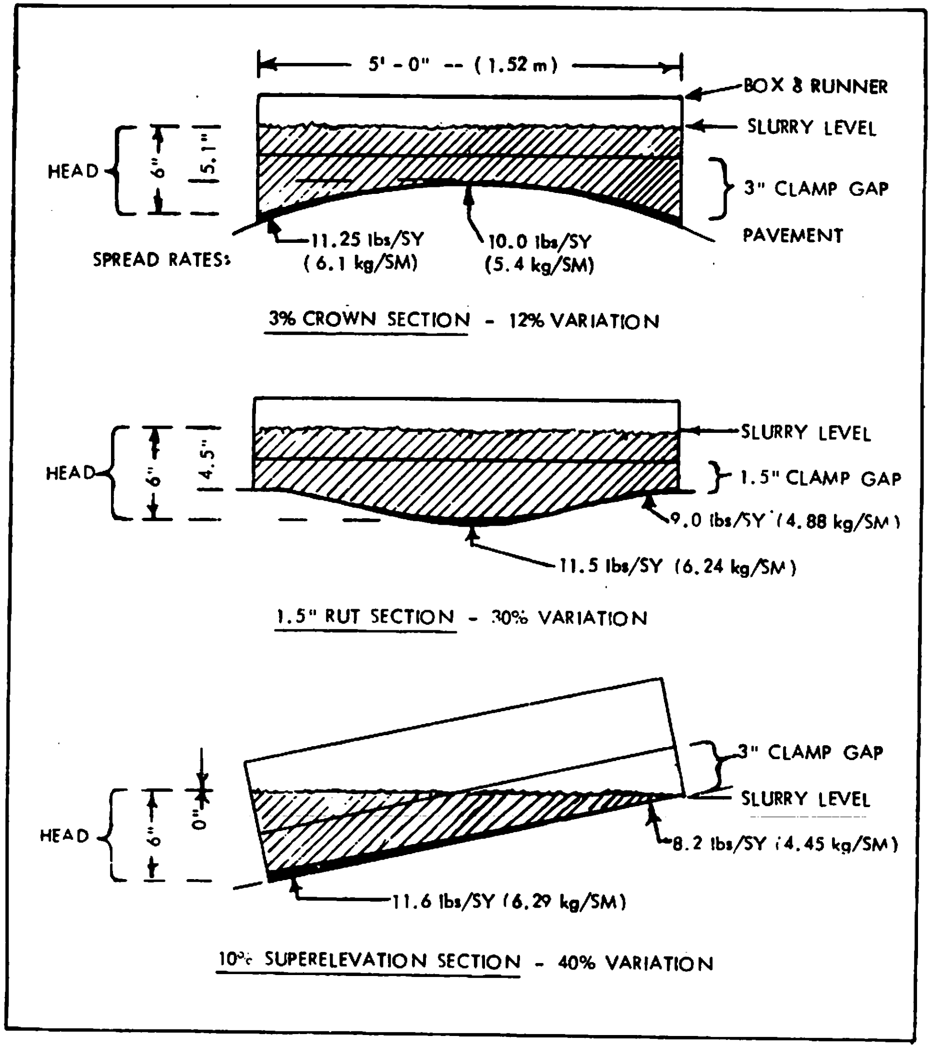


Figure 3. THEORETICAL SPREAD RATE VARIATIONS DUE TO PAVEMENT GEOMETRY
(Smooth Surface, 2.5 cm Consistency)

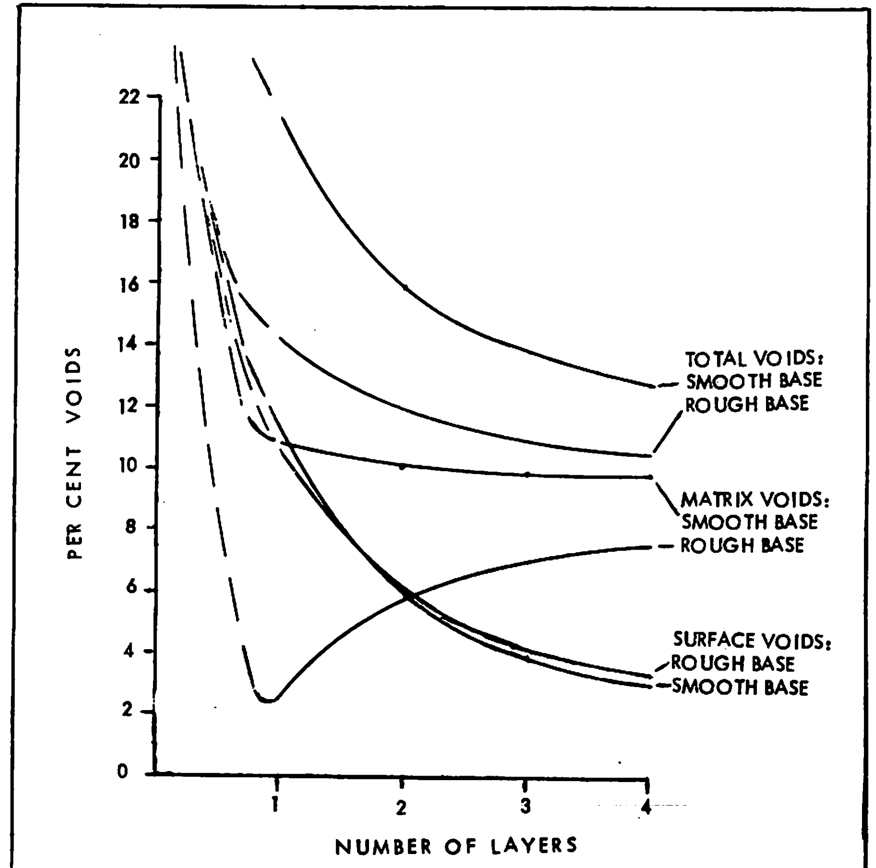


Figure 5. RELATIONSHIP OF TOTAL, SURFACE AND MATRIX VOIDS OF A HYPOTHETICAL MONO AND MULTILAYERED PAVEMENT
(Surface macrotexture remains constant)

Figure 5.

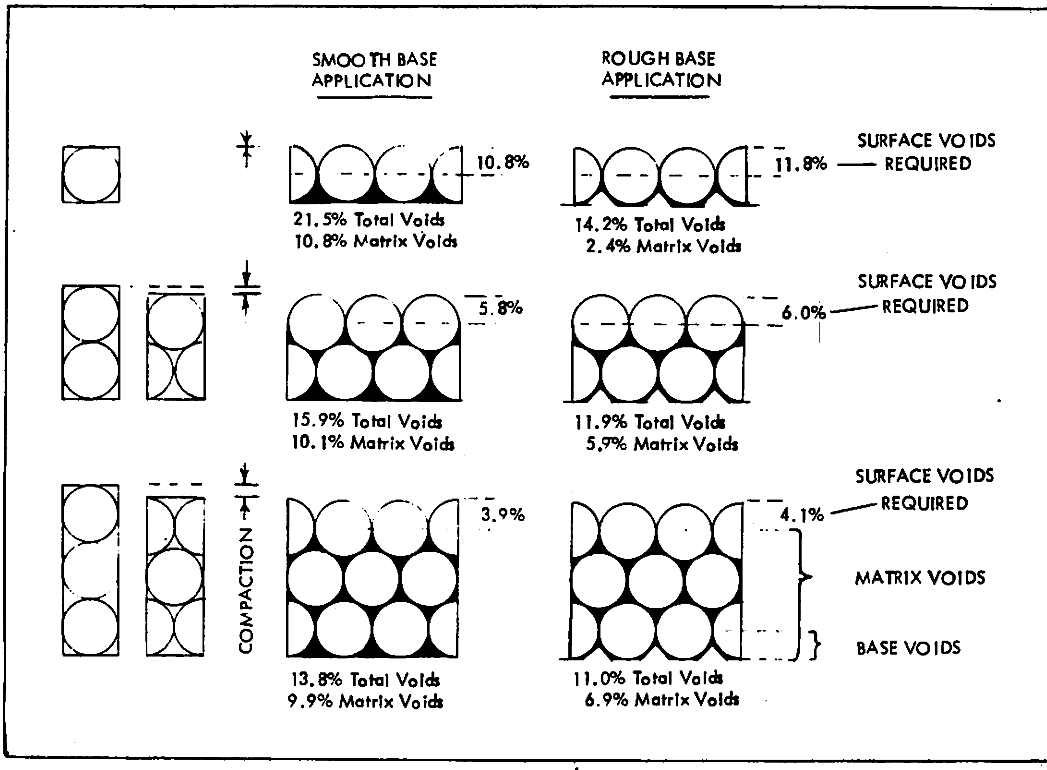


Figure 4. HYPOTHETICAL VOID STRUCTURE REQUIRED TO MAINTAIN ADEQUATE SURFACE MACROTEXTURE (50%) IN MONO AND MULTIPLE LAYERED ONE-SIZE SPHERICAL AGGREGATE PAVEMENTS.

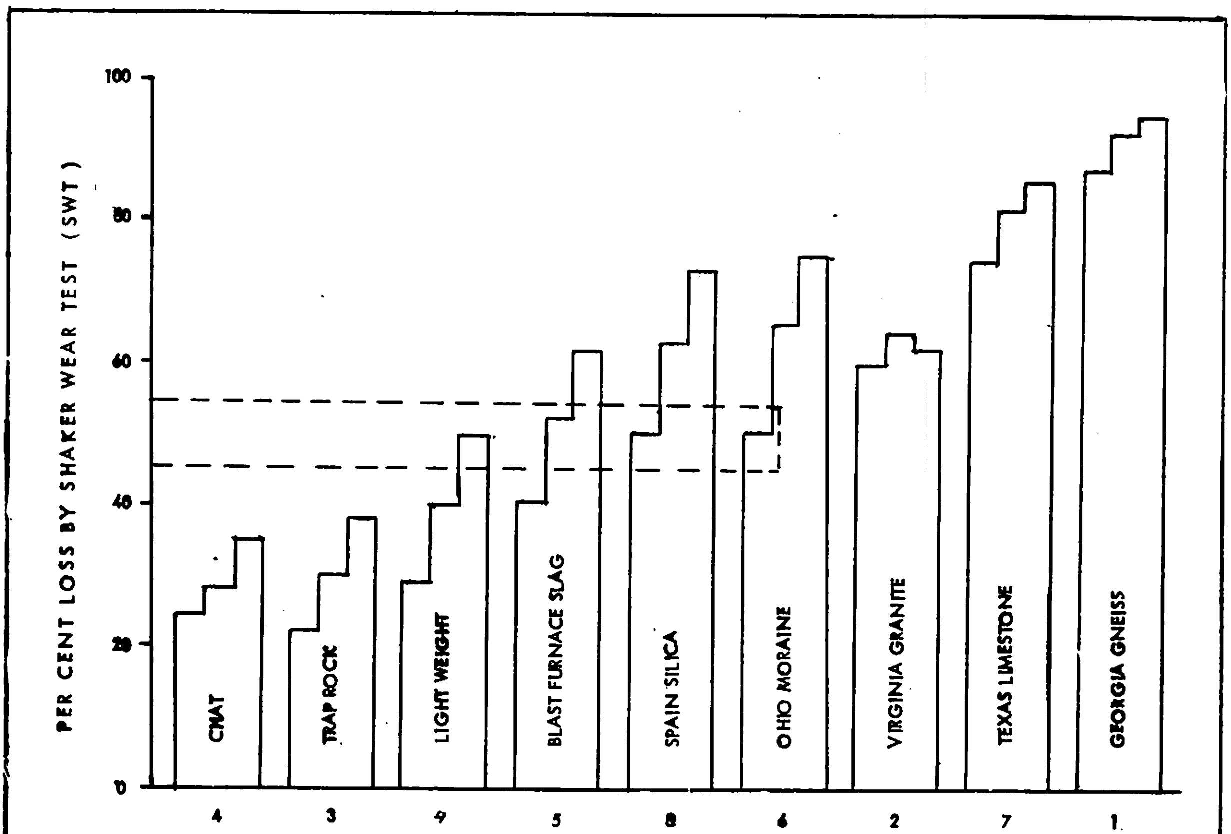


Figure 6. COMPARATIVE LEVELS OF WEAR FOR COARSE, MEDIAN & FINE TYPE 2 SLURRY SEAL AGGREGATES BY THE SHAKER WEAR TEST (SWT) Slurry Seal, Inc., Waco, Texas.