

HIGHWAY RESEARCH REPORT

EXPANDED CLAY HOT MIX STUDY PART II

INTRODUCTION

This is Part II of a two-part final report on the evaluation of the physical properties and the use of expanded clay aggregate in bituminous hot mix construction.

Part I of the final report encompassed the development of the necessary laboratory testing procedures for expanded clay hot mix, the methodology of plant and field control during construction, and a discussion of the results of the physical properties measured on the completed control and test sections. The physical properties measured and discussed included: roadway densities, percent compaction, Marshall Stability, roughness, longitudinal grooving, skid resistance, serviceability index of the wearing surface and the general visual appearance of the roadway.*

Part II of this final report is solely concerned with the measured skid resistance of the control and test sections over a 48-month period. The control and the test sections were constructed in January, 1968, on State Project 8-30-20, Federal Aid Project F-169(25) on Louisiana U.S. 190 (Livonia - Elliot City Highway). These test and control sections consisted of 20 sections, each approximately 0.5 mile in length. Four of these sections were control sections utilizing a crushed gravel hot mix. The remaining 16 test sections incorporated expanded clay as the coarse aggregate in the hot mix in lieu of the crushed gravel. The test sections were varied in percentages of expanded clay, mineral filler, sand and asphalt cement.

A detailed description of the individual test sections is located in the Appendix.

* Arena, P. J., Jr., Expanded Clay Hot Mix study, Final Report Part I, LDH Research Report No. 37, April 1969.

RESULTS OF SKID RESISTANCE MEASUREMENTS

The skid resistance of the control and test sections was measured by means of a skid trailer constructed to the specifications as stated in ASTM E-274, "Skid Resistance of Pavements Using a Two-Wheel Trailer."

The skid resistance for the test and control sections were measured immediately after construction and at 4, 8, 12, 18, 24, 36 and 48 months. These resultant skid measurements at 40 miles per hour versus months of service are depicted in Figures 1, 2 and 3.

Figure 1 illustrates the average skid numbers for the various sections, including inside and outside lanes. As indicated by Figure 1, all the expanded clay sections averaged 59 after four years exposure to heavy traffic. This is essentially the same average obtained after one year of service. While the crushed gravel sections that were used for control exhibited a trend which was the same as the lightweight sections, i.e. they reached a minimum SN and tended to remain at this minimum for the four years, their SN's were lower than the 59 mentioned above. The skid numbers averaged 47 and 45 for both lanes for the one and four year time span.

Figures 2 and 3 indicate the differences in average skid numbers between the inside and outside lanes. Figure 2 represents the average results on the outside lane, which is considered to carry the highest volume and heaviest traffic loads. Figure 3 represents the results for the inside or lesser traveled traffic lane. The expanded clay sections averaged 64 on the inside lane, as opposed to the 53 on the outside lane. Again these 48-month results are essentially the same as the one-year figures of 60 and 53. The crushed gravel sections after 48 months of service compared at 47 for the inside lane and 43 for the outside lane. The one-year figures for these sections were 49 for inside lanes and 45 for the outside lanes.

AVERAGE SKID NUMBER AT 40MPH - SN

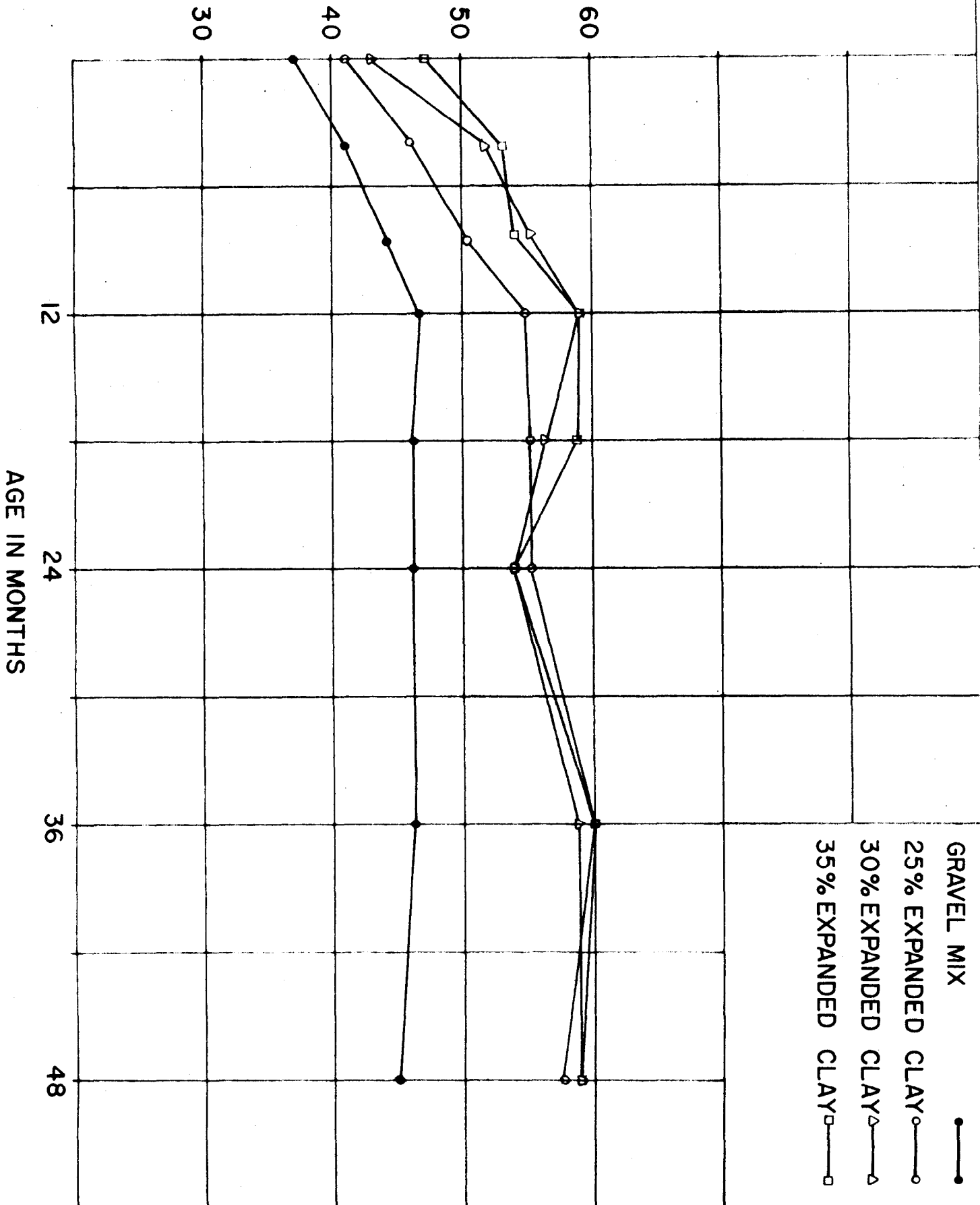
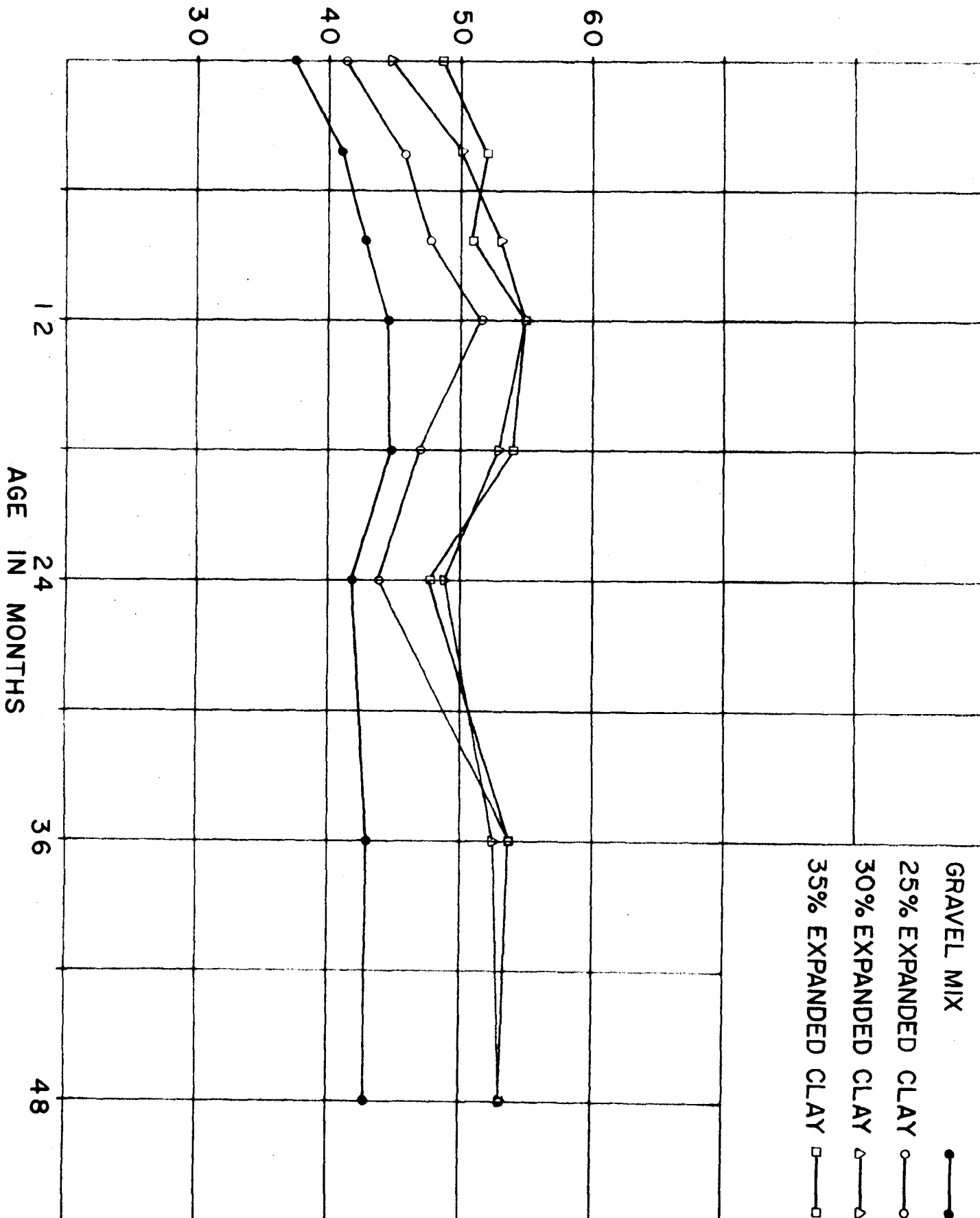


FIGURE 1

AVERAGE SKID NUMBERS OF THE TWO LANES

AVERAGE SKID NUMBER AT 40MPH - SN



AVERAGE SKID NUMBERS OF OUTSIDE LANE

FIGURE 2

AVERAGE SKID NUMBER AT 40MPH - SN

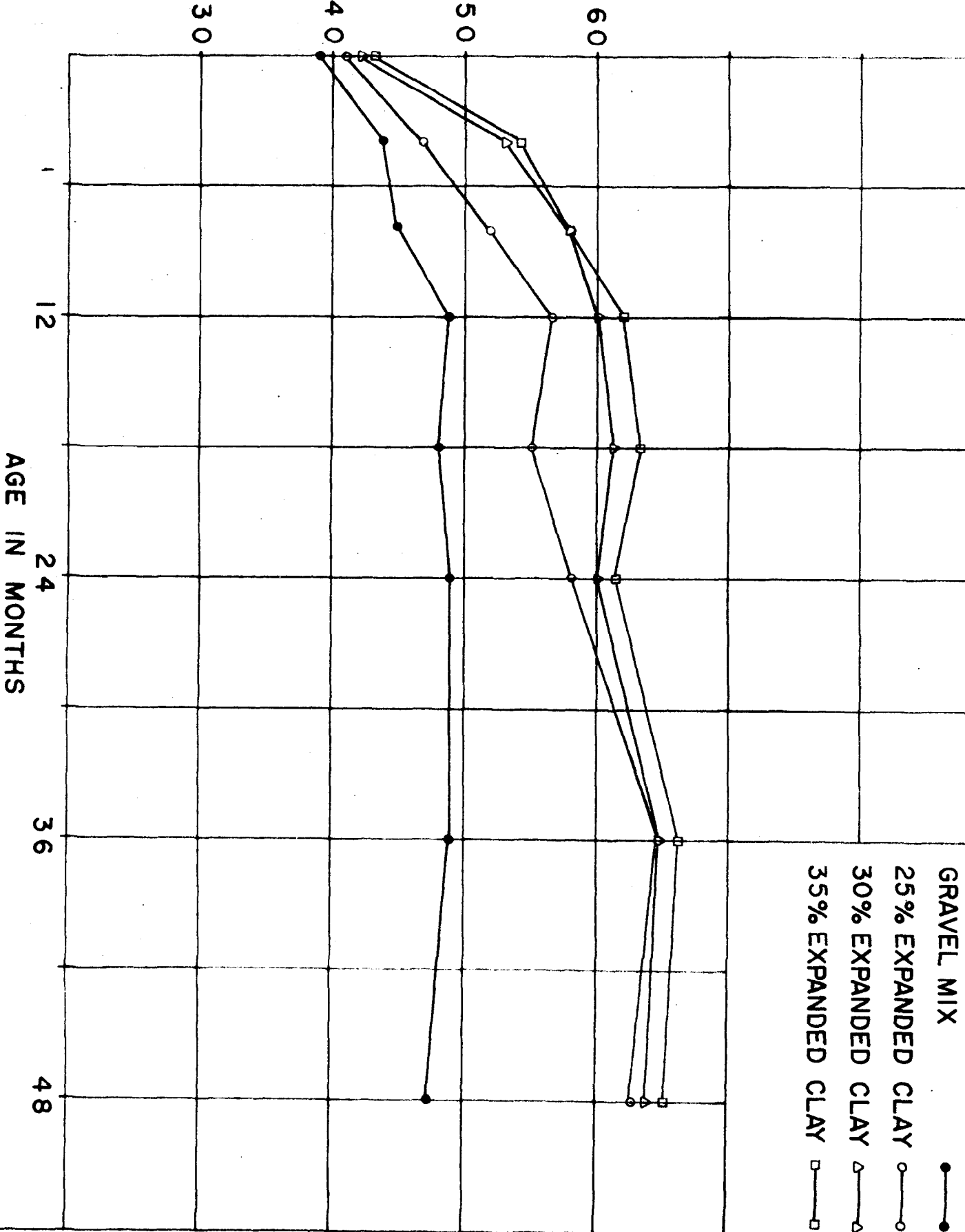


FIGURE 3
AVERAGE SKID NUMBERS OF THE INSIDE LANE

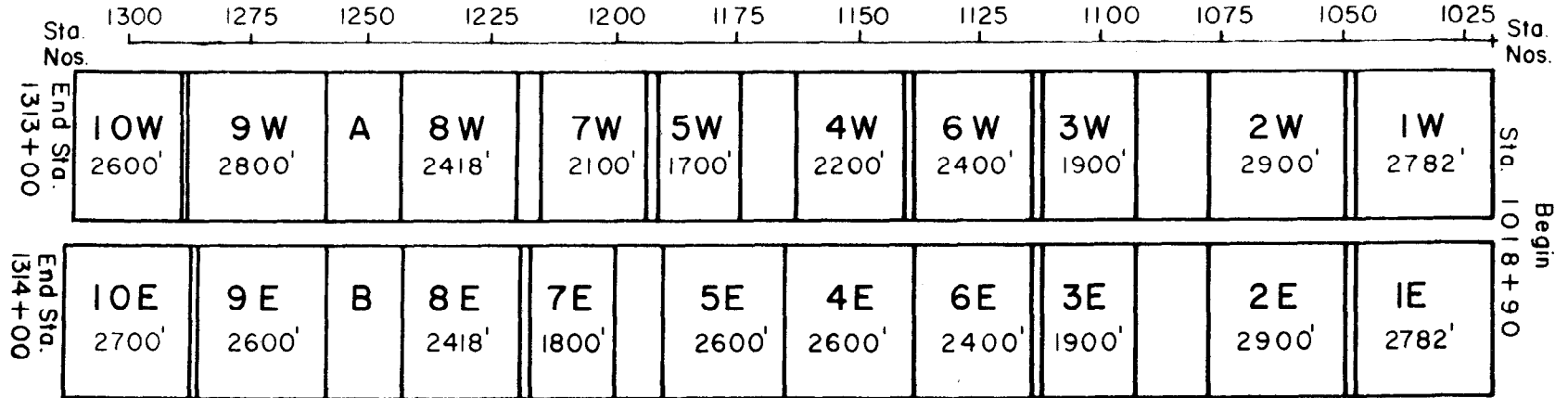
CONCLUSIONS

It appears that expanded clay aggregate with sand, mineral filler and an asphalt cement with varying percentages of 25, 30 and 35 expanded clay; can be successfully used for a good skid resistant surface. Skid resistance has maintained itself at a high level, while the riding surface is at least as good as that of any other asphaltic concrete.

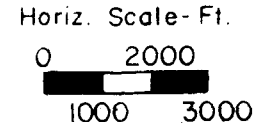
The Louisiana Department of Highways has incorporated the recommended proportions from the Phase I report of this study (Arena, P.J., Jr., Research Report No. 37, LDH) into the standard specifications for the State.

DETAILED DESCRIPTION OF TEST SECTIONS

TEST SECTION LAYOUT



- A - This Section Not Included in Study
- B - Extra Test Section - Variable Number of Roller Passes



DETAILED DESCRIPTION OF TEST SECTIONS

Eastbound Roadway

A typical section for the eastbound roadway consisted of a 1-1/2-inch Wearing Course lift overlaying an existing concrete pavement and asphaltic concrete pavement overlay.

<u>Test Section</u>	<u>Station</u>	<u>Description</u>
1E	1018 - 1048	Control Section. Type 1 Wearing Course mix consisting of crushed gravel, sand, mineral filler and 5.1% asphalt cement.
2E	1050 - 1079	Type 4 Mix. 30% plus No. 4 expanded clay, sand, mineral filler and 7.5% asphalt cement.
3E	1094 - 1113	Type 4 Mix. 30% plus No. 4 expanded clay, sand mineral filler and 7.0% asphalt cement.
4E	1139 - 1165	Type 4 Mix. 30% plus No. 4 expanded clay, sand, mineral filler and 8.0% asphalt cement.
5E	1165 - 1191	Type 4 Mix. 30% plus No. 4 expanded clay, sand, mineral filler and 7.5% asphalt cement.
6E	1115 - 1139	Control Section. Type 1 Wearing Course mix consisting of crushed gravel, sand, mineral filler, and 5.1% asphalt cement.
7E	1200 - 1218	Type 4 Mix. 25% plus No. 4 expanded clay, 10% minus No. 4 expanded clay, sand, mineral filler and 7.5% asphalt cement.
8E	1219 - 1243	Same as section 7E with the exception of 8.0 asphalt cement.
9E	1259 - 1285	Type 4 Mix. 25% plus No. 4 expanded clay, sand, mineral filler and 7.5% asphalt cement.

<u>Test Section</u>	<u>Station</u>	<u>Description</u>
10E	1287 - 1314	Same as section 9E with the exception of 5% mineral filler.

Westbound Roadway

A typical section for the westbound roadway consisted of a 1-3/4-inch Binder Course and a 1-3/4-inch Wearing Course overlaying an existing concrete pavement. In all test sections, except 4W and 5W, a Wearing Course mix was used for both lifts.

<u>Test Section</u>	<u>Station</u>	<u>Description</u>
1W	1018 - 1048	Control Section. Type 1 Wearing Course Mix consisting of crushed gravel, sand, mineral filler and 5.1% asphalt cement.
2W	1050 - 1079	Type 4 Wearing Course Mix. 30% plus No. 4 expanded clay, sand, no mineral filler. Bottom lift - 1-3/4 inches, 8% asphalt cement. Top lift - 1-3/4 inches, 7% asphalt cement.
3W	1094 - 1113	Type 4 Wearing Course Mix. 30% plus No. 4 expanded clay, sand, mineral filler. Top and Bottom lifts - 7% asphalt cement.
4W	1141 - 1163	Type 4 Mix. 30% plus No. 4 expanded clay, sand, mineral filler. Bottom lift - Binder Course Mix, 2 inches thick, 8% asphalt cement. Top lift - Wearing Course Mix, 1-1/2 inches thick, 8% asphalt cement.
5W	1174 - 1191	Type 4 Mix. Bottom lift - Binder Course mix 35% plus No. 4 expanded clay, sand, mineral filler, 2 inches thick, 7.5% asphalt cement. Top lift - Wearing Course mix 30% plus No. 4 expanded clay, sand, mineral filler, 1-1/2 inches thick, 7.5% asphalt cement.

<u>Test Section</u>	<u>Station</u>	<u>Description</u>
6W	1115 - 1139	Control Section. Type 1 Wearing Course mix consisting of crushed gravel, sand, mineral filler and 5.1% asphalt cement.
7W	1193 - 1214	Type 4 Mix. 25% plus No. 4 expanded clay, 10% minus No. 4 expanded clay, sand, mineral filler. Bottom and Top lifts - 7.5% asphalt cement.
8W	1219 - 1243	Same as section 7W with the exception of 8.0% asphalt cement.
9W	1258 - 1277	Inside lane - Top and Bottom lifts - Type 4A mix 35% plus No. 4 (Regular expanded clay), sand, mineral filler, 7.5% asphalt cement. Outside lane - Bottom lift - Type 4A mix 35% plus No. 4 (Regular expanded clay), sand, mineral filler, 7.5% asphalt cement. Top lift - Type 4 Wearing Course mix 35% plus No. 4 expanded clay, sand, mineral filler, 7.5% asphalt cement.
10W	1287 - 1313	Inside lane - Bottom lift - Type 4A mix 35% plus No. 4 (Regular expanded clay), sand, mineral filler, 8% asphalt cement. Outside lane - Top and Bottom lifts - Type 4 Wearing Course mix 35% plus No. 4 expanded clay, sand, mineral filler, 8% asphalt cement.