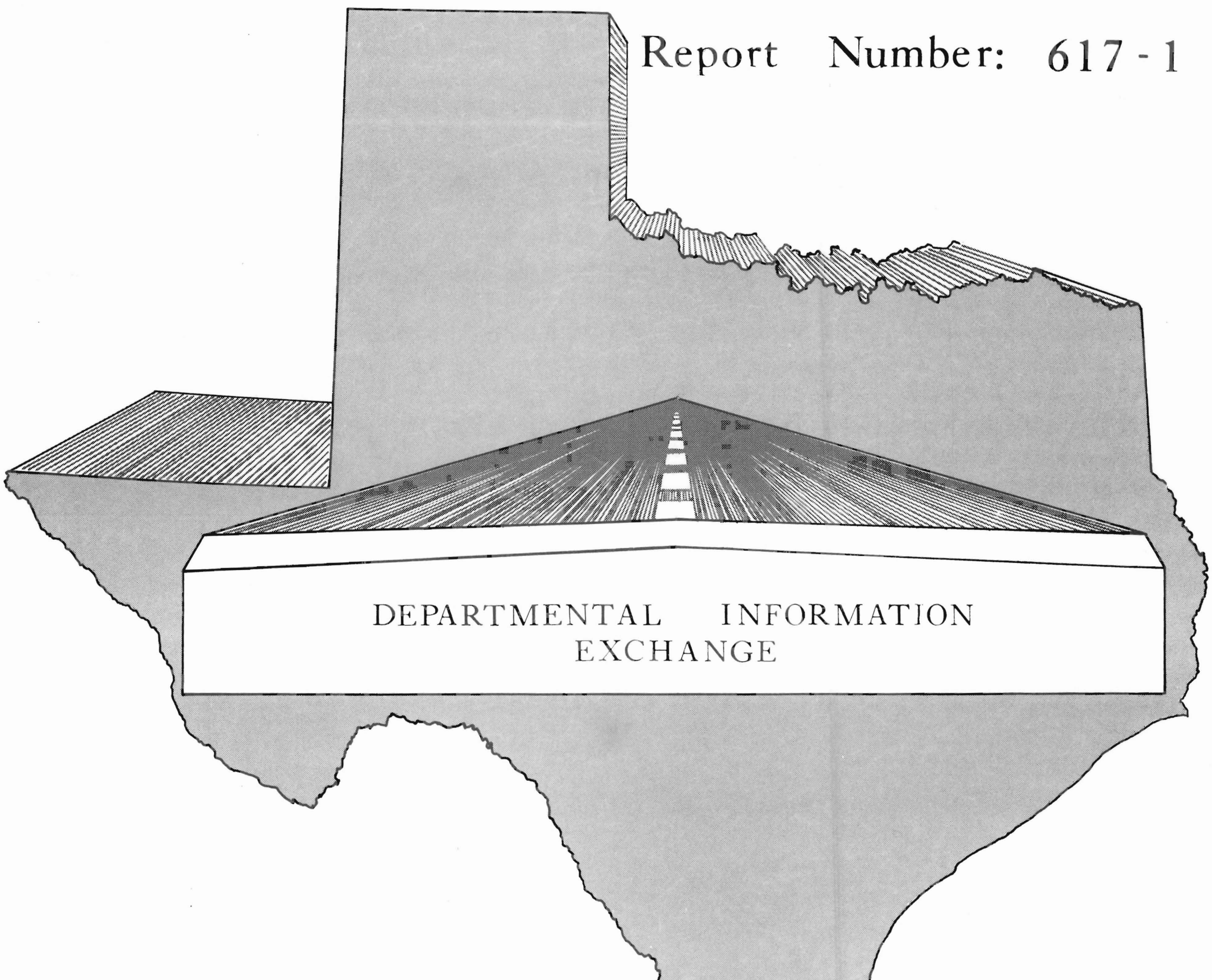
EXPERIMENTAL PROJECTS

BLACK BASES USING EMULSIONS

Report Number: 617-1



STATE DEPARTMENT OF HIGHWAYS
AND PUBLIC TRANSPORTATION

BLACK BASE USING EMULSION

Report 617-1

A Narrative Report

by

Warren N. Dudley

Supervising Resident Engineer

District 20

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BACKGROUND

For many years the predominant base material used for highway construction in Southeast Texas has been iron ore gravel. This material as used for highway construction is composed of a medium to low P.I, sandy loam binder with small ferrous nodules. It is usually found as surface deposits approximately 24" thick in wooded areas. To secure the quantity needed for most highway base material projects, it is necessary to clear large areas of trees and roots, windrow the iron ore gravel material, haul it to the roadway and now in recent years reseed the area that was cleared.

As time passed it has become more and more difficult to find deposits of i. o. g. base material on privately owned property and the timber industry land owners are more interested in growing trees than in producing base material for highway construction unless it benefits their particular needs. For this reason it has become necessary for us to develop other materials that are suitable for use as base material.

We recognize that for high traffic volume and primary highway construction, a high quality Class A base or concrete pavement is necessary. We also realize that there are many miles of highway construction needs in Southeast Texas where base materials of proven quality for lower traffic volumes are satisfactory. For this reason we took a long look at the service records of highway sections built with road mix soil asphalt stabilization. The sections indicated on the District map, Figure 1, shows approximately 180 miles of soil asphalt construction completed between 1948 and 1972 in District 20. Reviewing the service records of soil-asphalt base highways and discussion with the maintenance people responsible for upkeep of the highways indicated that soil-asphalt is quite adequate for farm road and secondary road construction.

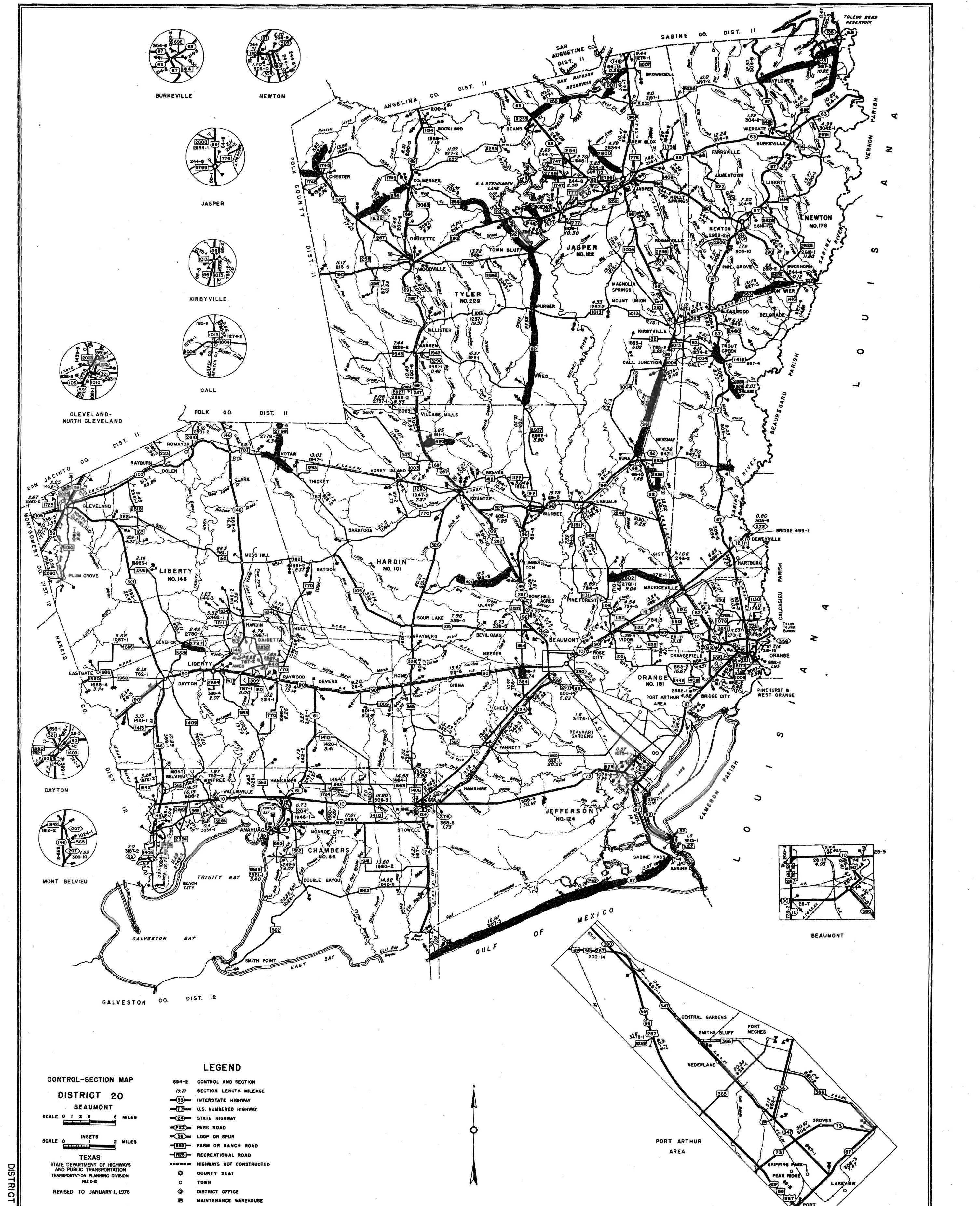

FIGURE 1 - LOCATIONS OF SOIL ASPHALT SECTIONS

DEVELOPMENT

After the decision that soil-asphalt base is satisfactory for designated projects, a review of past design, construction practices and resultant projects was made. Purpose of the review was to determine possible means of upgrading the quality of soil-asphalt base and base work. Like most improvement the developments and changes in soil asphalt construction can be measured in inches rather than miles. The ultimate goal is to obtain a uniform mixture of soil and asphalt that is impervious to moisture and that will carry the load requirement without failure.

Prior to 1970 all soil-asphalt projects had been constructed with the use of RC-2 or MC-3 asphalt. The first soil asphalt work that I have personal knowledge of was accomplished with RC-2 asphalt. The problem with using RC-2 asphalt was in getting a good uniform mixture before the volatiles escaped the RC-2 leaving a penetration grade asphalt to mix with the soil. We soon discovered that our Contractors could produce better soil-asphalt when MC-3 asphalt was used as the stabilizer. The MC-3 asphalt did not lose volatiles as rapidly as RC-2 asphalt and consequently allowed for longer mixing time. Generally the longer mixing time is an advantage for the Contractors that do soil-asphalt work in our area.

About 1970 we began to hear about emulsified asphalt for use as a soil stabilizer. As proper moisture content of the soil prior to mixing had been one problem when using RC-2 or MC-3 we became interested in comparing results that could be obtained with the various types of asphalt available for soil stabilization. For this reason a laboratory investigation into mixes utilizing the various types of asphalt was made. We performed the standard TEX-119-E test as outlined in Materials and Tests Testing Procedures Volume I to determine the compressive strength that we could expect from one single soil when mixed with the types of asphalt being compared. Results of these comparative tests are shown in Figure 2.

The most significant difference noted in the laboratory and one that does not show in the results unless as a direct bearing on the compressive strength obtained was the ease with which it was possible to mix the AES-300 emulsified asphalt with the soil. We began by wetting the soil to its liquid limit prior to addition of the emulsified asphalt. This produces a very homogeneous mixture but was very time-consuming when drying the mixture back to a moisture content suitable for molding. We soon found that by adding only approximately 2% moisture in excess of optimum that it was possible to obtain the desired mixture.

A review of Figure 2 will reveal that the mixture of soil and emulsified asphalt produced the best compressive strength results.

Further study of the subject indicated that the use of a cationic emulsified asphalt as a soil stabilizer should be investigated. One reason for considering the cationic emulsion was that the AES-300 anionic emulsion was not in our standard specification while EA-CMS-2 was. Specification Item 300 for EA-CMS-2 allowed the use of up to 12% oil distillate and only 2% to 3% in all other grades of emulsified asphalt. The higher percentage of oil distillate furnishes a longer allowable working time for the road mixing operation thus allowing the Contractor more latitude in his mixing operation while furnishing a satisfactory mix.

For example, if for some reason the asphalt emulsion broke before the mixing operation was completed the Contractor would still have a cut back asphalt with which to work and complete the mixing operation. Laboratory tests were made comparing MC-800 and EA-CMS-2 as stabilizers. In this instance an equal amount of each stabilizer was used. Triaxial results shown in Figure 3 indicate a higher strength obtainable with the EA-CMS-2. As in the earlier comparison laboratory mixing was accomplished with much less effort when using the EA-CMS-2 than when using the same amount of MC-800. It is possible that the higher strength could be attributed to a more uniform coating of soil grains but if so

Type of Asphalt Stabilizer	Stabilizer Used (%)	Dry Density #/Cu. Ft.	Triaxial Class
MC-3	5.8	127.7	3.8
EA-11-M	7.6	124.8	3.8
AES-300	7.0	127.1	3.2

One soil used and test results shown are at 75% of Fat Point.

Figure 2

Type of Asphalt Stabilizer	Stabilizer Used (%)	Dry Density #/Cu. Ft.	Triaxial Class
MC-800	5.0	134.0	2.9
EA-CMS-2	5.0	134.2	2.6

One soil used, stabilizer content fixed.

Figure 3

this would be true of field operations also.

The EA-CMS-2 used in testing contained approximately 6% oil distillate. For this reason it was not possible to perform the tests on residue from the Distillation Test as required in Item 300 and we replaced this requirement with a Float Test to determine the quality of residue.

APPLICATION

With the results of development testing accomplished the next step was to select a project suitable for soil asphalt stabilization with the modified EA-CMS-2. Such a project was available in the northeastern section of our District where natural base material is scarce. Adjoining projects had already been completed utilizing soil-asphalt as the base material using MC-3 as the stabilizer.

Stabilization work on 6.2 miles of F.M. 255 in Newton County was accomplished during September and October, 1972. EA-CMS-2 was applied at the rate of 6% by weight of dry soil through spray bars of a motorized pulverizer mixer. The mixing operation which followed consisted of using two maintainers to blade mix and windrow the soil-asphalt mixture and two pulverizer-mixers to complete the mixing operation. As in the laboratory trials a uniform mixing was accomplsihed with minimum effort. Compaction was done with one Hyster type roller and one 25 ton pneumatic roller.

RECOMMENDATIONS

Some projects have been constructed by rough mixing the asphalt stabilizer with the soil throughout the entire length of the project and then remixing and compacting for the completed base. We do not recommend this as standard practice. Each land should be completed before going on for best results.

When the soil to be stabilized as base is to be hauled from pits, we would recommend a central mixing plant. The advantage of the central mix plant is twofold: one, the base material is more uniform, the asphalt content would be constant and the moisture content could be controlled; two, the base material would be ready for spreading and compacting upon delivery to the road and the roadway operation would not be subject so much to weather conditions.

Finally it is recommended that the completed asphalt stabilized base be cured with "dirty water" in advance of the surfacing with seal coat or asphaltic concrete. We noted during preparation for the seal coat surface on our pilot project that the base surface was very dusty. Had we cured the "dirty water', this dust would have been controlled.

APPENDIX

EXAMPLE SPECIFICATIONS

STATE DEPARTMENT OF HIGHWAYS AND PUBLIC TRANSPORTATION
SPECIAL PROVISION
TO
ITEM 292
ASPHALT STABILIZED BASE
(PLANT MIX)

For this project, Item 292, "Asphalt Stabilized Base (Plant Mix)" is hereby amended with respect to the clauses cited below and no other clauses or requirements are waived or changed hereby:

Article 292.1 "Description." The first sentence is hereby voided and replaced with the following:

> This item shall consist of base courses, sub-base courses or foundation courses to be composed of a compacted mixture of mineral aggregate and asphaltic material mixed hot or cold in a mixing plant.

Article 292.5 "Stockpiling, Storage Proportioning and Mixing", Section (5) Mixing, Sub-section (c) The Asphaltic Mixture. The first sentence is hereby voided and replaced with the following:

> The asphaltic mixture shall be at a temperature between 50°F and 350°F when dumped from the mixer.

Article 292.8 Measurement is hereby voided and replaced by the following:

> Work and acceptable materials as prescribed by this item will be measured for payment by the square yard of completed and accepted asphalt stabilized base and by the ton of 2000 pounds of asphaltic material.

It is the intent of this specification that the asphalt stabilized base be constructed in strict conformity with the thickness and typical sections shown on plans. Where any such base is found not so constructed, the following rules relative to adjustment of payment for acceptable stabilized base and to replacement of faulty stabilized base shall govern.

(1) The asphalt stabilized base will be core drilled by the State Department of Highways and Public Transportation prior to final acceptance. The thickness of the base will be determined by measurement of the cores in accordance with Test Method Tex-424-A.

For the purpose of establishing an adjusted unit price for asphalt stabilized base, units to be considered separately are defined as 1000 lineal feet of pavement in each traffic lane starting at the end of the base bearing the smaller station number. The last unit in each lane shall be 1000 feet plus the fractional part of 1000 feet remaining. Lane width shall be considered as

the width between longitudinal construction joints or between the longitudinal construction joint and the edge of the asphalt stabilized base. For widening the width shall be considered as the average width placed of the widened section that is deficient in thickness. One core will be taken at random by the Department in each unit. When the measurement of the core from a unit is not deficient more than 0.5 inch from the plan thickness, full payment will be made. When such measurement is deficient more than 0.5 inch and not more than 1.50 inches from the plan thickness, two additional cores at intervals not less than 300 feet will be taken and used in the average thickness for that unit. An adjusted unit price as provided in Subarticle 292.8(2) will be paid for the unit represented.

Other areas such as intersections, entrances, crossovers, ramps, etc., will be considered as one unit, and the thickness of each unit will be determined separately. Small irregular unit areas may be included as part of another unit. At such points as the Engineer may select in each unit, one core will be taken for each 1000 square yards of asphalt stabilized base, or fraction thereof, in the unit. If the core so taken is not deficient more than 0.5 inch from the plan thickness, full payment will be made. If the core is deficient in thickness by more than 0.5 inch but not more than 1.50 inches from the plan thickness, two additional cores will be taken from the area represented and the average of the three cores determined. If the average measurement of these three cores is not deficient more than 0.5 inch from the plan thickness, full payment will be made. If the average thickness of the three cores is deficient more than 0.5 inch but not more than 1.50 inches from the plan thickness, an adjusted unit price as provided in Subarticle 292.8(2) will be paid for the area represented by these cores.

In calculating the average thickness of the asphalt stabilized base, measurements which are in excess of the specified thickness by more than 0.2 inch will be considered as the specified thickness plus 0.2 inch, and measurements which are less than the specified thickness by more than 1.50 inches will not be included in the average.

When the measurement of any core is less than the specified thickness by more than 1.50 inches, the actual thickness of the asphalt stabilized base in this area will be determined by taking additional cores at (not less than) 10-foot intervals parallel to the center line in each direction from the affected location until in each direction a core is found which is not deficient by more than 1.50 inches. Areas found deficient in thickness by more than 1.50 inches shall be evaluated by the Engineer, and if in his judgment the deficient areas warrant removal, they shall be removed and replaced with stabilized base of the thickness shown on the plans.

Exploratory cores for deficient thickness will not be used in averages for adjusted unit price.

(2) Price Adjustments. Where the average thickness of asphalt stabilized base is deficient in thickness by more than 0.5 inch, but not more than 1.50 inches, payment will be made at an adjusted price as specified in the following table.

Asphalt Stabilized Base Deficiency

Deficiency in Thickness Determined by Cores Inches	Proportional Part of Contract Price Allowed
0.00 thru 0.50	100 per cent
0.51 thru 0.75	80 per cent
0.76 thru 1.00	70 per cent
1.01 thru 1.25	60 per cent
1.26 thru 1.50	50 per cent

When the thickness of asphalt stabilized base is deficient by more than 1.50 inches and the judgment of the Engineer is that the area of such deficiency should not be removed and replaced, there will be no payment for the area retained.

(3) No additional payment over the contract unit price will be made for any asphalt stabilized base of a thickness exceeding that required by the plans.

Asphaltic material of the type and grade shown on the plans to be measured by the ton, the asphaltic material suppliers certificate of weights may be accepted provided the delivery is made in transports with seals unbroken. The Contractor shall furnish a set of standard platform truck scales conforming to the applicable provisions of Item "Weighing and Measuring Equipment" if the material is weighed on the project.

Article 292.9 Payment is hereby voided and replaced by the following:

(1) The work performed and materials furnished as prescribed by this item and measured as provided under "Measurement" will be paid for at the unit prices bid for "Asphalt" and "Asphalt Stabilized Base", of the types and/or grade and depth specified, which prices shall each be full compensation for quarrying, furnishing all materials, including royalty payments on mineral aggregate where applicable, tack coat, all stripping unless specifically stated otherwise on the plans, and freight involved; for all heating, mixing, hauling, shaping and fine grading the subgrade or cleaning the existing base course or pavement, placing asphalt stabilized base, rolling and finishing; and for all manipulations, labor, tools, equipment and incidentals necessary to complete the work except prime coat when required.

(2) The prime coat, performed where required, will be measured and paid for in accordance with the provisions governing the Item "Prime Coat".

(3) All scales and other weighing and measuring devices necessary for the proper construction, measuring and checking of the work shall be furnished, operated and maintained by the Contractor at his expense.