PAVEMENT DESIGN AND PERFORMANCE STUDIES

Final Report on Phase A:

Performance Study of Typical Virginia Pavements

by

K. H. McGhee
Highway Research Engineer

(The opinions, findings, and conclusions expressed in this report are those of the author and not necessarily those of the sponsoring agencies.)

Virginia Highway Research Council
(A Cooperative Organization Sponsored Jointly by the Virginia Department of Highways and the University of Virginia)

In Cooperation with the U. S. Department of Transportation
Federal Highway Administration

Charlottesville, Virginia

April 1972
VHRC 71-R31

SUMMARY

The performance of in-service typical Virginia flexible and rigid pavements in all areas of the state has been under evaluation since 1954. The objectives are to provide a ready reference for designers and field engineers and to provide background information for design improvement. Periodic deflection and roughness tests have been conducted along with field inspections. The records maintained on each pavement reflect condition, traffic, construction costs, and major repairs.

Among the major findings of the study are:

1. Cement stabilized subgrades under recently constructed flexible pavements have virtually eliminated rutting and other major distortions;

2. the estimated cumulative number of 18 kip equivalent axle loads sustained by a pavement up to a fixed degree of cracking is directly related to a parameter used to define the shape of the dynaflect deflection basin;

3. terminal PSI as defined from the AASHO Road Test is too insensitive for use in the evaluation of flexible pavement performance in Virginia; and

4. the use of too long a joint spacing and of metal joint forming inserts has impaired the performance of rigid pavements in Virginia.

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INTRODUCTION

In an earlier report on this study,[1] F. P. Nichols, former highway research engineer, defined the objectives in the following paragraph:

> The Performance Study of Typical Virginia Pavements was begun in 1954 in an attempt to provide, for ready reference, case histories on the behavior of pavements of all major types in all soil areas of the state and subjected to all classes of traffic. It was felt that such a reference would enable those engineers charged with the responsibility for pavement design decisions to give proper consideration to the success or failure of earlier designs in making future design selections.

At the time of that progress report (1965), the efforts to evaluate all types of pavements in all soil areas and under all traffic conditions had resulted in the growth of the study to include some 200 projects. With this unwieldy number, it was impractical even for the personnel in charge of the study to adequately keep abreast of the performance of each project. It was, therefore, concluded that pavement designers and field engineers would have difficulty in making use of information from such a massive study. A subsequent major reduction along with a few additions resulted in a total of 63 projects at the conclusion of the study.

The projects to be retained in the study were selected according to the following criteria:

(1) To include only very recently or presently used designs;

(2) to include, where possible, both rigid and flexible pavements of interstate standard in each of the eight construction districts; and,

(3) to include pavements representative of a range of traffic volumes in each district.

As a further general guide, it was decided that to qualify for future inclusion in the study a project would have to either represent a new design concept in Virginia (such as continuously reinforced concrete pavements or full depth asphalt) or include contrasting designs in the same vicinity.

It is the intent of the present report to finalize and make available to operating personnel the information derived from the study through calendar year 1971.

PERFORMANCE STUDY PROCEDURE

In general, projects selected for inclusion in the performance study are closely observed by Research Council personnel from the time of construction until useful information can no longer be gained (usually until the second resurfacing). The steps included in the evaluation of each pavement are as outlined below:

(1) Procurement of final plans and cross sections, materials descriptions, construction costs, and date of acceptance from the contractor.

(2) Establishment of easily identified project limits by the use of roadside markers and written descriptions.

(3) Initial and periodic, usually semiannual, collection of data reflecting:

  (a) traffic characteristics,

  (b) structural capability as indicated by deflection tests,

  (c) roughness, and

  (d) visual defects such as cracking, rutting, patching, and the presence of settlements.

(4) Maintenance of records of major maintenance operations (bituminous concrete overlays, for example), and their costs.

Clearly, the accumulation of the above information requires the cooperation of personnel in nearly every operating division of the Highway Department, so that the study is far more than an undertaking of the Research Council.

Before a meaningful display of information can be presented, it is necessary to outline some of the more subtle features. The following discussion has particular reference to item 3 above.

Traffic Characteristics

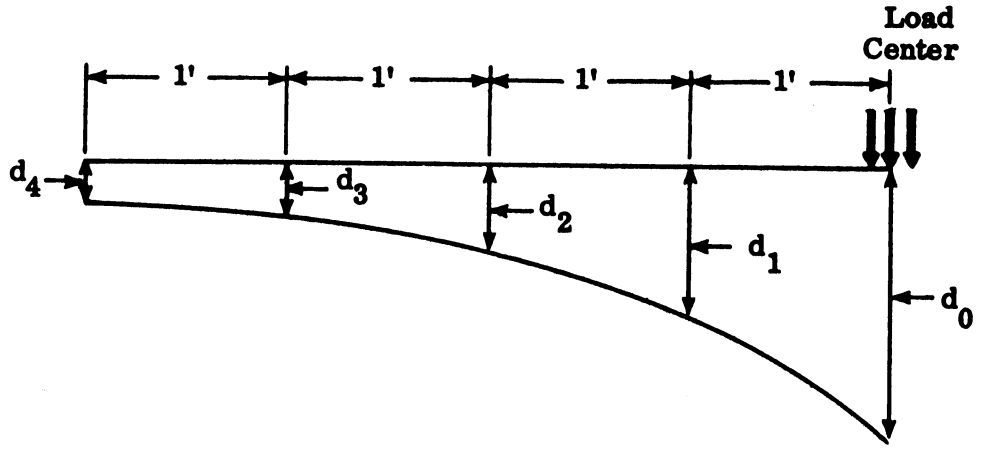
While Virginia's present design method utilizes the 18 kip equivalency concept defined by AASHO,[2] most of the pavements currently in the study were designed on the basis of traffic categories reflecting average daily tractor-trailers and buses in

both directions (T. T. & B.). Furthermore, T. T. & B. data are routinely collected by the Traffic and Safety Division while 18 kip equivalency determinations are obtained only through weight studies and are too expensive for other than special requirements. For these reasons, only T. T. & B. information is available directly for the study projects. Estimated cumulative 18 kip axle loads have been computed for each flexible study pavement. These estimates were based on the method developed by Shook and Lepp[3] as modified by Thacker[14] for application in Virginia.

Structural Capability

In this presentation, as in the last two progress reports,[1,5] rebound deflections are used as an indication of the structural capabilities of the various flexible pavement systems. Tests conducted prior to 1966 were performed with Benkelman beams[1] and a truck loaded to 18,000 lb. on its rear axle. In 1966 a dynaflect was purchased and its results correlated with those from Benkelman beam tests.[6] Since the regression equation (Benkelman Beam = 27.8 dynaflect) was found to have an excellent correlation coefficient, all tests subsequent to 1966 have been conducted with the much faster and less laborious dynaflect method.

This method provides for deflection measurements directly at the point of load application and at distances of one, two, three, and four feet from that point. The plot of all five deflections defines the deflection basin as shown in Figure 1. Recent studies[7] have shown that the shape of the deflection basin may be of more importance than the maximum deflection. As a means of interpreting the shape of the basin, a bending factor, or a "spreadability", has been defined and is also shown in Figure 1. This factor is the ratio of the average deflection to the maximum, expressed as a percentage. An increase in the factor indicates an ability of the pavement to spread the load over a wider area. Thus, a 65 bending factor indicates a much stiffer pavement than does a 45. The use of a bending factor in assessing flexible pavement performance will be discussed later in this report.



$$\text{Spreadability} = \frac{d_0 + d_1 + d_2 + d_3 + d_4}{5\, d_0} \times 100$$

Figure 1. Dynaflect deflection basin.

The structural evaluation of rigid pavements is based totally on visual observations of defects as discussed later.

Roughness

Road roughness tests utilizing a BPR type roughometer towed at 20 mph have been conducted on each project throughout most of the study period. These data also will be discussed later in this report.

Visual Defects

Periodic inspections of the study pavements have resulted in the accumulation of considerable data reflecting various kinds of physical defects, the most common of which is cracking. Other defects noted are rutting, patching, and settlements.

Rutting of flexible pavements, once fairly common in Virginia, seems to have been nearly eliminated over the past few years with the advent of cement and lime stabilization and the resultant more stable subgrades. More rigorous density requirements along with the adoption of nuclear testing techniques very likely have also played some part in reducing the rutting of modern pavements. For example, the 1958 Virginia Department of Highways Road and Bridge Specifications called for a minimum density corresponding to 95 percent of the AASHO T99 standard for unstabilized subgrades, while with cement stabilization the minimum was raised to 100 percent. Rutting is, thus, seldom a factor in performance surveys but is noted as to extent and frequency as are patching and settlements.

To make cracking data more useable, a crack factor (CF) has been defined for flexible pavements and it is determined for each of the study projects at the time of each inspection. To determine the factor, the project is separated into 1,000 ft. sections and each section is surveyed for cracking. Each incidence of cracking has been arbitrarily assigned a value of 15 units and 20 units for longitudinal cracking and pattern or alligator cracking, respectively. Transverse cracking of flexible pavements is so often related to cement stabilization that its presence is not considered detrimental. Thus, a section with five incidences of pattern cracking would have a crack factor of 100. Similarly, two incidences of longitudinal cracking and one of pattern cracking yield a factor of 50. An upper limit of 100 units per 1,000 ft. section is imposed on the data. After all sections within a project have been surveyed, the average crack factor is determined and designated as the factor for the project.

Clearly, the crack factor as used in this study is somewhat arbitrary and would not be adaptable to strict quantitative analysis. It is, however, the opinion of the researchers that the data are useful on a qualitative basis to determine whether or not a project is performing well. For example, other factors being equal, one can say that a crack factor of 5 for a ten-year old project clearly indicates better performance than say a crack factor of 50 for a five-year old project.

Visual defects noted for rigid pavements are transverse and longitudinal cracking, corner breaks, evidences of joint failure, and evidences of pumping. Also noted are surface defects such as scaling and flecking.

DISCUSSION

Project Case Histories

Project case histories (Appendix A) follow this discussion section and they are arranged in order by highway district according to the usual district numbering system shown below:

District	Series
Bristol	100
Salem	200
Lynchburg	300
Richmond	400
Suffolk	500
Fredericksburg	600
Culpeper	700
Staunton	800

Thus, project 101 is the first project in the Bristol District, while No. 305 is the fifth project in the Lynchburg District. In addition, projects having alphabetical suffixes (304A, 304B, 304C, 304D, for examples) are subsections of the same age and built by the same contractor within a single contract but have different pavement cross sections. Within a district, projects are arranged in ascending order according to route number.

Each data sheet is headed by a project description consisting of route number, county, project limits, completion date, pavement cross section, and the original construction cost per 24-foot lane mile. A projected cost of construction for 1971 (based on the typical unit costs listed in Appendix B) is also included. Final items in the project description consist of a soil area designation and a pavement thickness index (flexible pavements only). These parameters are compatible with Virginia's new pavement design concept, described by Vaswani, and refer to the relative resiliency of the soils in and around the project location and to the equivalent asphaltic concrete thickness of the pavement, respectively. The method is outlined in Appendix C, where a soil area map will be found.

The remainder of the data sheet for a given project is devoted to a summary of performance data including the daily T. T. & B. range to which the pavement has been subjected over its life, the estimated cumulative 18 kip axle loads sustained, deflection

data and a crack factor for flexible pavements, and such remarks as are prompted by maintenance records and field inspections. Deflection data collected with the dynaflect have the maximum deflection and the bending factor listed. Those collected with a Benkelman beam (indicated by asterisks) have been converted to dynaflect values through use of the previously described regression equation.

Performance Evaluation

Present Serviceability Index

Progress Report No. 4[5] discussed the researcher's dissatisfaction with the Present Serviceability Index (PSI) concept derived from the AASHO Road Test.[2]

The difficulty with the application of the PSI in Virginia appears to be in the relative lack of sensitivity of the PSI equation to cracking. Most of Virginia's primary pavements built since the evolution of the PSI concept (about 1960) either have had stabilized subgrades or have been built in good soil areas. Pavements built on unstabilized poor soils have been for low traffic categories. Experience has shown that these improved design practices have reduced distortions to a minimum. Thus, cracking without an appreciable increase in roughness has become the principal factor contributing to loss of pavement serviceability. Maintenance practices[8] give considerable weight to this cracking and to the engineer's judgement and often result in resurfacing before any public awareness that a pavement is in need of maintenance. Cracking, especially of the alligator type, is considered detrimental because of the tendency toward potholing.

In summary, the PSI concept in its present form, notwithstanding the huge research effort behind its development, has little application to present Virginia flexible pavements. Since most of the rigid pavements are relatively new, it is difficult at this time to assess the applicability of the PSI to their evaluation. Roughness and PSI data collected through 1969 may be found in Appendix D of Progress Report No. 4.[5]

Cracking and Bending Factors

The lack of success with the PSI meant that Virginia had no well accepted quantitative measure of flexible pavement performance. Thus, it was necessary to establish some definition of failure other than the terminal serviceability index, so the researchers attempted to relate performance and parameters which received lesser attention in the AASHO evaluation.

As discussed in the last Progress Report[5] a flexible pavement was considered to have failed when the cracking factor exceeded 50 units because:

(a) Substantial cracking is indicated at this level,

(b) cracking progresses rapidly after this level is reached, and

(c) few pavements are resurfaced at cracking factors below 50 but most are resurfaced within a year or two after reaching that level.

While the cracking factor is more appropriately a qualitative parameter, its use as an index of performance was outlined previously[5] as indicated by Table I and Figure 2 below. The data shown in Table I are for fifteen projects on which the researchers have watched the progress of the cracking factor from a low level (often zero) to a value in excess of 50 units. The cracking factor listed in the table is the first in excess of 50 recorded for each project. Also recorded are the estimated cumulative 18 kip axle load counts from the date of completion of construction until the cracking factor exceeded 50. The averages of all bending factors measured for a project up to a cracking factor exceeding 50 are listed along with the earliest bending factor for each project, the soil area in which each project is located, and the age of the project at the time cracking exceeded 50 units. Finally, the initial and terminal serviceability indices are listed for comparison purposes. The flexible pavements not listed in Table I were omitted because they had not reached a 50 crack factor or because they had exceeded that crack factor the first time the bending factor was determined so that insufficient data are available.

TABLE I

CRACKING AND BENDING FACTORS
(Flexible Pavements)

Project	Soil Area	Estimated Cumulative 18 kip Equiv. (millions)	CF	Age, Months	Bending Factor		Serviceability Index	
					Initial	Average	Initial	Terminal
206	1	0.56	51	74	59	58	3.89	4.04
209	1	0.52	54	128	60	57	4.27	4.09
301	1	0.10	54	73	52	49	4.90	4.47
305	1	0.28	75	83	55	54	4.30	4.19
307	2	0.12	83	60	48	48	4.46	4.21
308	1	1.25	62	70	65	60	4.69	4.44
309B	1	1.19	56	87	54	59	4.40	3.85
311	1	0.11	71	103	54	55	4.24	3.95
313A	1	0.89	52	65	54	58	4.28	4.26
406	3	1.43	55	73	59	61	4.69	4.07
407	3	0.18	87	72	53	52	4.25	4.01
604	4	0.06	69	99	45	45	3.82	3.89
701	1	0.03	79	76	56	56	4.37	4.09
702	2	0.40	96	92	62	59	4.49	3.96
704	2	0.32	86	75	63	61	4.91	4.23

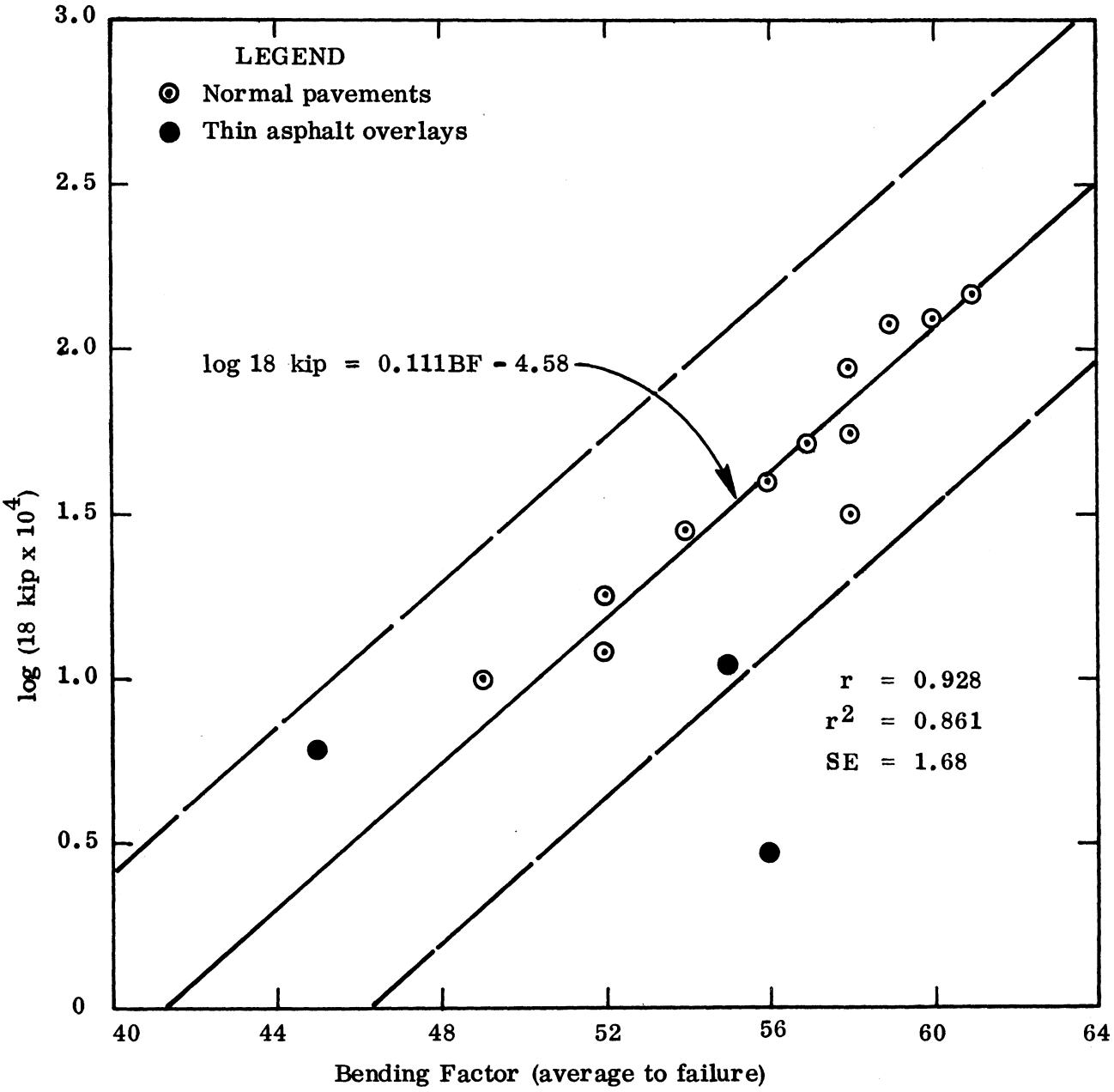


Figure 2. Estimated 18 kip equivalent axle loads sustained to failure, as a function of bending factor. (Flexible Pavements)

As can be noted in Table I, there is usually a slight decrease in the bending factor as a pavement reaches a cracking factor in excess of 50 units. This is no doubt due to a deterioration in the structural integrity of the pavement, which reduces the area over which the deformation is spread. A similar slight decrease in the serviceability index is due to the influence of cracking in the PSI equation and to a small increase in roughness.

Figure 2 shows that there is an excellent correlation between the accumulated 18 kip axle loads sustained by a pavement up to substantial cracking and the average bending factor for the pavement up to that level of cracking. Thus, as might be expected, the more rigid a pavement the more repetitions of heavy trucks it can be expected to carry before a failure condition is reached. In Progress Report No. 4[5] a similar correlation was developed for the bending factor and the T. T. & B. count sustained to failure. The present correlation utilizing 18 kip equivalencies is more consistent with current design practices.

Projects having thin bituminous layers on stone bases do not fit the correlation as well as pavements constructed of thick bituminous concrete layers. Projects 311, 604, and 701 having 2 to $2\frac{1}{2}$ inch overlays are examples. These are shown as darkened data points on Figure 2. Considered as a whole, however, the correlation provides some basis for the estimation of pavement life in terms of the bending factor and 18 kip axle load volume.

Performance of Typical Pavements

Flexible Pavements

Utilizing the criteria established earlier in this report, each of the flexible pavements has been generally rated as to its performance. Based on traffic, age, deflections, roughness, cracking and the general impression of the researchers each project has been rated as excellent, good, fair or poor in performance. There are fairly graphic examples of both good and poor performance in all soil areas except area 5, for which all projects have shown good performance. Certain definite trends which indicate differences in performance have been identified. For example, of eleven good to excellent projects is soil area 1, nine have cement stabilized subgrades, one has cement stabilized crushed stone subbase, and the last an unstabilized stone base. Nine also have a minimum of 7 in. of asphaltic concrete base and surface. A typical poor project in this soil area has 4 to 9 in. of asphalt, 4 to 8 in. of crushed stone, and 12 in. of select material. Others showing relatively poor performance have 3 to $4\frac{1}{2}$ in. of asphalt over a soil cement subgrade but with a layer of select material between. Several of the projects in soil area 1 have been discussed in detail in an earlier report.[9]

In soil areas 2 and 3 similar examples of good and poor performance can be cited, with the best performance noted for heavy asphalt over a crushed stone subbase and cement stabilized subgrade.

Projects in soil area 4 are constructed primarily of local materials and for the most part have performed well. Several showing worse performance contain cement stabilized local materials, which appear to have led to excessive transverse cracking

of the already shrinkage-prone material. Soils in this area are predominately sands and gravels of very low resiliency. They are, however, highly siliceous, and thus have greater thermal sensitivity than do the soils in other areas of the state. Pavements built in the area are, therefore, more prone to transverse shrinkage cracking, particularly when the bituminous layers also contain siliceous materials. While these cracks have not been shown to affect the structural behavior of pavements, field engineers often find them undesirable. As a consequence, pavements in soil area 4 may be overlayed before traffic volumes, pattern cracking, or roughness would indicate maintenance to be required. Unfortunately, overlays because of the transverse cracking alone are seldom successful due to the virtual certainty that the cracking will reflect through in a short period of time (often within a few days).

In general, the performance of flexible pavements still is somewhat related to the resiliency of roadbed soils. Pavements in the silty resilient soils show poorer performance than those constructed in sandy areas or in areas where clay is predominant. In the resilient areas, pavements without cement stabilization appear to be too flexible to sustain many repetitions of heavy wheel loads (project 304, for example) as evidenced by low bending factors. Stabilized projects are somewhat stiffer (see project 306) and have performed better than older unstabilized projects constructed in the same areas.

Rigid Pavements

The eleven rigid pavements included in the performance study range in age from 5 to 25 years. Ten are jointed pavements, while one, the newest, is continuously reinforced. Most are relatively new in relation to the expected 30 to 35 year life span for portland cement concrete pavements, and they provide no dramatic performance characteristics either of the good or bad variety.

Studies of the cracking characteristics of the continuously reinforced project (No. 402) have been conducted as a state research project and are summarized in two reports.[10,11] Briefly, these studies showed that the Virginia pavement developed a crack pattern nearly identical to that reported by other states for pavements containing the same percentage (0.6%) of continuous reinforcement. Cracks were found to be spaced from 3 to 5 feet and to have a surface width of approximately .015 inch. Since the above mentioned studies, the pavement has performed well with the exception of the development of several potholes, which were shown by cores to have resulted from inadequate consolidation at isolated points. Since the pavement is only five years old, no assessment of its long-range performance can be made.

All jointed pavements in the study have performed well from the standpoint of the total pavement structures. However, as shown in the detailed condition survey (Table II), all have suffered to some degree from joint problems. The most severe of these relate to a metal joint-forming insert used in projects 503, 504, and 706, on which spalled joints are abundant. Studies of these and similar projects[12] showed that the rusting away of the metal insert had permitted the intrusion of incompressible materials that had, in turn, aggravated the spalling.

TABLE II

JOINTED RIGID PAVEMENT CONDITION SURVEYS (1971)

Project No.			204	310	404	502	503	504	505	606	706
Age (yrs.)			7	25	9	14	6	9	12	8	7
Soil Area			2	1	3 & 4	4	4	4	4	3 & 4	2
T. T. & B (daily)			1,690	1,270	6,410	485	455	1,820	1,890	5,250	4,830
Reinforced			yes	yes	yes	yes	no	no	yes	yes	yes
Dowels			yes	yes	yes	yes	no	no	yes	yes	yes
Joints Formed			fiber	fiber	fiber	fiber	metal ins.	metal ins.	fiber	fiber	metal ins.
Joint Spacing (ft.)			61.5	30	50	50	20	20	50	61.5	50
Percentage of	joints	Spalled	3	9	16	13	12	76	9	4	27
		Corner cracking	1	3	1	6	1	0	1	2	3
		Faulted	0	0	14	9	0	0	0	3	21
		Pumping	0	38	3	0	0	1	0	1	1
	slabs	Transverse cracking	33	7	3	11	1	0	2	15	4
		Longitudinal cracking	1	16	13	4	8	0	1	7	12
		Scaling	1	2	49	1	0	11	3	11	1
		Edge pumping	0	0	14	0	0	0	0	8	8

Joint spacing (slab length) has been found to be a factor in the performance of the study pavements. Long slabs and the accompanying large joint movements have resulted in the failure of all attempts to maintain poured joint sealants intact. Other studies[12]

have shown that in order to maintain an effective poured seal in joints spread 50 to 61.5 feet apart, the joints would have to be unacceptably wide (approximately 1 in.). Resealing of the pavements is to be accomplished with preformed seals used in joints resawed to a width of 5/8 inch from an original 3/8 inch width. The same studies resulted in revised design standards[13] providing for a maximum slab length of 40 ft.

The transverse cracking of longer slabs (projects 204, 502, and 606) has been an additional factor leading to the revised design standards.

Features suggesting ultimate structural problems are found only on those pavements having very heavy traffic or on those having reached 10 to 15 years of age. Note that most of the faulted joints are found on projects 404 and 706, which have daily T. T. & B counts of 6,410 and 4,830, respectively. Project 310 (25 years old) has the only significant degree of joint pumping, while only the projects with heavy truck traffic have a measurable amount of slab edge pumping. At present, none of these features have led to slab cracking or other evidence of pavement failure. In most cases, the edge pumping is being countered by maintenance personnel through the provision of shoulder drains to remove excess water from beneath the pavements.

With the possible exception of project 310 in soil area 1, the performance of rigid pavements shows no apparent relationship to soil area. Most of the these pavements, however, are located in the silty sands to sandy gravels and clays comprising soil areas 3 and 4 and usually considered to be good subgrade soils. Most of those in soil area 4 also employ local or natural material as subbases. These materials have proven satisfactory except in instances where grading was too dense to provide adequate drainage. Then, the shoulder drains mentioned above were provided.

In summary, rigid pavement performance problems appear primarily related to long slabs and the accompanying joint sealing difficulties, to joint forming techniques, or to extreme volumes of truck traffic.

CONCLUSIONS

The following conclusions appear to be warranted from the performance studies reported herein:

1. Cement stabilized subgrades are, once again, shown to contribute substantially to the performance of flexible pavements. Recently constructed pavements having stabilized subgrades exhibit vastly superior resistance to rutting and other distortions as compared to most pavements ten or more years old.

2. A crack factor indicating the degree of longitudinal and pattern cracking appears satisfactory for use in the performance evaluation of Virginia flexible pavements.

3. At a fixed degree of cracking, the estimated number of accumulated 18 kip axle loads sustained by a flexible pavement is directly related to the rigidity of the pavement as determined from analysis of the dynaflect deflection basin.

4. The terminal PSI as defined from the AASHO Road Test is too insensitive for use with Virginia flexible pavement designs.

5. The use of too long a joint spacing and metal joint-forming inserts has impaired the performance of rigid pavements in Virginia.

ACKNOWLEDGEMENTS

The author gratefully acknowledges the excellent cooperation of numerous resident engineers and field maintenance personnel who have made essential contributions to the conduct of the study through their provision of maintenance records and their assistance in the collection of field data.

C. S. Hughes and Dr. N. K. Vaswani are acknowledged for their conduct of portions of the study and for their technical assistance in other portions. The interest and cooperation shown by R. W. Gunn and G. V. Leake in the collection and analysis of data are sincerely appreciated. Mr. Gunn is to be particularly commended for his development of the bending factor concept utilized in the analysis of deflection data.

The work was conducted under the general direction of Jack H. Dillard and the late Dr. Tilton E. Shelburne, state highway research engineers. The study was financed from HPR funds in cooperation with the Federal Highway Administration.

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APPENDICES

APPENDIX A

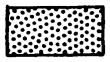
PROJECT CASE HISTORIES

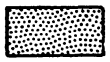
The case histories tabulated on the following pages have been described in a preceding section of this report. The major components of pavement cross sections have been sketched with the materials indicated according to the following key:


Surface and binder courses, all types; also penetration tops.


Black base courses, H-3 (1) or special sand asphalts.

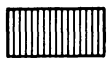

Water bound macadam bases.


Compacted aggregate bases or subbases (commercial sources).

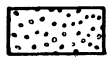

Compacted aggregates (local pits).


Select material, Type I, commercially crushed.


Select materials, all other types.


In place soil, cement or lime added.

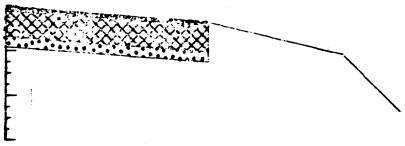

Imported material, cement or lime added.


Portland cement concrete.

1615

Project No. 0019 & 0460-092-011
From: 5.136 mi. W. WCL Tazewell
To : 10.310 mi. W. WCL Tazewell
Cost: $39,985/mi. Estimated Cost: $62,779/mi.

Completed: 9-17-55
County: Tazewell
Length: 5.174 mi.
Soil Area 5
Thickness Index 8



Surface: 1½" H-2
Base : 5½" H-3(1)
Subbase: 3" B-1 stone

Traffic: 94-235 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 590,000

Deflection Data

		BF
3-5-67	0.000704	45
4-25-68	0.001000	42
6-9-69	0.001074	41
4-9-71	0.000753	47

Crack Factor

5-23-67	92
6-18-68	95
11-17-69	54**
4-7-71	52

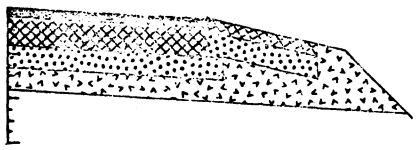
Remarks:

Resurfaced 1961-62 30#/sq. yd. F-4
**Partial resurface 135#/sq. yd. 8-29-69

Bad alligator cracking in areas not recently resurfaced. Occasional major patching. Considering age project has done well. Resurfaced portion in good shape except two isolated patches.

Project No. 0081-095-038,P1,P3
From: 0.110 mi. N. Int. Rte. 611
To : 0.036 mi. N. Int. Rte. 11 & 58
Cost: $76,507 - 106,930/mi. Estimated Cost: $161,584 - $223,300/mi.

Completed: 6-27-62
County: Washington
Length: 6.304 mi.
Soil Area 5
Thickness Index 13.7-17.9



Surface: ½" F-1
Binder : 1½" H-2
Base : 7½" H-3(1)
Subbase: 6" Cr. Aggr.
Subbase: 6" - 18" S. M. CBR 30

Traffic: 675-1350 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 1,459,000

Deflection Data

		BF
5-11-65	0.000827*	
5-2-67	0.000566	58
4-23-68	0.000532	60
4-8-71	0.000696	67

Crack Factor

4-24-67	1
6-19-68	1
11-19-69	1

Remarks:

Isolated cracks; otherwise excellent performance.

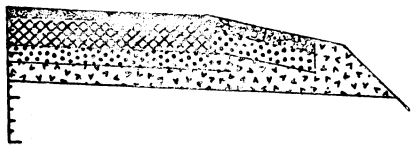
*Benkelman Beam Deflections, converted to Dynaflect.

1616

Project No. 0081-095-038,F-01
-038,I-4C2

From: 0.036 mi. N. Int. Rte. 58 & 11
To : 0.397 mi. E. Int. Rte. 60
Cost: $65,789/mi. Estimated Cost: $127,501/mi.
After Stage Construction:
Cost: $81,570/mi. Estimated Cost: $154,804/mi.

Completed: 8-23-63
County: Washington
Length: 4.623
Soil Area 5
Thickness Index 10.5
After Stage Construction 13.5



Surface: 3/4" I-3
Base : 5½" H-3(1)
Subbase: 6" Cr. Aggr.
Subbase: 6" S. M. CBR 30

Traffic: 820-1295 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 1,611,000

Deflection Data

		BF
5-13-65	0.001151*	
5-2-67	0.000708	57
4-22-68	0.000874	53
4-8-71	0.000758	61

Crack Factor

5-24-67	0
6-19-68	0
11-19-68	0
4-8-71	2

Remarks:

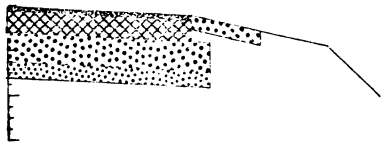
This project was designed for stage construction and 80#/sq. yd. S-5 and 250#/sq. yd. I-2 were added 6-27-67.
Mix in second stage had a brown color.
Resurface in excellent shape, excellent performance.

(1617

201

Project No. 0058-017-002-005
From: ECL Galax
To : W. End of bridge over Crooked Run
Cost: $60,298/mi. Estimated Cost: $79,453/mi.

Completed: 11-13-57
County: Carroll
Length: 4.820 mi.
Soil Area 1
Thickness Index 10.6



Surface: 1½" I-3
Base : 5½" H-3(1)
Subbase: 8" Cr. Aggr.
Subbase: 4" S. M.

Traffic: 65-155 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 316,000

Deflection Data

		BF
9-11-57	0.001654*	
4-27-67	0.000711	67
4-11-68	0.000684	72
7-22-71	0.000949	70

Crack Factor

6-28-67	2
7-31-68	3
10-24-69	7
7-22-71	14

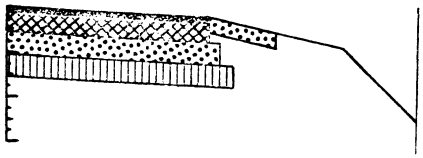
Remarks:

Select material on this project is processed mine tailings from Austinville. This material was also used to strengthen weak spots in subgrade. Project 0058-017-003,C501,P492 east of this project has not performed any better than this project; deflections are similar; appears not to have derived much from stabilization.
Isolated cracks, performance excellent.

202

Project No. 0058-017-003,C501,P402
From: 3.382 mi. W. WCL Hillsville
To : 0.411 mi. W. WCL Hillsville
Cost: $61,565/mi. Estimated Cost: $91,000/mi.

Completed: 10-19-62
County: Carroll
Length 2.951
Soil Area 1
Thickness Index 11.5



Surface: 1½" I-3
Base : 5½" H-3(1)
Subbase: 6" Cr. Aggr.
Subbase: 6" Soil Cement

Traffic: 65-155 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 265,000

Deflection Data

		BF
4-27-67	0.000794	68
4-11-68	0.000747	74
7-22-71	0.001069	73

Crack Factor

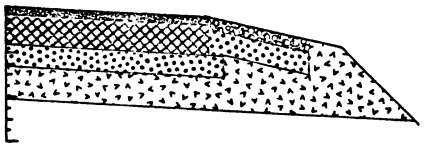
6-28-67	6
7-31-68	7
10-23-69	2
7-22-71	5

Remarks:

See remarks preceding Project. Excellent performance.

Project No. 0081-011-001
From: 0.843 mi. N. NCL Buchanan
To : 0.274 mi. S. of Int. Rte. 610
Cost: $82,579/mi. Estimated Cost: $163,511/mi.

Completed: 12-23-60
County: Botetourt
Length: 4.890 mi.
Soil Area 2
Thickness Index 15.25



Surface: ½" F-1
Binder : 1½" H-2
Base : 7½" H-3(1)
Subbase: 6" Cr. Aggr.
Subbase: 9" S.M. CBR 10

Traffic: 828-1690 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 2,302,000

Deflection Data

		BF
10-4-60	0.000468*	
5-10-62	0.000468*	
4-5-67	0.000520	49
4-18-68	0.000489	53
5-23-69	0.000512	51

Crack Factor

6-27-67	78
6-13-68	83
10-10-68	0** resurface
10-13-69	0
7-22-71	0

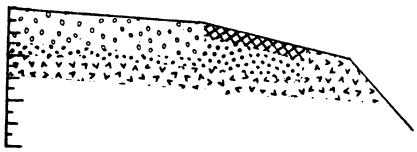
Remarks:

**Resurfaced 10-5-68 100#/sq. yd. S-5. Resurface in good shape, performance fair.

204

Project No. 0081-011-010,P401
007,P401
From: Roanoke-Botetourt CL
To : 0.280 mi. S. Int. Rte. 651
Cost: $116,899/mi. Estimated Cost: $163,126/mi.

Completed: 12-3-64
County: Botetourt
Length: 5.220 mi.
Soil Area 2



Surface: 9" reinforced concrete
Leveling Course: 2" No. 10 aggregate
Subbase: 6" S. M. CBR 30
61.5' Jts. spacing

Traffic: 900-1690 Tractor-trailers & Buses per day

Remarks:

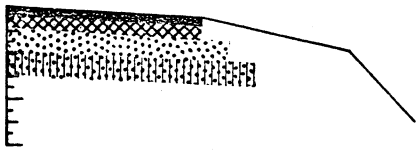
(Toll 1971) Joints fairly well sealed. About one-third have slight spalls. Very little faulting. About one-third of slabs have transverse morning cracking. Cracking found in first slab placed in the morning and continues for 10-30 slabs.

(1619

205

Project No. 0122-009-101,C502
From: 0.121 mi. S. Int. Rte. 24
To : 0.323 mi. S. Int. Rte. 747
Cost: $69,860/mi. Estimated Cost: $85,974/mi.

Completed: 8-30-68
County: Bedford
Length: 3.867 mi.
Soil Area 1
Thickness Index 9.1



Surface: 1" S-5
Binder : 1-1/4" I-2
Base : 3" B-3
Subbase: 6" Cr. Aggr.
Subbase: 6" Cement Tr. Cr. Aggr.

Traffic: 35-50 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 11,000

Deflection Data

		BF
6-5-69	0.000640	64
7-27-71	0.000687	67

Crack Factor

10-2-68	0
8-29-69	0
7-27-71	0

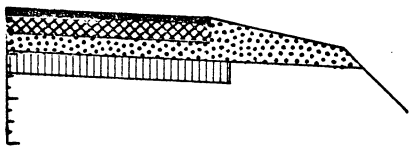
Remarks:

Excellent condition.

206

Project No. 0220-044-019,C501
From: 2.197 mi. N. North Carolina State Line
To : 4.508 mi. N. North Carolina State Line
Cost: $67,056 Estimated Cost: $84,728

Completed: 6-25-62
County: Henry
Length: 1.556 mi.
Soil Area 1
Thickness Index 10.8



Surface: 1½" I-3
Base : 5⅝" H-3(1)
Subbase: 4" Cr. Aggr.
Subbase: 6" soil cement

Traffic: 480-810 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 1,009,000

Deflection Data

		BF
3-30-66	0.000719*	
4-19-66	0.000576*	
5-4-66	0.000647*	
10-21-66	0.000647*	
10-21-66	0.000585	59
4-21-67	0.000551	58
5-22-68	0.000729	57

Crack Factor

6-29-67	22
10-2-68	51
8-28-69	53

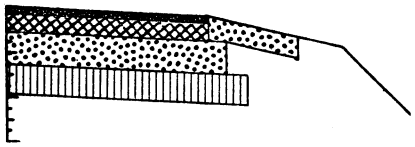
Remarks:

Some wheelpath cracking. Project has performed well. This is last report due to new construction which results in limit changes and resurfacing.

Project No. 0220-044-030
From: 1.342 mi. S. SCL Martinsville
To : 0.144 mi. S. SCL Martinsville
Cost: $76,032/mi. Estimated Cost: $95,518/mi.

Completed: 10-29-59
County: Henry
Length: 1.067 mi.
Soil Area 1
Thickness Index 13.0

1620



Surface: 1½" I-3
Base : 5½" H-3(1)
Subbase: 8" Cr. Aggr.
Subbase: 8" Soil Cement

Traffic: 455-1030 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 1,878,000

Deflection Data

		BF
4-28-60	0.002122*	
3-30-66	0.000719*	
4-19-66	0.000755*	
5-4-66	0.000899*	
10-21-66	0.000791*	
10-21-66	0.000852	68
4-21-67	0.000976	70
5-22-68	0.000976	64

Crack Factor

6-29-67	88
10-3-68	49
8-28-69	84

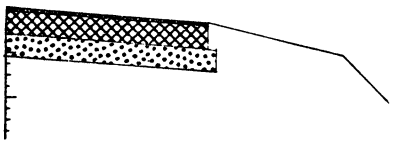
Remarks:

Project north of river in city had severe failures shortly after completion of project. This is shown in high deflections of 4-28-60. There were extensive repairs and 2 resurfacings. We do not have cost and rate of application as this part of project is in city of Martinsville. Recommend termination of project due to inability to secure data and dangerous traffic due to design of Rte. 58 interchange & curves north of river. Load related cracking fairly prevalent in unresurfaced portion, wheelpath alligator cracking. Performance is fair, poor in places.

208

Project No. 0460-009-017
From: 0.667 mi. W. W. End Big Otter River Bridge
To : 0.270 mi. E. of Little Otter River
Cost: $53,011/mi. Estimated Cost: $74,253/mi.

Completed: 7-20-55
County: Bedford
Length: 2.472 mi.
Soil Area 1
Thickness Index 9.1



Surface: 1" I-3
Base : 6" H-3(1)
Subbase: 6" Cr. Aggr.

Traffic: 130-332 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 679,000

Deflection Data

		BF
3-29-66	0.000971*	
4-19-66	0.001295*	
5-3-66	0.001079*	
10-25-66	0.000935*	
10-25-66	0.000782	59
4-24-67	0.001074	51
5-21-68	0.000972	54
6-4-69	0.000918	53
7-26-71	0.001102	55

Crack Factor

6-16-66	68
6-29-67	83
6-13-68	70
8-27-69	28**
7-26-71	0

Remarks:

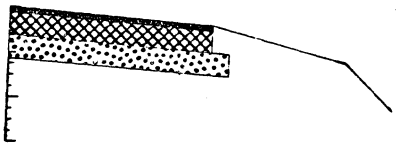
Partial resurface 1968. No M-15 available. **1968 CF reflects patches; 1969 CF reflects partial resurface. Resurface doing well (some places pushed). Resurface on rest of project 8-13-70. Performance good.

1821

209

Project No. 0460-009-019
From: 3.154 mi. E. of E. End Bridge over Big Otter River
To : E. End of Bridge over Big Otter River
Cost: $53,222/mi. Estimated Cost: $78,783/mi.

Completed: 10-12-56
County: Bedford
Length: 3.154 mi.
Soil Area 1
Thickness Index 9.10



Surface: 1" I-3
Base : 6" H-3(1)
Subbase: 6" Cr. Aggr.

Traffic: 130-332 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 625,000

Deflection Data

		BF
6-25-57	0.001403*	
3-28-66	0.001187*	
4-18-66	0.001043*	
5-3-66	0.001043*	
10-25-66	0.000863*	
10-25-66	0.000843	60
4-24-67	0.001057	55
5-21-68	0.001095	56
6-4-69	0.000996	59
7-26-71	0.001257	59

Crack Factor

6-16-66	38
6-29-67	54
6-13-68	65
8-27-69	71
7-26-71	69

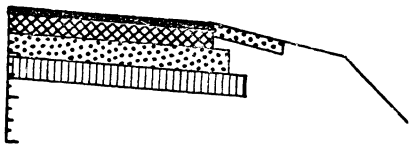
Remarks:

General cracking (some severe), some rutting, some distortion, isolated patches. Performance good.

210

Project No. 7220-033-032
From: 0.394 mi. N. Rte. 619 (S. of Rocky Mount)
To : 2.350 mi. N. NCL Rocky Mount
Cost: $63,307/mi. Estimated Cost: $96,096/mi.

Completed: 12-7-60
County: Franklin
Length: 5.057 mi.
Soil Area 1
Thickness Index 11.5



Surface: 1½" I-3
Base : 5½" H-3(1)
Subbase: 6" Cr. Aggr.
Subbase: 6" soil cement

Traffic: 375-737 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 976,000

Deflection Data

		BF
3-29-66	0.000719*	
4-19-66	0.000719*	
10-24-66	0.000719*	
10-24-66	0.000692	60
4-25-67	0.000702	58
5-22-68	0.000790	60

Crack Factor

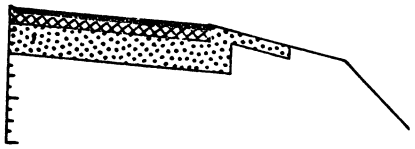
6-29-67	5
10-2-68	5

Remarks:

Project partially resurfaced with new construction 1969; project (other part) resurfaced with new construction 1970. Now 4 lane divided: Excellent performance 10 years in bad soil area under fairly heavy traffic. Very minor rutting. Both northern and southern ends have been resurfaced due to new construction. Dropped from test schedule after 1968 because of new construction interference.

Project No. 0015-014-101, C502
From: 5.139 mi. N. Buckingham-Prince Edward CL
To : 4.238 mi. S. Int. Rte. 60
Cost: $44,880/mi. Estimated Cost: $66,005/mi.

Completed: 7-7-62
County: Buckingham
Length: 5.306 mi.
Soil Area 1
Thickness Index 7.8



Surface: 1½" I-3
Base : 3½" H-3(3)
Subbase: 8" Cr. Aggr.

Traffic: 60-90 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 143,000

Deflection Data

		BF
4-7-66	0.000899*	
4-22-66	0.000863*	
5-9-66	0.001043*	
10-17-66	0.000719*	
11-3-66	0.000755	52
4-11-67	0.000867	49
4-2-68	0.001146	47
3-25-69	0.001114	48
4-15-69	0.000957	54
4-14-71	0.001362	49

Crack Factor

7-10-67	9
8-6-68	54
8-12-69	64
4-14-71	79

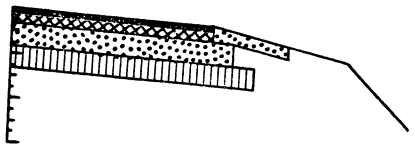
Remarks:

Rides good, substantial alligator cracking. Fair to poor performance.

302

Project No. 0015-019-101,C2
From: 4.546 mi. N. Mecklenburg CL
To : 0.468 mi. N. Int. Rte. 47 & 360 (Barnes Junction)
Cost: (Light Design) $59,242/mi. Estimated Cost: $77,664/mi.
(Heavy Design) $72,494/mi. Estimated Cost: $96,555/mi.

Completed: 5-16-61
County: Charlotte
Length: 3.368 mi.
Soil Area 1
Thickness Index
Light Design 9.0
Heavy Design 12.5



	Light	Heavy
Surface:	1½"	1½" I-3
Base :	3"	5½" H-3(1)
Subbase:	6"	6" Cr. Aggr.
Subbase:	6"	6" Soil Cement

Traffic: Light Design - 43-65 Heavy Design - 80-1180 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv.: Light - 120,000
Heavy - 1,359,000

Deflection Data

			BF	
4-5-61	0.000576*			
4-3-62	0.000576*			
	Light	Heavy	L	H
4-5-66	0.000576*	0.000719*		
4-21-66	0.000612*	0.000540*		
5-6-66	0.000719*	0.000612*		
10-17-66	0.000540*	0.000540*		
10-28-66	0.000760	0.000616	61	61
4-12-67	0.000927	0.000812	57	56
5-7-68	0.000864	0.000730	57	59
5-15-69	0.000954	0.000880	57	63

Crack Factor

8-30-67	66
8-8-68	67
9-17-69	95

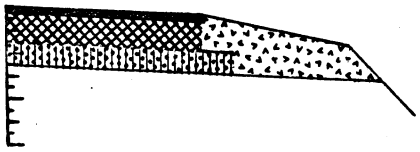
Remarks:

Additional 2½" H-3(1) appears to reduce deflections 9%; however, difference in traffic on two sections makes this questionable. Cracking general, fair performance.

303

Project No. 0029-015-101,C501
From: 0.471 mi. S. SCL Lynchburg
To : 2.114 mi. S. SCL Lynchburg
Cost: $111,197/mi. Estimated Cost: $119,328/mi.

Completed: 9-14-64
County: Campbell
Length: 1.643 mi.
Soil Area1
Thickness Index 11.4



Surface: 1½" I-3
Base : 7½" H-3(1)
Subbase: 6" Cement Tr. Cr. Aggr.

Traffic: 340-430 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 411,000

Deflection Data

		BF
4-20-65	0.000396*	
4-20-67	0.000449	72
5-9-68	0.000440	73
4-17-69	0.000518	74
7-21-71	0.000491	76

Crack Factor

8-28-67	0
8-6-68	0
8-27-69	0
7-21-71	0

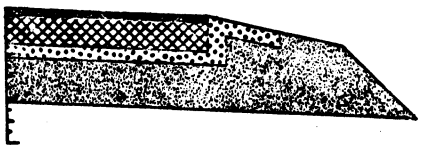
Remarks:

Excellent performance.

304A

Project No. 0058-041-012-033
From: 0.192 mi. W. of Int. Rte. 501
To : 4.570 mi. E. of Turbeville P.O.
Cost: $67,478/mi. Estimated Cost: $120,115/mi.

Completed: 1-15-59
County: Halifax
Length: 4.452 mi.
Soil Area 1
Thickness Index 10.4



Surface: 1½" I-3
Base : 7½" H-3(1)
Subbase: 4" Cr. Aggregate
Subbase: 12" S. B. CBR 12

Traffic: 875-1190 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 2,281,000

Deflection Data

		BF
2-26-59	0.001331*	
10-29-59	0.002050*	
4-21-60	0.002878*	
3-3-61	0.002921*	
3-29-62	0.002906*	
4-?-64	0.001882*	
4-9-65	0.001863*	
4-19-67	0.001382	50
5-8-68	0.001200	53
5-14-69	0.001242	53
5-18-71	0.001311	55

Crack Factor

8-29-67	38
8-7-68	85
10-16-69	100
5-26-71	94

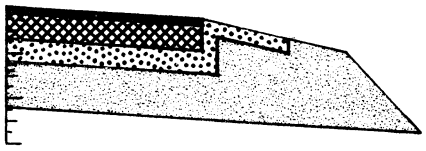
Remarks:

Summer 1963 12' seal tr. 8-30-63 160#/sq. yd. I-3 Poor performance. Project resurfaced during summer of 1971.

304B

Project No. 0058-041-012-033
From: 0.192 mi. W. of Int. Rte. 501
To : 4.570 mi. E. of Turbeville P.O.
Cost: $62,304/mi. Estimated Cost: $110,822/mi.

Completed: 1-15-59
County: Halifax
Length: 4.452 mi.
Soil Area 1
Thickness Index 9.1



Surface: 1½" I-3
Base : 5½" H-3(1)
Subbase: 6" Cr. Aggr.
Subbase: 12" S. B. CBR 12

Traffic: 875-1190 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 2,281,000

Deflection Data

		BF
2-26-59	0.001007*	
10-26-59	0.001223*	
4-21-60	0.001681*	
3-3-61	0.001547*	
3-29-62	0.001518*	
4-?-64	0.001511*	
4-9-65	0.001302*	
4-19-67	0.001166	46
5-8-68	0.000977	50
5-14-69	0.001007	50
5-18-71	0.001127	51

Crack Factor

8-29-67	13
8-7-68	65
10-16-69	74
5-26-71	82

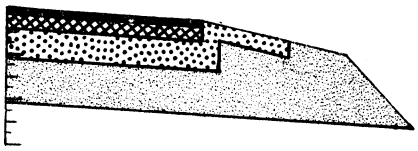
Remarks:

Summer 1963 12' seal over traffic lane. 8-30-63 160#/sq. yd. I-3 resurface. Poor performance. Project resurfaced during summer of 1971.

304C

Project No. 0058-041-012-033
From: 0.192 mi. W. of Int. Rte. 501
To : 4.570 mi. E. of Turbeville P.O.
Cost: $57,077/mi. Estimated Cost: $102,501

Completed 1-15-59
County: Halifax
Length: 4.452 mi.
Soil Area 1
Thickness Index 7.8



Surface: 1½" I-3
Base : 3½" H-3(1)
Subbase: 8" Cr. Aggr.
Subbase: 12" S. B. CBR 12

Traffic: 875-1190 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 2,281,000

Deflection Data

		BF
2-26-59	0.001799*	
10-26-59	0.001583*	
4-21-60	0.002033*	
3-3-61	0.001964*	
3-29-62	0.001878*	
4-?-64	0.001809*	
4-9-65	0.001518*	
4-19-67	0.001496	49
5-8-68	0.001259	53
5-14-69	0.001326	53
5-18-71	0.001458	55

Crack Factor

8-29-67	47
8-7-68	87
10-16-69	99
5-26-71	100

Remarks:

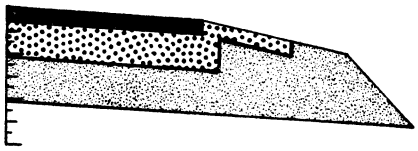
1960 150#/sq. yd. I-3 on portion design C, extensive work on subgrade and base. 1963 12' seal over traffic lane. 8-30-63 160#/sq. yd. I-3 resurface. Poor performance. Project resurfaced during summer of 1971.

1625

304D

Project No. 0058-041-012-033
From: 0.192 mi. W. of Int. Rte. 501
To : 4.570 mi. E. of Turbeville P.O.
Cost: $55,018/mi. Estimated Cost: $103,039

Completed: 1-15-59
County: Halifax
Length: 4.452 mi.
Soil Area 1
Thickness Index 7.2



Surface: 1½" I-3
Binder : 2½" H-2
Base : 9" Cr. Aggr.
Subbase: 12" S. B. CBR 12

Traffic: 875-1190 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 2,281,000

Deflection Data

		BF
8-26-59	0.001331*	
10-26-59	0.001223*	
4-21-60	0.001831*	
3-3-61	0.001856*	
3-29-62	0.001871*	
4-?-64	0.001554*	
4-9-65	0.001406*	
4-19-67	0.001322	45
5-8-68	0.001163	50
5-14-69	0.001209	49
5-18-71	0.001332	50

Crack Factor

8-29-67	28
8-7-68	86
10-16-69	90
5-26-71	95

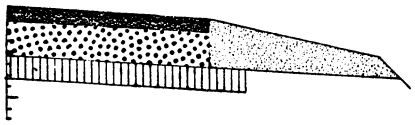
Remarks:

1963 12' seal over traffic lane. 8-30-63 160#/sq. yd. I-3 resurfacing. Poor performance. Project resurfaced during summer of 1971.

305

Project No. 0058-071-020
From: 4.353 mi. E. Henry CL
To : 4.524 mi. W. WCL Danville
Cost: $51,005/mi. Estimated Cost: $86,708

Completed: 11-11-61
County: Pittsylvania
Length: 5.457 mi.
Soil Area 1
Thickness Index 9.6



Surface: 1½" I-3
Binder : 2½" H-2
Base : 9" Cr. Aggr.
Subbase: 6" Soil Cement

Traffic: 210-320 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 450,000

Deflection Data

		BF
4-4-62	0.000827*	
4-27-64	0.001043*	
3-31-66	0.000817*	
4-20-66	0.000791*	
5-4-66	0.000899*	
10-20-66	0.000683*	
10-20-66	0.000896	55
4-24-67	0.001055	54
5-29-68	0.001216	52
3-31-71	0.001171	54

Crack Factor

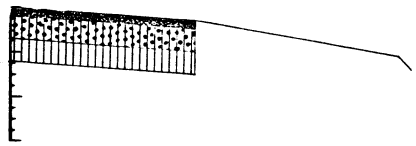
8-28-67	41
10-3-68	75
8-28-69	95
5-26-71	95
3-31-71	60**

Remarks:

Extensive long cracking WP mostly in traffic lane. Performance - fair. Western portion of WBL resurfaced August 1970, ending at Rte. 841 in north side. **Partial resurface.

Project No. 0060-024-746,HS-1,IS-1
From: Powhatan County Line
To : 0.063 mi. W. Int. Rte. 622 (Cumberland C.H.)
Cost: $33,898/mi. Estimated Cost: $59,252/mi.

Completed: 5-20-48
County: Cumberland
Length: 7.686 mi.
Soil Area 1
Thickness Index 10.9



Surface: 1" F-1
Binder : 1½" H-2
Base : 6" cement treated select material
Subbase: 6" soil cement

Traffic: 156-230 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 852,000

Deflection Data

		BF
5-10-55	0.000468*	
4-9-62	0.000647*	
4-10-67	0.000921	68
5-3-68	0.001051	72
3-31-69	0.000976	72
7-29-71	0.000984	74

Crack Factor

7-10-67	88
8-12-68	83
7-29-71	100

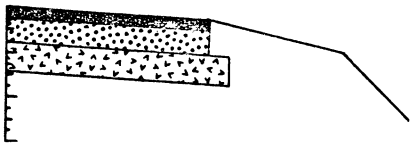
Remarks:

9-15-59 150#/sq. yd. I-3 resurface 7.00/ton. 10-21-67 120#/sq. yd. S-5 resurface 7.70/ton. 8-19-70 abundance of transverse cracking, substantial longitudinal cracking (not clearly load related). Sealing cracks has hurt appearance and riding quality. Pavement has performed well. Sealing which was done in summer of 1969 is now ineffective because cracks have come through seal.

307

Project No. 0151-062-101,C501
From: 0.102 mi. S. Rte. 610
To : Int. Rte. 151 at Avon
Cost: $45,619/mi. Estimated Cost: $58,809/mi.

Completed: 6-27-62
County: Nelson
Length: 1.598 mi.
Soil Area 2
Thickness Index 6.7



Surface: 1" I-3
Binder : 2" H-2
Base : 6" Cr. Aggr.
Subbase: 8" S. M. CBR 30

Traffic: 110-145 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 239,000

Deflection Data

		BF
4-14-67	0.001024	48
3-22-68	0.000878	56
3-27-69	0.001009	52
5-21-71	0.001147	53

Crack Factor

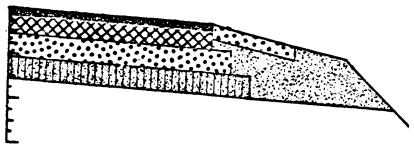
10-18-62	0
6-20-63	0
4-5-65	12
7-6-67	83
8-14-68	94
9-16-69	100
5-21-71	100

Remarks:

Some patching, 100% cracked. Poor performance.

Project No. 0304-041-002,C501
From: ECL South Boston
To : 0.170 mi. E. Int. Rte. 344 (Foster's Store)
Cost: $57,710/mi. Estimated Cost: $112,992/mi.

Completed: 10-6-62
County: Halifax
Length: 6.130 mi.
Soil Area 1
Thickness Index 12.7



Surface: 1½" I-3
Base : 5½" H-3(1)
Subbase: 6" Cr. Aggr.
Subbase: 6" Cement treated select material

Traffic: 970-1152 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 1,687,000

Deflection Data

		BF
4-30-63	0.000612*	
4-4-66	0.000576*	
4-21-66	0.000504*	
5-6-66	0.000612*	
10-18-66	0.000465*	
10-18-66	0.000592	65
4-19-67	0.000778	58
5-7-68	0.000904	61
5-14-69	0.000817	61
5-18-71	0.001033	61

Crack Factor

11-2-62	0
7-23-63	0
10-1-65	2
8-29-67	19
8-7-68	62
10-16-69	76
5-18-71	71

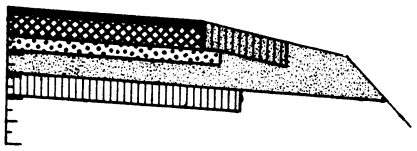
Remarks:

Passing lane cracked in some areas (inside curve). Settlement patch. Cracking; occasional transverse cracking. Fair performance.

309A

Project No. 0360-073-008
-019-002
From: 1.768 mi. W. Charlotte-Prince Edward CL
To : 0.014 mi. W. of W. End future Virginian R.R. overpass
Cost: $65,842/mi. Estimated Cost: $97,363/mi.

Completed: 11-14-62
County: Charlotte & Prince Edward
Length: 5.821 mi.
Soil Area 1
Thickness Index 10.8



Surface: 1½" I-3
Base : 5½" H-3(1)
Subbase: 4" Cr. Aggr.
Subbase: 6" S. M. CBR 20
Subbase: 6" Soil Cement

Traffic: 1015-1265 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 1,668,000

Deflection Data

		BF
4-10-62	0.001260*	
4-16-62	0.001607*	
12-5-62	0.000845*	
3-19-63	0.001229*	
4-17-64	0.001379*	
4-6-66	0.001230*	
4-21-66	0.001230*	
11-3-66	0.000893	51
12-13-66	0.000935*	
4-12-67	0.001172	51
5-7-68	0.001277	50
4-21-69	0.001505	49
4-21-71	0.001566	

Crack Factor

7-12-67	35
8-8-68	60
8-13-69	49
5-26-71	89

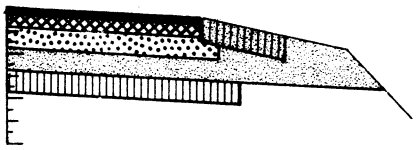
Remarks:

Isolated patching; minor alligator cracking; longitudinal crkg.; transverse cracks, minor rutting; best performance of four designs. Project resurfaced during summer of 1971.

309B

Project No. 0360-073-008
-019-002
From: 1.768 mi. W. Charlotte-Prince Edward CL
To : 0.014 mi. W. of W. end future Virginian RR overpass
Cost: $69,221/mi. Estimated Cost:

Completed: 11-14-62
County: Charlotte & Prince Edward
Length: 5.821 mi.
Soil Area 1
Thickness Index 12.9



Surface: 1½" I-3
Base : 3" H-3(1)
Subbase: 6" Cement tr. cr. aggr.
Subbase: 6" S. M. CBR 20
Subbase: 6" Soil Cement

Traffic: 1015-1265 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 1,668,000

Deflection Data

		BF
4-10-62	0.000659*	
4-16-62	0.000581*	
12-5-62	0.000581*	
3-19-63	0.000695*	
4-17-64	0.000672*	
4-5-65	0.000689*	
4-6-66	0.000773*	
4-21-66	0.000659*	
11-3-66	0.000613	54
12-13-66	0.000576*	
4-12-67	0.000852	57
5-7-68	0.000870	58
4-21-69	0.001003	59
4-21-71	0.000922	66

Crack Factor

7-12-67	28
8-8-68	34
8-13-69	56
5-26-71	77

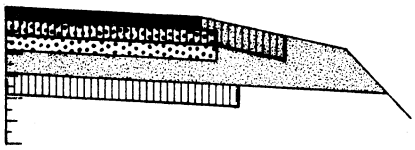
Remarks:

Transverse cracks, alligator & long. cracks; riding surface good; 2nd best performance--would be best except for deterioration in riding qualities due to transverse cracks. Project resurfaced during summer of 1971.

309C

Project No. 0360-073-008
-019-002
From: 1.768 mi. W. Charlotte-Prince Edward CL
To : 0.014 mi. W. of W. end future Virginian RR overpass
Cost: $64,838/mi. Estimated Cost: $83,234/mi.

Completed: 11-14-62
County: Charlotte & Prince Edward
Length: 5.821 mi.
Soil Area 1
Thickness Index 10.8



Surface: 1½" I-3
Binder : 1½" H-2
Base : 4" cement tr. cr. aggr.
Subbase: 4" Cr. Aggr.
Subbase: 6" S. M. CBR 20
Subbase: 6" soil cement

Traffic: 1015-1265 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 1,668,000

Deflection Data

		BF
4-10-62	0.001049*	
4-16-62	0.000581*	
12-5-62	0.000773*	
3-19-63	0.001103*	
4-17-64	0.001121*	
4-5-65	0.001133*	
4-6-66	0.001252*	
4-21-66	0.001115*	
11-3-66	0.001012	50
12-13-66	0.001043*	
4-12-67	0.001176	48
5-7-68	0.001179	49
4-21-69	0.001511	49
4-21-71	0.001385	54

Crack Factor

7-12-67	92
8-8-68	99
8-13-69	100
5-26-71	100

Remarks:

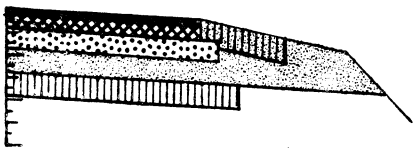
Some patches; transverse cracks; severe alligator cracks; poor riding surface; <u>poor</u> performance.
Project resurfaced during summer of 1971.

1629

309D

Project No. 0360-073-008
-019-002
From: 1.768 mi. W. Charlotte-Prince Edward CL
To : 0.014 mi. W. of W. end future Virginian RR overpass
Cost: $61,248/mi. Estimated Cost: $84,750/mi.

Completed: 11-14-62
County: Charlotte & Prince Edward
Length: 5.821 mi.
Soil Area 1
Thickness Index 9.0



Surface: 1½" I-3
Base : 3" H-3(1)
Subbase: 6" Cr. Aggr.
Subbase: 6½" S. M. CBR 20
Subbase: 6" Soil Cement

Traffic: 1015-1265 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 1,668,000

Deflection data

		BF
4-10-62	0.002151*	
4-16-62	0.001727*	
12-5-62	0.001103*	
3-19-63	0.001565*	
4-19-64	0.001463*	
4-5-65	0.001583*	
4-6-66	0.001428*	
4-21-66	0.001263*	
11-3-66	0.001043	48
12-13-66	0.001151*	
4-12-67	0.001346	43
5-7-68	0.001428	43
4-21-69	0.001676	41
4-21-71	0.001611	44

Crack Factor

7-12-67	92
8-8-68	95
8-13-69	84
5-26-71	100

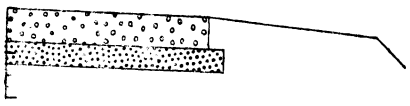
Remarks:

Severe cracking throughout; patched; minor rutting; terminal condition. Poor performance. Project resurfaced during summer of 1971.

310

Project No. 0360-285-A2R-1,A1R-1
From: 0.082 mi. E. Nottoway-Prince Edward CL
To : 1.106 mi. E. of Green Bay
Cost: $50,477/mi. Estimated Cost: $126,049/mi.

Completed: 12-4-47
County: Prince Edward
Length: 4.630 mi.
Soil Area 1



Surface: 9" Reinf. concrete
Subbase: 6" subgrade treatment
Slab length = 30'
Expansion Jts. at 90' spacing

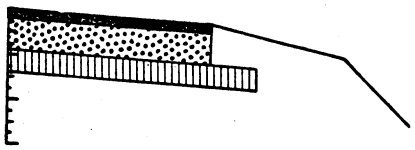
Traffic: 549-1270 Tractor-trailers & Buses per day

Remarks: (Fall 1971) Faulting: some slab scaling, some are covered with plant mix. Joints poorly sealed but in fair condition, about one-third have slight spalls, a few are faulted. Five blowups on project.

311

Project No. 0501-041-102,C501
From: 0.728 mi. N. Volens
To : 3.056 mi. N. Volens
Cost: $49,579/mi. Estimated Cost: $62,959/mi.

Completed: 11-16-62
County: Halifax
Length: 2.327 mi.
Soil Area 1
Thickness index 7.7



Surface: 1" I-3
Binder : 1½" H-2
Base : 8" Cr. Aggr.
Subbase: 6" soil cement

Traffic: 45-95 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 120,000

Deflection Data

		BF
4-30-63	0.000755*	
4-1-66	0.000935*	
4-20-66	0.000863*	
5-5-66	0.000971*	
10-20-66	0.000863*	
10-20-66	0.000958	54
4-19-67	0.001006	53
5-9-68	0.000985	56
5-15-69	0.001138	56
6-3-71	0.001228	57

Crack Factor

8-29-67	17
8-7-68	20
8-26-69	30
6-3-71	71

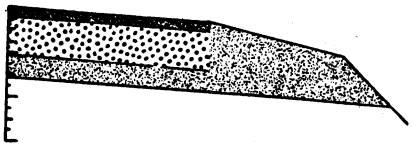
Remarks:

Isolated patches; distortion; rutting occurs in areas of alligator cracking; performance disappointing when compared with other projects 102,C502.

312

Project No. 0501-041-102,C502-104,C501
From: 3.056 mi. N. Volens
To : S. End Staunton River Bridge
Cost: $46,992/mi. Estimated Cost: $68,365/mi.

Completed: 8-22-62
County: Halifax
Length: 5.008 mi.
Soil Area 1
Thickness Index 10.0



Surface: 1" I-3
Binder : 1½" H-2
Base : 10" Cr. Aggr.
Subbase: 6" S. M. CBR 12

Traffic: 35-95 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 130,000

Deflection Data

		BF
4-1-63	0.001079*	
4-1-66	0.001295*	
4-20-66	0.001331*	
5-5-66	0.001403*	
10-20-66	0.000892	57
4-20-67	0.000995	55
5-8-68	0.001209	54
5-15-69	0.001211	56
6-3-71	0.001550	53

Crack Factor

8-29-67	8
8-7-68	12
8-26-69	25
6-3-71	49

Remarks:

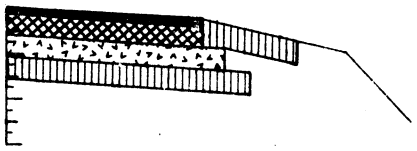
Isolated patches; settlement; distortion in high deflection areas; north & south ends in terminal condition otherwise in good shape. Performance - fair.

O 1631

313A

Project No. 7360-019-102,C501
From: 2.014 mi. S. Int. Rte. 40
To : 1.263 mi. W. Prince Edward CL
Cost: $70,752/mi. Estimated Cost: $110,811/mi.

Completed: 12-31-65
County: Charlotte
Length: 4.486 mi.
Soil Area 1
Thickness Index 11.5



Surface: 1½" I-3
Base : 5½" H-3(1)
Subbase: 6" S. M. Gr. 1
Subbase: 6" Soil cement

Traffic: 835-1220 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 1,021,000

Deflection Data

		BF
4-5-66	0.000899*	
4-11-67	0.001028	54
5-7-68	0.000974	62
4-21-69	0.001200	57
4-20-71	0.001220	59

Crack Factor

7-12-67	2
9-17-69	15
5-26-71	52

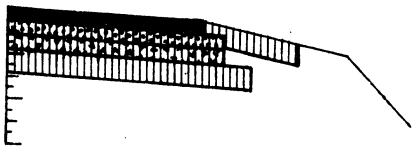
Remarks:

Very minor cracking, performance fair.

313B

Project No. 7360-019-102,C501
From: 2.014 mi. S. of Int. Rte. 40
To : 1.263 mi. W. Prince Edward CL
Cost: $73,075/mi. Estimated Cost: $99,412/mi.

Completed: 12-31-65
County: Charlotte
Length: 4.486 mi.
Soil Area 1
Thickness Index 13.4



Surface: 1" I-3
Binder : 2" H-2
Base : 4" cement treated cr. aggr.
Subbase: 4" Cement treated subbase matl.
Subbase: 6" Soil cement

Traffic: 835-1220 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 1,021,000

Deflection Data

		BF
4-5-66	0.000360*	
4-11-67	0.000430	70
5-6-68	0.000419	77
4-21-69	0.000465	74
4-20-71	0.000485	78
Passing Lane No Cement in 4" Cr. Aggr.		
4-6-66	0.000899*	
4-11-67	0.000879	50
5-6-68	0.000770	49
4-21-69	0.001056	47

Crack Factor

7-12-67	2
9-17-69	37
5-26-71	43

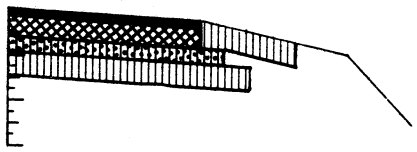
Remarks:

Transverse cracking (traffic lane only) some are pumping. Cement in both lanes on exp. sections E. of Rte. 40. Transverse cracking across both lanes. One mile east of Rte. 40 on EBL--appears to be slab action including obvious pumping. Performance - poor.

313C

Project No. 7360-019-102,C501
From: 2.014 mi. S. of Int. Rte. 40
To : 1.263 mi. W. Prince Edward CL
Cost: $72,230/mi. Estimated Cost: $105,933/mi.

Completed: 12-31-65
County: Charlotte
Length: 4.486 mi.
Soil Area 1
Thickness Index 13.4



Surface: 1½" I-3
Base : 5½" H-3(1)
Subbase: 4" Ct. Aggr.
Subbase: 6" soil cement

Traffic: 835-1220 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 1,021,000

Deflection Data

		BF
4-5-66	0.000432*	
4-11-67	0.000486	70
5-6-68	0.000436	79
4-21-69	0.000608	77
4-20-71	0.000545	79
Passing Lane less Cement in 4" Cr. Aggr.		
4-6-66	0.000576*	
4-11-67	0.000687	63
5-6-68	0.000677	66
4-21-69	0.001050	65

Crack Factor

7-12-67	0
9-17-69	16
5-26-71	22

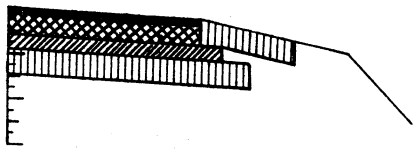
Remarks:

Compare with Design B. Transverse cracking--occurred after cracks in B section. Non-visible in passing lane even in section E of Rte. 40, which has cement. Performance - fair.

313D

Project No. 7360-019-102,C501
From: 2.014 mi. S. Int. Rte. 40
To : 1.263 mi. W. Prince Edward CL
Cost: $77,141/mi. Estimated Cost: $119,856/mi.

Completed: 12-31-65
County: Charlotte
Length: 4.486 mi.
Soil Area 1
Thickness Index 13.4



Surface: 1½" I-3
Base : 5½" H-3(1)
Subbase: 4" B-4 (lean mix)
Subbase: 6" soil cement

Traffic: 835-1220 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 1,021,000

Deflection Data

		BF
4-5-66	0.000504*	
4-11-67	0.000568	69
5-6-68	0.000572	76
4-21-69	0.000635	75
4-20-71	0.000687	75

Crack Factor

7-12-67	0
9-17-69	11
5-26-71	21

Remarks:

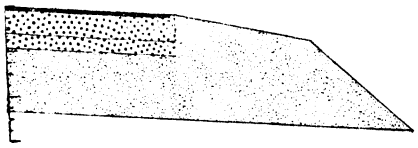
Excellent performance.

401

C 1633

Project No. 0005-018-016
From: 0.041 mi. E. Int. Rte. 155 (Charles City C.H.)
To : 2.272mi. E. Charles City C.H.
Cost: $28,723/mi. Estimated Cost: $55,836/mi.

Completed: 10-30-58
County: Charles City
Length: 2.226 mi.
Soil Area 4
Thickness Index 4.4



Surface: ½" surface tr.
Base : 6" soil aggr.
Subbase: 4" subgrade tr.
Subbase: 18" select borrow

Traffic: 18-75 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 81,000

Deflection Data

		BF
4-5-67	0.000842	44
3-20-68	0.001037	35
4-29-69	0.000860	59
8-25-71	0.000933	50

Crack Factor

10-26-67	5
9-10-68	15
9-4-69	13
8-25-71	20

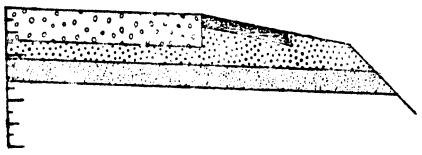
Remarks:

150#/sq. yd. F-1 added 5-2[illegible]-61. Project in good shape; good riding quality. Excellent performance.

402

Project No. 0064-043-001,C501
From: 0.356 mi. W. Rte. 250 (N. Short Pump)
To : 0.316 mi. W. Parham Road
Cost: $140,818/mi. Estimated Cost: $109,030

Completed: 6-21-67
County: Henrico
Length: 2.756 mi.
Soil Area 3



Surface: 8" Cont. Reinf. Concrete
Subbase: 6" Subbase matl. (modified)
0.6 percent steel

Traffic: 210-370 Tractor-trailers & Buses per day

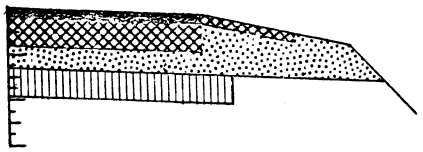
Remarks:

(Fall 1971) Occasional pattern cracking appears related to poor batches of concrete. Transverse pattern of approximately 3 ft. spacing is as expected. Several settlements have been bridged by pavement. One or two have been jacked back to grade with no apparent damage to pavement.

403

Project No. 0095-042-003,P401
From: 0.368 mi. N. Int. Rte. 54
To : 4.582 mi. N. Int. Rte. 54
Cost: $75,240/mi. Estimated Cost: $143,051

Completed: 9-11-63
County: Hanover
Length: 4.120 mi.
Soil Areas 3 & 4
Thickness Index 14.9



Surface: 1" I-3
Binder : 1½" H-2
Base : 7½" H-3(1)
Subbase: 6" subbase matl. Gr. 1
Subbase: 7" soil cement

Traffic: 4,090-6,170 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 7,371,000

Deflection Data

		BF
4-4-67	0.000475	56
3-25-68	0.000474	58
4-9-69	0.000540	56

Crack Factor

11-29-67	3
8-15-68	0

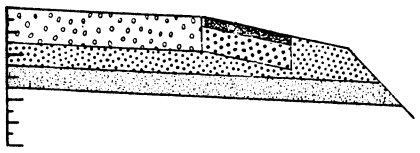
Remarks:

As of June 1970, approximately 12.6 million Tractor-trailers & Buses have used road. Excellent performance. Trace of crkg.; occasional aggr. plucking.

404

Project No. 0095-042-101,P401
From: Henrico-Hanover CL
To : 0.368 mi. N. Int. Rte. 54
Cost: $101,587/mi. Estimated Cost: $177,366/mi.

Completed: 7-15-63
County: Hanover
Length: 5.881 mi.
Soil Area 3 & 4



Surface: 9" Reinf. Concr.
Subbase: 6" Subbase matl. Gr. I
Subbase: 6" S. M. CBR 30
slab length = 50'

Traffic: 1535-6410 Tractor-trailers & Buses per day

Remarks:

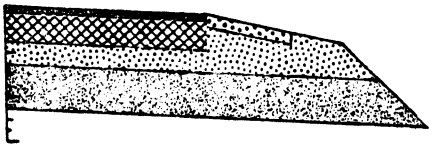
(Fall 1971) Joints well sealed. Fifty percent have light spalling. Extensive pumping (edge & joint), some faulting of longitudinal joints, surface badly "flecked". Some longitudinal cracking. General performance has been good under circumstances.

1635

405

Project No. 0360-020-031,C1
From: 4.984 mi. W. Int. Rte. 621
To : 1.937 mi. W. Int. Rte. 621
Cost: $61,987 - $70,171/mi. Estimated Cost: $114,407 - 140,405/mi.

Completed: 9-4-59
County: Chesterfield
Length: 3.047 mi.
Soil Area 3
Thickness Index 11.1



Surface: 1½" F-1
Base : 7½" H-3(1)
Subbase: 6" subgrade tr.
Subbase: 12"-24" S. M. CBR 20

Traffic: 1153-1745 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 2,841,000

Deflection Data

		BF
5-3-65	0.001187*	
4-7-66	0.000741*	
4-26-66	0.000612*	
5-11-66	0.000576*	
10-12-66	0.000504*	
10-27-66	0.000449	66
9-12-67	0.000791	60
3-19-68	0.000876	63
4-22-69	0.000773	60
8-24-71	0.000947	59

Crack Factor

9-12-67	34
8-13-68	1
9-18-69	11
8-24-71	34

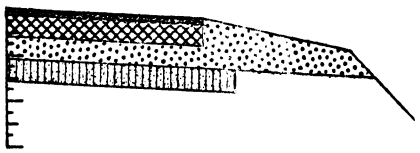
Remarks:

Project resurfaced 10-20-67 150#/sq. yd. S-5 (CF 34). Appears wavy; some alligator cracking; isolated fat spots; fair performance.

406

Project No. 0360-020-031,C502
From: 1.206 mi. E. Amelia CL
To : 4.984 mi. W. Int. Rte. 621
Cost: $78,883/mi. Estimated Cost: $119,059/mi.

Completed: 8-5-63
County: Chesterfield
Length: 5.256 mi.
Soil Area 3
Thickness Index 11.5



Surface: 1½" F-1
Base : 5½" H-3(1)
Subbase: 6" subgrade matl. gr. 1
Subbase: 6" cement tr. select matl.

Traffic: 1225-1745 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 2,122,000

Deflection Data

		BF
4-30-65	0.000612*	
3-19-68	0.000826	59
4-22-69	0.000776	63
8-24-71	0.000955	61

Crack Factor

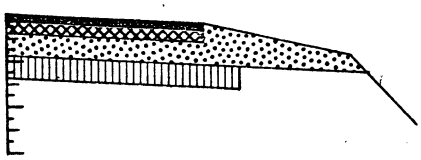
9-12-67	26
8-13-68	28
9-18-69	55
8-24-71	55

Remarks:

0.4 mi. of project at east end resurfaced 150#/sq. yd. S-5 10-10-67. Some alligator & longitudinal cracking; fair riding quality; appears wavy; performance fair.

Project No. 0460-067-008,C501
From: Dinwiddie-Nottoway CL
To : 3.302 mi. W. Dinwiddie-Nottoway CL
Cost: $86,909/mi. Estimated Cost: $85,716/mi.

Completed: 8-24-63
County: Nottoway
Length: 3.302 mi.
Soil Area 3
Thickness Index 9.0



Surface: 1½" I-3
Base : 3" H-3(1)
Subbase: 6" subbase matl. gr. 1
Subbase: 6" Lime stabilization

Traffic: 110-215 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 278,000

Deflection Data

		BF
5-4-64	0.001115*	
4-7-67	0.001095	53
3-19-68	0.001224	50
4-23-69	0.001244	54
7-30-71	0.001075	59

Crack Factor

7-21-65	0
8-30-67	12
10-11-68	41
8-29-69	87
7-30-71	0

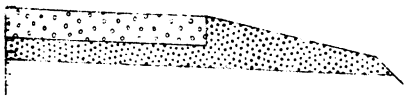
Remarks:

Resurfaced 1970; poor performance.

501

Project No. 0013-065-001
From: Int. Rte. 645
To : 0.421 mi. N. Int. Rte. 624
Cost: $60,984 - $67,795/mi. Estimated Cost: $124,043 - $143,896/mi.

Completed: 8-28-50
County: Northampton
Length: 2.780 mi.
Soil Area 4



Surface: 8" Reinf. Concrete
Subbase: 6" subgrade tr.
30' jt. spacing

Traffic: 279-485 Tractor-trailers & Buses per day

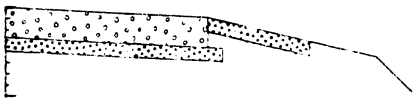
Remarks:

(Fall 1971) Reflection cracking experiment on this project. 140#/sq. yd. H-2 and 100#/sq. yd. I-3 applied 9-10-63. 2335' of northern end resurfaced 1968. 8-5-70 - reflection crack experiment: Sanding has prevented about 1/3 of reflection cracks. Visible cracks are very fine--probably should not be sealed at this time.

502

Project No. 0013-065-006
From: Int. Rte. 703
To : 0.0413 mi. N. Int. Rte. 624
Cost: $80,203/mi. Estimated Cost: $127,913/mi.

Completed: 11-21-57
County: Northampton
Length: 2.878 mi.
Soil Area 4



Surface: 8" Reinf. concrete
Subbase: 6" subgrade tr.
50' jt. spacing

Traffic: 305-485 Tractor-trailers & Buses per day

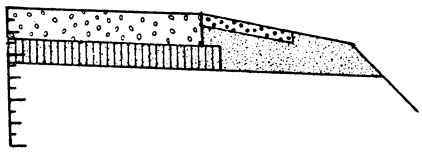
Remarks:

(Fall 1971) Occasional blowup, light joint spalls, occasional longitudinal cracking, minor faulting, some wear in traffic lane, fairly well sealed joints; project has performed near average.

503

Project No. 0013-065-101,C501
From: 0.284 mi. S. Int. Rte. 184
To : 0.170 mi. N. NCL Cheriton
Cost: $84,533/mi. Estimated Cost: $132,908/mi.

Completed: 12-8-65
County: Northampton
Length: 2.627 mi.
Soil Area 4



Surface: 8" plain Cem. Concr.
Subbase: 6" Select borrow
20' jt. spacing

Traffic: 360-455 Tractor-trailers & Buses per day

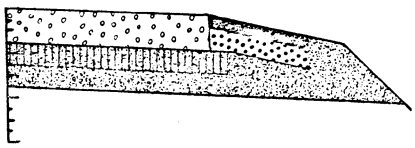
Remarks:

(Fall 1971) Project is actually 7.901 mi. long, but only southernmost 2.627 mi. in study. 8-5-70 - minor faulting, isolated joint spalls, rusted unitube, poorly sealed joints, evidence of occasional "frozen" dowels. Project rides good. Some wear in traffic lanes.

504

Project No. 0095-040-012-033
From: North Carolina State Line
To : 3.791 mi. S. Rte. 58
Cost: $83,846/mi. Estimated Cost: $169,847/mi.

Completed: 10-26-62
County: Greensville
Length: 7.206 mi.
Soil Area 4



Surface: 9" plain cem. concr.
Subbase: 6" cement treated select M.
Subbase: 6" select m.
20' jts.

Traffic: 1210-1820 Tractor-trailers & Buses per day

Remarks:

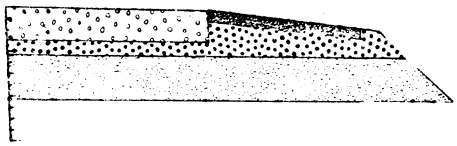
(Fall 1971) First slip form paver in state. Note major maintenance to joints in 1969. Joints were constructed with metal inserts which corroded and caused extensive joint spalling. Seventy-five percent of joints have been patched. Resealing was with cold poured polysulfide, which has split in places but remains in joints. Performance good except for joint problems.

(1639

505

Project No. 0095-040-015
From: 0.224 mi. S. Int. Rte. 58
To : 2.329 mi. N. Int. Rte. 58
Cost: $106,075/mi. Estimated Cost: $177,646/mi.

Completed: 10-9-58
County: Greensville
Length: 2.493 mi.
Soil Area 4



Surface: 9" Reinf. Concr.
4" Cr. Aggr.
12" Select Matl.
50' jts.

Traffic: 778-1890 Tractor-trailers & Buses per day

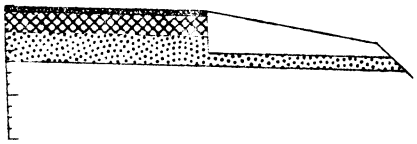
Remarks:

(Fall 1971) Project has wear in wheel paths; some scaling, joints in good shape, fairly well sealed. Performance good.

506

Project No. 0301-040-005
From: NCL Emporia
To : 1.019 mi. S. Sussex CL
Cost: $31,680/mi. Estimated Cost: $87,194/mi.

Completed: 6-23-55
County: Greensville
Length: 3.950 mi.
Soil Area 4
Thickness Index 9.8



Surface: 1½" F-1
5½" sand asphalt
8" subgrade tr.

Traffic: 586-1865 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 3,591,000

Deflection Data

		BF
4-29-55	0.001151*	
6-13-57	0.000978*	
4-7-67	0.000782	57
3-18-68	0.000896	57
4-3-69	0.000958	58

Crack Factor

12-19-67	61
10-17-68	59
9-7-71	52

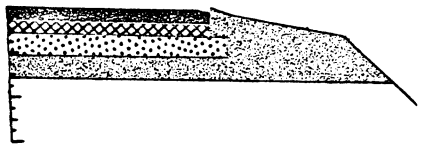
Remarks:

Partial resurface (NBL) June 1963. Partial resurface (SBL) June 1965. Partial resurface (NBL) 1968. Project limits have changed because of I-95 construction due to type of maintenance (partial resurfacings), recommend dropping project from study. Resurface slurry seal 1969 or 70, riding quality poor; transverse cracking easily seen through slurry seal; performance - fair.

601

Project No. 0003-048-010
From: 1.210 mi. E. Int. Rte. 676
To : 0.016 mi. W. Int. Rte. 301
Cost: $43,402 - $52,958/mi. Estimated Cost: $92,279 - $102,680/mi.

Completed: 10-29-60
County: King George
Length: 1.326 mi.
Soil Area 4
Thickness Index 9.1



Surface: 1½" F-1
Binder : 1½" F-3
Base : 4" F-2
Subbase: 6" Subbase Matl. Gr. 2
Subbase: 0-18" Select Matl.

Traffic: 25-67 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 107,000

Deflection Data

		BF
5-11-64	0.000827*	
4-3-67	0.000708	52
3-26-68	0.000851	57
4-30-69	0.000689	57
9-1-71	0.000830	56

Crack Factor

7-12-65	0
12-4-67	2
4-6-68	11
4-30-69	11
9-1-71	11

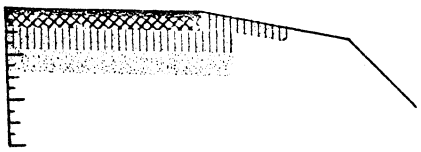
Remarks:

Excellent performance.

602A

Project No. 0003-059-103,C501
0033
From: 0.307 mi. E. Int. Rtes. 3 & 33 (Harmony Village P.O.)
To : 2.044 mi. E. Int. Rtes. 3 & 33 (Hartfield P.O.)
Cost: $60,757/mi. Estimated Cost: $77,970/mi.

Completed: 3-4-70
County: Middlesex
Length: 4.818 mi.
Soil Area 4
Thickness Index 11.7



Surface: 1½" S-4
Base : 3" B-1
Subbase: 6" cement tr. select matl.
Subbase: 6" select matl.

Traffic: 35 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 16,000

Deflection Data

		BF	
5-6-69	0.001556	37	Select Matl. 12" in place
5-21-69	0.001087	50	with cement added
6-6-69	0.000879	54	with cement added
8-21-70	0.000555	61	complete
8-31-71	0.000700	61	complete

Crack Factor

5-26-70	0
8-31-71	0

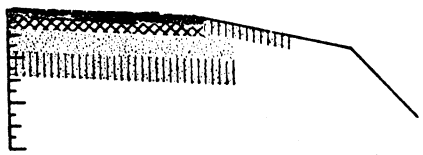
Remarks:

Excellent condition.

602B

Project No. 0003-059-103,C501
0033-
From: 0.307 mi. E. Int. Rtes. 3 & 33 (Harmony Village P.O.)
To : 2.044 mi. E. Int. Rtes. 3 & 33 (Hartfield P.O.)
Cost: $60,757/mi. Estimated Cost: $77,970/mi.

Completed: 3-4-70
County: Middlesex
Length: 4.818 mi.
Soil Area 4
Thickness Index 8.10



Surface: 1½" S-4
Base : 3" B-1
Subbase: 6" Select Matl.
Subbase: 6" cement tr. select matl.

Traffic: 35 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 16,000

Deflection Data

		BF
5-6-69	0.001385	39 6" S.M.
5-21-69	0.001195	44 6" S.M. cement added
6-6-69	0.000783	56 6" S.M. over C. Tr. S.M.
8-21-70	0.000624	53 Compl. proj.
8-31-71	0.000665	54 Compl. proj.

Crack Factor

5-26-70	0
8-31-70	0

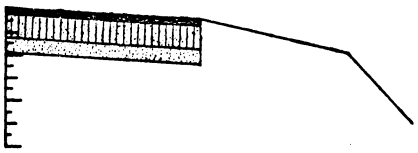
Remarks:

Excellent Condition

603

Project No. 0003-096-103,C501
From: 0.090 mi. E. Int. Rte. 624 (W. of Lerty)
To : 0.111 mi. E. Int. Rte. 204
Cost: $32,419/mi. Estimated Cost: $33,718/mi.

Completed: 11-13-64
County: Westmoreland
Length: 2.337 mi.
Soil Area 4
Thickness Index 8.9



Surface: 1½" F-1
Base : 6" cement tr. aggr. base
Subbase: 4" aggr. base

Traffic: 45-100 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 124,000

Deflection Data

		BF
4-3-67	0.000713	65
3-27-68	0.001122	50
4-3-69	0.000823	60
9-1-71	0.000970	61

Crack Factor

12-16-65	49
12-4-67	70
3-27-68	84
4-30-69	82
9-1-71	78

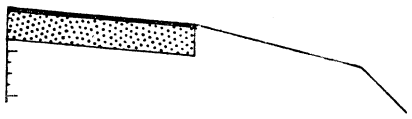
Remarks:

Severe cracking, transverse & longitudinal; poor riding quality, poor performance.

604

Project No. 0030-050-009
From: Int. Rte. 360
To : 0.494 mi. W. of Int. Rte. 611
Cost: $8,131 - $17,661/mi. Estimated Cost: $18,580 - $33,718/mi.

Completed: 7-10-61
County: King William
Length: 1.894 mi.
Soil Area 4
Thickness Index 2.80 - 4.80



Surface: 2" H-2
Base : 8" Soil Aggr.

Traffic: 25-85 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 110,000

Deflection Data

		BF
4-27-65	0.001367*	
4-4-67	0.000949	45
3-28-68	0.001088	42
5-5-69	0.000965	47
8-25-71	0.000934	50

Crack Factor

6-24-65	0
12-4-67	3
10-7-68	21
10-8-69	69
8-25-71	18

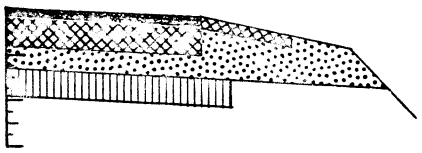
Remarks:

Stage construction 200#/sq. yd. H-2 applied 7-10-61. Isolated patches; excellent performance (some oxidation?)

605

Project No. 0095-016-002,P401
From: 0.050 mi. N. Hanover CL
To : 3.557 mi. N. Int. Rte. 207
Cost: $76,507/mi. Estimated Cost: $144,408/mi.

Completed: 7-26-64
County: Caroline
Length: 6.809 mi.
Soil Area 3 & 4
Thickness Index 14.9



Surface: 1" I-3
Binder : 1½" H-2
Base : 7½" H-3(1)
Subbase: 6" subbase matl.
Subbase: 7" soil cement

Traffic: 4270-6020 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 6,187,000

Deflection Data

		BF
5-19-65	0.000612*	
3-27-67	0.000458	68
3-26-68	0.000526	64
4-10-69	0.000573	65

Crack Factor

6-30-65	0
10-11-67	6
9-25-68	25
8-25-71	0

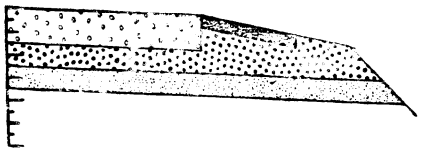
Remarks: Moderate cracking, not all load related. Resurfaced summer 1970 except for northernmost 3.5 miles of SBL. Fair performance. Rest of project resurfaced in summer 1971.

0 1643

606

Project No. 0095-016-002,P402
From: 3.537 mi. N. Int. Rte. 207
To : Spotsylvania-Caroline CL
Cost: $104,650/mi. Estimated Cost: $143,146/mi.

Completed: 8-18-64
County: Caroline
Length: 8.859 mi.
Soil Area 3 & 4



Surface: 9" Reinf. Concr.
Subbase: 6" Subbase matl. Gr. I
Subbase: 6" Select Matl. Gr. I
Slab length = 61.5'

Traffic: 3760-5250 Tractor-Trailers & Buses per day

Remarks:

(Fall 1971) Occasional light scaling: Shoulders have had drains placed since construction; occasional pumping; joints fairly well sealed. Many joints have small spalls. Excellent performance.

607A

Project No. 0360-050-001-002(WBL only)
From: Int. Rte. 30
To : E. End Bridge over Moncuin Creek
Cost: $22,662/mi. Estimated Cost: $31,305

Completed: 4-24-57 10-15-65
County: King William
Length: 2.212 mi.
Soil Area 4
Thickness Index 4.5

Surface: 2½" F-1
Base : 6" soil aggr.

Traffic: 59-165 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 419,000

Deflection Data

		BF
3-28-68	0.000902	49
9-5-69	0.000827	50
8-25-71	0.000816	51

Crack Factor

10-7-68	1
10-8-69	1

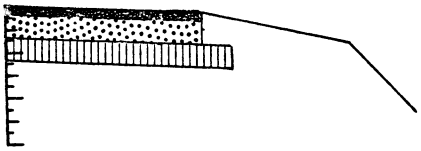
Remarks:

This project was completed with 6" soil aggregate & 2½" of F-1, 4-24-57; 3" of F-1 was added in 1959 and 1" F-1 10-15-65. This project was set up to compare with EBL, which is cement treated aggregate under plant mix. Isolated transverse cracking; excellent condition.

701

Project No. 0006-032-101,C501
From: 0.512 mi. W. Int. Rte. 620 (Kidd's Store)
To : 0.093 mi. E. Int. Rte. 640
Cost: $46,094/mi. Estimated Cost: $53,207/mi.

Completed: 10-13-64
County: Fluvanna
Length: 1.934 mi.
Soil Area 1
Thickness Index 6.5



Surface: 3/4" I-3
Binder : 1¼" H-2
Base : 6" Aggr. Base
Subbase: 6" soil cement

Traffic: 10-24 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 41,000

Deflection Data

		BF
3-24-67	0.000713	56
4-2-68	0.000767	54
5-27-69	0.000836	57
9-2-71	0.000944	57

Crack Factor

3-30-65	0
3-24-67	10
4-2-68	22
9-19-69	43
2-18-71	79

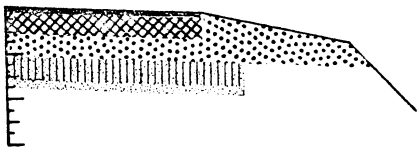
Remarks:

8-19-70 - Substantial alligator cracking; good riding quality. Fair to poor performance.

702

Project No. 0017-030-008
From: 3.123 mi. W. Stafford-Fauquier CL
To : 5.708 mi. W. Stafford-Fauquier CL
Cost: $82,157/mi. Estimated Cost: $96,661/mi.

Completed: 10-12-59
County: Fauquier
Length: 2.585 mi.
Soil Area 2
Thickness Index 13.9



Surface: 1½" I-3
Base : 5⅝" H-3(1)
Subbase: 6" Cr. Aggr.
Subbase: 8" cement tr. select borrow

Traffic: 245-310 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 644,000

Deflection Data

		BF
3-14-61	0.000637*	
5-17-62	0.000647*	
4-26-66	0.000590*	
4-29-66	0.000468*	
5-13-66	0.000504*	
10-?-66	0.000504*	
10-26-66	0.000510	62
3-23-67	0.000665	56
3-28-68	0.000817	52
5-22-69	0.000921	50
6-10-71	0.000686	62

Crack Factor

3-15-61	0
7-17-62	0
2-20-64	0
9-22-65	11
6-22-67	96
8-2-68	100
9-23-69	100
6-10-71	100

Remarks:

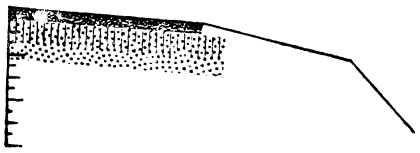
Severe cracking throughout; rides good; isolated patching; performance has been good.

0 1645

607B

Project No. 0360-050-104,C501 (EBL only)
From: E. End Bridge over Moncuin Creek
To : Int. Rte. 30
Cost: $38,058/mi. Estimated Cost: $61,090

Completed: 10-26-65
County: King William
Length: 2.212 mi.
Soil Area 4
Thickness Index 7.40



Surface: 3/4" F-1
Binder : 2½" H-2
Base : 6" cement tr. subbase matl.
Subbase: 4" subbase matl.

Traffic: 59-165 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 186,000

Deflection Data

		BF
3-28-68	0.000780	56
5-5-69	0.000752	62
8-25-71	0.000696	63

Crack Factor

10-7-68	27
10-8-69	6

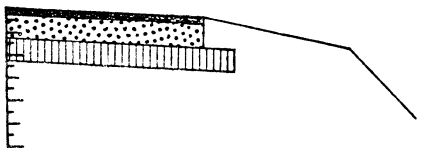
Remarks:

Isolated transverse cracks; excellent condition.

703

Project No. 0020-068-102,C501
From: 0.485 mi. E. Int. Rte. 522
To : 4.051 mi. E. Int. Rte. 522
Cost: $33,158/mi. Estimated Cost: $43,449/mi.

Completed: 12-9-65
County: Orange
Length: 3.566 mi.
Soil Area 2
Thickness Index 6.0



Surface: 1½" I-3
Base : 6" Aggr. base
Subbase: 6" Lime stabilization

Traffic: 60-125 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 108,000

Deflection Data

		BF
3-31-65	0.001612*	
3-23-67	0.000724	50
3-29-68	0.000889	51
4-3-69	0.000663	55
6-8-71	0.000856	54

Crack Factor

6-22-67	13
8-2-68	7
9-19-69	20
6-8-71	39

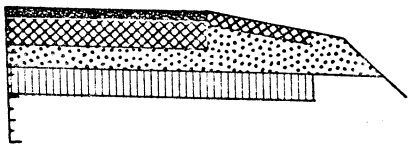
Remarks:

West end of project had extensive rehabilitation shortly after completion; this work done by State forces & changed design at these points. Part of project resurfaced 1968. Transverse cracking in portion rehabilitated with cement stabilized stone; occasional settlement; occasional longitudinal cracking; some patching; severe flushing; poor performance.

704

Project No. 0066-030-001
From: 0.587 mi. W. of Int. Rte. 731
To : 2.489 mi. W. of Int. Rte. 17 at Marshall
Cost: $102,274/mi. Estimated Cost: $159,224/mi.

Completed: 6-7-62
County: Fauquier
Length: 3.298 mi.
Soil Area 2
Thickness Index 14.8



Surface: ½" F-1
Binder : 1½" H-2
Base : 7½" H-3(1)
Subbase: 6" Cr. Aggr.
Subbase: 8" soil cement

Traffic: 140-425 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 502,000

Deflection Data

		BF
11-11-66	0.000338*	
4-28-66	0.000252*	
8-13-66	0.000468*	
10-11-66	0.000432*	
10-26-66	0.000331	63
4-28-67	0.000334	64
3-29-68	0.000481	55
5-28-69	0.000552	57
7-13-71	0.000559	55

Crack Factor

9-18-62	0
2-6-64	0
9-23-65	0
8-8-66	2
6-21-67	41
9-5-68	86
9-22-69	84
9-10-71	94

Remarks:

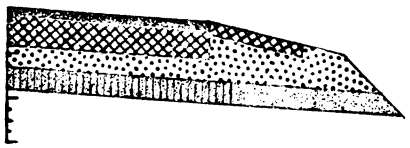
Longitudinal trending cracks not confined to wheelpaths and appear not be be load oriented. Evident in both traffic and passing lanes. Possibly a surface defect. Performance poor.

0 1647

705

Project No. 0066-076-101,P1
From: Int. Rte. 29 & 211 E. of Gainesville
To : 0.050 mi. W. Int. Rte. 234 (N. of Manassas)
Cost: $88,546/mi. Estimated Cost: $152,280/mi.

Completed: 10-3-62
County: Prince William
Length: 3.843 mi.
Soil Area 2
Thickness Index 1> 2



Surface: ½" F-1
Binder : 1½" H-2
Base : 7½" H-3(1)
Subbase: 6" Cr. Aggr.
Subbase: 6" cement tr. S.M.

Traffic: 230-670 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 908,000

Deflection Data

		BF
5-20-62	0.000791*	
5-4-65	0.000647*	
4-14-66	0.000532*	
4-28-66	0.000504*	
5-12-66	0.000576*	
10-10-66	0.000647*	
10-25-66	0.000459	48
4-22-67	0.000496	49
4-29-68	0.000626	46
6-2-69	0.000729	43
7-14-71	0.000782	44

Crack Factor

4-3-62	0
9-24-62	0
4-22-65	90
8-8-66	100
6-21-67	84
9-5-68	99
9-22-69	91
9-9-71	0 resurfaced

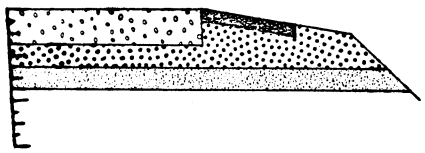
Remarks:

Project limits changed to permit turn arounds for testing. Prince William County only. Resurfaced summer 1970; performance fair.

706

Project No. 0095-029-102,P401
From: 0.080 mi. N. Prince William-Fairfax CL
To : 1.528 mi. N. Prince William-Fairfax CL
Cost: $115,368/mi. Estimated Cost: $170,618/mi.

Completed: 9-16-64
County: Fairfax
Length: 1.343 mi.
Soil Area 2



Surface: 9" reinf. conc.
Subbase: 6" subbase matl.
Subbase: 6" S.M.
slab length = 50'

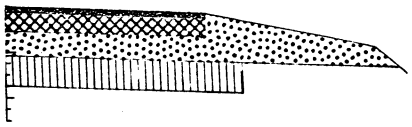
Traffic: 3700-4830 Tractor-trailers & Buses per day

Remarks:

(Fall 1971) 8-3-70 - Joints poorly sealed, unitube rusted. Considerable faulting of transverse joints. Extensive joint spalling, mostly small spalls. Some edge pumping.

Project No. 0236-029-007-C0?
From: 0.230 mi. W. Int. Rte. 244 (Annandale)
To : ECL Fairfax
Cost: $73,392/mi. Estimated Cost: $114,447/mi.

Completed: 9-15-60
County: Fairfax
Length: 5.142 mi.
Soil Area 2
Thickness Index 12.3



Surface: 1½" F-1
Base : 5½" H-3(1)
Subbase: 6" Cr. Aggr.
Subbase: 8" soil cement

Traffic: 520-690 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 1,422,000

Deflection Data

		BF
3-15-61	0.000540*	
4-15-66	0.000590*	
4-28-66	0.000432*	
5-12-66	0.000504*	
10-10-66	0.000468*	
10-20-66	0.000529	62
4-20-67	0.000574	61
4-30-68	0.000632	62
6-2-69	0.000776	60

Crack Factor

4-12-62	0
6-21-62	0
1-31-64	12
8-10-65	4
8-8-66	15
6-21-67	28
9-19-68	31
9-25-69	24

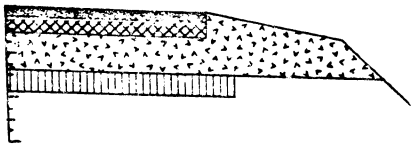
Remarks:

Project limits changed due to expansion CL Fairfax. Occasional transverse cracking. Minor longitudinal cracking; localized alligator cracking. Project has generally done well.

801

Project No. 0020-034-101,C501
From: 7.218 mi. W. WCL Winchester
To : 4.247 mi. W. WCL Winchester
Cost: $56,443 - $64,489/mi. Estimated Cost: $80,472 - $95,309/mi.

Completed: 9-22-62
County: Frederick
Length: 2.952 mi.
Soil Area 5
Thickness Index 11.4



Surface: ¼" F-4
Binder : 1½" H-2
Base : 5½" H-3(1)
Subbase: 10" Select Matl.
Subbase: 6" Lime stab. (part of proj.)

Traffic: 145-235 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 361,000

Deflection Data

		BF
6-7-6[illegible]	0.000683*	
5-5-67	0.000535	44
4-30-68	0.000597	43
5-8-69	0.000532	45
6-14-71	0.000774	41

Crack Factor

9-19-62	0
10-3-63	0
9-17-65	0
6-8-67	0
8-30-68	0
9-30-69	1
6-14-71	32

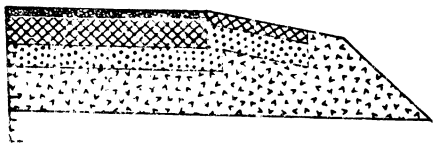
Remarks:

Lime in cuts only. 10% deslicking worn & popped off; occasional long. crack (most appear at center joint). Performance excellent.

802

Project No. 0081-082-021-026
From: 2.057 mi. S. Int. Prop. Rte. 33
To : 3.601 mi. N. Int. Prop. Rte. 33
Cost: $99,792 - $128,[illegible]62/mi. Estimated Cost: $150,765 - $186,849/mi.

Completed: 7-23-60
County: Rockingham
Length: 5.692 mi.
Soil Area 5
Thickness Index 14.0 - 16.40



Surface: ¼" F-1
Binder : 1½" H-2
Base : 7½" H-3(1)
Subbase: 6" Cr. Aggr.
Subbase: 12"-24" S.M.

Traffic: 890-1845 Tractor-trailers & Buses per day
Estimated cumulative 18 kip equiv. = 2,532,000

Deflection Data

		BF
4-12-60	0.000417*	
4-10-64	0.000442*	
5-10-67	0.000309	58
5-2-68	0.000209	57
5-12-69	0.000284	58
7-19-71	0.000344	64

Crack Factor

3-13-61	0
3-13-62	0
9-3-63	0
7-7-65	0
6-12-67	3
8-30-68	7
10-3-69	10
6-14-71	0 resurfaced

Remarks:

Occasional long. crack. Some alligator cracking around Rte. 33 interchange. Severe settlements over structure. Pavement has performed well. Resurfaced summer of 1970.

APPENDIX B

UNIT PRICES USED IN ESTIMATING COST TO BUILD IN 1971

The unit prices below were selected after a study of statewide bids for 1971, and reflect averages determined after the exclusion of very small or otherwise unrepresentative projects. Similarly, the costs shown may be somewhat in error where very small or very large quantities are involved and where a given material is in short supply or is very plentiful. Thus, use of the prices shown will yield only an approximation of what a given project would have cost in 1971.

	Item	Unit Cost
Surface or Binder:	Asphaltic Concrete	$11.75/ton
	P.C.C., reinforced, 9" thick	8.50/s.y.
	P.C.C., cont. reinf., 8" thick	7.80/s.y.
Base:	Asphaltic Concrete	9.35/ton
	Commercial Aggregate (cement treated)	5.10/ton
	Commercial Aggregate	4.00/ton
	Local Material	2.50/ton
Subbase:	Commercial Aggregate	3.25/ton
	Local Material	2.50/ton
Select Material:	Commercially processed	3.40/c.y.
	Local Material	2.50/c.y.
Stabilization:	Portland Cement	6.75/bbl.
	Manipulation	0.45/s.y.

APPENDIX C

RECOMMENDED DESIGN METHOD FOR FLEXIBLE PAVEMENTS IN VIRGINIA

by
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The sophisticated design techniques developed from the AASHO Road Test results and other investigations necessitated modification of the charts used for the design of flexible pavements in Virginia. The increased knowledge of the materials now used in the construction of flexible pavements in Virginia (e.g., cement treated aggregate, soil cement, and soil lime) also needed to be properly incorporated in the design method.

Investigations* have been carried out and a new design method has been determined. While incorporating the latest design techniques and use of the materials discussed above, this method still permits present construction practices.

From the investigations referred to, the following were determined.

(I) Thickness equivalencies (i.e., the ratio of the strength of one inch of material in the layer to one inch of asphaltic concrete) of the materials in each layer. The values for Virginia are given in Table A-I.

(II) Soil Support Value = SSV = soil resiliency value x design CBR.

On the basis of the investigations, Virginia was divided into five soil classification areas according to the soil resilience properties as shown in Figure (a). The following values were determined for each classification.

Soil Classification	Soil Resiliency Value
1	0.5
2	1.0
3	1.5
4	3.0
5	2.0

*Vaswani, N. K., "AASHO Road Test Findings Applied to Flexible Pavements in Virginia", Virginia Highway Research Council, Charlottesville, Virginia.

TABLE A-I

Soil No.	Material and Location	Notation	a	Value of a
1.	Surface — Asphalt concrete	A.C.	a_1	1.0
2.	Base (a) Cement treated aggregate base material over untreated aggregate base or soil cement or soil lime and under A.C. mat.	CTA	a_{21}	1.0
	(b) Untreated aggregate base material crushed or uncrushed. Spec. No. 20, 21 and 22	Agg.	a_2	0.35
	(c) Select material I directly under A.C. mat and over a subbase of a good quality ($a > 0.2$) subbase.	Agg.	a_3	0.35
3.	Subbase (a) Select material type I, II & III.	Sel. Mat.	a_3	
	1. In Piedmont area		a_3	0.0
	2. In Valley & Ridge area and Coastal Plain		a_3	0.2
	(b) Soil cement or soil lime	S.C.	a_4	0.4
	(c) Cement treated aggregate base directly over subgrade.	CTA	a_{21}	0.6

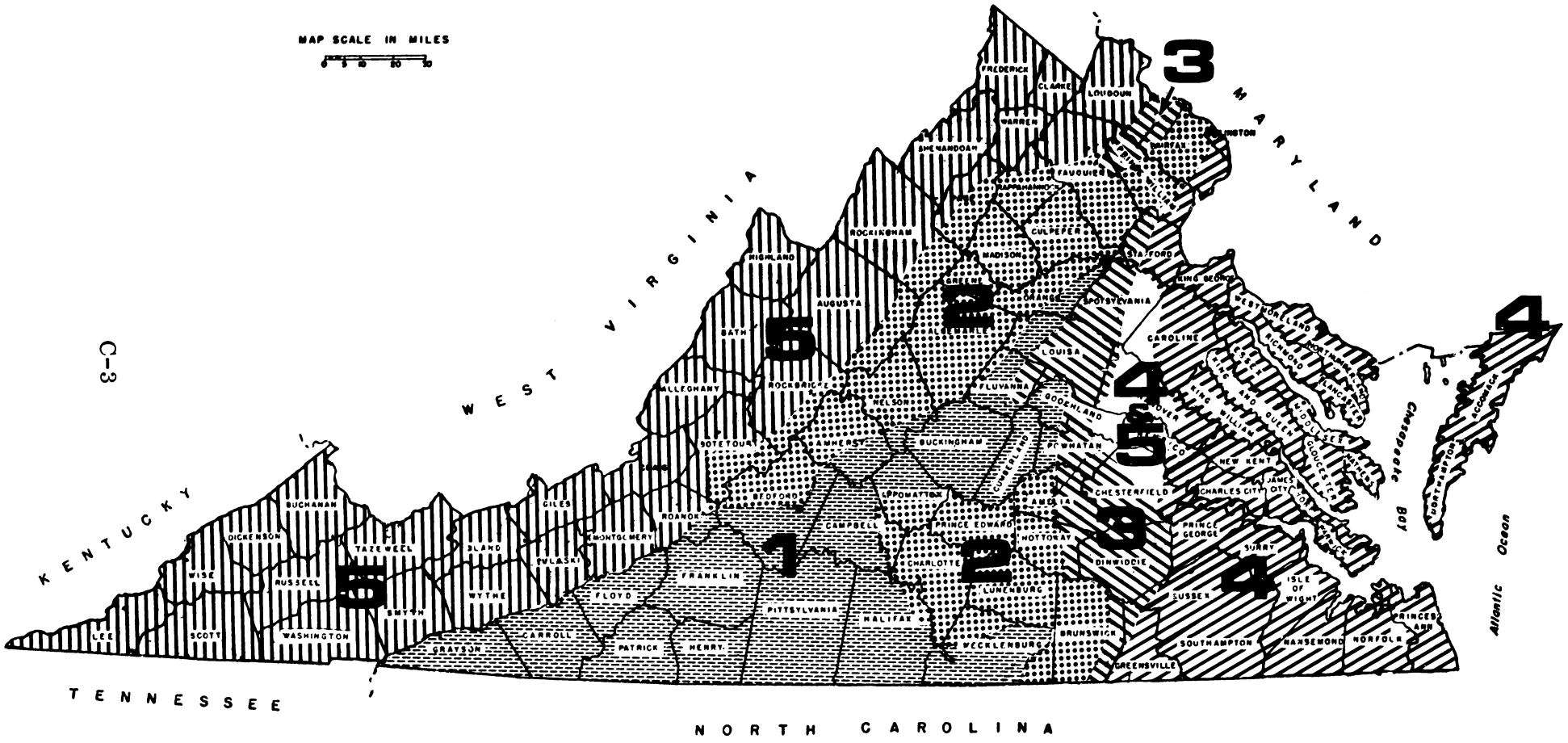

Figure (a). Virginia Soil Resiliency Classification.

(III) The design chart is given in Figure (b). This chart is based on design daily traffic in 18-kip equivalents* (L) and on soil support values (SSV). From this chart the thickness index, D, of the pavement can be determined. After the value of D is determined, the thickness of each layer can be determined.

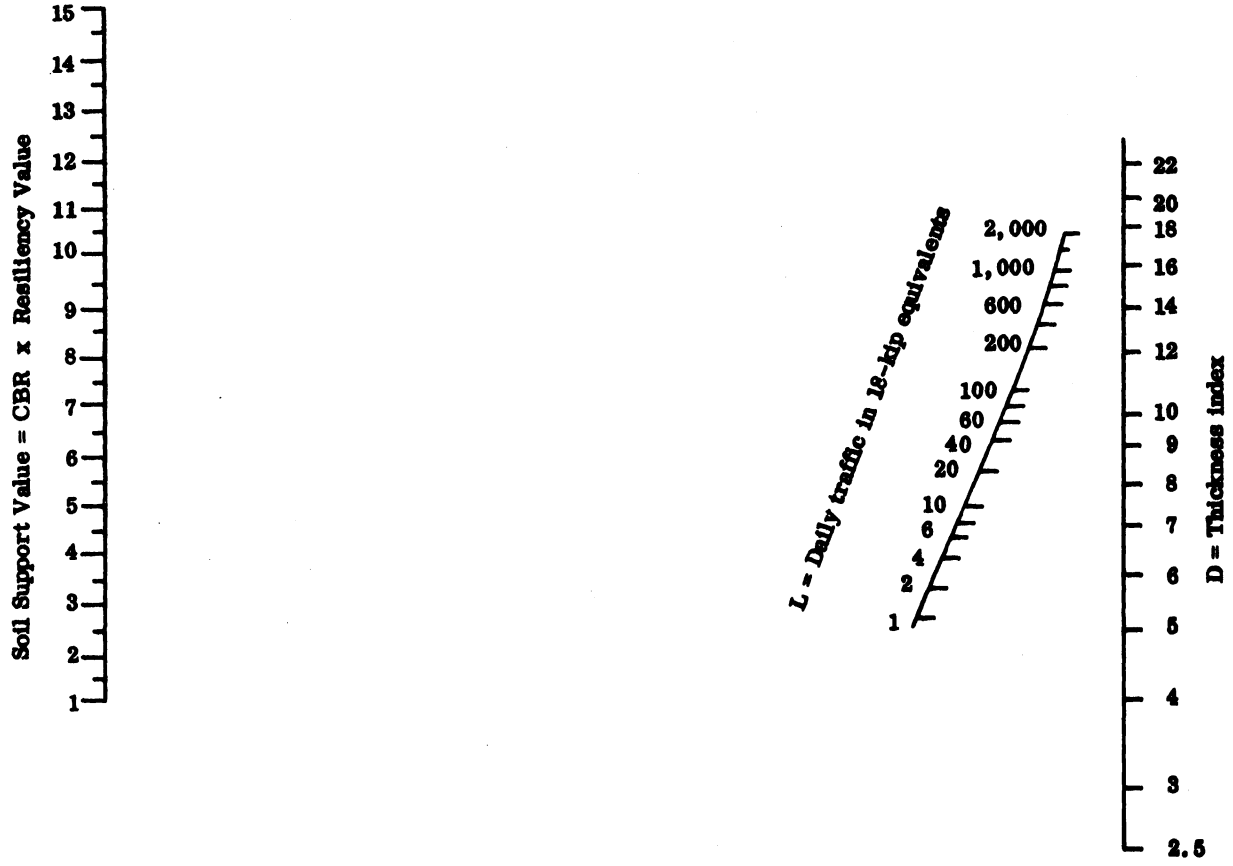

Figure (b). Nomograph correlating soil support value, traffic and thickness equivalencies (based on AASHO equation).

*Daily design traffic in 18-kip equivalents for a road is available from the Traffic and Planning Division of the Virginia Department of Highways.