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SENSITIVITY ANALYSIS OF TRUCK WEIGHTS ON PAVEMENT DETERIORATION

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16. Abstract

This report was intended to investigate the effect of truck weights on pavement deterioration. The major tool in this effort was a computer program developed by Austin Research Engineers, Inc. (ARE). Program "NULOAD" was to perform the analysis of effects of legal load limit changes on pavement performance. A test network of highways impacted by energy development was to serve as the initial model. However, inconsistencies of the program execution with the sample data provided by ARE prompted termination of the study.

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CONVERSION FACTORS
English to Metric System (SI) of Measurement

Quantity	English unit	Multiply by	To get metric equivalent
Length	inches (in) or (")	2.54×10^{1}	millimetres (mm)
		2.54×10^{-2}	metres (m)
	feet (ft) or (')	3.048×10^{-1}	metres (m)
	miles (mi)	1.609	kilometres (km)
Area	square inches (in^2)	6.452×10^{-4}	square metres (m^2)
	square feet (ft^2)	9.29×10^{-2}	square metres (m^2)
	acres	4.047×10^{-1}	hectares (ha)
Volume	gallons (gal)	3.785	litres (l)
	cubic feet (ft^3)	2.832×10^{-2}	cubic metres (m^3)
	cubic yards (yd^3)	7.646×10^{-1}	cubic metres (m^3)
Volume/Time (Flow)	cubic feet per second (ft^3/s)	2.832×10^{1}	litres per second (l/s)
	gallons per minute (gal/min)	6.309×10^{-2}	litres per second (l/s)
Mass	pounds (lb)	4.536×10^{-1}	kilograms (kg)
	ounces (oz)	2.835×10^{1}	grams (g)
Velocity	miles per hour (mph)	4.47×10^{-1}	metres per second (m/s)
	feet per second (fps)	3.048×10^{-1}	metres per second (m/s)
Weight/Density	pounds per cubic foot (lb/ft^3)	1.602×10^{1}	kilograms per cubic metre (kg/m^3)
Force	pounds (lbs)	4.448	newtons (N)
	kips (1000 lbs)	4.448×10^{3}	newtons (N)
Pressure	pounds per square inch (psi)	6.895×10^{3}	pascals (Pa)
	pounds per square foot (psf)	4.788×10^{1}	pascals (Pa)
Temperature	degrees fahrenheit (F)	$\frac{^{o}F - 32}{1.8} = {}^{o}C$	degrees celsius (^{o}C)

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SENSITIVITY ANALYSIS OF TRUCK WEIGHTS ON
PAVEMENT DETERIORATION

Introduction

Much attention has been given to pavement deterioration over the past several years. Citizen concern as well as complaints regarding poor pavements have reached government agencies at virtually every level. There are several factors that affect the status of a highway system at any point in time:

1. Original design criteria
2. Traffic
3. Maintenance
4. Environment

While all of the above factors are interdependent to a certain degree, they can be analyzed individually. Colorado's pavements are designed for a twenty year lifetime. Besides strength factors of roadway materials and regional factors, traffic loading, as expressed in 18 kip equivalent daily load applications (18 k EDLA), constitute the major considerations in the design process. Traffic volumes relating to truck traffic make up the major portion of the 18 k EDLA.

It is in the area of pavement loading and the associated pavement deterioration where the most controversial questions are raised. Experts in the trucking industry contend that pavements are at least as susceptible to environmental influences, such as freezing and thawing, as to loads applied by the trucks, while roadway designers continue to stress the importance of 18k EDLA's. Much of the controversy is due to design procedures based on the AASHTO road test results which the trucking industry considers outdated, inasfar as the load test did not specifically contain overweight loads. However, roadway designers still adhere to design criteria based on the experiences of the AASHTO test.

This study was not intended to resolve the controversy but primarily to investigate effects of loading on pavement deterioration using presently accepted design principles. Data is needed to determine if user taxes on trucks are proportional to the amount of pavement repair that they necessitate. Additionally, the establishment of reasonable truck weight limits is needed without jeopardizing the vast investment that is represented by a highway network. Increases in weight limits have taken place in the recent past because of sharp increases in fuel prices, and further increases are still sought by the transportation industry.

The focus of this study is on the effects of legal weight limit changes on pavement performance.

Background

This study was initiated upon learning of the availability of a computer program capable of handling the tasks mentioned throughout the introduction. Program NULOAD had been written by Austin Research Engineers, Inc. under a D.O.T. grant and appeared to be a good starting point for this study. Further literature search confirmed that the program at that time indeed was the state of the art for conducting the analysis. Other articles, in particular the November 1979 Civil Engineering Magazine[1], discuss truck induced damage to the pavement. The major point in the write-up is the emphasis on overload violations ranging from 22 percent nationally (according to the G.O.A. office of the U.S. Congress) to as much as 90 percent in local incidences in Texas. Assessments as to what consequential damage can be attributed to trucks were quite varied. They range from 10 or 20 percent as estimated by FHWA to 90 percent according to California DOT. The difference is explained as follows: In areas where soils and aggregates are sound, and environmental effects of freeze-thaw cycles are not a problem, trucks are the major contributor to pavement damage.

The main support for this study is provided by a two-volume report on "Effects of Changes in Legal Load Limits on Pavement Costs"[2] which was developed by Austin Research Engineers, Inc. to provide a tool for pavement managers who must decide on a good balance of allowable loads on the roads and the associated costs. The report describes the development and methodology of the computer program NULOAD. It is designed to determine the effect of changes in truck size, weight and configuration on pavement performance and the resulting maintenance and rehabilitation costs.

Program input parameters can be classified into the following groups:

1. Traffic and load information to establish the 18k EDAL's.
2. Pavement information relative to pavement and sublayer thickness, layer strength, and regional factors.
3. Economic information pertaining to interest rates and loss rates of pavement values.

Program Capability

Program NULOAD has the capability to model various sizes of highway network for which input data can be developed. The mileage of a network should be distributed based on functional classification (Interstate PCC, or composite), and pavement age (time since construction or major reconstruction). A network may be divided into as many representative structural sections as is necessary to adequately characterize the network. The lane miles of each representative section are distributed by pavement age. Program NULOAD predicts pavement performance and related maintenance, repair, and rehabilitation costs for both present and proposed traffic loadings for all lane miles of each pavement age of each representative section. NULOAD can handle up to five systems (i.e. interstate, primary, etc.) each having a maximum of ten representative sections (each section consisting of pavements with identical layer thickness and corresponding layer strength coefficients).

Instructions to NULOAD are supplied in the form of directives each of which occupies an entire card. The first twenty characters of each directive contain a "Keyword" identifying the type of information being entered. All relevant information must be supplied for the first problem of a run via the various directives. Subsequent problems in the same program execution need only specify directives which are to be changed, since all other variable values will be retained from the preceding problem. Some directives require additional data cards which always follow immediately after the card on which the keyword directive appears.

The major capabilities of NULOAD include:

1. The ability to handle up to a maximum of ten representative sections for each system;

2. The ability to make pavement performance predictions with the total payload per year under present and proposed limits either equal or unequal;
3. Different maintenance cost models can be used for each representative section;
4. A traffic stream mix with up to 10 different truck classifications can be considered for both present and proposed regulations;
5. The percent of each truck type as a percent of all vehicles can vary by year in the analysis period;
6. Pavement performance predictions are based not only on pavement structure and traffic but also on existing pavement age;
7. Overlay cost predictions include necessary costs to bring the shoulders up to the same level as the driving lanes;
8. Remaining network functional life in terms of remaining 18-kip (80 kN) EDLA at the end of the analysis period provides information on structural condition of the systems;
9. The expected economic consequences of various proposed legal limits changes on maintenance and rehabilitation, and salvage value are predicted and summarized by section, by system classification, and for the entire network;
10. Those pavements already in poor condition (below terminal serviceability) are considered, and a number of options are available to the user for handling those pavements in the POTTS (Pavements Older Than Terminal Serviceability);
11. Problem stacking and solution of numerous different problems is possible through the flexible input order of Program NULOAD;

12. Asphalt concrete, portland cement concrete, and composite pavements may be considered in any one problem;
13. Provision is made for differences between the AASHTO performance predictions and state experience through the use of various age parameters at terminal serviceability in conjunction with Iowa type survivor curves (Reference 6);
14. The effect of different truck and multiple trailer configurations can be modeled using vehicle designations and equivalency factors for single axles, steering axles, tandem axles, and tridem axles; and
15. The NCHRP 141 (Reference 2) load distribution shifting procedure has been included in NULOAD.

The computer output consists of one default option and three optional outputs. The default option is primarily an input echo (hard copy of the input data file), a summary result of maintenance and rehabilitation cost differences, and cost ratios between the four scenarios of loading. Option 1 supplies, in addition to the default option, output pavement performance tables, tables for pavements older than terminal serviceability, and summary cost tables. Option 2, in addition to Option 1, prints a summary payload and 18k EDLA information, while Option 3 adds a listing of the shifted weight distribution resulting from application of the NCHRP 141 shifting procedure.

The above information is a nutshell description of the capabilities of the computer program. Appendix C contains suggestions for improvements of the program's utility.

It appeared that with the information available in the two-volume report and the availability of the computer program NULOAD the feasibility of using the program for prediction of load-induced impacts on Colorado's highway network could be investigated.

Study Approach

The following steps were envisioned to define the various phases of the study:

1. Finish literature search to insure that the computer program NULOAD is the state of the art.
2. Determine availability of input data from 1) Size & Weight Reports, 2) Design Factors, 3) Roadway Geometry logs, etc. Select default values where data does not exist.
3. Run model using small data sample. Review output for accuracy and reasonableness (Panel activity).
4. Rework input if needed and run model for entire Highway System.
5. Analyze findings and document procedures and findings - final report.

After it was decided that program NULOAD was indeed the state of the art, a computer tape copy of NULOAD was obtained from Austin Research Engineers, Inc. (ARE). The copy has a source code, an executable binary code, as well as an input data set. Because of computer system differences, the program could not be used without modification. ARE's installation has a Scope system, whereas the Colorado Highway Department uses a Cyber system. Once the program modification was accomplished, the program executed flawlessly with the provided input data set inasfar as the output corresponded with the output provided in the report. Appendix A shows the organization of the required input set-up including the various optional input parameters.

The next step was to test the various program capabilities. One of the important aspects was the shortening of this analysis interval which according to the report was possible. While an analysis interval of twenty years might be appropriate for roads that are typically designed for the same design life, shorter intervals are sometimes more useful to predict short-range impacts. However, the attempt was futile because program execution never went beyond printing out the input information. Recompiling the source code on the Cyber facility did nothing to correct the problem. Similar problems were encountered when one of the truck classifications was dropped from the input file. While the computation proceded somewhat further than in the analysis interval run, it stopped prematurely.

The next attempt was to test the maintenance model options. This was very important because the department's maintenance department was in the process of developing a maintenance management program. This would have provided an excellent opportunity to test various maintenance efforts in program NULOAD. As with all previous runs the input data set was the one provided by ARE. For each individual run only the pertinent parameters were changed (i.e. analysis interval, truck classes and maintenance codes) along with changes in the associated data areas. First the program was run with the model maintenance option, followed by the no maintenance option. When a comparison between performance tables of the two runs was made, it became obvious that the program did not respond to the maintenance option (Appendix B). Appendix B is a copy of the two runs containing the data input echo (which are the first three pages of the appendix) followed by eleven pages depicting various performance parameters. Starting ón page B-11 is the second run in which the NO MAINTENANCE option was selected. The corresponding input file, with the exception of the maintenance option can be compared with the first input file for consistency. The resulting output file (B-15 through B-22) can be found to be identical. The output tables have the identical values as if the program did not recognize the different instructions supplied in the second run. At this point it was decided to reevaluate the validity and applicability of the study. The study phase dealing with establishing a test network had been initiated, and the northwest section of Colorado was to serve as the pilot test network. The primary reason for selecting this area was the inordinate increase of heavy trucks because of oil shale exploration. In light of the problems encountered with the computer program, work on further development of the test network was suspended.

Inquiries were made if any other states or municipal highway agencies were using program NULOAD in their network evaluation. When it became apparent that the program was not used anywhere else, the project advisory panel agreed to suspend any further work on the study and report the experiences encountered thus far. Since the literature search did not reveal any other program that might be applicable to this project a new method would have to be developed. However, a development of such a method is beyond the scope of this study.

Conclusion

The report on Effects of Changes in Legal Load Limits on Pavement Costs and the computer program NULOAD, which was developed in that report, appear to be invaluable tools for a pavement manager. Some of the features of the program, specifically the routine dealing with the increase in the legal load limit, are operational inasfar as prediction of pavement performance is made to reflect the increase in the load limit. The resulting increases in cost must be viewed cautiously since the pavement performance curves are based on the AASHTO road test results and consequently might not reflect specific changes in pavement cost. Further errors in the performance tables could easily be caused by inconsistent program behavior when a maintenance option is introduced (Appendix 2).

Current research efforts in the area of pavement management, notably the multistate Long Term Pavement Monitoring Study and a nationwide cost allocation study, are aimed at finding causal relationships between loading and deterioration as well as determining if the design equations developed in the AASHTO road test are still applicable. Since the major prediction computation of program NULOAD hinges on those performance curves, it seems prudent to view the output of the program with caution and possibly suspend further implementation of the program.

Recommendation

Based on the experiences learned in the attempt to implement program NULOAD in Colorado's pavement performance prediction associated with load changes, it appears that with the present program configuration an accurate prediction of either cost or pavement performance is not possible. Moreover, pending the outcome of the ongoing Long Term Pavement Monitoring Study, a revision of program NULOAD might be in order to reflect appropriate survivor curves, provided other aspects of the program such as the maintenance option are working properly.

References: 1. Civil Engineering - ASCE November, 1979, Pages 64 and 65.

2. R. F. Carmichael, III, F.L. Roberts, P.R. Jordahl, H.J. Treybig, and F.N. Finn, "Effect of Changes in Legal Load Limits on Pavement Costs, Volume 1. Development of Evaluation Procedure," FHWA Report Number FHWA-RD-79-73, July, 1978. Volume 2. Users Manual for Program NULOAD, FHWA Report Number FHWA-RD-79-74.

Appendix A

NULOAD INPUT DECK SET-UP

(+ KEYWORD CARDS)

+RUN PARAMETERS

+SYSTEM TITLE (1 for each Hwy. System)

TITLE (3 cards)

+FLEXIBLE* (*omit if RIGID is used)

SECTTL (section description)

Materials (up to four layers; from top to bottom)

+AGE DISTRIBUTION

MILEAGE (1 or 2 cards)

VALUE (-"-) **

LOSS RATE (-"-)**

(** only if salvage value is set.)

+TRUCK TYPE

TTYP (2 cards max.) Label types (i.e. 2A4 etc.)

AXLES (-"-)

TRUCK DATA

+LOAD LIMITS

WEIGHT LIMTS

STEERING WEIGHT

WEIGHT INCREASE

+SINGLE AXLES

ELDINT (Upper Load interval) 1 card for each load interval

+TANDEM AXLES

ELDINT (As above)

+GVW - Gross Vehicle Weight information

ELDINT (upper load interval loading)

+Empty - Empty Load distribution

ELDINT (upper load interval loading)

NULOAD Input Deck Set-up

- +STEERING AXLE (optional)
- ELDINT (upper load interval loading)
- +TRIDEMS (optional)
- ELDINT (as above)
- +PERFORMANCE (1 card)
- AGE (Terminal PSI, 25% & 75% overlay)
- +OVERLAY (1 card)
- MISC. DATA (-"-)
- +HISTORICAL MAINT. (omit if Model Maint. or No Maint. is used)
- COST DATA
- +NO MAINT. (omit if above cards are used)
- +MODEL MAINT. (omit if Historic or No Maint.)
- COST DATA (2 cards, Flexible & rigid)
- +OLD SECTIONS
- PROJECTED FUNDS
- +EXECUTE
- +OUTPUT
- +STOP

```
1
AUSTIN RESEARCH ENGINEERS INC

NULOAD - WEIGHT EFFECTS ON PAVEMENT PERFORMANCE
VERSION 1.0 - OCTOBER 1978


RUN PARAMETERS          20    0      2.00         6.00         0.00         0.00         0.00
SYSTEM TITLE             0    0      0.00         0.00         0.00         0.00         0.00
SAMPLE SOLUTION USING HYPOTHETICAL STATE DATA
-THIS RUN INTENDED FOR ILLUSTRATIVE PURPOSES ONLY
INTERSTATE SYSTEM, RIGID AND FLEXIBLE.
FLEXIBLE                 0    0     12.00         5.50         2.00         0.00         0.00
INTFLX A  INTERSTATE SYSTEM FLEXIBLE SECTION *A*
ACP    6.0 .440 ATB    4.0 .340 AGS    6.0 .110        0.00.000
AGE DISTRIBUTION        25    1      0.00         0.00         0.00         0.00         0.00
   107.0    87.0   110.0   118.0   118.0    87.0    78.0    65.0    80.0    50.0    48.0    28.0    17.0    22.0    17.0
    10.0    17.0    13.0    10.0     7.0     2.0     3.0     3.0     2.0     2.0
    287.00    270.00    264.00    251.00    182.00    159.00    146.00    134.00
    114.00    102.00     94.00     89.00     83.00     77.00     72.00     67.00
     63.00     59.00     55.00     51.00     48.00     45.00     42.00     39.00
     36.00
      3.00      3.00      3.00      3.00      3.00      3.00      3.00      3.00
      3.00      3.00      3.00      3.00      3.00      3.00      3.00      3.00
      3.00      3.00      3.00      3.00      3.00      3.00      3.00      3.00
      3.00
PERFORMANCE              0    0      4.20         2.50         4.20         0.00         0.00
     14.00     11.50     16.00
MODEL MAINT              1    0      0.00         0.00         0.00         0.00         0.00
      1.45       .06      9.40
     10.30      0.00      0.00       .20     20.00       .04     7
OVERLAY                  2    3      0.00         0.00         0.00         0.00         0.00
     95.00      7.00      5.00     25.00       .35      0.00      0.00
OLD SECTIONS             1    0   1500.00        10.00         0.00         0.00         0.00
OUTPUT                   3    0      0.00         0.00         0.00         0.00         0.00
TRUCK TYPE               4    0      0.00         0.00         0.00         0.00         0.00
2D          3A          3-S2        2-S1-2
 1 0 0 0    0 1 0 0     0 2 0 0     4 0 0 0
   1    3.75   .93 12.43   .57  0.00  0.00  0.00  0.00  0.00  0.00 17.68
   2    3.81   .93 12.51   .57  0.00  0.00  0.00  0.00  0.00  0.00 17.82
   3    3.92   .93 12.60   .57  0.00  0.00  0.00  0.00  0.00  0.00 18.01
   4    3.96   .92 12.68   .57  0.00  0.00  0.00  0.00  0.00  0.00 18.13
   5    4.04   .92 12.77   .57  0.00  0.00  0.00  0.00  0.00  0.00 18.30
   6    4.10   .92 12.75   .57  0.00  0.00  0.00  0.00  0.00  0.00 18.34
   7    4.14   .92 12.83   .57  0.00  0.00  0.00  0.00  0.00  0.00 18.46
   8    4.21   .91 12.81   .57  0.00  0.00  0.00  0.00  0.00  0.00 18.39
```

```
     9    4.25   .91 12.89   .57  0.00   0.00   0.00   0.00   0.00   0.00 18.62
    10    4.31   .91 12.87   .58  0.00   0.00   0.00   0.00   0.00   0.00 18.67
    11    4.35   .91 12.86   .58  0.00   0.00   0.00   0.00   0.00   0.00 18.70
    12    4.41   .90 12.85   .58  0.00   0.00   0.00   0.00   0.00   0.00 18.74
    13    4.45   .90 12.83   .58  0.00   0.00   0.00   0.00   0.00   0.00 18.76
    14    4.48   .90 12.81   .58  0.00   0.00   0.00   0.00   0.00   0.00 18.77
    15    4.52   .90 12.79   .58  0.00   0.00   0.00   0.00   0.00   0.00 18.79
    16    4.58   .89 12.77   .58  0.00   0.00   0.00   0.00   0.00   0.00 18.82
    17    4.63   .89 12.76   .58  0.00   0.00   0.00   0.00   0.00   0.00 18.85
    18    4.67   .89 12.74   .58  0.00   0.00   0.00   0.00   0.00   0.00 18.89
    19    4.69   .89 12.72   .58  0.00   0.00   0.00   0.00   0.00   0.00 18.89
    20    4.73   .88 12.70   .58  0.00   0.00   0.00   0.00   0.00   0.00 18.90
  LOAD LIMITS                1    0     0.00          0.00          0.00          0.00          0.00
        80.00      18.00     32.00      56.00
       120.00      20.00     34.00      58.00
         13.        13.        12.        8.
         16.        16.        16.       16.
        0.00       0.00       .50       .75
  SINGLE AXLES               13   0     0.00          0.00          0.00          0.00          0.00
             3.       12.        0.        0.        0.
             7.      169.        5.        0.       37.
             8.       29.        7.        0.       13.
            12.       50.       19.        0.       89.
            16.       25.        2.        0.       62.
            18.        9.        2.        0.        9.
            19.        0.        0.        0.        2.
            20.        0.        0.        0.        1.
            22.        0.        0.        0.        1.
            24.        0.        0.        0.        1.
            26.        0.        0.        0.        0.
            30.        0.        0.        0.        0.
            35.        0.        0.        0.        0.
  TANDEM AXLES               16   0     4.00          0.00          0.00          0.00          0.00
             6.        0.        0.       68.        0.
            12.        0.       18.      249.        0.
            18.        0.        6.      110.        0.
            24.        0.        3.      160.        0.
            30.        0.        2.      148.        0.
            32.        0.        0.       22.        0.
            33.        0.        2.        6.        0.
            34.        0.        1.        3.        0.
            36.        0.        1.        4.        0.
            38.        0.        2.        1.        0.
            40.        0.        0.        3.        0.
            42.        0.        0.        1.        0.
            44.        0.        0.        0.        0.
            46.        0.        0.        0.        0.
            50.        0.        0.        0.        0.
            55.        0.        0.        0.        0.
  GVW                        23   0     8.00          0.00          0.00          0.00          0.00
            10.      125.        0.        0.        0.
```

	18.	110.	1.	0.	0.				
	20.	132.	13.	4.	0.				
	22.	28.	5.	16.	0.				
	24.	15.	1.	46.	0.				
	26.	14.	2.	39.	1.				
	28.	5.	3.	23.	1.				
	30.	7.	0.	16.	0.				
	32.	2.	2.	15.	2.				
	34.	1.	0.	8.	0.				
	36.	2.	2.	12.	1.				
	38.	0.	1.	10.	0.				
	40.	1.	2.	6.	2.				
	45.	0.	1.	12.	1.				
	50.	0.	3.	27.	2.				
	55.	0.	1.	33.	5.				
	60.	0.	0.	58.	10.				
	65.	0.	0.	34.	6.				
	70.	0.	0.	22.	4.				
	72.	0.	0.	0.	0.				
	75.	0.	0.	1.	0.				
	80.	0.	0.	5.	0.				
	85.	0.	0.	1.	0.				
EMPTY			13	0	4.00	0.00	0.00	0.00	0.00
	6.	14.	0.	0.	0.				
	8.	78.	0.	0.	0.				
	10.	143.	4.	0.	0.				
	12.	107.	10.	0.	0.				
	14.	75.	26.	0.	0.				
	16.	50.	47.	2.	0.				
	18.	9.	35.	4.	0.				
	20.	7.	14.	19.	0.				
	25.	4.	23.	290.	3.				
	30.	0.	6.	262.	10.				
	35.	0.	0.	120.	4.				
	40.	0.	0.	24.	0.				
	45.	0.	0.	4.	2.				
EXECUTE			0	0	0.00	0.00	0.00	0.00	0.00

1

NULOAD - WEIGHT EFFECTS ON PAVEMENT PERFORMANCE
VERSION 1.0 - OCTOBER 1978

SAMPLE SOLUTION USING HYPOTHETICAL STATE DATA
-THIS RUN INTENDED FOR ILLUSTRATIVE PURPOSES ONLY
INTERSTATE SYSTEM, RIGID AND FLEXIBLE.

INTFLX A INTERSTATE SYSTEM FLEXIBLE SECTION *A*

4	1.387	14	1.387
5	1.387	15	1.387
6	1.387	16	1.387
7	1.387	17	1.387
8	1.387	18	1.387
9	1.386	19	1.387
10	1.387	20	1.387

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NULOAD - WEIGHT EFFECTS ON PAVEMENT PERFORMANCE
VERSION 1.0 - OCTOBER 1978

AVERAGE PAVEMENT AGE WHEN 25 PERCENT OF MILEAGE IS ALREADY OVERLAID - 11.50 YEARS
AVERAGE PAVEMENT AGE WHEN 75 PERCENT OF MILEAGE IS ALREADY OVERLAID - 16.00 YEARS
AVERAGE AGE AT TERMINAL PSI FOR EXISTING DESIGN --------------------- 14.00 YEARS
STANDARD DEVIATION OF THE SURVIVOR CURVE --------------------------- 3.34 YEARS
PERCENT OF TOTAL LANE MILES IN POTTS
(BEGINNING OF ANALYSIS PERIOD) ---------------------------------- 11.57

LANE-MILES FROM GIVEN AGE SLICE DUE FOR TIMELY OVERLAY IN GIVEN ANALYSIS YEAR

		PAVEMENT AGE AT			ANALYSIS YEAR													
VALUE	LOSS RATE	BEGINNING OF A.P.	TOTAL	INTO POTTS	1	2	3	4	5	6	7	8	9	10	11	12	13
287.	3.00	1	107.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	4.4	6.6	9.0	11.3	12.9	13.5
270.	3.00	2	87.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	3.6	5.3	7.3	9.2	10.5	11.0	10.5
264.	3.00	3	110.0	0.0	0.0	0.0	0.0	0.0	2.8	4.5	6.8	9.2	11.6	13.2	13.8	13.2	11.6
251.	3.00	4	118.0	0.0	0.0	0.0	0.0	3.0	4.8	7.2	9.9	12.4	14.2	14.9	14.2	12.4	9.9
182.	3.00	5	118.0	0.0	0.0	0.0	3.0	4.8	7.2	9.9	12.4	14.2	14.9	14.2	12.4	9.9	7.2
159.	3.00	6	87.0	0.0	0.0	2.2	3.6	5.3	7.3	9.2	10.5	11.0	10.5	9.2	7.3	5.3	3.6
146.	3.00	7	78.0	0.0	2.0	3.2	4.8	6.6	8.2	9.4	9.8	9.4	8.2	6.6	4.8	3.2	2.0
134.	3.00	8	65.0	1.6	2.7	4.0	5.5	6.8	7.8	8.2	7.8	6.8	5.5	4.0	2.7	1.6	0.0
114.	3.00	9	80.0	5.3	4.9	6.7	8.4	9.6	10.1	9.6	8.4	6.7	4.9	3.3	2.0	0.0	0.0
102.	3.00	10	50.0	6.4	4.2	5.3	6.0	6.3	6.0	5.3	4.2	3.1	2.1	1.3	0.0	0.0	0.0
94.	3.00	11	48.0	10.2	5.0	5.8	6.0	5.8	5.0	4.0	2.9	2.0	1.2	0.0	0.0	0.0	0.0
89.	3.00	12	28.0	8.9	3.4	3.5	3.4	2.9	2.4	1.7	1.1	.7	0.0	0.0	0.0	0.0	0.0
83.	3.00	13	17.0	7.4	2.1	2.0	1.8	1.4	1.0	.7	.4	0.0	0.0	0.0	0.0	0.0	0.0
77.	3.00	14	22.0	12.4	2.6	2.3	1.8	1.4	.9	.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
72.	3.00	15	17.0	11.6	1.8	1.4	1.0	.7	.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
67.	3.00	16	10.0	7.9	.8	.6	.4	.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
63.	3.00	17	17.0	14.8	1.0	.7	.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
59.	3.00	18	13.0	12.1	.5	.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55.	3.00	19	10.0	9.7	.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51.	3.00	20	7.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48.	3.00	21	2.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

45.	3.00	22	3.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42.	3.00	23	3.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39.	3.00	24	2.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36.	3.00	25	2.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		TOTALS		127.3	31.4	38.1	46.1	54.9	64.0	72.5	80.6	85.2	86.8	84.7	79.0	69.6	58.2
AVERAGE AGE AT TERMINAL PSI					12.29	12.36	12.42	12.54	12.73	12.95	13.15	13.52	13.94	14.40	14.92	15.47	16.09

VALUE IN THOUSANDS OF DOLLARS LOSS RATE IN PERCENT PER YEAR

1

NULOAD - WEIGHT EFFECTS ON PAVEMENT PERFORMANCE
VERSION 1.0 - OCTOBER 1978

LANE-MILES FROM GIVEN AGE SLICE DUE FOR TIMELY OVERLAY IN GIVEN ANALYSIS YEAR

PAVEMENT AGE AT BEGINNING OF A.P.	ANALYSIS YEAR 14	15	16	17	18	19
1	12.9	11.3	9.0	6.6	4.4	2.7
2	9.2	7.3	5.3	3.6	2.2	0.0
3	9.2	6.8	4.5	2.8	0.0	0.0
4	7.2	4.8	3.0	0.0	0.0	0.0
5	4.8	3.0	0.0	0.0	0.0	0.0
6	2.2	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0
20	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0

TOTALS 45.5 33.1 21.8 12.9 6.6 2.7

AVERAGE AGE AT TERMINAL PSI
16.75 17.42 18.07 18.70 19.33 20.00

VALUE IN THOUSANDS OF DOLLARS LOSS RATE IN PERCENT PER YEAR

1

NULOAD - WEIGHT EFFECTS ON PAVEMENT PERFORMANCE
VERSION 1.0 - OCTOBER 1978

INTFLX A INTERSTATE SYSTEM FLEXIBLE SECTION *A*

P E R F O R M A N C E   T A B L E

P R E S E N T   R E G U L A T I O N S

B-6

LANE MILES DUE OVERLAY	LANE MILES OVERLAID	YEAR OF OVERLAY	OVERLAY DESIGN SN	OVERLAY THICKNESS	PSI AT BEGINNING OF ANALYSIS	PSI AT END PERIOD	REMAINING LIFE (MILLION 18-KIP EAL)	OVERLAY COST ($/LANE MILE)
31.4	27.8	1.00	5.24	3.57	2.58	2.55	1.698	27280.
38.1	33.8	2.00	5.23	3.56	2.67	2.60	3.348	27221.
46.1	40.9	3.00	5.23	3.55	2.76	2.65	4.948	27158.
54.9	48.7	4.00	5.22	3.54	2.85	2.70	6.479	27050.
64.0	56.8	5.00	5.21	3.51	2.93	2.76	7.918	26888.
72.5	64.3	6.00	5.20	3.49	3.02	2.81	9.268	26696.
80.6	71.5	7.00	5.19	3.47	3.11	2.87	10.566	26526.
85.2	75.6	8.00	5.17	3.43	3.19	2.93	11.668	26214.
86.8	77.0	9.00	5.15	3.38	3.27	2.99	12.663	25881.
84.7	75.1	10.00	5.13	3.33	3.35	3.05	13.553	25448.
79.0	70.0	11.00	5.11	3.28	3.42	3.11	14.320	25065.
69.6	61.7	12.00	5.09	3.23	3.49	3.18	15.002	24679.
58.2	51.6	13.00	5.06	3.17	3.55	3.25	15.562	24258.
45.5	40.4	14.00	5.04	3.12	3.60	3.33	16.051	23841.
33.1	29.4	15.00	5.01	3.06	3.66	3.41	16.480	23431.
21.8	19.3	16.00	4.99	3.01	3.71	3.50	16.896	23059.
12.9	11.4	17.00	4.97	2.97	3.77	3.60	17.280	22705.
6.6	5.8	18.00	4.95	2.92	3.83	3.71	17.641	22372.
2.7	2.4	19.00	4.93	2.88	3.89	3.86	17.942	22033.

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NULOAD - WEIGHT EFFECTS ON PAVEMENT PERFORMANCE

INTFLX A INTERSTATE SYSTEM FLEXIBLE SECTION *A*

P E R F O R M A N C E   T A B L E

P R O P O S E D   R E G U L A T I O N S

LANE MILES DUE OVERLAY	LANE MILES OVERLAID	YEAR OF OVERLAY	OVERLAY DESIGN SN	OVERLAY THICKNESS	PSI AT BEGINNING OF ANALYSIS	PSI AT END PERIOD	REMAINING LIFE (MILLION 18-KIP EAL)	OVERLAY COST ($/LANE MILE)
31.4	27.8	.72	5.47	4.11	2.58	2.53	1.698	31425.
38.1	33.8	1.45	5.47	4.09	2.67	2.57	3.346	31294.
46.1	40.9	2.18	5.46	4.07	2.76	2.61	4.946	31160.
54.9	48.7	2.91	5.45	4.05	2.85	2.64	6.476	30981.
64.0	56.8	3.65	5.43	4.02	2.93	2.68	7.915	30747.
72.5	64.3	4.40	5.42	3.99	3.02	2.72	9.265	30484.
80.6	71.5	5.14	5.41	3.95	3.11	2.76	10.564	30245.
85.2	75.6	5.89	5.38	3.90	3.19	2.80	11.666	29862.
86.8	77.0	6.65	5.36	3.85	3.27	2.84	12.661	29459.
84.7	75.1	7.40	5.34	3.80	3.35	2.88	13.551	29038.
79.0	70.0	8.16	5.31	3.74	3.42	2.93	14.319	28583.
69.6	61.7	8.93	5.28	3.68	3.49	2.97	15.001	28126.
58.2	51.6	9.70	5.26	3.61	3.55	3.02	15.561	27634.
45.5	40.4	10.47	5.23	3.55	3.60	3.07	16.050	27147.
33.1	29.4	11.24	5.20	3.49	3.66	3.12	16.479	26669.
21.8	19.3	12.02	5.17	3.43	3.71	3.18	16.895	26231.
12.9	11.4	12.80	5.15	3.36	3.77	3.23	17.279	25729.
6.6	5.8	13.59	5.12	3.31	3.83	3.29	17.639	25336.
2.7	2.4	14.38	5.10	3.26	3.89	3.35	17.942	24936.

INTFLX A INTERSTATE SYSTEM FLEXIBLE SECTION *A*

P O T T S   T A B L E

P R E S E N T   R E G U L A T I O N S

ANALYSIS YEAR	LANE MILES IN POTTS	LANE MILES OVERLAID FROM POTTS	OVERLAY DESIGN SN	OVERLAY THICKNESS	PSI AT END OF ANALYSIS PERIOD	OVERLAY COST ($/LANE-MILE)
1	126.8	4.1	4.81	4.72	2.55	36077.
2	126.1	5.0	4.82	4.75	2.60	36315.
3	125.3	6.0	4.84	4.78	2.66	36553.
4	124.3	7.2	4.85	4.81	2.71	36793.
5	123.2	8.4	4.86	4.84	2.77	37032.
6	121.9	9.5	4.88	4.87	2.83	37272.
7	120.5	10.5	4.89	4.90	2.88	37512.
8	119.0	11.1	4.91	4.94	2.94	37753.
9	117.4	11.4	4.92	4.97	3.00	37994.
10	115.9	11.1	4.93	5.00	3.06	38236.
11	114.5	10.3	4.95	5.03	3.12	38477.
12	113.3	9.1	4.96	5.06	3.19	38720.
13	112.3	7.6	4.98	5.09	3.26	38963.
14	111.5	6.0	4.99	5.13	3.33	39206.
15	110.9	4.3	5.00	5.16	3.41	39450.
16	110.5	2.9	5.02	5.19	3.50	39694.
17	110.3	1.7	5.03	5.22	3.59	39938.
18	110.1	.9	5.05	5.25	3.70	40183.
19	110.1	.4	5.06	5.29	3.85	40428.
20	110.1	0.0	5.07	5.32	4.20	40674.

INTFLX A INTERSTATE SYSTEM FLEXIBLE SECTION *A*

P O T T S   T A B L E

P R O P O S E D   R E G U L A T I O N S

ANALYSIS YEAR	LANE MILES IN POTTS	LANE MILES OVERLAID FROM POTTS	OVERLAY DESIGN SN	OVERLAY THICKNESS	PSI AT END OF ANALYSIS PERIOD	OVERLAY COST ($/LANE-MILE)
1	126.8	4.1	5.04	5.24	2.55	40063.
2	126.1	5.0	5.05	5.27	2.60	40308.

3	124.3	13.2	5.07	5.30	2.65	40554.
4	123.2	8.4	5.08	5.33	2.70	40800.
5	121.9	9.5	5.09	5.37	2.76	41046.
6	119.0	21.7	5.11	5.40	2.81	41293.
7	117.4	11.4	5.12	5.43	2.87	41540.
8	115.9	11.1	5.14	5.46	2.92	41788.
9	113.3	19.4	5.16	5.51	2.99	42120.
10	112.3	7.6	5.17	5.54	3.05	42371.
11	111.5	6.0	5.19	5.57	3.11	42621.
12	110.9	4.3	5.20	5.60	3.17	42872.
13	110.3	4.5	5.21	5.64	3.24	43123.
14	110.1	.9	5.23	5.67	3.31	43375.
15	110.1	.4	5.24	5.70	3.39	43627.
16	110.1	0.0	5.26	5.74	3.47	43880.
17	110.1	0.0	5.27	5.77	3.57	44133.
18	110.1	0.0	5.29	5.80	3.68	44386.
19	110.1	0.0	5.30	5.84	3.83	44640.
20	110.1	0.0	5.32	5.87	4.20	44894.

NULOAD - WEIGHT EFFECTS ON PAVEMENT PERFORMANCE
VERSION 1.0 - OCTOBER 1978

INTFLX A INTERSTATE SYSTEM FLEXIBLE SECTION *A*

U N D I S C O U N T E D   C O S T S

(MILLIONS OF DOLLARS)

YEAR IN	MAINTENANCE		OVERLAY	
ANALYSIS PERIOD	PRESENT	PROPOSED	PRESENT	PROPOSED
1	0.000	0.000	.908	1.040
2	0.000	0.000	1.100	1.258
3	0.000	0.000	1.332	3.320
4	0.000	0.000	1.581	2.088
5	0.000	0.000	1.837	2.348
6	0.000	0.000	2.069	5.315
7	0.000	0.000	2.291	2.740
8	0.000	0.000	2.403	2.644
9	0.000	0.000	2.424	4.555
10	0.000	0.000	2.335	1.749
11	0.000	0.000	2.153	1.350
12	0.000	0.000	1.875	.969
13	0.000	0.000	1.549	.997
14	0.000	0.000	1.196	.185
15	0.000	0.000	.859	.075

16	0.000	0.000	.539	0.000
17	0.000	0.000	.327	0.000
18	0.000	0.000	.165	0.000
19	0.000	0.000	.067	0.000
20	0.000	0.000	0.000	0.000
TOTALS	0.000	0.000	27.030	30.631

S A L V A G E   V A L U E
(MILLIONS OF DOLLARS)

	ANALYSIS PERIOD BEGINNING	END
PRESENT	-197.739	-118.024
PROPOSED	-197.739	-116.299
	DELTA	1.725

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NULOAD - WEIGHT EFFECTS ON PAVEMENT PERFORMANCE
VERSION 1.0 - OCTOBER 1978

STOP 0 0 0.00 0.00 0.00 0.00 0.00
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NULOAD - WEIGHT EFFECTS ON PAVEMENT PERFORMANCE
VERSION 1.0 - OCTOBER 1978

SAMPLE SOLUTION USING HYPOTHETICAL STATE DATA
-THIS RUN INTENDED FOR ILLUSTRATIVE PURPOSES ONLY
INTERSTATE SYSTEM, RIGID AND FLEXIBLE.

SECTION NUMBER	SECTION IDENTIFIER	LANE MILES	UNDISCOUNTED DELTA COST	COST RATIO	DELTA SALVAGE VALUE	PRESENT WORTH DELTA COST	COST RATIO	UNIFORM ANNUAL COST DELTA COST	COST RATIO	RATIO OF REMAINING LIFE PROPOSED/PRESENT
1	INTFLX A	1101.	3.602	1.13	1.725	4.599	1.27	.401	1.27	1.01
TOTAL		1101.	3.602		1.725	4.599		.401		

(Flexible Only) No Maintenance

7/15/1981

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AUSTIN RESEARCH ENGINEERS INC                                                                              PAGE  1

NULOAD - WEIGHT EFFECTS ON PAVEMENT PERFORMANCE
VERSION 1.0 - OCTOBER 1978


RUN PARAMETERS         20    0      2.00       6.00       0.00       0.00       0.00
SYSTEM TITLE            0    0      0.00       0.00       0.00       0.00       0.00
SAMPLE SOLUTION USING HYPOTHETICAL STATE DATA
-THIS RUN INTENDED FOR ILLUSTRATIVE PURPOSES ONLY
INTERSTATE SYSTEM, RIGID AND FLEXIBLE.
FLEXIBLE                0    0     12.00       5.50       2.00       0.00       0.00
INTFLX A  INTERSTATE SYSTEM FLEXIBLE SECTION #A#
ACP    6.0 .440 ATB    4.0 .340 AGS    6.0 .110      0.00.000
AGE DISTRIBUTION       25    1      0.00       0.00       0.00       0.00       0.00
   107.0   87.0  110.0  118.0  118.0   87.0   78.0   65.0   80.0   50.0   48.0   28.0   17.0   22.0   17.0
    10.0   17.0   13.0   10.0    7.0    2.0    3.0    3.0    2.0    2.0
    287.00    270.00    264.00    251.00    182.00    159.00    146.00    134.00
    114.00    102.00     94.00     89.00     83.00     77.00     72.00     67.00
     63.00     59.00     55.00     51.00     48.00     45.00     42.00     39.00
     36.00
      3.00      3.00      3.00      3.00      3.00      3.00      3.00      3.00
      3.00      3.00      3.00      3.00      3.00      3.00      3.00      3.00
      3.00      3.00      3.00      3.00      3.00      3.00      3.00      3.00
      3.00
PERFORMANCE             0    0      4.20       2.50       4.20       0.00       0.00
     14.00     11.50     16.00
NO MAINT                0    0      0.00       0.00       0.00       0.00       0.00
OVERLAY                 2    3      0.00       0.00       0.00       0.00       0.00
     95.00      7.00      5.00     25.00       .35      0.00      0.00
OLD SECTIONS            1    0   1500.00      10.00       0.00       0.00       0.00
OUTPUT                  3    0      0.00       0.00       0.00       0.00       0.00
TRUCK TYPE              4    0      0.00       0.00       0.00       0.00       0.00
2D         3A         3-S2      2-S1-2
 1 0 0 0    0 1 0 0    0 2 0 0    4 0 0 0
  1    3.75    .93 12.43   .57  0.00  0.00  0.00  0.00  0.00  0.00 17.68
  2    3.81    .93 12.51   .57  0.00  0.00  0.00  0.00  0.00  0.00 17.82
  3    3.92    .93 12.60   .57  0.00  0.00  0.00  0.00  0.00  0.00 18.01
  4    3.96    .92 12.68   .57  0.00  0.00  0.00  0.00  0.00  0.00 18.13
  5    4.04    .92 12.77   .57  0.00  0.00  0.00  0.00  0.00  0.00 18.30
  6    4.10    .92 12.75   .57  0.00  0.00  0.00  0.00  0.00  0.00 18.34
  7    4.14    .92 12.83   .57  0.00  0.00  0.00  0.00  0.00  0.00 18.46
  8    4.21    .91 12.81   .57  0.00  0.00  0.00  0.00  0.00  0.00 18.39
  9    4.25    .91 12.89   .57  0.00  0.00  0.00  0.00  0.00  0.00 18.62
 10    4.31    .91 12.87   .58  0.00  0.00  0.00  0.00  0.00  0.00 18.67
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     11    4.35   .91 12.86   .58  0.00   0.00   0.00   0.00   0.00   0.00 18.70
     12    4.41   .90 12.85   .58  0.00   0.00   0.00   0.00   0.00   0.00 18.74
     13    4.45   .90 12.83   .58  0.00   0.00   0.00   0.00   0.00   0.00 18.76
     14    4.48   .90 12.81   .58  0.00   0.00   0.00   0.00   0.00   0.00 18.77
     15    4.52   .90 12.79   .58  0.00   0.00   0.00   0.00   0.00   0.00 18.79
     16    4.58   .89 12.77   .58  0.00   0.00   0.00   0.00   0.00   0.00 18.82
     17    4.63   .89 12.76   .58  0.00   0.00   0.00   0.00   0.00   0.00 18.85
     18    4.67   .89 12.74   .58  0.00   0.00   0.00   0.00   0.00   0.00 18.89
     19    4.69   .89 12.72   .58  0.00   0.00   0.00   0.00   0.00   0.00 18.89
     20    4.73   .88 12.70   .58  0.00   0.00   0.00   0.00   0.00   0.00 18.90
   LOAD LIMITS            1     0      0.00          0.00          0.00          0.00          0.00
        80.00      18.00      32.00      56.00
       120.00      20.00      34.00      58.00
        13.        13.        12.        8.
        16.        16.        16.       16.
       0.00       0.00       .50        .75
   SINGLE AXLES          13     0      0.00          0.00          0.00          0.00          0.00
            3.    12.     0.     0.     0.
            7.   169.     5.     0.    37.
            8.    29.     7.     0.    13.
           12.    50.    19.     0.    89.
           16.    25.     2.     0.    62.
           18.     9.     2.     0.     9.
           19.     0.     0.     0.     2.
           20.     0.     0.     0.     1.
           22.     0.     0.     0.     1.
           24.     0.     0.     0.     1.
           26.     0.     0.     0.     0.
           30.     0.     0.     0.     0.
           35.     0.     0.     0.     0.
   TANDEM AXLES          16     0      4.00          0.00          0.00          0.00          0.00
            6.     0.     0.    68.     0.
           12.     0.    18.   249.     0.
           18.     0.     6.   110.     0.
           24.     0.     3.   160.     0.
           30.     0.     2.   148.     0.
           32.     0.     0.    22.     0.
           33.     0.     2.     6.     0.
           34.     0.     1.     3.     0.
           36.     0.     1.     4.     0.
           38.     0.     2.     1.     0.
           40.     0.     0.     3.     0.
           42.     0.     0.     1.     0.
           44.     0.     0.     0.     0.
           46.     0.     0.     0.     0.
           50.     0.     0.     0.     0.
           55.     0.     0.     0.     0.
   GVW                   23     0      8.00          0.00          0.00          0.00          0.00
           10.   125.     0.     0.     0.
           14.   110.     1.     0.     0.
           20.   132.    13.     4.     0.
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	22.	28.	5.	16.	0.				
	24.	15.	1.	46.	0.				
	26.	14.	2.	39.	1.				
	28.	5.	3.	23.	1.				
	30.	7.	0.	16.	0.				
	32.	2.	2.	15.	2.				
	34.	1.	0.	8.	0.				
	36.	2.	2.	12.	1.				
	38.	0.	1.	10.	0.				
	40.	1.	2.	6.	2.				
	45.	0.	1.	12.	1.				
	50.	0.	3.	27.	2.				
	55.	0.	1.	33.	5.				
	60.	0.	0.	58.	10.				
	65.	0.	0.	34.	6.				
	70.	0.	0.	22.	4.				
	72.	0.	0.	0.	0.				
	75.	0.	0.	1.	0.				
	80.	0.	0.	5.	0.				
	85.	0.	0.	1.	0.				
EMPTY			13	0	4.00	0.00	0.00	0.00	0.00
	6.	14.	0.	0.	0.				
	8.	78.	0.	0.	0.				
	10.	143.	4.	0.	0.				
	12.	107.	10.	0.	0.				
	14.	75.	26.	0.	0.				
	16.	50.	47.	2.	0.				
	18.	9.	35.	4.	0.				
	20.	7.	14.	19.	0.				
	25.	4.	23.	290.	3.				
	30.	0.	6.	262.	10.				
	35.	0.	0.	120.	4.				
	40.	0.	0.	24.	0.				
	45.	0.	0.	4.	2.				
EXECUTE			0	0	0.00	0.00	0.00	0.00	0.00

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NULOAD - WEIGHT EFFECTS ON PAVEMENT PERFORMANCE
VERSION 1.0 - OCTOBER 1978

SAMPLE SOLUTION USING HYPOTHETICAL STATE DATA
-THIS RUN INTENDED FOR ILLUSTRATIVE PURPOSES ONLY
INTERSTATE SYSTEM, RIGID AND FLEXIBLE.

INTFLX A INTERSTATE SYSTEM FLEXIBLE SECTION *A*

RUN PARAMETERS
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76.000	0.00	85.78	0.00	0.00	0.00	0.00
78.000	0.00	89.93	0.00	0.00	0.00	0.00
80.000	0.00	93.43	0.00	0.00	0.00	0.00

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NULOAD - WEIGHT EFFECTS ON PAVEMENT PERFORMANCE
VERSION 1.0 - OCTOBER 1978

INTFLX A INTERSTATE SYSTEM FLEXIBLE SECTION *A*

CUMULATIVE SHIFTED AXLE DISTRIBUTIONS (IN 2-KIP INTERVALS) FOR EACH TRUCK

TRUCK TYPE 2-S1-2

END OF WEIGHT INTERVAL (KIPS)	UNSHIFTED PERCENT WEIGHED GROSS	FINAL PERCENT WEIGHED GROSS	PERCENT SINGLE AXLES	PERCENT TANDEM AXLES	PERCENT TRIDEM AXLES	PERCENT STEERING AXLES
82.000	0.00	96.72	0.00	0.00	0.00	0.00
84.000	0.00	100.00	0.00	0.00	0.00	0.00

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NULOAD - WEIGHT EFFECTS ON PAVEMENT PERFORMANCE
VERSION 1.0 - OCTOBER 1978

INTFLX A INTERSTATE SYSTEM FLEXIBLE SECTION *A*

TRUCK TYPE	PAYLOAD PER TRUCK		18-KIP AXLES PER TRUCK	
	PRESENT	PROPOSED	PRESENT	PROPOSED
2D	3.97	5.30	.08	.14
3A	9.71	11.69	.26	.38
3-S2	15.53	18.21	.36	.57
2-S1-2	23.42	31.56	.89	1.94

YEAR 18-KIP ESAL RATIO YEAR 18-KIP ESAL RATIO

(PROPOSED/PRESENT)			(PROPOSED/PRESENT)
1	1.388	11	1.387
2	1.387	12	1.387
3	1.387	13	1.387
4	1.387	14	1.387
5	1.387	15	1.387
6	1.387	16	1.387
7	1.387	17	1.387
8	1.387	18	1.387
9	1.386	19	1.387
10	1.387	20	1.387

NULOAD - WEIGHT EFFECTS ON PAVEMENT PERFORMANCE
VERSION 1.0 - OCTOBER 1978

AVERAGE PAVEMENT AGE WHEN 25 PERCENT OF MILEAGE IS ALREADY OVERLAID - 11.50 YEARS
AVERAGE PAVEMENT AGE WHEN 75 PERCENT OF MILEAGE IS ALREADY OVERLAID - 16.00 YEARS
AVERAGE AGE AT TERMINAL PSI FOR EXISTING DESIGN -------------------- 14.00 YEARS
STANDARD DEVIATION OF THE SURVIVOR CURVE ------------------------- 3.34 YEARS
PERCENT OF TOTAL LANE MILES IN POTTS
(BEGINNING OF ANALYSIS PERIOD) ---------------------------------- 11.57

LANE-MILES FROM GIVEN AGE SLICE DUE FOR TIMELY OVERLAY IN GIVEN ANALYSIS YEAR

VALUE	LOSS RATE	PAVEMENT AGE AT BEGINNING OF A.P.	TOTAL	INTO POTTS	ANALYSIS YEAR 1	2	3	4	5	6	7	8	9	10	11	12	13
287.	3.00	1	107.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.7	4.4	6.6	9.0	11.3	12.9	13.5
270.	3.00	2	87.0	0.0	0.0	0.0	0.0	0.0	0.0	2.2	3.6	5.3	7.3	9.2	10.5	11.0	10.5
264.	3.00	3	110.0	0.0	0.0	0.0	0.0	0.0	2.8	4.5	6.8	9.2	11.6	13.2	13.8	13.2	11.6
251.	3.00	4	118.0	0.0	0.0	0.0	0.0	3.0	4.8	7.2	9.9	12.4	14.2	14.9	14.2	12.4	9.9
182.	3.00	5	118.0	0.0	0.0	0.0	3.0	4.8	7.2	9.9	12.4	14.2	14.9	14.2	12.4	9.9	7.2
159.	3.00	6	87.0	0.0	0.0	2.2	3.6	5.3	7.3	9.2	10.5	11.0	10.5	9.2	7.3	5.3	3.6
146.	3.00	7	78.0	0.0	2.0	3.2	4.8	6.6	8.2	9.4	9.8	9.4	8.2	6.6	4.8	3.2	2.0
134.	3.00	8	65.0	1.6	2.7	4.0	5.5	6.8	7.8	8.2	7.8	6.8	5.5	4.0	2.7	1.6	0.0
114.	3.00	9	80.0	5.3	4.9	6.7	8.4	9.6	10.1	9.6	8.4	6.7	4.9	3.3	2.0	0.0	0.0
102.	3.00	10	50.0	6.4	4.2	5.3	6.0	6.3	6.0	5.3	4.2	3.1	2.1	1.3	0.0	0.0	0.0
94.	3.00	11	48.0	10.2	5.0	5.8	6.0	5.8	5.0	4.0	2.9	2.0	1.2	0.0	0.0	0.0	0.0
89.	3.00	12	28.0	8.9	3.4	3.5	3.4	2.9	2.4	1.7	1.1	.7	0.0	0.0	0.0	0.0	0.0
83.	3.00	13	17.0	7.4	2.1	2.0	1.8	1.4	1.0	.7	.4	0.0	0.0	0.0	0.0	0.0	0.0
77.	3.00	14	22.0	12.4	2.6	2.3	1.8	1.4	.9	.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
72.	3.00	15	17.0	11.6	1.8	1.4	1.0	.7	.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

67.	3.00	16	10.0	7.9	.8	.6	.4	.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
63.	3.00	17	17.0	14.8	1.0	.7	.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
59.	3.00	18	13.0	12.1	.5	.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
55.	3.00	19	10.0	9.7	.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
51.	3.00	20	7.0	7.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
48.	3.00	21	2.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.	3.00	22	3.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
42.	3.00	23	3.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
39.	3.00	24	2.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36.	3.00	25	2.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
		TOTALS		127.3	31.4	38.1	46.1	54.9	64.0	72.5	80.6	85.2	86.8	84.7	79.0	69.6	58.2
AVERAGE AGE AT TERMINAL PSI					12.29	12.36	12.42	12.54	12.73	12.95	13.15	13.52	13.94	14.40	14.92	15.47	16.09

VALUE IN THOUSANDS OF DOLLARS LOSS RATE IN PERCENT PER YEAR

1

NULOAD - WEIGHT EFFECTS ON PAVEMENT PERFORMANCE
VERSION 1.0 - OCTOBER 1978

LANE-MILES FROM GIVEN AGE SLICE DUE FOR TIMELY OVERLAY IN GIVEN ANALYSIS YEAR

PAVEMENT AGE AT BEGINNING OF A. P.	ANALYSIS YEAR 14	15	16	17	18	19
1	12.9	11.3	9.0	6.6	4.4	2.7
2	9.2	7.3	5.3	3.6	2.2	0.0
3	9.2	6.8	4.5	2.8	0.0	0.0
4	7.2	4.8	3.0	0.0	0.0	0.0
5	4.8	3.0	0.0	0.0	0.0	0.0
6	2.2	0.0	0.0	0.0	0.0	0.0
7	0.0	0.0	0.0	0.0	0.0	0.0
8	0.0	0.0	0.0	0.0	0.0	0.0
9	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0
12	0.0	0.0	0.0	0.0	0.0	0.0
13	0.0	0.0	0.0	0.0	0.0	0.0
14	0.0	0.0	0.0	0.0	0.0	0.0
15	0.0	0.0	0.0	0.0	0.0	0.0
16	0.0	0.0	0.0	0.0	0.0	0.0
17	0.0	0.0	0.0	0.0	0.0	0.0
18	0.0	0.0	0.0	0.0	0.0	0.0
19	0.0	0.0	0.0	0.0	0.0	0.0

20	0.0	0.0	0.0	0.0	0.0	0.0
21	0.0	0.0	0.0	0.0	0.0	0.0
22	0.0	0.0	0.0	0.0	0.0	0.0
23	0.0	0.0	0.0	0.0	0.0	0.0
24	0.0	0.0	0.0	0.0	0.0	0.0
25	0.0	0.0	0.0	0.0	0.0	0.0
TOTALS	45.5	33.1	21.8	12.9	6.6	2.7

AVERAGE AGE AT TERMINAL PSI

16.75	17.42	18.07	18.70	19.33	20.00

VALUE IN THOUSANDS OF DOLLARS   LOSS RATE IN PERCENT PER YEAR

1

NULOAD - WEIGHT EFFECTS ON PAVEMENT PERFORMANCE
VERSION 1.0 - OCTOBER 1978

INTFLX A   INTERSTATE SYSTEM FLEXIBLE SECTION *A*

P E R F O R M A N C E   T A B L E

P R E S E N T   R E G U L A T I O N S

LANE MILES DUE OVERLAY	LANE MILES OVERLAID	YEAR OF OVERLAY	OVERLAY DESIGN SN	OVERLAY THICKNESS	PSI AT BEGINNING OF ANALYSIS	PSI AT END PERIOD	REMAINING LIFE (MILLION 18-KIP EAL)	OVERLAY COST ($/LANE MILE)
31.4	27.8	1.00	5.24	3.57	2.58	2.55	1.698	27280.
38.1	33.8	2.00	5.23	3.56	2.67	2.60	3.348	27221.
46.1	40.9	3.00	5.23	3.55	2.76	2.65	4.948	27158.
54.9	48.7	4.00	5.22	3.54	2.85	2.70	6.479	27050.
64.0	56.8	5.00	5.21	3.51	2.93	2.76	7.918	26888.
72.5	64.3	6.00	5.20	3.49	3.02	2.81	9.268	26696.
80.6	71.5	7.00	5.19	3.47	3.11	2.87	10.566	26526.
85.2	75.6	8.00	5.17	3.43	3.19	2.93	11.668	26214.
86.8	77.0	9.00	5.15	3.38	3.27	2.99	12.663	25881.
84.7	75.1	10.00	5.13	3.33	3.35	3.05	13.553	25448.
79.0	70.0	11.00	5.11	3.28	3.42	3.11	14.320	25065.
69.6	61.7	12.00	5.09	3.23	3.49	3.18	15.002	24679.
58.2	51.6	13.00	5.06	3.17	3.55	3.25	15.562	24258.
45.5	40.4	14.00	5.04	3.12	3.60	3.33	16.051	23841.
33.1	29.4	15.00	5.01	3.06	3.66	3.41	16.480	23431.
21.8	19.3	16.00	4.99	3.01	3.71	3.50	16.896	23059.
12.9	11.4	17.00	4.97	2.97	3.77	3.60	17.280	22705.

6.6	5.8	18.00	4.95	2.92	3.83	3.71	17.641	[illegible]
2.7	2.4	19.00	4.93	2.88	3.89	3.86	17.942	22033.

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NULOAD - WEIGHT EFFECTS ON PAVEMENT PERFORMANCE
VERSION 1.0 - OCTOBER 1978

INTFLX A INTERSTATE SYSTEM FLEXIBLE SECTION *A*

P E R F O R M A N C E   T A B L E

P R O P O S E D   R E G U L A T I O N S

LANE MILES DUE OVERLAY	LANE MILES OVERLAID	YEAR OF OVERLAY	OVERLAY DESIGN SN	OVERLAY THICKNESS	PSI AT BEGINNING OF ANALYSIS	PSI AT END PERIOD	REMAINING LIFE (MILLION 18-KIP EAL)	OVERLAY COST ($/LANE MILE)
31.4	27.8	.72	5.47	4.11	2.58	2.53	1.698	31425.
38.1	33.8	1.45	5.47	4.09	2.67	2.57	3.346	31294.
46.1	40.9	2.18	5.46	4.07	2.76	2.61	4.946	31160.
54.9	48.7	2.91	5.45	4.05	2.85	2.64	6.476	30981.
64.0	56.8	3.65	5.43	4.02	2.93	2.68	7.915	30747.
72.5	64.3	4.40	5.42	3.99	3.02	2.72	9.265	30484.
80.6	71.5	5.14	5.41	3.95	3.11	2.76	10.564	30245.
85.2	75.6	5.89	5.38	3.90	3.19	2.80	11.666	29862.
86.8	77.0	6.65	5.36	3.85	3.27	2.84	12.661	29459.
84.7	75.1	7.40	5.34	3.80	3.35	2.88	13.551	29038.
79.0	70.0	8.16	5.31	3.74	3.42	2.93	14.319	28583.
69.6	61.7	8.93	5.28	3.68	3.49	2.97	15.001	28126.
58.2	51.6	9.70	5.26	3.61	3.55	3.02	15.561	27634.
45.5	40.4	10.47	5.23	3.55	3.60	3.07	16.050	27147.
33.1	29.4	11.24	5.20	3.49	3.66	3.12	16.479	26669.
21.8	19.3	12.02	5.17	3.43	3.71	3.18	16.895	26231.
12.9	11.4	12.80	5.15	3.36	3.77	3.23	17.279	25729.
6.6	5.8	13.59	5.12	3.31	3.83	3.29	17.639	25336.
2.7	2.4	14.38	5.10	3.26	3.89	3.35	17.942	24936.

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NULOAD - WEIGHT EFFECTS ON PAVEMENT PERFORMANCE
VERSION 1.0 - OCTOBER 1978

INTFLX A INTERSTATE SYSTEM FLEXIBLE SECTION *A*

P O T T S   T A B L E

P R E S E N T   R E G U L A T I O N S

ANALYSIS YEAR	LANE MILES IN POTTS	LANE MILES OVERLAID FROM POTTS	OVERLAY DESIGN SN	OVERLAY THICKNESS	PSI AT END OF ANALYSIS PERIOD	OVERLAY COST ($/LANE-MILE)
1	126.8	4.1	4.81	4.72	2.55	36077.
2	126.1	5.0	4.82	4.75	2.60	36315.
3	125.3	6.0	4.84	4.78	2.66	36553.
4	124.3	7.2	4.85	4.81	2.71	36793.
5	123.2	8.4	4.86	4.84	2.77	37032.
6	121.9	9.5	4.88	4.87	2.83	37272.
7	120.5	10.5	4.89	4.90	2.88	37512.
8	119.0	11.1	4.91	4.94	2.94	37753.
9	117.4	11.4	4.92	4.97	3.00	37994.
10	115.9	11.1	4.93	5.00	3.06	38236.
11	114.5	10.3	4.95	5.03	3.12	38477.
12	113.3	9.1	4.96	5.06	3.19	38720.
13	112.3	7.6	4.98	5.09	3.26	38963.
14	111.5	6.0	4.99	5.13	3.33	39206.
15	110.9	4.3	5.00	5.16	3.41	39450.
16	110.5	2.9	5.02	5.19	3.50	39694.
17	110.3	1.7	5.03	5.22	3.59	39938.
18	110.1	.9	5.05	5.25	3.70	40183.
19	110.1	.4	5.06	5.29	3.85	40428.
20	110.1	0.0	5.07	5.32	4.20	40674.

INTFLX A INTERSTATE SYSTEM FLEXIBLE SECTION *A*

P O T T S   T A B L E

P R O P O S E D   R E G U L A T I O N S

ANALYSIS LANE MILES LANE MILES OVERLAY OVERLAY PSI AT END OF OVERLAY COST

YEAR	IN POTTS	OVERLAID FROM POTTS	DESIGN SN	THICKNESS	ANALYSIS PERIOD	($/LANE-MILE)
1	126.8	4.1	5.04	5.24	2.55	40063.
2	126.1	5.0	5.05	5.27	2.60	40308.
3	124.3	13.2	5.07	5.30	2.65	40554.
4	123.2	8.4	5.08	5.33	2.70	40800.
5	121.9	9.5	5.09	5.37	2.76	41046.
6	119.0	21.7	5.11	5.40	2.81	41293.
7	117.4	11.4	5.12	5.43	2.87	41540.
8	115.9	11.1	5.14	5.46	2.92	41788.
9	113.3	19.4	5.16	5.51	2.99	42120.
10	112.3	7.6	5.17	5.54	3.05	42371.
11	111.5	6.0	5.19	5.57	3.11	42621.
12	110.9	4.3	5.20	5.60	3.17	42872.
13	110.3	4.5	5.21	5.64	3.24	43123.
14	110.1	.9	5.23	5.67	3.31	43375.
15	110.1	.4	5.24	5.70	3.39	43627.
16	110.1	0.0	5.26	5.74	3.47	43880.
17	110.1	0.0	5.27	5.77	3.57	44133.
18	110.1	0.0	5.29	5.80	3.68	44386.
19	110.1	0.0	5.30	5.84	3.83	44640.
20	110.1	0.0	5.32	5.87	4.20	44894.

1

NULOAD - WEIGHT EFFECTS ON PAVEMENT PERFORMANCE
VERSION 1.0 - OCTOBER 1978

INTFLX A INTERSTATE SYSTEM FLEXIBLE SECTION *A*

U N D I S C O U N T E D C O S T S

(MILLIONS OF DOLLARS)

YEAR IN ANALYSIS PERIOD	MAINTENANCE PRESENT	MAINTENANCE PROPOSED	OVERLAY PRESENT	OVERLAY PROPOSED
1	.447	.543	.908	1.040
2	.515	.700	1.100	1.258
3	.599	.878	1.332	3.320
4	.699	1.055	1.581	2.088
5	.805	1.214	1.837	2.348
6	.902	1.242	2.069	5.315
7	.968	1.134	2.291	2.740
8	.983	.968	2.403	2.644
9	.944	.767	2.424	4.555

10	.870	.592	2.333	1.749
11	.786	.505	2.153	1.350
12	.714	.485	1.875	.969
13	.669	.525	1.549	.997
14	.656	.632	1.196	.185
15	.679	.776	.859	.075
16	.736	.942	.559	0.000
17	.824	1.115	.327	0.000
18	.936	1.281	.165	0.000
19	1.062	1.432	.067	0.000
20	1.194	1.560	0.000	0.000
TOTALS	15.988	18.345	27.030	30.631

S A L V A G E   V A L U E
(MILLIONS OF DOLLARS)

	ANALYSIS PERIOD BEGINNING	END
PRESENT	-197.739	-118.024
PROPOSED	-197.739	-116.299
DELTA		1.725

NULOAD - WEIGHT EFFECTS ON PAVEMENT PERFORMANCE
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STOP 0 0 0.00 0.00 0.00 0.00 0.00

NULOAD - WEIGHT EFFECTS ON PAVEMENT PERFORMANCE
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SAMPLE SOLUTION USING HYPOTHETICAL STATE DATA
-THIS RUN INTENDED FOR ILLUSTRATIVE PURPOSES ONLY
INTERSTATE SYSTEM, RIGID AND FLEXIBLE.

SECTION NUMBER	SECTION IDENTIFIER	LANE MILES	UNDISCOUNTED DELTA COST	COST RATIO	DELTA SALVAGE VALUE	PRESENT WORTH DELTA COST	COST RATIO	UNIFORM ANNUAL COST DELTA COST	COST RATIO	RATIO OF REMAINING LIFE PROPOSED/PRESENT

```
          1    INTFLX A   1101.   5.959  1.14    1.725  6.003  1.23     .523   1.23         1.01

       TOTAL              1101.   5.959          1.725  6.003           .523

      ALL COSTS ARE IN MILLIONS OF DOLLARS
      4.154 CP SECONDS EXECUTION TIME
/

COST
 JOB COST  H0B5054  PHAI/H085 81/07/15  15.04.10  $   4.75 (NORMAL)
  PF ACCUMULATION RATE PER DAY      $    0.86
COST.
/


SCRIBE,NUDAT
SCRIBE <V02-09> 80/12/03.
*? G/MODEL MAINT/OAL
MODEL MAINT            1
*? 3KL
OVERLAY                2    3
*? -2A5L
PERFORMANCE                4.2       2.5       4.2
14.       11.5      16.
OVERLAY                2    3
95.       7.0       5.00      25.0      .35
OLD SECTIONS           1    0 1500.     10.
*? 2AL
OVERLAY                2    3
*? I
>? NO MAINT
>? -2A4L
>? STOP
SCRIBE RETURNS TO COMMAND MODE.
*? -AL
-2A4L
*? K
*? -2A4L
14.       11.5      16.
NO MAINT
OVERLAY                2    3
95.       7.0       5.00      25.0      .35
*? Q
 * SCRIBE,NUDAT
/REREAAEENUDAT
$REPLACE,NUDAT.
/GET,NUDAT
$GET,NUDAT.
```

APPENDIX C

Volume 1 of the report dealing with the development of evaluation procedure suggests the following refinements and improvements which could enhance the program's utility.

1. Truck weight information should be refined to more clearly indicate the following:

   a. Steering axle weight distribution by truck type and system.
   b. 18k EDLA growth rates by system.
   c. Empty vehicle weight distribution by truck type.
   d. Tridem axle weight distribution by truck type.
   e. Delineation between truck type in weight data (i.e. by AASHTO classification; 3-52 etc.).
   f. More useful data using a more rational interval system (e.g., 2 kips)

2. Improvement of Rigid Pavement Predictions:

   The equivalency factors obtained with the model did not agree with the AASHTO Road Test factors, partly due to the model's tendency to overpredict traffic levels that are projected for forty years, using structure and AASHTO performance equations.

3. Additional Survivor Curves:

The model uses a symmetrical survivor curve (Based on AASHTO Tests) to determine pavement failure age distribution. Left or right-modal curves might be more representative of actual pavement failure age distribution. Verification of this nature as well as additional survivor curves should be supported through field information for primary and secondary systems.

4. Maintenance Effects on Performance:

Although it is agreed that routine maintenance can extend the pavement life, data collected for the study from various State visits was not sufficient to quantify that relationship.

5. Multiply Overlays in Life Cycle:

Currently the program limits the user to make predictions that describe the pavement status during one overlay cycle. A multiple overlay analysis would be useful, particularly in cases of stage type construction.