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16. Abstract This study verified earlier oil field traffic characteristics and documented a procedure for assessing current and future effects of oil field truck traffic on surface-treated pavements. Specific information regarding daily traffic characteristics was photographically obtained at three oil well drilling sites. Associated truck traffic was converted to 18-kip equivalent single axle load repetitions. A computer program was developed to analyze the effects of additional truck axle loadings. The program calculates several types of pavement distress and serviceability parameters to evaluate pavement performance under combined axle loads of intended-use and oil field traffic. A stepwise regression analysis of the information supplied by periodic site inspections of 132 sections led to the development of individual distress equations for rutting, raveling, flushing, alligator cracking, patching, longitudinal and transverse cracking, and failures (potholes). As an assessment tool, the program estimates the current condition of pavements impacted by oil field truck traffic. As a planning tool, the program predicts the future performance of a pavement impacted by projected levels of development. The versatility of the program provides a means of anticipating early pavement failures due to increased axle load repetitions. In its current form, the program also provides the basic framework for computing the effects of other "special-use" truck traffic demands.			
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**ESTIMATING SERVICE LIFE OF SURFACE-TREATED
PAVEMENTS IN OIL FIELD AREAS**

By

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RESEARCH REPORT 299-2

Research Project 2-8-81-299

PHASE II

conducted for

THE STATE DEPARTMENT OF HIGHWAYS AND PUBLIC TRANSPORTATION

by the

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College Station, Texas 77843

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ABSTRACT

This study verified earlier oil field traffic characteristics and documented a procedure for assessing current and future effects of oil field truck traffic on surface-treated pavements. Specific information regarding daily traffic characteristics was photographically obtained at three oil well drilling sites. Associated truck traffic was converted to 18-kip equivalent single axle load repetitions.

A computer program was developed to analyze the effects of additional truck axle loadings. The program calculates several types of pavement distress and serviceability parameters to evaluate pavement performance under combined axle loads of intended-use and oil field traffic.

A detailed discussion is presented on the program's development and an example given of its utility. Comparison of the results illustrated that additional axle load repetitions cause a reduction in pavement service life and increase the severity of many types of pavement distress.

SUMMARY

The principal objectives of this study were to verify oil well traffic characteristics of Phase I and to develop and document a procedure for predicting the reduction in pavement life due to oil field truck traffic.

Oil field traffic at three well sites in Brazos County was monitored using a Super 8-mm camera to photograph vehicles as they entered or left the sites. Analysis of the filmed observations yielded an average total of 1365 trucks during a 60-day drilling period, followed by production traffic estimated at 150 (3-S2 type) per month. Conversations with a petroleum consultant and a local oil well investment firm indicated that production rates tend to follow a "half-life" behavior, that is, an annual production rate decrease of 50 percent per year per well in the observed oil field region. These data served as the basis for the development of the "Oil Field Damage Program".

This program computes the service life of thin surface-treated pavements impacted by oil field traffic. Because predictions of pavement serviceability based on the AASHO Road Test Equations did not appear to agree with the observed performance of thin surface-treated roadways in Texas, the Department has established a Flexible Pavement Data Base in an attempt to monitor the performance of different types of pavement sections. Of the 400 sections in the Data Base, 132 are thin surface-treated pavements. A step-wise regression analysis of the information supplied by periodic site inspections of these 132 sections led to the development of individual distress equations for rutting, raveling, flushing, alligator cracking, patching, longitudinal and transverse cracking, and failures (potholes). These

distress equations, along with an equation for Present Serviceability Index, provide predictions of pavement performance which tend to conform to observed field conditions.

The Oil Field Damage Program is a FORTRAN 77 computer program which uses data describing intended-use traffic, oil field traffic, pavement structure, and site-specific environmental conditions to compute the reduction in service life due to a specified level of oil field development. The program aids in planning rehabilitation strategies by indicating which distress types cause a reduction in service life. Because it accepts oil field development information at any time during the life of a pavement, the program allows for the practical consideration of pavement performance for highways with pavement sections of various ages along a designated route.

IMPLEMENTATION STATEMENT

Phase I of this research demonstrated the potential impact of oil field development on rural highways. The load-intensive traffic associated with oil field development can result in a dramatic reduction in pavement service life. This additional traffic demand accelerates maintenance and reconstruction schedules and creates a financial burden for the Department.

The Oil Field Damage Program developed in this study phase offers two methods of analyzing the effects of oil field development. As an assessment tool, the program estimates the current condition of pavements impacted by oil field truck traffic. As a planning tool, the program predicts the future performance of a pavement impacted by projected levels of development. The versatility of the program provides a means of anticipating early pavement failures due to increased axle load repetitions. In its current form, the program also provides the basic framework for computing the effects of other "special-use" truck traffic demands.

DISCLAIMER

The views, interpretations, analysis, and conclusions expressed or implied in this report are those of the authors. They are not necessarily those of the Texas State Department of Highways and Public Transportation.

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INTRODUCTION

During the late 1970's and early 80's, several Texas counties witnessed a rapid expansion of oil field exploration and development work. The majority of the pavements in these rural areas are surface-treated pavements which typically have a 6-inch flexible base. These pavements were not designed to carry the high intensity of loads associated with oil field traffic, and subsequently, many severe pavement failures occurred. Road problems associated with oil field exploration and development are not unique; they are similar in many respects to other load-intensive commercial hauls, such as coal, timber, and grain.

The Texas State Department of Highways and Public Transportation found that it was incurring considerable additional expense to keep these highways open to traffic, and then to rebuild many of them once the oil field work had moved elsewhere. These additional expenses created a greater demand for the State's maintenance and rehabilitation funds. This problem led to the funding of a project between the Texas State Department of Highways and Public Transportation and the Texas Transportation Institute. The project's main objective is to provide a means of predicting the reduced pavement life from oil field development.

The project has been segregated into several phases. Phase I dealt with quantifying the effect of oil field traffic on rural highways by determining the traffic levels and axle loadings associated with the drilling and production of one oil well. The current work, Phase II, involves defining a procedure by which reductions in pavement life can be calculated. Future efforts are underway to expand the analytic procedures to reflect statewide oil field activity.

Phase I Results

The first phase of this study estimated the effects of oil field truck traffic on light-duty pavements (1). This "special-use" industry can conservatively reduce the expected "intended-use" service life of a thin pavement by approximately 50 percent or more (Figure 1). Although the successful ventures of oil production efforts have resulted in the benefits of economic growth, the adverse effect of this intense, concentrated activity has caused the physical destruction of the pavement surface on the highways serving the entire oil producing area.

Phase II Objectives

The goal of the ongoing research is to examine the effects of oil field traffic on Texas highways. In working toward this goal, several phases of study were envisioned. The objectives of this particular phase are as follows:

1. Verify the oil well traffic characteristics found in Phase I.
2. Develop and document a procedure to predict the reduction in pavement life due to oil field truck traffic.
3. Develop a method for estimating the amount and type of oil field traffic on a particular roadway.
4. Use the Texas Pavement Distress Equations to assess the condition of a pavement due to past oil field traffic.
5. Use the Texas Pavement Distress Equations to predict the condition of a pavement under future levels of oil field development.

This report covers the first two objectives of Phase II. A subsequent report, Report 299-3, addresses the remaining three objectives.

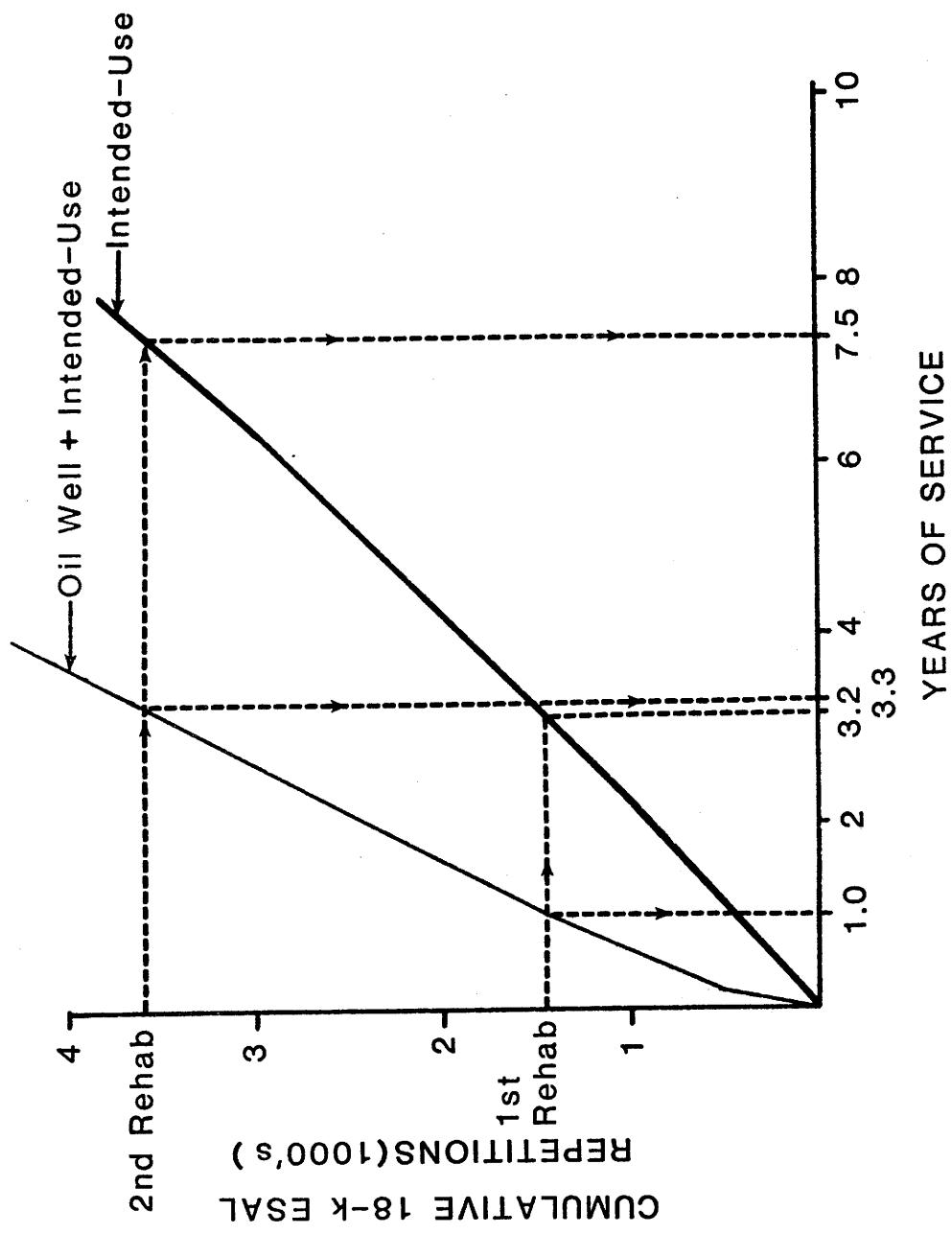


Figure 1. Reduction In Service Life Due to Oil Field Development.

ANALYSIS PROCEDURE

The main work in Phase II of this research project involves defining a procedure by which reductions in pavement life can be calculated. This report, Research Report 299-2, will describe the development of this procedure, while another report, Research Report 299-3, to be published concurrently, will illustrate the procedure. In Report 299-3, the procedure will be used to evaluate the current and future performance of surface-treated pavements impacted by oil field traffic. Together, these two reports will describe the final Phase II research procedure, as illustrated by Figure 2.

The procedure developed in this report is a computer program, the "Oil Field Damage Program", which analyzes surface-treated pavements according to the flow chart shown in Figure 3. Both intended-use and oil field-use traffic characteristics are converted into 18-kip equivalent single axle load repetitions (18-k ESAL) and placed upon a pavement of known structural capability. The program calculates several types of pavement distress and serviceability parameters to evaluate a pavement's performance under the combined axle loads of intended-use and oil field traffic.

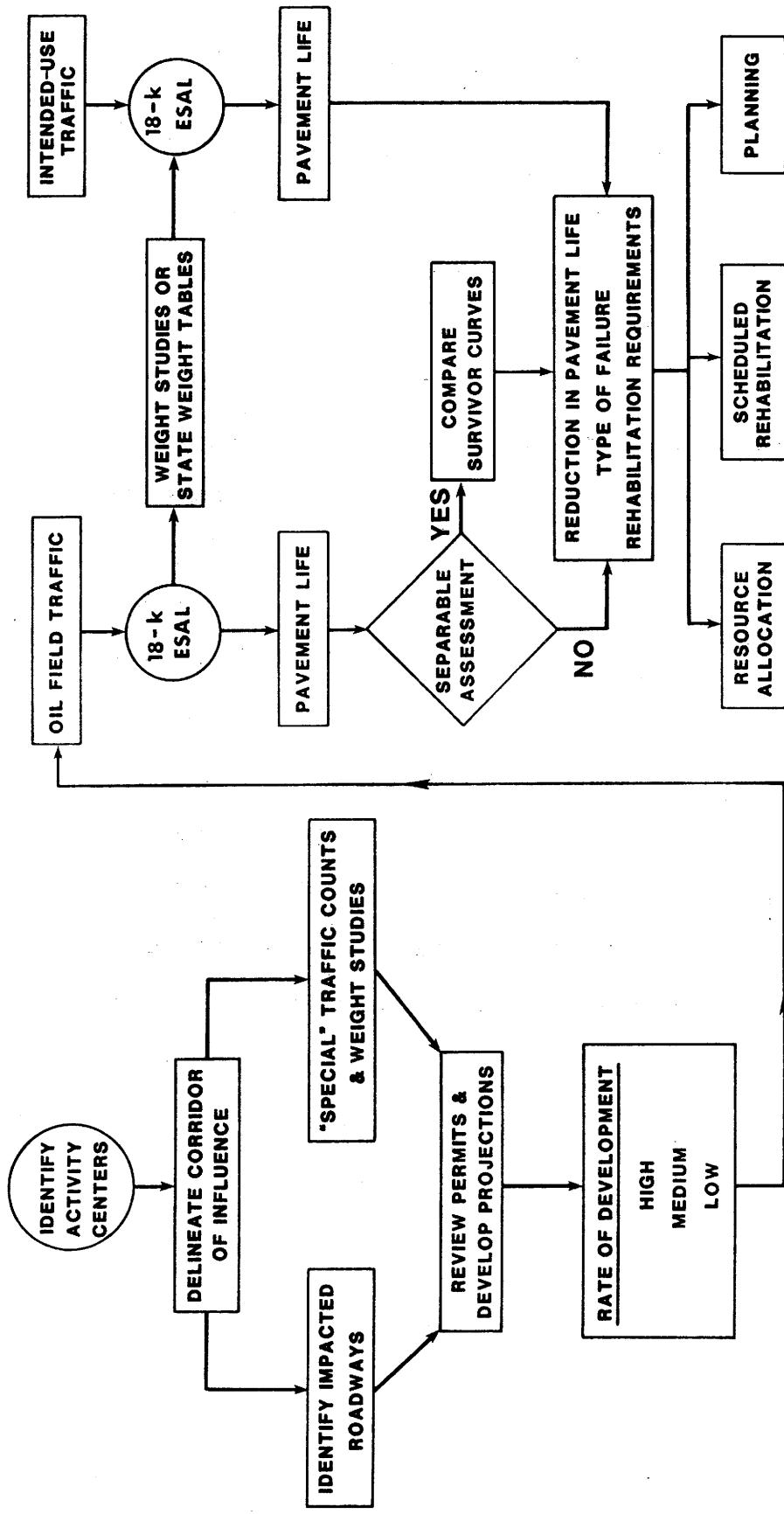


Figure 2. Phase II Research Procedure.

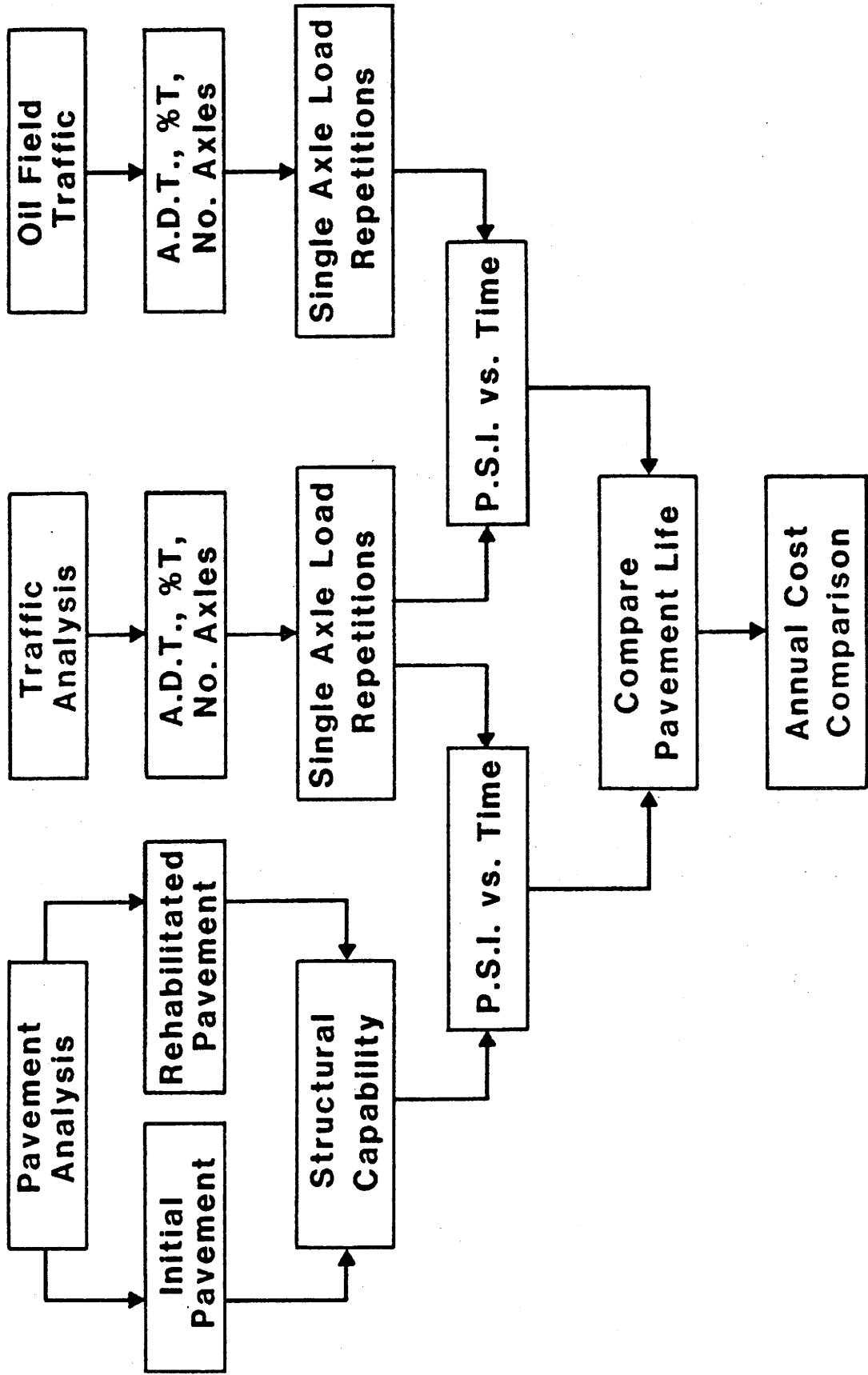


Figure 3. Flow Chart of Analysis Procedure.

TRAFFIC CHARACTERISTICS

Oil Field Traffic

Continuous photographic monitoring recorded transportation related activity during the evolution of an oil well. Monitoring also included daily site visits to talk with servicing companies and field representatives. A Super-8-mm camera photographing all vehicles entering or leaving the drilling site was used to record traffic counts and vehicle characteristics. Conversations with field representatives at the site supplemented this information, thus providing the historical evolution of an oil well site.

Five general activities were found to comprise the sequential development of an oil well. These include: site preparation, rigging-up, drilling, completion (rigging-down), and production. Each fundamental stage of oil well activity developed unique traffic characteristics. Specifically, the vehicle mix included a disproportionate frequency of large vehicles as compared to the vehicle mix of many typical farm-to-market (F.M.) roads.

Description of Traffic Characteristics. In Phase I, as previously mentioned, oil field traffic characteristics were determined by monitoring activity at one oil well site. The results obtained in Phase I indicated a measurable increase in traffic demand. Additional site observations were conducted to verify the magnitude of additional traffic. Filmed observations made at two additional oil well sites further documented vehicle traffic during the development of an oil well. The data was collected using a Timelapse 3410, Super-8-mm camera equipped with a remote control, single

frame adaptor. As each axle passed over the pneumatic tube, a frame was exposed, making a valid count of axles possible. In this way, all vehicle travel was recorded daily.

The vehicles observed entering and leaving the site were classified according to axle combination. Table 1 lists the vehicles defined according to axle combination and corresponding vehicle type code. The vehicle type code was used to assign vehicle load weights to the various axle configurations. Coding of the vehicle type generally follows the AASHTO classification for axle combinations.

Based on the filmed data and on conversations with oil field representatives and the state agencies regulating the production rates, a distribution of truck types was developed. Table 2 lists the final results of the well site observations during the construction of the access roads and drilling phases of the three observed oil well sites. Further review verified an average time period of 60 days for site preparation and drilling. Given allowable production rates set by the Texas Railroad Commission, production truck traffic (3S-2 type) was estimated at 150 trucks per month. For the oil field examined in this study, production traffic is assumed to decrease at a rate of 50 percent per year. Based on conversations with local oil field developers, this decrease is considered to be representative of the actual crude oil production rates in Brazos County.

Table 1. Vehicles Defined According to Axle Combination
and Corresponding Vehicle Type Code.

Axle Combinations	Vehicle Type Code For Axle Combination
<u>Single-Unit Vehicles</u>	
Passenger car	PC
2-Axle, 4 Tires (Pickup Truck)	PU-1
2-Axle, 6 Tires (Pickup Truck)	PU-2
2-Axle, 6 Tires	SU-1
3-Axle	SU-2
<u>Multi-Unit Vehicles</u>	
2-Axle Tractor, 1-Axle Semitrailer	2-S1
2-Axle Tractor, 2-Axle Semitrailer	2-S2
3-Axle Tractor, 1-Axle Semitrailer	3-S1
3-Axle Tractor, 2-Axle Semitrailer	3-S2
2-Axle Tractor, 3-Axle Semitrailer	2-S3
3-Axle Tractor, 3-Axle Semitrailer	3-S3
2-Axle Truck, 1-Axle Balance Trailer	2-1
2-Axle Truck, 2-Axle Full Trailer	2-2
2-Axle Truck, 3-Axle Full Trailer	2-3
3-Axle Truck, 2-Axle Full Trailer	3-2
3-Axle Truck, 3-Axle Full Trailer	3-3
3-Axle Truck, 1-Axle Balance Trailer	3-1
2-Axle Tractor, 1-Axle Semitrailer, 2-Axle Full Trailer	2-S1-2
3-Axle Full Trailer, 1-Axle Semitrailer, 2-Axle Full Trailer	3-S1-2

Table 2. Truck Type Distribution Per Well.

<u>Truck Type</u>	<u>Number of Trucks (60 Day Period)</u>	<u>Percent</u>
SU-1	300	22
SU-2	150	11
2-S1	45	3
3-S2	655	48
2-1	90	7
3-2 or greater	125	9
	<u>1365</u>	<u>100</u>

18-kip Equivalent Single-Axle Load Repetitions

The study procedure requires the computation of 18-kip equivalent single axle load (18-k ESAL) repetitions be applied to a pavement section serving both its intended-use and the additional oil field traffic. An estimate of the number of 18-k ESAL repetitions was determined based on Department loadometer data. Briefly, the total number of trucks in the intended-use condition were distributed by truck type classification and assigned an appropriate axle load as reported in the 1980 Texas rural highway weight tables. Each axle load range was converted into 18-kip equivalents, using equivalency factors for flexible pavements.

The vehicles observed entering and leaving an oil well site were categorized by axle combination and were distributed across axle load ranges. To maintain consistency in the analysis, the final distribution was also based on Department axle weight data. This approach prevented biasing the oil truck traffic, since actual axle weights were not possible. The method was considered "conservative" because it assumed the axle weight distribution of oil trucks was similar to all other truck combinations. However,

many oil field vehicles must secure overweight permits. Review of the film data further collaborated the conservative nature of the study. Many of the axle loads may actually have exceeded the allowable legal limits.

DEVELOPMENT OF THE OIL FIELD DAMAGE PROGRAM

AASHO Road Test Equations

The AASHO Road Test conducted in Ottawa, Illinois, in 1960 has been a major source of pavement performance data. Numerous inferences have been drawn from this test, including the interim guide equations (2) for the design of flexible and rigid pavements. This design equation relates the number of 18-kip equivalent single axle load repetitions required to reach a predetermined terminal serviceability level for any given pavement structure, climatic condition, and subgrade soil.

Damage was defined at the AASHO Road Test to be a normalized score between 0 and 1; when the pavement reaches a terminal condition, the damage is 1. A "damage function" is an equation which describes how the damage proceeds from its initial value to its terminal value and beyond. In the AASHO Road Test (3), the damage function was assumed to be of the form

$$g = \left(\frac{N}{\rho}\right)^{\beta} \quad (1)$$

where g = the damage;

N = the number of 18-kip equivalent single axle loads;

ρ = a constant which equals the number of 18-kip equivalent single axle loads when $g = 1$; and

β = a power which dictates the curvature of the damage function.

In the AASHO Road Test, damage was defined as

$$g = \frac{P_i - P}{P_i - P_t} \quad (2)$$

where P_i = initial serviceability index;

P_t = terminal serviceability index; and

P = present serviceability index.

Values of α and β were found for each pavement section by regressing the logarithm of damage against the logarithm of 18-kip equivalent single axle loads. Further regression analysis determined how α and β depended upon the thickness and stiffness of each pavement layer.

This analysis led to the development of the AASHTO flexible pavement design system, first published as an Interim Design Guide in 1961 and issued as a revised edition in 1972 (2). A design equation similar to the AASHO equation was required for this study in order to predict reductions in pavement life caused by the oil field traffic. However, the AASHTO design equation is recommended for flexible pavements with a minimum asphalt surfacing thickness of 2 inches (3). As such, the researchers expected that the AASHO equation might not yield satisfactory estimates of pavement life for the thin surface-treated pavements under investigation in this study. With a structural number of approximately 1 to 1.5, the AASHO equation predicts a life for Texas pavements of less than 5000 18-kip equivalent single axle loads. However, this is considerably less than has been observed on "in-service" thin pavements in the state. For these reasons, it was decided to develop new performance equations for thin flexible pavements in Texas.

Texas Flexible Pavement Data Base

As the AASHO Road Test drew to a close, one of the strongest recommendations made by the Test Staff was that "satellite" studies should be

made in other parts of the country in order to determine, with some objectivity, the real effects of subgrade and climate.

Texas participated in these studies with the establishment of a Flexible Pavement Data Base (4) containing detailed data on over 400 sections of pavement. The sections were chosen by a stratified random selection process which gave a reasonably uniform distribution of pavement type, age, materials, layer thickness, soil types, and climate. Of these 400 sections, 132 were on thin surface-treated pavements on farm-to-market type routes. These thin pavement sections were chosen for analysis in this study. They typically carry between 100 and 750 vehicles per day and were constructed with granular base courses ranging in thickness from 4 to 10 inches. All of these sections originally had a single or double seal surfacing, and many have received additional seal coat treatments.

Data collection of these sections started in 1972 when each section's full construction, maintenance, and traffic history was compiled. Riding quality (PSI), distress, and skid surveys have been made periodically on all sections since 1973. In most cases, five or six separate observations have been made on each section since the survey began.

During the distress survey, the following eight types of distress were observed: alligator cracking, transverse cracking, longitudinal cracking, rutting, raveling, flushing (or bleeding), failures (potholes), and patching. Each of these were rated for its area and severity of distress according to the distress identification manual prepared for the State of Texas (5).

Texas Pavement Distress Equations

In this study, a different form of damage function was assumed which produces a sigmoidal (S-shaped) curve, a shape that appears to reproduce long term pavement distress and performance better than does the assumed form of the AASHO Road Test damage function (6, 7, 8). The assumed form of the damage function for Texas flexible pavements is

$$g = \exp - \left(\frac{\rho}{N} \right)^{\beta}$$

where g = the normalized damage;

N = the number of 18-kip equivalent single axles; and
 ρ , β , are constants for each pavement section.

Space does not permit a full description of the analysis undertaken to produce the pavement performance equations used in this study. However, the procedure and typical equations have been published elsewhere (9). An overview of the procedure is as follows:

1. For each pavement section, the observed distress and serviceability index histories were analyzed to determine the values of ρ and β .
2. Regression analysis, using SAS (10) stepwise regression, was then performed to explain the variations between sections of the same pavement type. The final regression equations are as shown:

$$\rho = f(\text{climate, base thickness, subgrade properties, etc.})$$

An example equation is given below for rutting area:

$$\begin{aligned} \rho = [-0.1035 + 0.00549 (\text{AVT}) 0.00670 (\text{D}) - 0.0015 (\text{LL}) \\ + 0.00162 (\text{PI}) + 0.00077 (\text{FTC})] \times 10^6 \text{ with } R^2 = 0.38 \end{aligned}$$

where AVT = average district temperature °F = 50°F;

D = thickness of flexible base course;

LL = liquid limit of subgrade soil;

PI = plasticity index of subgrade soil; and

FTC = average number of annual air freeze-thaw cycles.

Equations such as the above have been generated for each of the seven distress types and for present serviceability index. The correlation coefficients, R^2 , of these equations, in general, range from 0.30 to 0.60. For a few distress types, particularly raveling and flushing, no acceptable models were found. In these instances, the mean values of ρ and/or β were used for predictive purposes.

Several runs were made to test the validity of predicting pavement performance with these regression equations. Such a prediction using the PSI equation is shown in Figure 4 for Texas F.M. 556 in District 19, which is a section in the earlier described TTI flexible pavement data base. This section was reconstructed in 1969, and PSI measurements were made in 1974 thru 1977.

As can be seen from Figure 4, the Texas regression equations fit the observed data very well. However, the AASHO Road Test Equation does not do a good job of predicting actual performance. The pavement depicted in Figure 4 has a Structural Number of approximately 1.0. The AASHO equation predicted a life until $PSI = 1.5$ of 5000 18-k ESALs. Under actual traffic levels, these axle repetitions would be achieved in the first six months of service.

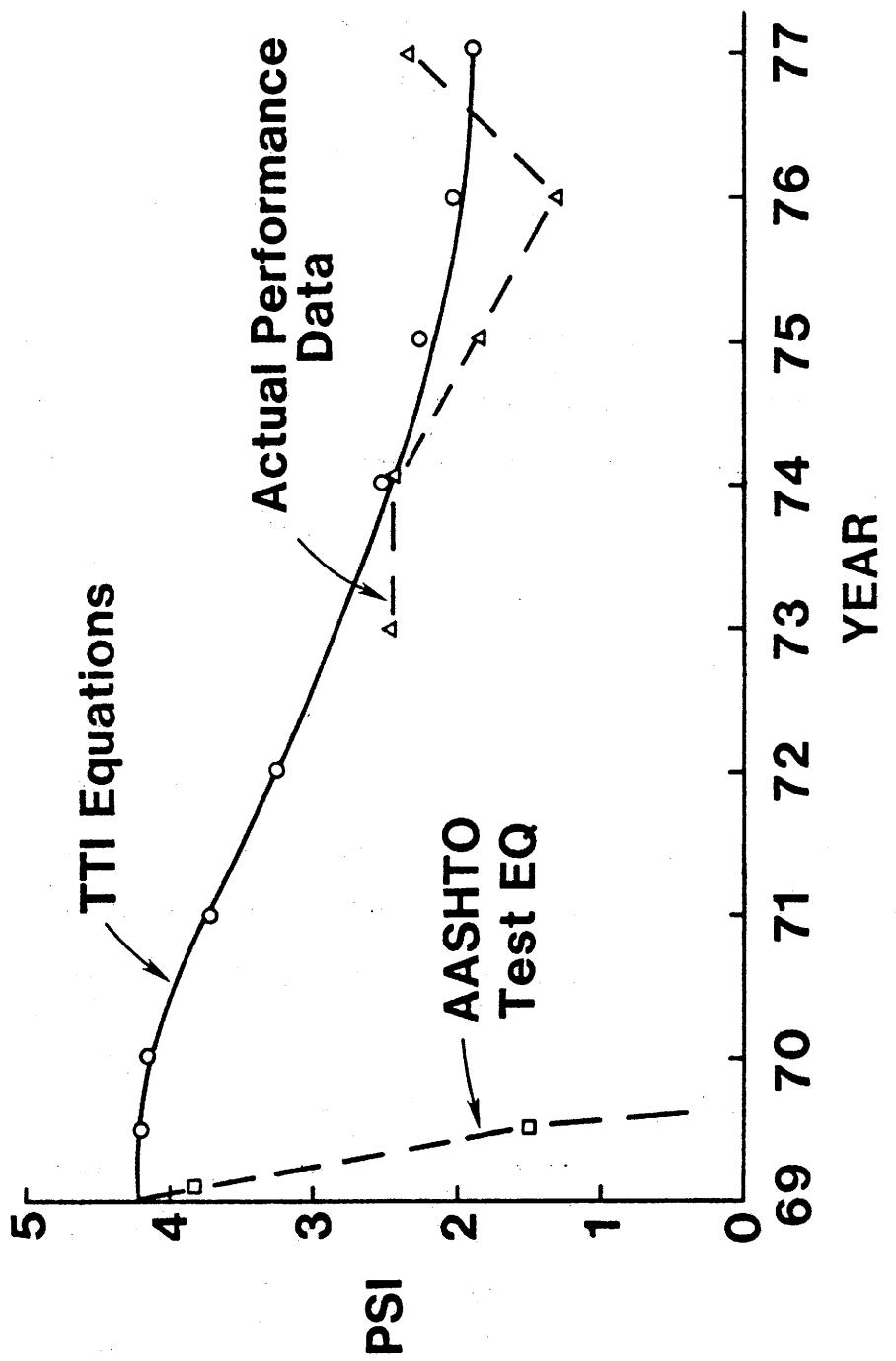


Figure 4. Regression Equation Versus Actual Performance.

Pavement Score. In the AASHO Road Test, damage was defined in terms of reduction in present serviceability index (PSI). In this study, damage was made more general by applying it to distress as well as to a loss of serviceability index. Pavement condition (damage) was expressed in terms of a composite index which combines distress with loss in serviceability to produce a Pavement Score. Several states and agencies, including Arizona, Florida, Utah, and the U.S. Air Force, are using such a composite index (11). In general, these indices are used to determine which pavement sections are most in need of rehabilitation, the section with the lowest score being the one most in need of repair.

Texas also uses this pavement score approach (12). A pavement utility score (range 0-1) is calculated using the following equation. The final pavement score is equal to this utility score x 100:

$$\text{Pavement Utility Score} = U_{\text{RIDE}}^{a_1} \times U_{\text{DIST}}^{a_2}$$

Where U_{RIDE} = the riding quality utility score of range 0-1;

U_{DIST} = the visual distress utility score of range 0-1; and

a_1, a_2 are weighting factors on each utility score.

The visual distress utility score is further defined as

$$U_{\text{DIST}} = (U_{\text{rut}})^{b_1} (U_{\text{ravel}})^{b_2} (U_{\text{flush}})^{b_3} (U_{\text{failures}})^{b_4} \\ (U_{\text{allig.}})^{b_5} (U_{\text{long.}})^{b_6} (U_{\text{trans.}})^{b_7}$$

Where each U_i value is determined from the visual inspection data and has a range of 0 to 1, the b_i are weighting factors.

Using the Texas definition of pavement score, if any single utility value becomes low, the Pavement Utility score will be low. For instance, if the highway's ride value falls to a critical level, then the pavement score will drop to a failure level. Alternatively, a pavement score may reach failure by a combination of distress types while still maintaining a high PSI. In Texas, new pavements have a pavement score of 100, and for surface-treated pavements, failure level is defined to be a pavement score of 35.

With the Texas Pavement Evaluation System (13), this pavement score is used to determine which strategy should be used to rehabilitate those pavements below minimum score. This is done by examining what are the principal causes of a low pavement score. For surface type distresses, (e.g., transverse cracking, raveling, or flushing), a seal coat would be recommended. For other load associated distress types, (e.g., severe rutting, alligator cracking, failures or loss in PSI), a sectional or full reconstruction would be recommended.

Oil Field Damage Program. A computer program was written to incorporate the Texas Pavement Distress Equations and pavement score concepts discussed above. The input required to make predictions of pavement performance are as follows:

- Average daily traffic.
- Percentage of trucks.
- Flexible base thickness.
- Subgrade Atterberg limits (PI, LL), obtained from construction records or county soil reports.

- Section maximum dynaflect deflection, obtained from a field observation or elastic layered analysis.
- Texas county number. For each of the 254 Texas counties, the program has stored the relevant climatic data, such as rainfall and average temperatures.

The program uses the input traffic data to calculate the expected 18-kip loading for the analysis period (10 years). It then uses the distress equations to predict pavement condition and hence pavement score for each year in the analysis period. When the pavement score reaches the failure level (35), the number of months to failure is calculated. Once failure has occurred, it is then possible to determine which distress types have caused the reduction in pavement life (Figure 5) and, consequently, which rehabilitation strategy would be most appropriate.

The three curves illustrate the predicted change in pavement score for pavements with three different granular base thicknesses. The important points from this figure are (1) as expected, the thinner pavements require rehabilitation much earlier, and (2) the most significant distresses on the thin 4-inch pavements are rutting and loss of PSI, which would indicate that costly pavement strengthening is required. However, the 8-inch pavement only requires a seal coat.

The above described work has concentrated on the development of a predictive procedure to calculate distress values for any level of 18-kip equivalent single axle loads. The developed computer program has been

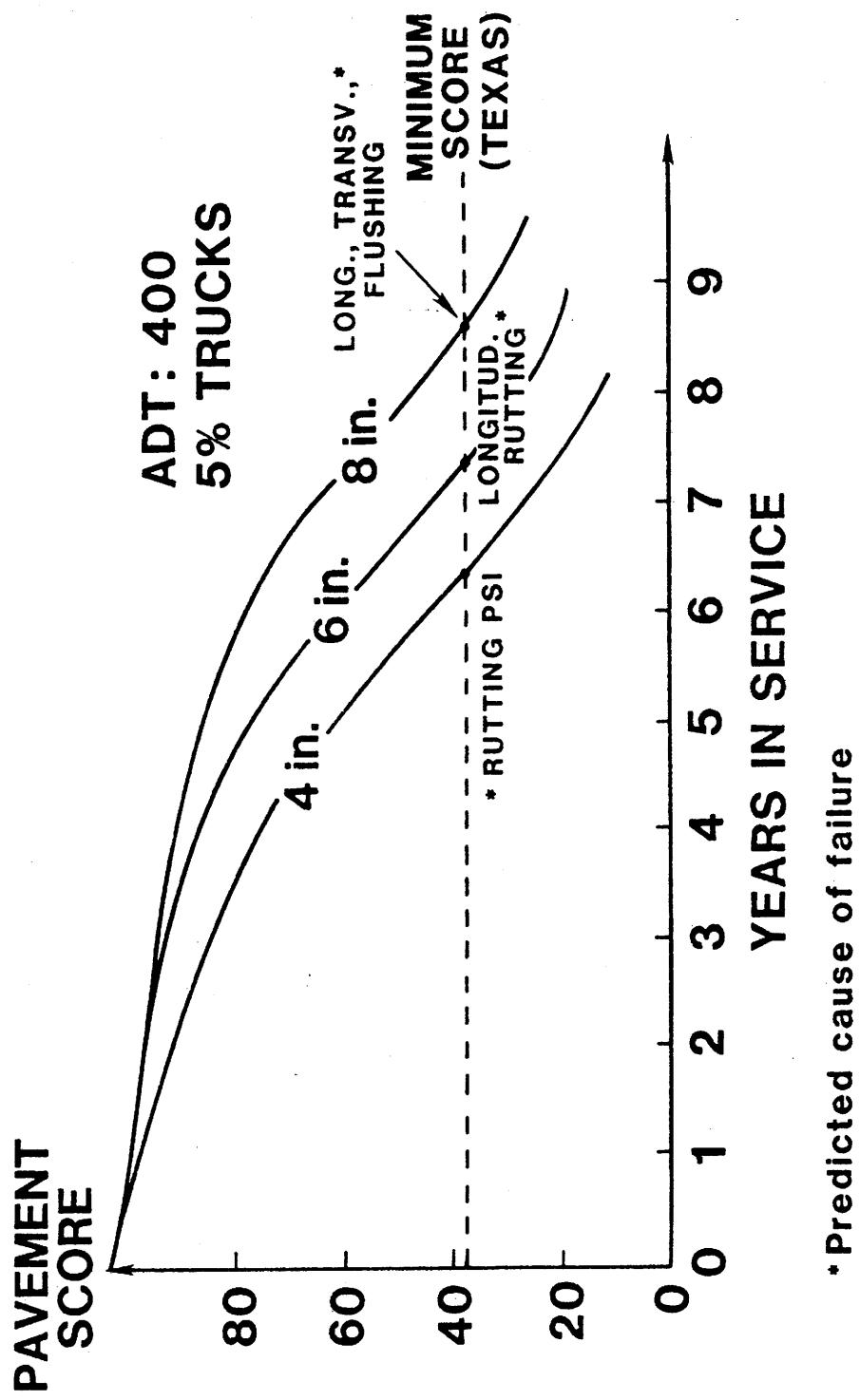
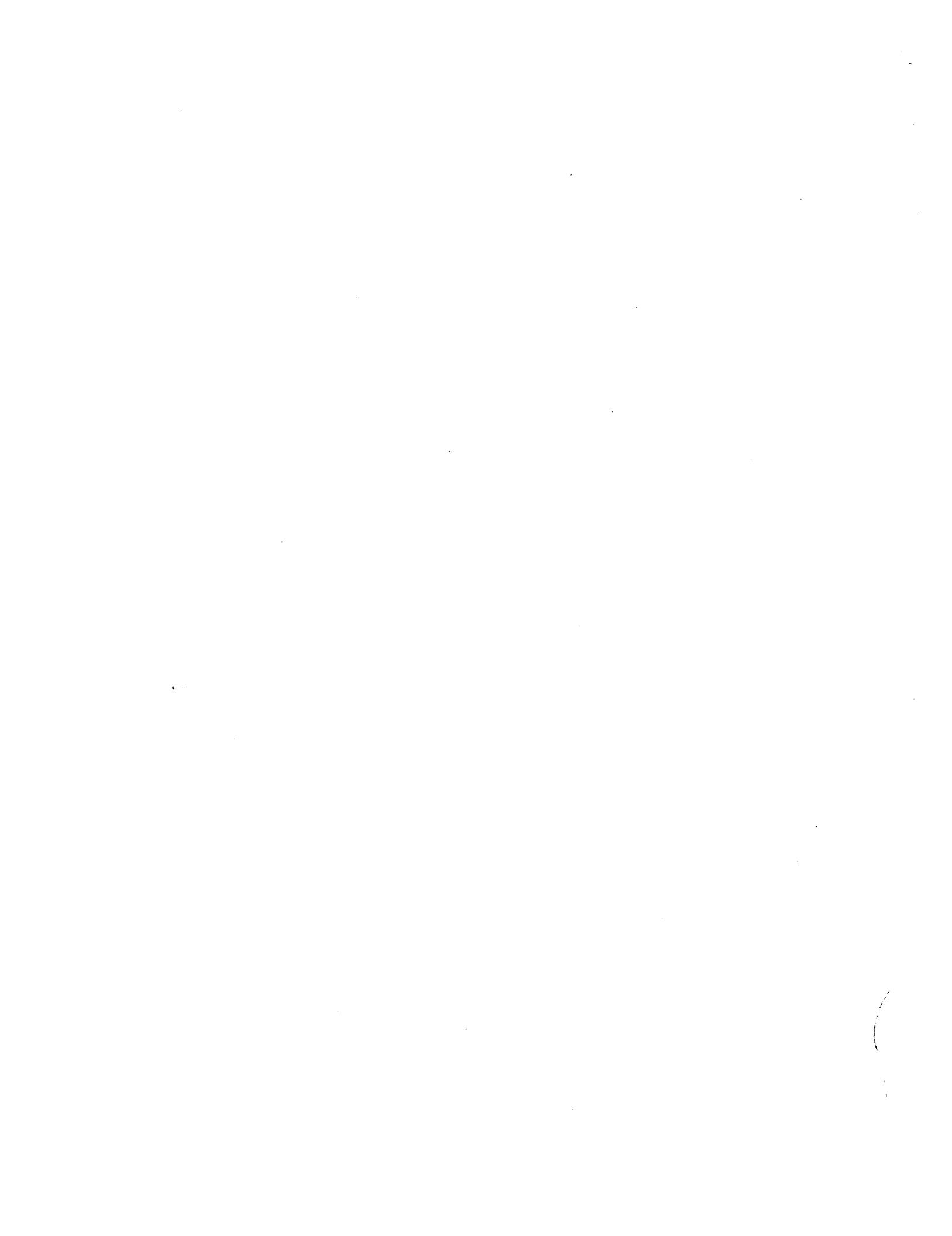


Figure 5. Pavement Score versus Time.

extended to permit analysis of what impact oil field development and servicing work will have on pavement performance. A case study describing this work is presented in the next section.



STUDY EXAMPLE

As previously discussed, considerable progress has been made since Report 299-1, "The Effects of Oil Field Development on Rural Highways," in calculating reductions in pavement life associated with oil-related traffic. It is thought that the following case study is an appropriate method of demonstrating the potential of the proposed approach.

Site Conditions

An oil field impacted area in Brazos County, Texas, was chosen for this example. Average climatic data for this county, found by referring to the States' computerized weather data files, are tabulated below:

Mean Annual Temperature °F	67.7
Thorntwaite Index	4.59
Mean Annual Air Freeze-Thaw Cycles	24.84

Typical subgrade properties are:

Liquid Limit	41.63
Plasticity Index	12

The range of pavement structural variables (thickness of granular base and dynaflect maximum deflection) were selected to represent the range of strong to weak pavements found in Brazos County.

For the purpose of this analysis, the highway was assumed to carry an intended-use ADT of 500 vehicles/day, 5 percent of which were trucks; its growth rate was also assumed to be 5 percent per year.

Traffic Analysis

The first phase of the analysis included a calculation of the intended-use traffic levels over a 10-year analysis period. Oil field traffic levels were calculated assuming that the highway under investigation began serving oil field development traffic 1 month after reconstruction. In this example, three levels of drilling activity were investigated: 1 well/month, 3 wells/month, and 6 wells/month. A sample of the traffic level predictions is shown in Table 3.

Table 3. Cumulative ADT and 18-k ESAL Repetitions
for Intended-Use and Intended-Use + 1 Oil Well/Month
(Starting in Month 1).

Pavement Age Months	Intended-Use Analysis		Intended + 1 Oil Well/Month	
	ADT	18-k ESAL	ADT	18-k ESAL
1	7,500	376	12,000	645
12	92,091	4,622	278,091	14,566
36	290,648	14,588	1,292,272	64,742
60	510,040	25,600	2,525,568	124,988
120	1,164,589	58,452	3,843,217	188,093

Pavement Performance

The traffic levels presented in Table 3 were used with the previously described regression equations to predict the pavement's present serviceability index and distress levels under both the intended and intended-plus-oil-field traffic.

The relationship of predicted present serviceability index (PSI) versus cumulative 18-k ESAL repetitions for the assumed site conditions is shown in Figure 6. Two typical base thicknesses (6-inch and 10-inch) for surface-treated pavements were calculated. The resulting "design curves" generally follow an expected trend of rapid PSI decline on very thin pavements and extended service on thicker bases.

The reduction in Present Serviceability Index caused by the oil field traffic is shown in Figure 7. This thin surface-treated pavement with a 6-inch granular base was impacted with oil field traffic 1 month after reconstruction.

As described earlier, the pavement's life in this study had been defined in terms of pavement score, which is a composite index including both PSI and distress levels. Figure 8 presents the pavement's performance in terms of reduced pavement score. The time to failure under each level of oil field activity is listed in Table 4.

Table 4. Predicted Time to Failure for 6" Pavement Under Various Traffic Levels (Drilling Starting in Month 1).

Traffic Level	Time to Failure (Months)	Reduction in Life (Months)
Intended + 0 Well/Month	97	0
Intended + 1 Well/Month	29	68
Intended + 3 Wells/Month	17	80
Intended + 6 Wells/Month	10	87

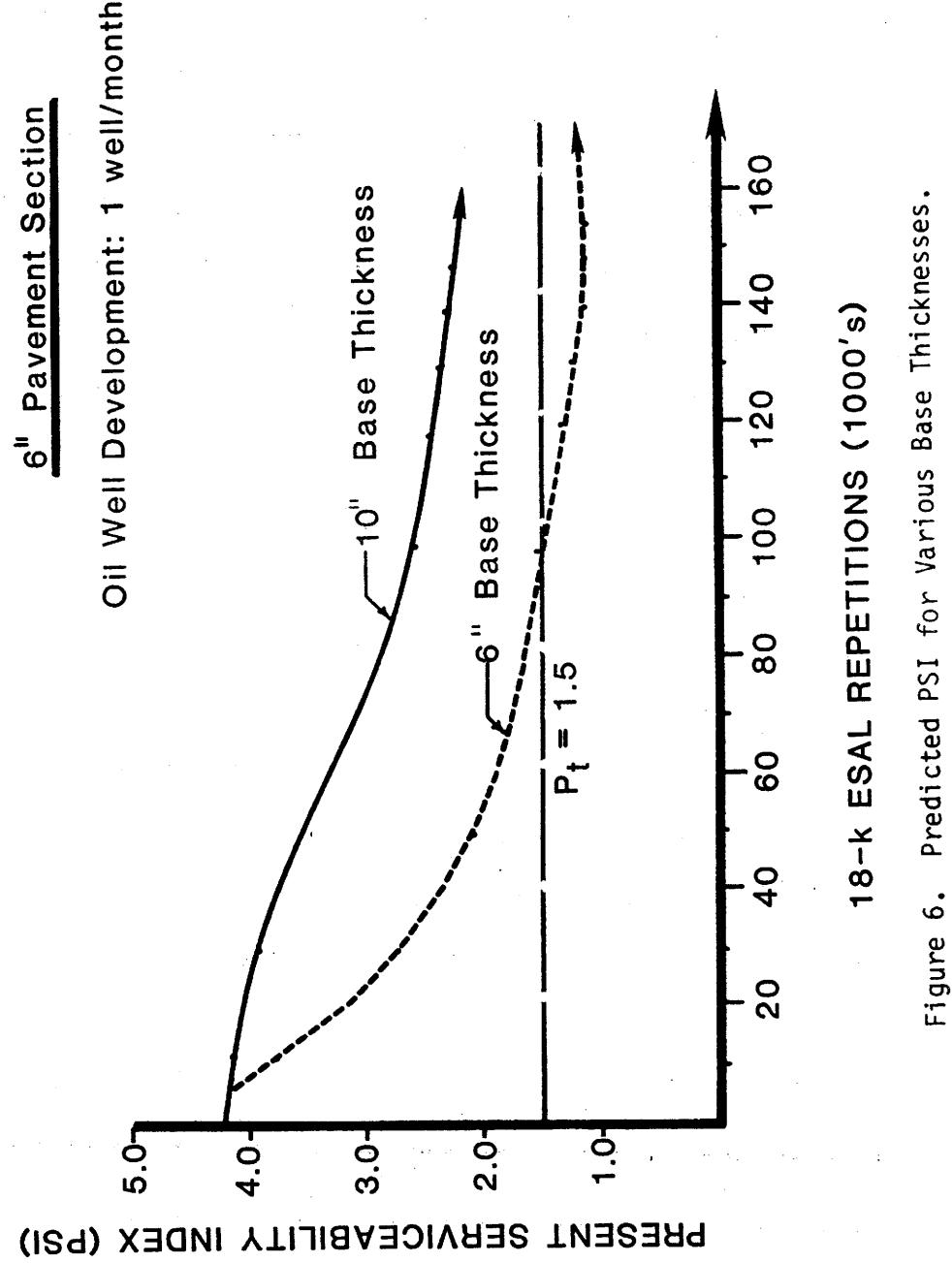


Figure 6. Predicted PSI for Various Base Thicknesses.

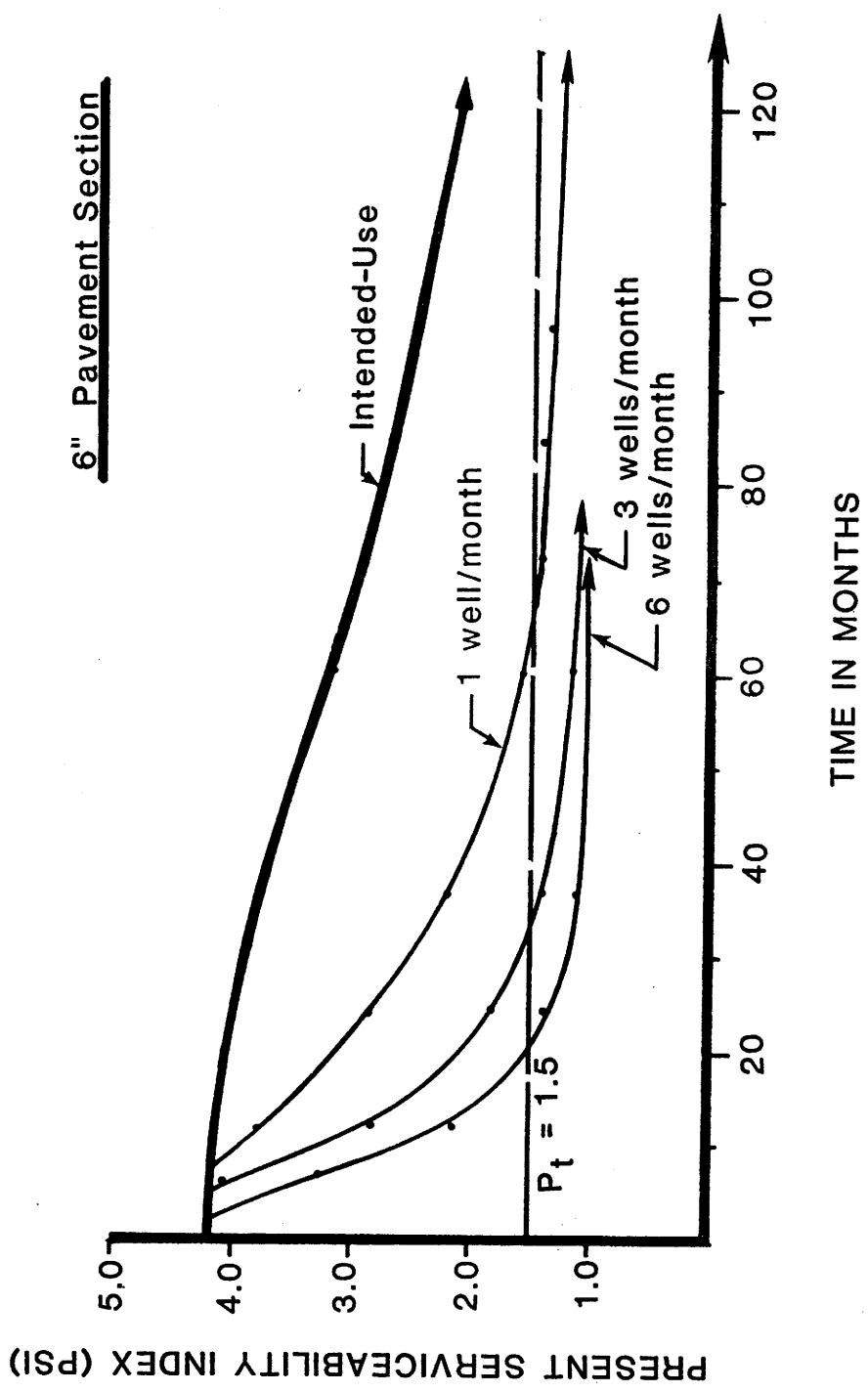


Figure 7. Predicted PSI With Oil Field Development.

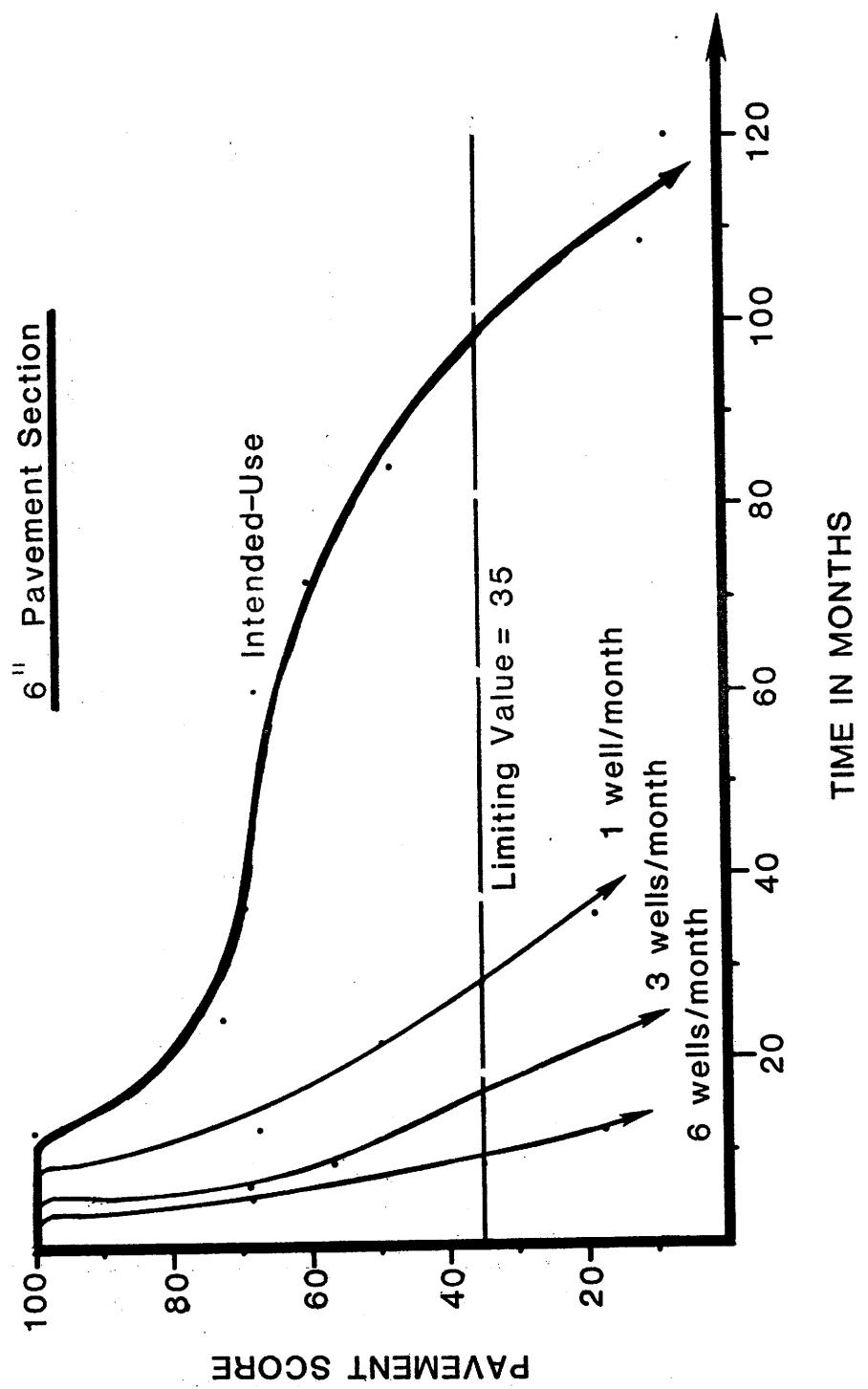


Figure 8. Predicted Pavement Score With Oil Field Development.

As would be expected, the increasing oil field traffic drastically reduces time to failure of these thin pavements. Under oil field traffic associated with a development rate of 1 well/month, the highway life was reduced from 97 to 29 months. When the oil field traffic was impacted in month 1, the newly-reconstructed highway still had a perfect score of 100. In less than three years, this score had been reduced to the failure level at which point the highway required total reconstruction.

The analysis of present serviceability index levels and distress levels at failure indicates that under intended-use traffic, the primary causes of the pavement score reaching failure level are surface distress types (transverse cracking, raveling, and flushing). However, under the oil field traffic with its high intensity of heavy traffic, load associated distresses (rutting and alligatoring) become the primary cause of pavement failure.

These results are not surprising. It is common to find many thin pavements which only require regular reseals to prolong their lives. However, when these pavements carry much heavier than anticipated traffic, rapid pavement deterioration can result. The implication of this is that failure under intended-use traffic will typically require only a seal coat to prolong pavement life, whereas failure under intense oil field traffic will require earlier full reconstruction.

Pavement Age. The study example demonstrated the effects of oil field truck traffic on a newly reconstructed roadway. The computer program can also be applied to the effect of oil field traffic on a road at any time in the pavement's life. This feature allows for the practical consideration of pavement performance for highways with varying ages of pavement life. Figure 9 depicts pavement performance over time for a pavement impacted by

6" Pavement Section

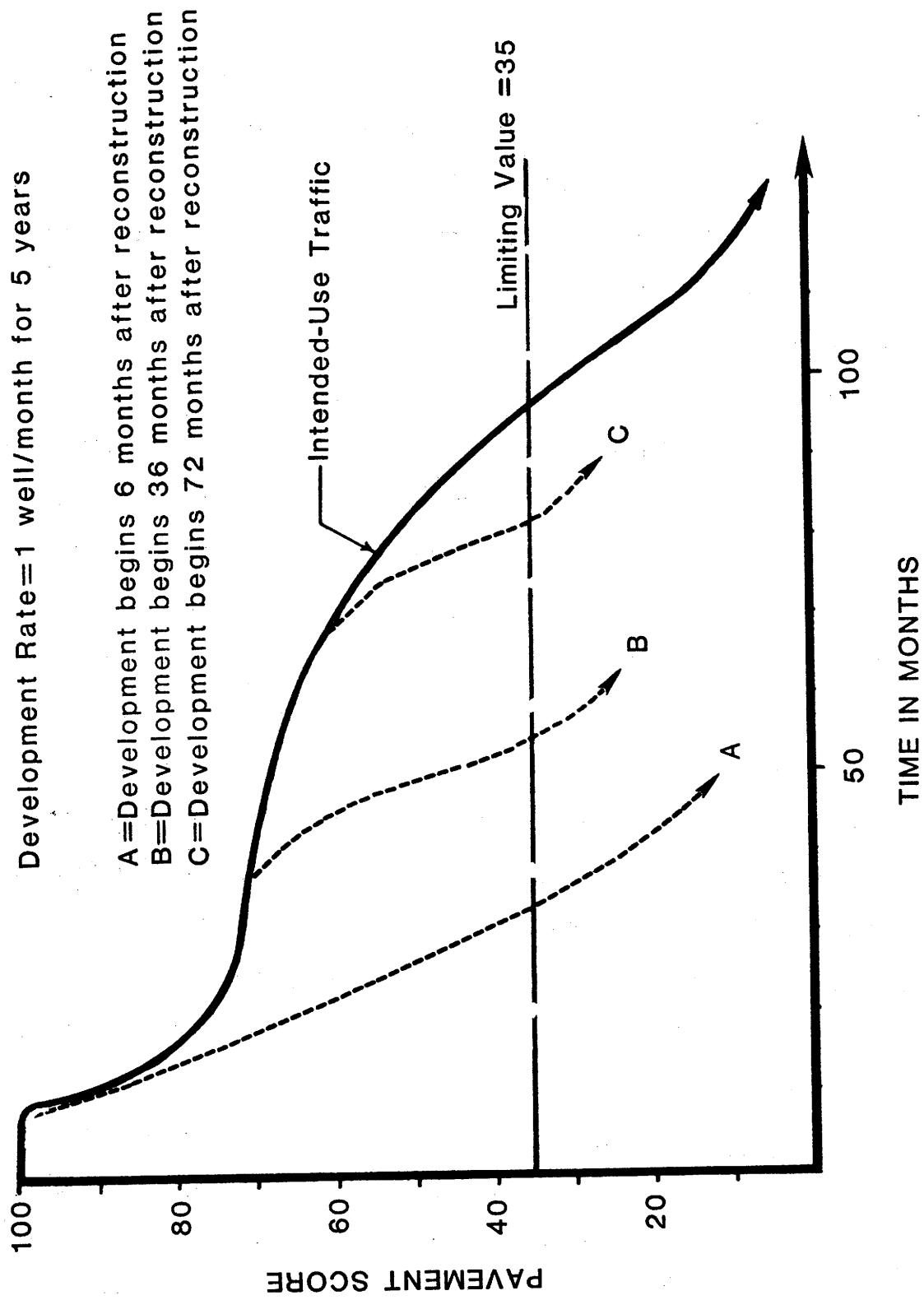


Figure 9. Effect of Pavement Age Upon Loss of Service Life.

the same rate of oil development, but at different points in time. Although no specific conclusions can be drawn, the program was shown to be useful for analyzing pavement sections of various ages along a designated route.

CONCLUSIONS AND RECOMMENDATIONS

This report describes the development of a computer program to be used in estimating the service life of thin surface-treatment pavement impacted by oil field truck traffic. The program uses site-specific environmental, pavement, and traffic data to compare the service life of a light-duty rural roadway impacted by intended-use and oil field traffic.

Service life of a roadway is usually described by its Present Serviceability Index (PSI), which is a measure of ride quality. The program computes PSI, but it also computes area and severity ratings for many types of pavement distress, using distress equations developed from site inspections of in-service, light-duty rural roadways. These area and severity ratings, combine with PSI into a single index--pavement score--which acts as a more complete predictor of pavement condition.

Recommendations for Implementation

The Oil Field Damage Program has both assessment and predictive applications. As an assessment tool, the program can aid officials in allocating current funds to those roads which are in particular need of maintenance or reconstruction. Because it describes pavement distress as well as ride quality, the program can also aid in determining reconstruction strategies for impacted roadways.

Predictive applications of the Oil Field Damage Program make it suitable for determining long-range maintenance and reconstruction needs for

roadways to be impacted by future oil field development. The versatility of the program not only would allow a highway agency to predict where work will be needed, but also the type of work required and when it should be done.

Recommendations for Future Research

In its current form, the Oil Field Damage Program determines the impact of current and future oil field traffic upon light-duty rural highways. Future research should involve making modifications to the existing program, enabling it to compute the effects of other types of load-intensive, special-use traffic.

Such a modified program should be "user-friendly" so that persons of varying technical backgrounds could use it. Its versatility and simplicity would make it attractive to highway agencies not only within the oil field regions of Texas but also to those agencies within other special-use truck traffic development areas. The Oil Field Damage Program in its current form provides the basic framework for computing the effects of "special-use" traffic on light-duty roadways.

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APPENDIX A

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A GUIDE TO RUNNING THE OIL FIELD DAMAGE PROGRAM

Documentation of the Program

This section describes the Oil Field Damage Program which has been developed under Project 299-2. A flow chart of the program is given in Figure A-1, and a complete listing is presented at the end of this appendix. The flow chart has been limited to describing the functions of the main subroutines and arrays used in the program. Description of the program variables is presented in the program comments.

In order to demonstrate how to run the program, a case study will be presented which describes the preparation of the input data and the required Job Control Language. The program was run on an Amdahl 470 V/6 machine at Texas A&M University with the FORTRAN 77 compiler. This configuration is compatible with the Texas Highway Department's requirements.

Description of Case Study Example

The program to be run demonstrates the effects of oil field traffic on an F.M. route in Brazos County (county number 21). The highway currently carries an intended use traffic of 500 vehicles/day, 5 percent of which are trucks. A 5 percent growth in ADT is estimated to be appropriate for this section. The highway structure consists of a 6-inch flexible base layer on top of a sandy/clay subgrade with a Liquid Limit of 41.63 and a Plasticity Index of 12.0.

Figure A-1. Flow Chart of Oil Field Damage Program.

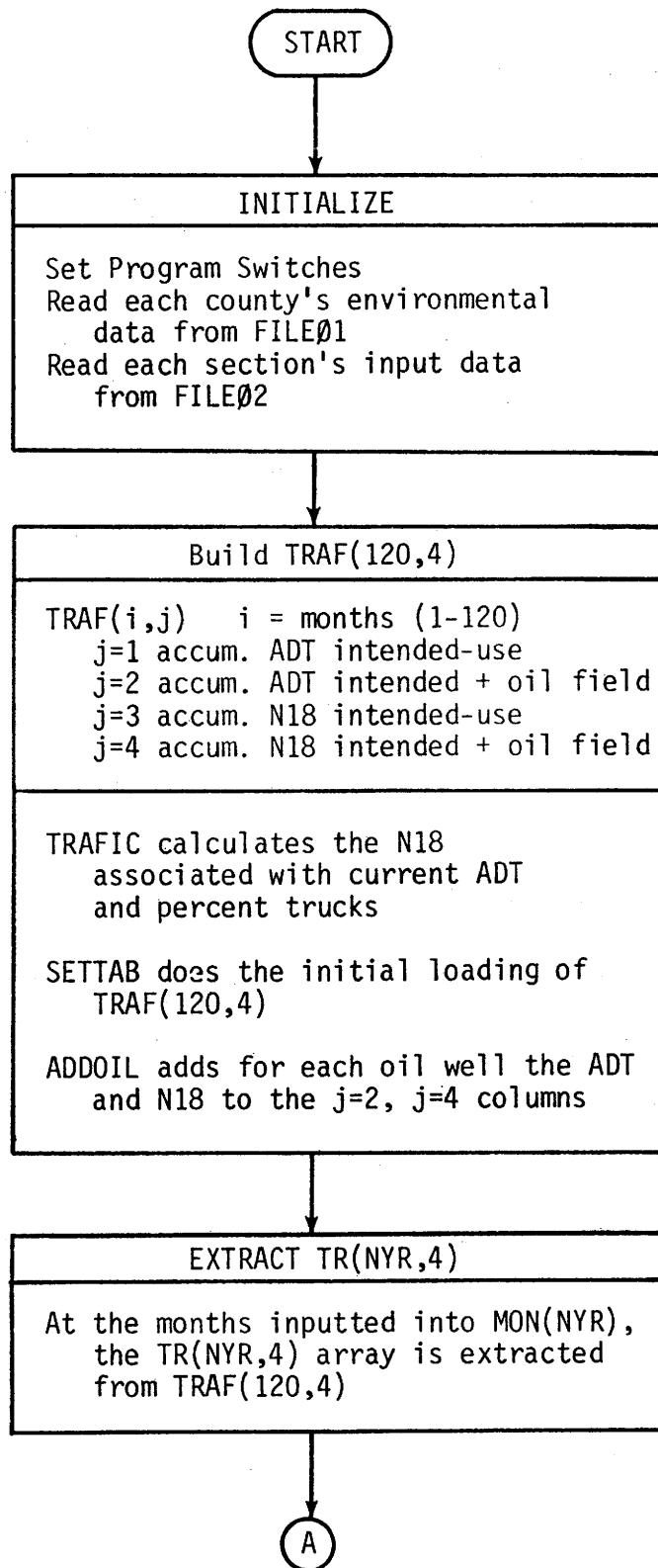
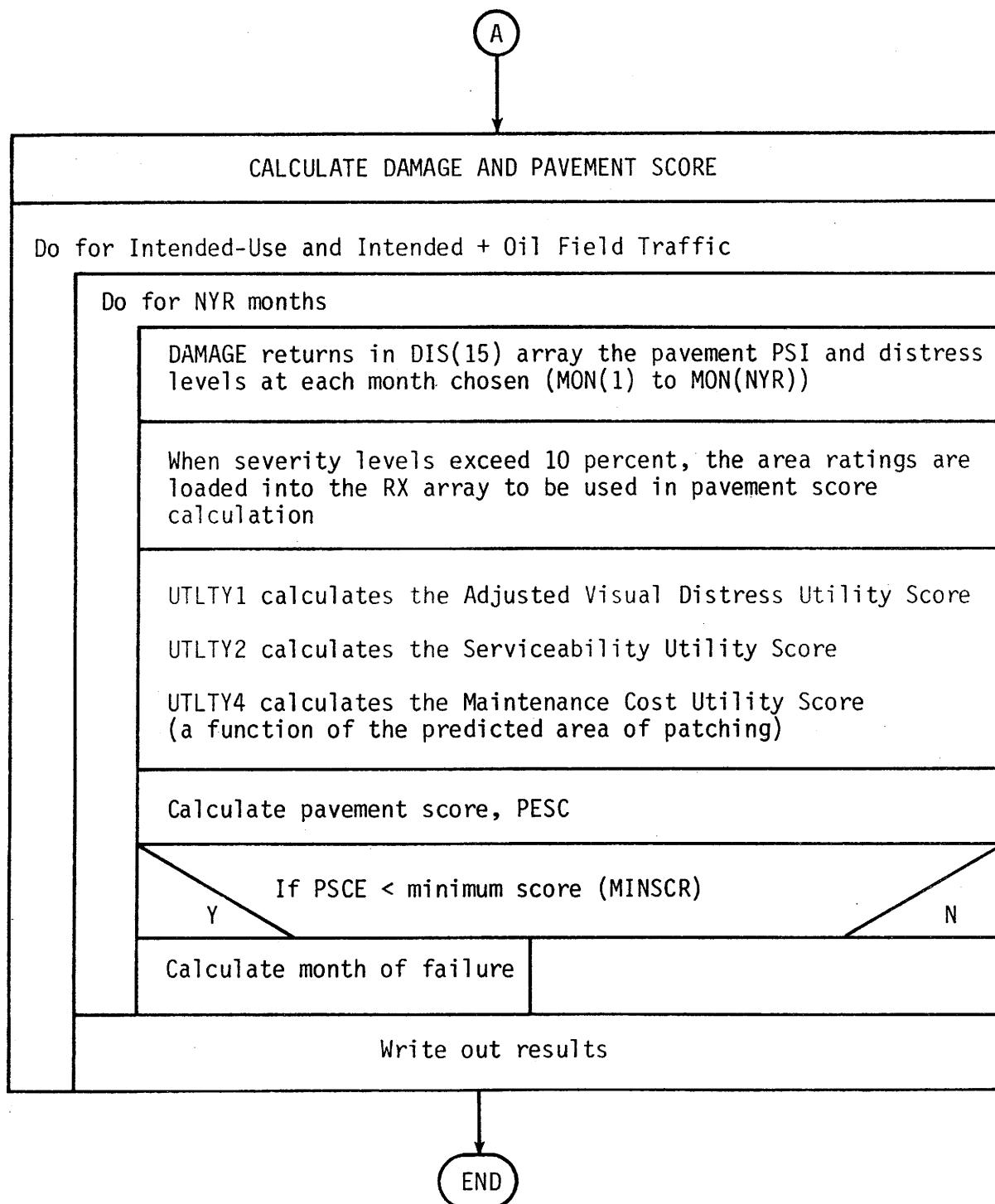


Figure A-1. Flow Chart of Oil Field Damage Program (cont.).



The highway is to be impacted with the following oil field traffic:

Month Oil Field Development Starts	Number of Wells Drilled
1	1
2	1
3	1
4	1
5	1
.	.
.	.
.	.
60	1

At the beginning of the analysis period, the highway is presumed to be in perfect condition, with zero distresses present and a present serviceability index of 4.20.

Preparation of Input Data

The program reads input data from the following two files:

FILE01 (FT01F001, fixed file NOT user supplied)

This file contains the required environmental data for each of the 254 counties in Texas, one county per record. Table A-1 below shows the first five and last five records from this file, which are the required environmental data for counties 1 through 5 and 250 through 254.

Table A-1. Extracts From FILE01.

1	12.5	3.57	4.82	0.900	76.7	65.4
2	-39.3	1.14	8.48	0.637	77.8	63.3
3	11.7	3.60	3.81	0.430	78.1	66.7
4	-10.3	3.10	0.610	0.167	78.0	70.6
5	-16.2	2.35	5.83	0.854	76.3	63.9
250	9.81	2.59	9.73	1.16	73.4	60.0
251	-25.5	1.41	10.5	0.715	74.1	58.7
252	-14.9	2.48	8.77	0.800	76.9	63.7
253	-40.1	1.63	0.886	0.182	84.6	72.9
254	-30.2	1.87	1.61	0.117	82.7	71.0

The format of this record is as follows:

- | | |
|-------------------------------------|---------------|
| 1. County Number | Columns 2-4 |
| 2. Thornthwaite Index | Columns 8-12 |
| 3. Rainfall Per Month | Columns 18-22 |
| 4. Freeze-Thaw Cycles Per Month | Columns 28-32 |
| 5. Wet-Freeze-Thaw Cycles Per Month | Columns 38-42 |
| 6. Mean Maximum Temperature | Columns 48-52 |
| 7. Mean Average Temperature | Columns 58-62 |

Note that the program reads only the following from this file: the Thornthwaite Index, the rainfall per month, the freeze-thaw cycles per month, and the mean average monthly temperature.

FILE02 (FT02F001, user-supplied)

This file, which is supplied by the user, contains all information relating to the section under analysis. The complete file for the pavement section described above is shown below in Table A-2.

Table A-2. User-Supplied Input File (FILE02).

```
35
1.5 50. 30. 80. 30. 80. 30. 50. 50. 70. 30. 70. 30.
PSI      RUTTING RAVELINGFLUSHINGALGR+PATLONG CRKTRNS CRK
21       6.00     1.55    12.0   41.63
        1   6   12   24   36   60   72   84   96   108  120
OILFIELD TRAFFIC MODEL -- SURFACE TREATED PAVEMENT
        500.  5.0  5.0 50.0
060
001 001
002 001
003 001
004 001
005 001
  *  *
  *  *
  *  *
  *  *
  *  *
060 001
```

The individual card-images are defined as follows:

CARD 1 MINSCR I2

This is the minimum score permissible for the section under analysis. This is normally fixed at 35 as defined in the Department's Pavement Evaluation System for this type of pavement.

CARD 2 DISLIM (16) 16F5.0

These values are limits for each of the distress types. Initially they were to be used to specify possible pavement failures as well as to determine the minimum pavement score. For instance, using these limits, it would be possible to set a maximum value for the amount of rutting allowed on a pavement before failure is defined to occur, or it would be possible to predict minimum values of PSI. Note that this option is not used in the current program. Pavement failure is defined solely in terms of pavement score. This card should not be changed when running the current program.

CARD 3 FAIL (7) 7A8

This card gives the names of the distress limits set on Card 2. This information is not used in the current version of the program.

CARD 4

This card contains the following pavement-specific information:

Name	Code	Columns	Format
County Number	CTY	1-3	I3
Thickness of Flexible Base Layer (inches)	FLEXL	4-13	F10.2
Dynaflect Mean Deflection (mils)	DMD	14-23	F10.2
Subgrade Plasticity Index	PI	24-33	F10.2
Subgrade Liquid Limit	LL	34-43	F10.2

Suggested values for the Dynaflect mean deflection are listed below; the mean pavement deflection was 1.55 mils with a standard deviation of 0.49 mils:

Weak Pavement $(N + \sigma)$ = 2.04 mils

Medium Pavement (N) = 1.55 mils

Strong Pavement $(N - \sigma)$ = 1.06 mils

The subgrade soils information can readily be obtained from county soil survey maps.

CARD 5 MON(I) 1615

These are the months at which the pavement damage and score are to be calculated. The value of NYR, which is hardwired into the program, defines the number of months to be read in. Currently, NYR is set to 11, and MON(1) = 1, ..., MON(11) = 120.

CARD 6 HEAD(I) 10A8

This is the heading to be printed for this particular run.

CARD 7

This card contains the following intended use traffic data:

Name	Code	Columns	Format
Average Daily Traffic	ADT	1-8	F8.0
Percentage Trucks	PCTTRK	9-13	F5.1
Growth Rate Per Year	GROWTH	14-18	F5.1
Percentage of ADT in Design Lane	PCTLNE	19-23	F5.1

CARD 8 NDATES I3

NDATES is the number of dates in which oil field activity started.

Note that there are NDATES cards which follow this card, each giving month number and number of wells started that month.

CARDS 9-68 IDATE, NWELLS, (I3, 1X, I3)

There are NDATES of these cards, in this example NDATES = 60. Hence, there are 60 cards each containing:

IDATE = month number in which oil field development activity starts;
NWELLS = the number of oil wells started in that month.

Table A-3 contains the final contents of FILE02.

Running the Program

The following job control language has been used to run the program on the Amdahl at the Texas A&M University Computer Center.

```
//BRAZOS JOB (W250,505A,S5,2,BS),'OILFIELD'  
//EXEC FORTVCLG,FVREGN=1024K  
//FORT.SYSIN DD *  
C  
C  
C  
  
(program goes here)  
END  
//GO.FT01F001 DD DSN=USR.W250.BS.FILE01,DISP=SHR  
//GO.FT02F001 DD DSN=USR.W250.BS.FILE02,DISP=SHR  
/*END
```

Table A-3. Final Contents of FILE02.

ACADEMIC COMPUTER CENTER		PROBLEM: EXAMPLE — REPORT 299-2		PAGE
		PROGRAMMER:		DATE
GENERAL CODING FORM				
35	1.5	50.	30.	80.
PSI	RUTTING	RAVELLING	FLUSHING	GALVANIC
21	6.00	1.	55	50.
OILFIELD	6	12	24	36
060	001	001	001	001
002	001	001	001	001
003	001	001	001	001
004	001	001	001	001
005	001	001	001	001
060	001	001	001	001

PROGRAM LISTING

LEVEL 1.2.0 (SEPT 82)

VS FORTRAN DATE: JUL 18, 1983 TIME: 12:38:33

NAME: MAIN PAGE: 2

..........1.....2.....3.....4.....5.....6.....7.*.....8
C PAVE SCORE = F (PSI, VISUAL, MAINT COST)
C
C THIS IS A MULTIPLICATIVE UTILITY APPROACH WHERE:
C
C
C PSI = UTILITY VALUE OF PSI
C VISUAL = UTILITY VALUE OF DISTRESS TYPES
C MAINT COST = UTILITY VALUE OF MAINTENANCE COST
C IT IS A FUNCTION OF AREA OF PATCHING
C
C 5) PAVEMENT FAILURE IS DEFINED TO OCCUR WHEN PAVEMENT
C SCORE FAILS TO AN INPUTTED LEVEL
C
C
C *****
C
C

INPUT FILES :

THE PROGRAM READS DATA FROM 2 FILES,

FILEO1 : ENVIRONMENTAL DATA

FILEO2 : USER SUPPLIED PAVEMENT AND RUN DATA

FILEO1 : HAS STORED FOR EACH OF THE 254 TEXAS COUNTIES

1) TIN(I) THORNTONWAITE INDEX

2) RAIN(I) AVERAGE RAINFALL

3) FRTH(I) AIR FREEZE-THAW CYCLES

4) AVTP(I) AVERAGE MAXIMUM TEMPERATURE

FILEO2 : USER SUPPLIES THE FOLLOWING

MNSCR MINIMUM PAVEMENT SCORE
DISLIM MAXIMUM LEVEL OF INDIVIDUAL DISTRESS TYPES
PERMITTED UNTIL FAILURE - NOTE THIS OPTION
IS NOT USED IN CURRENT PROGRAM WHERE FAILURE
IS DEFINED IN TERMS OF PAVEMENT SCORE
FAIL NAMES OF DISTRESS TYPES
MON MONTHS IN WHICH CALCULATIONS ARE TO BE
PERFORMED

CTY TEXAS COUNTY NUMBER

FLEXL THICKNESS OF FLEX BASE IN INCHES
DMD DYNAFLECT MEAN DEFLECTION
PI SUBGRADE PLASTICITY INDEX
LL SUBGRADE LIQUID LIMIT
ADT AVERAGE DAILY TRAFFIC (2- WAY)
PCTTRK PERCENTAGE TRUCKS

LEVEL 1.2.O (SEPT 82) VS FORTRAN DATE: JUL 18, 1983 TIME: 12:38:33 NAME: MAIN PAGE: 3

* . . * . 1 2 3 4 5 6 7 8

C GROWTH PCTLINE PERCENTAGE GROWTH IN ADT
C C ADT SPLIT
C NDATES NUMBER OF MONTHS THAT OILFIELD DEVELOPMENT
C C WORK IS STARTED
C IDATE MONTH OIL DEVELOPMENT STARTS
C NWELLS NUMBER OF WELLS TO BE DRILLED
C *****
C C

REAL N18, LL, MTH , N18OIL, N18SER
REAL*8 FAIL, HEAD
INTEGER CTY, ENDSCR, ENDMTH
COMMON FLEXL, DMD, PI, LL, AVT50, T150, FTC
DIMENSION HEAD(10), DIS(15), DISLIM(15), MON(15), FAIL(15), TR(15,4)
DIMENSION RAIN(254), FRTH(254), TIN(254), AVTP(254), RX(8), V(8)
DIMENSION TRAF(120,4), IW(60,2)

C SET PROGRAM SWITCHES

C JSW = 0
NST = 4
NEN = 3
NYR = 11
NDS = 15
NDSPR = 13

C READ ENVIRONMENTAL DATA FROM FILE01

C DO 95 I = 1, 254
I95 READ(1,97) TIN(I), RAIN(I), FRTH(I), AVTP(I)
I97 FORMAT(7X, G9.3, 2G10.3, 20X, G10.3)

C READ PAVEMENT AND RUN DATA FROM FILE02

C READ(2, 98) MNSCR
I98 FORMAT(12)

C READ(2,100) (DISLIM(I), I = 1, NDSPR)
I100 FORMAT(16F5.0)

C READ(2,101) (FAIL(I), I = 1, 7)

C READ(2,102) CTY, FLEXL, DMD, PI, LL
I102 FORMAT(I3,4F10.2)
RFAL = RAIN(CTY) * 12.0
AVT = AVTP(CTY)
TI = TIN(CTY)
FTC = FRTH(CTY) * 12.0

C

LEVEL 1.2.O (SEPT 82)

VS FORTRAN

DATE : JUL 18, 1983

TIME : 12:38:33

NAME : MAIN

PAGE : 4

```
* ..... * ..... 1 ..... 2 ..... 3 ..... 4 ..... 5 ..... 6 ..... 7 ..... 8
ISN 29 READ(2,108) (MON(I), I = 1, NVR )
ISN 30 108 FORMAT( 16I5 )
ISN 31 C READ(2,104) (HEAD(I), I = 1, 10 )
ISN 32 C 104 FORMAT( 10A8 )
ISN 33 10 READ(2,106,END=50) ADT, PCTRK, GROWTH, PCTLNE
ISN 34 106 FORMAT( F8.0, 3(F5.1) )

C *****
C TRAFFIC ANALYSIS IS PERFORMED BY THE FOLLOWING SUBROUTINES
C TRAFIC : RETURNS 18K ESAL PER MONTH CALCULATION BASED ON
C W - TABLES DATA AS DESCRIBED IN RESEARCH REPORT
C 299-1 OF PROJECT 2-8-8-299
C SETTAB : THIS ROUTINE LOADS THE ACCUMULATIVE ADT AND N18
C FOR 120 MONTHS INTO A 120 X 4 ARRAY. NOTE OILFIELD
C TRAFFIC WILL BE ADDED TO COLS 2 AND 4 IN SUBROUTINE
C ADDOIL
C OILDEV : RETURNS 18K ESAL AND ADT PER MONTH ASSOCIATED
C WITH OILFIELD DEVELOPMENT
C OILSER : RETURNS 18K ESAL AND ADT PER MONTH ASSOCIATED
C WITH OILFIELD SERVICING
C ADDOIL : THIS ROUTINE ADDS OILFIELD DEVELOPMENT AND SERVICING
C ADT AND N18 TO THE TRAF ARRAY
C CONVER : RETURNS THE 15 X 4 ARRAY TR WHICH CONTAINS THE
C ADT AND 18K ESAL UNDER OILFIELD AND NORMAL
C TRAFFIC FOR EACH MONTH CHOSEN IN THE PLANNING
C HORIZON . SPECIFIED IN MON(I) ARRAY
C *****
C CALL TRAFIC ( ADT, PCTRK, PCTLNE, N18 )
C 35 CALL SETTAB ( N18, ADT, GROWTH, TRAF )
C 36 CALL OILDEV ( N18OIL, ADTOIL )
C 37 CALL OILSER ( N18SER, ADTSER )
C 38 READ ( 2, 107 ) NDATES
C 39 107 FORMAT ( I3 )
C 40 DO 110 I = 1, NDATES
C 41 READ ( 2, 109 , END=710 ) IDATE , NWELLS
C 42 109 FORMAT ( I3, 1X, I3 )
C 43 IDW(I,1) = IDATE
C 44 IW(I,2) = NWELLS
C 45 CALL ADDOIL ( IDATE, NWELLS, N18OIL, ADTOIL, N18SER, ADTSER ,
C 46 1 TRAF )
C 47 110 CONTINUE
C 48 CALL CONVER ( MON , NVR, TRAF, TR )
C 49 WRITE(6,200) (HEAD(I), I = 1, 10 )
C 50 200 FORMAT( 1, T26, 10A8, // )
C 51 WRITE(6,202) FLEXL, DMD, PI, LL
C 52 202 FORMAT( T26, 'STRUCTURAL VARIABLES' // T26,
1 'FLEXIBLE LAYER THICKNESS' : T60, F7.2 / T26,
2 'W1. MEAN DEFLECTION' : T60, F7.2 / T26,
3 'SUBGRADE PLASTICITY INDEX' , T60, F7.2 / T26,
```



```

LEVEL 1.2.O (SEPT 82) VS FORTRAN DATE : JUL 18, 1983 TIME : 12:38:33 NAME : MAIN

```

6

* . * . 1 2 3 4 5 6 7 * 8

```

      ISN     81      C      WRITE(6,215)
      ISN     82      C      215 FORMAT( T16, 'RUTTING      RAVELING      FLUSHING ALLIGATOR '
      ISN     83      C      1, 'LONGITUDNL TRANSVERSE PATCHING      PAVEMENT SCORE (PES) '
      ISN     84      C      2, / T3, 'MONTH RIDE AREA SEV. AREA SEV. AREA SEV. AREA SEV.
      ISN     85      C      3, 'AREA SEV. AREA SEV. AREA SEV. AREA SEV. AREA SEV.
      ISN     86      C      4, 'VISUAL PSI MCOST TOTAL '

```

NORMALLY $NYR = 11$ THIS BEING NUMBER OF DATES AT WHICH THE PAVEMENT SCORE IS TO BE CALCULATED. THE ACTUAL MONTHS ARE STORED IN $MON(NYR) = 1, 6,$ FOR EACH OF THESE MONTHS THE ACC. ADT AND N18 ARE INPUTTED INTO THE DAMAGE SUBROUTINE WHICH RETURNS PAVEMENT CONDITION IN TERMS OF AREA AND SEVERITY OF EACH DISTRESS TYPE AND PSI

THE DIS ARRAY CONTAINS THE AREA AND SEVERITY VALUES THESE VALUES ARE NOW PRE PROCESSED BEFORE ENTRY INTO THE RAMS STATE COST ESTIMATING PAVEMENT SCORE CALCULATION ROUTINES.

NOTE: AREA OF DISTRESS IS ONLY USED WHEN THE SEVERITY VALUE EXCEEDS 10.0 PERCENT

THE UTILITY SUBROUTINES ARE TAKEN FROM THE STATES PES SYSTEM PROJECIT 2239

卷之三十一

```

92      ADTS = ADT * 55.0
93      SRCE = DIS(1)
94      DO 135 N = 1, 8
95      RX(N) = 0.0
96      135 CONTINUE
97      IF ( DIS(3) .LT. 0.15 ) GOTO 140
98      RX(1) = 0.0
99      RX(2) = DIS(2)
100     GOTO 150
101     RX(1) = DIS(2)
102     RX(2) = 0.0

```

```

* .....*.....1.....2.....3.....4.....5.....6.....7.*.....8

ISN 103      150 CONTINUE
ISN 104      IF ( DIS(5) .GT. 10.0 ) RX(3) = DIS(4)
ISN 105      IF ( DIS(7) .GT. 10.0 ) RX(4) = DIS(6)
ISN 106      IF ( DIS(9) .GT. 10.0 ) RX(6) = DIS(8)
ISN 108      IF ( DIS(11) .GT. 10.0 ) RX(7) = DIS(10)
ISN 110      IF ( DIS(13) .GT. 10.0 ) RX(8) = DIS(12)
ISN 112      PATCH = DIS(14)
ISN 114      CALL UTILITY1 ( RX, V, AVUC )
ISN 115      CALL UTILITY2 ( ADTS, SRCE, SIUC )
ISN 116      CALL UTILITY4 ( PATCH, RMUC )
ISN 117
ISN 118      A2 = 1.0
ISN 119      A4 = 1.0
ISN 120      PESC = AVUC ** A1 * SIUC ** A2 * RMUC ** A4
ISN 121      IPES = INT(PESC * 100.)
ISN 122      IAVU = INT(AVUC * 100.)
ISN 123      ISIU = INT(SIUC * 100.)
ISN 124      IRMC = INT(RMUC * 100.)

ISN 125      C   22 WRITE(6,220) MON(I), (DIS(L), L = 1, NDS ), IAVU, ISIU, IRMC, IPES
ISN 126      C   220 FORMAT( /, T2, I4, F8.2, 14F6.1, 4(4X, I3) )

ISN 127      IF ( IPES .GT. MINSCR ) GOTO 25
ISN 128      IF ( IFAIL .GT. 0 ) GOTO 25
ISN 129      IFAIL = 1
ISN 130      INSCR = INPES
ISN 131      ENDSCR = IPES
ISN 132      INMTH = MON(I-1)
ISN 133      ENDMTH = MON(I)
ISN 134      25 CONTINUE
ISN 135      IF ( IFAIL .EQ. 0 ) GOTO 99
ISN 136      IDIF = INSCR - ENDSCR
ISN 137      IREQ = INSCR - MINSCR
ISN 138      IMTH = ENDMTH - INMTH
ISN 139      RABC = FLOAT(IREQ) / FLOAT(IDIF)
ISN 140      REQ = INMTH + RABC * IMTH
ISN 141      IF ( J .EQ. 1 ) WRITE(6, 301) REQ
ISN 142      IF ( J .EQ. 2 ) WRITE(6, 302) REQ
ISN 143      GOTO 26
ISN 144      99 IF ( J .EQ. 1 ) WRITE(6, 303)
ISN 145      IF ( J .EQ. 2 ) WRITE(6, 304)
ISN 146      26 CONTINUE
ISN 150      C   GO TO 10

ISN 151      C   50 WRITE(6,250)
ISN 152      250 FORMAT( '1' )
ISN 153      299 FORMAT( 1H1, '///', T20, 'OILFIELD DAMAGE PROJECT ----',
ISN 154      1, 'NORMAL TRAFFIC', '///' )
ISN 155      300 FORMAT( 1H1, '///', T20, 'OILFIELD DAMAGE PROJECT ----',
ISN 156      1, 'NORMAL PLUS OILFIELD TRAFFIC', '///' )
ISN 157      301 FORMAT( '////', 10X, 'TIME TO FAILURE UNDER NORMAL TRAFFIC',
ISN 158      1, '20X, ', F5.1, 'MTHS' )
ISN 159      302 FORMAT( '///', 10X, 'TIME TO FAILURE UNDER NORMAL + OILFIELD',
ISN 160      1, 'TRAFFIC', '///', F5.1, 'MTHS' )
ISN 161      2, '10X, 'OIL WELL DEVELOPMENT MONTH
ISN 162      3, '15(40X, 13, 10X, I3, '/') )

```

```

LEVEL 1.2.O (SEPT 82)          VS FORTRAN          DATE: JUL 18, 1983    TIME: 12:38:33      NAME: MAIN      PAGE: 8
*....*....1.....2.....3.....4.....5.....6.....7.*.....8

ISN   158   303 FORMAT ( //, 10X, 'SECTION DID NOT FAIL UNDER NORMAL TRAFFIC',
1           'IN ANALYSIS PERIOD')
ISN   159   304 FORMAT ( //, 10X, 'SECTION DID NOT FAIL UNDER NORMAL PLUS',
1           'OILFIELD TRAFFIC IN ANALYSIS PERIOD')
ISN   160   GOTO 900
ISN   161   710 WRITE ( 6, 720)
ISN   162   720 FORMAT ( 1H1, 'ERROR IN INPUT DATA', /
1           'NUMBER OF INPUT DATES DOES NOT MATCH ACTUAL NO.')
ISN   163   900 CONTINUE
ISN   164   STOP
ISN   165   END

*STATISTICS* SOURCE STATEMENTS = 154, PROGRAM SIZE = 13260 BYTES, PROGRAM NAME = MAIN      PAGE: 1.
*STATISTICS* NO DIAGNOSTICS GENERATED.
***** END OF COMPILED 1 *****

```

LEVEL 1.2.0 (SEPT 82) VS FORTRAN DATE: JUL 18, 1983 TIME: 12:38:36 NAME: MAIN PAGE: 9
 OPTIONS IN EFFECT: NOLIST NOMAP NOXREF GOSTMT NODECK SOURCE TERM OBJECT FIXED NOTE^T
 OPTIMIZE(O) LANGLVL(77) NOFIPS FLAG(1) NAME(MAIN) LINECOUNT(60)
1.....2.....3.....4.....5.....6.....7.*.....8

```

ISN      1      C      SUBROUTINE DAMAGE( N18, ADT, MTH, DIS )
ISN      2      C      *****
ISN      3      C      THESE REGRESSION EQUATIONS FOR EACH DISTRESS TYPE WERE
ISN      4      C      DEVELOPED AS PART OF SDHPT RESEARCH PROJECT 2284 USE
ISN      5      C      INSPECTION DATA COLLECTED ON OVER 100 THIN PAVEMENT
ISN      6      C      SECTIONS IN TEXAS.
ISN      7      C      NOTE: MAX AND MIN VALUES HAVE BEEN PLACED ON EACH RHO
ISN      8      C      AND BETA VALUE.
ISN      9      C      *****
ISN     10      C      *****
ISN     11      C      *****
ISN     12      C      DIMENSION DIS(15)
ISN     13      C      REAL N18, LL, MTH
ISN     14      C      COMMON FLEXL, DMD, PI, LL, AVT50, T150, FTC
ISN     15      C      P1 = 4.2
ISN     16      C      PF = 0.83
ISN     17      C      PSI
ISN     18      C      RHO = -0.173 + 0.00687*AVT50 - 0.000632*T150 + 0.0133*FLEXL
ISN     19      C      1 + .00075*LL + .00153*FTC - 0.0214*DMD
ISN     20      C      IF( RHO .GT. 0.511 ) RHO = 0.511
ISN     21      C      IF( RHO .LT. 0.0009 ) RHO = 0.0009
ISN     22      C      DIS(1) = 4.2
ISN     23      C      X = ( RHO/N18 )
ISN     24      C      IF ( X .GT. 10.0 ) GOTO 1
ISN     25      C      DIS(1) = P1 - (PF - PF) * EXP( - (X) )
ISN     26      C      1 CONTINUE
ISN     27      C      RUT AREA
ISN     28      C      RHO = -0.1035 + 0.00549*AVT50 + 0.0067*FLEXL - 0.0015*LL
ISN     29      C      & + 0.00162*PI + 0.00077*FTC
ISN     30      C      BETA = 1.540 + 0.0169*T150 - 0.072*FLEXL
ISN     31      C      IF( BETA .GT. 6.27 ) BETA = 6.27
ISN     32      C      IF( BETA .LT. 0.615 ) BETA = 0.615
ISN     33      C      DIS(2) = 0.0
ISN     34      C      X = ( RHO/N18 ) ** BETA
ISN     35      C      IF ( X .GT. 10.0 ) GOTO 2
ISN     36      C      DIS(2) = EXP( -(X) )
ISN     37      C      2 CONTINUE
ISN     38      C      RUT SEV
ISN     39      C      RHO = -0.0678 + 0.0032*AVT50 + 0.00566*FLEXL - 0.00031*LL
  
```

LEVEL 1.2.0 (SEPT 82) VS FORTRAN DATE: JUL 18, 1983 TIME: 12:38:36 NAME: DAMAGE PAGE: 10

```
*....*....1.....2.....3.....4.....5.....6.....7.*.....8  
  
     & + 0.00048*FTC  
     BETA = 1.780  
  
ISN 33 C IF( RHO .GT. 0.121 ) RHO = 0.121  
ISN 34 C IF( RHO .LT. 0.0027 ) RHO = 0.0027  
  
ISN 36 C IF( BETA .GT. 5.94 ) BETA = 5.94  
ISN 38 C IF( BETA .LT. 0.527 ) BETA = 0.527  
ISN 40 C  
  
ISN 42 C DIS(3) = 0.0  
ISN 43 C X = ( RHO/N18 ) ** BETA  
ISN 44 C IF ( X .GT. 10.0 ) GOTO 3  
ISN 45 C DIS(3) = EXP ( -(X) )  
ISN 46 C 3 CONTINUE  
  
ISN 47 C RAV AREA  
ISN 48 C RHO = 1.030 + 0.0146*T150 + 0.0064*FTC - 0.6089*DMD  
ISN 49 C BETA = 1.28  
ISN 51 C IF( RHO .GT. 2.76 ) RHO = 2.76  
ISN 53 C IF( RHO .LT. 0.095 ) RHO = 0.095  
ISN 55 C IF( BETA .GT. 6.1 ) BETA = 6.1  
ISN 57 C IF( BETA .LT. 0.52 ) BETA = 0.52  
  
ISN 58 C DIS(4) = 0.0  
ISN 59 C X = ( RHO/ADT ) ** BETA  
ISN 60 C IF ( X .GT. 10.0 ) GOTO 4  
ISN 61 C DIS(4) = EXP ( -(X) )  
ISN 62 C 4 CONTINUE  
  
ISN 63 C RAV SEV  
ISN 64 C RHO = 0.621 + 0.0129*T150 + 0.0066*FTC - 0.449*DMD  
ISN 66 C BETA = 1.40  
ISN 68 C IF( RHO .GT. 2.8 ) RHO = 2.8  
ISN 69 C IF( RHO .LT. 0.077 ) RHO = 0.077  
ISN 70 C  
ISN 71 C DIS(5) = 0.0  
ISN 72 C X = ( RHO/ADT ) ** BETA  
ISN 73 C IF ( X .GT. 10.0 ) GOTO 5  
ISN 74 C DIS(5) = EXP ( -(X) )  
ISN 75 C 5 CONTINUE  
  
ISN 76 C FLUSH AREA  
ISN 77 C RHO = 0.488 + 0.0127*T150 + 0.00345*FTC - 0.213*DMD  
ISN 78 C BETA = 1.27  
ISN 79 C IF( RHO .GT. 2.84 ) RHO = 2.84  
ISN 80 C IF( RHO .LT. 0.062 ) RHO = 0.062  
ISN 81 C DIS(6) = 0.0  
ISN 82 C X = ( RHO/ADT ) ** BETA  
ISN 83 C IF ( X .GT. 10.0 ) GOTO 6  
ISN 84 C DIS(6) = EXP ( -(X) )
```

LEVEL 1.2.0 (SEPT 82) VS FORTRAN DATE: JUL 18, 1983 TIME: 12:38:36

NAME: DAMAGE PAGE:

* * . * . 1 2 3 4 5 6 7 8

ISN 83 C 6 CONTINUE

```

C FLUSH SEV
C RHO = -0.14 + 0.031*AVT50 + 0.0103*T150 + 0.00541*FTC - 0.201*DMD
C BETA = 1.50

```

```

ISN 84 C
ISN 85 C
      IF( RHO .GT. 2.18 ) RHO = 2.81
      IF( RHO .LT. 0.063 ) RHO = 0.063

```

```

ISN 86 C
ISN 88 C
      IF( BETA .GT. 5.45 ) BETA = 5.45
      IF( BETA .LT. 0.51 ) BETA = 0.51

```

```

ISN 90 C
ISN 92 C
      DIS(7) = 0.0
      X = ( RHO/ADT ) ** BETA
      IF ( X .GT. 10.0 ) GOTO 7
      DIS(7) = EXP ( -(X) )
7 CONTINUE

```

C ALLIGATOR AREA

```

ISN 94 C
ISN 95 C
      RHO = -0.179 + 0.0121*AVT50 + 0.0040*FLEXL - 0.0011*LL
      ! + 0.00153*FTC
      BETA = 1.867 - 0.00908*T150 + 0.144*FLEXL - 0.572*DMD

```

```

59 ISN 101 C
ISN 103 C
      IF( RHO .GT. 0.19 ) RHO = 0.19
      IF( RHO .LT. 0.003 ) RHO = 0.003

```

```

ISN 105 C
ISN 107 C
      IF( BETA .GT. 7.29 ) BETA = 7.29
      IF( BETA .LT. 0.51 ) BETA = 0.51

```

```

ISN 109 C
ISN 110 C
      DIS(8) = 0.0
      X = ( RHO/N18 ) ** BETA
      IF ( X .GT. 10.0 ) GOTO 8
      DIS(8) = EXP ( -(X) )
8 CONTINUE

```

C ALLIGATOR SEV

```

ISN 114 C
ISN 115 C
      RHO = -0.2219 + 0.0119*AVT50 + 0.000327*T150 + 0.00274*FLEXL
      ! - 0.000579*LL + 0.00166*FTC
      BETA = 2.909 + 0.0998*AVT50 + 0.013*LL - 1.567*DMD

```

```

ISN 116 C
ISN 118 C
      IF( RHO .GT. 0.07 ) RHO = 0.07
      IF( RHO .LT. 0.003 ) RHO = 0.003

```

```

ISN 120 C
ISN 122 C
      IF( BETA .GT. 9.8 ) BETA = 9.8
      IF( BETA .LT. 0.51 ) BETA = 0.51

```

```

ISN 124 C
ISN 125 C
      DIS(9) = 0.0
      X = ( RHO/N18 ) ** BETA
      IF ( X .GT. 10.0 ) GOTO 9
      DIS(9) = EXP ( -(X) )
9 CONTINUE

```

128

LEVEL 1.2.0 (SEPT 82) VS FORTRAN DATE: JUL 18, 1983 TIME: 12:38:36 NAME: DAMAGE PAGE: 12

........1.....2.....3.....4.....5.....6.....7.*.....8

```

C
C
C LONG AREA
C
ISN 129      RHO = -63.1 + 4.52*AVT50 + 0.541*TI50 + 7.41*FLEXL + 1.1145*FTC
ISN 130      BETA = 1.15
ISN 131      IF( RHO .GT. 172.0 ) RHO = 172.0
ISN 132      IF( RHO .LT. 30.0 ) RHO = 30.0
ISN 133      IF( BETA .GT. 2.65 ) BETA = 2.65
ISN 134      IF( BETA .LT. 0.68 ) BETA = 0.68
ISN 135      C
ISN 136      DIS(10) = 0.0
ISN 137      X   = ( RHO/MTH ) ** BETA
ISN 138      IF ( X .GT. 10.0 ) GOTO 10
ISN 139      DIS(10) = EXP ( -(X) )
ISN 140      10 CONTINUE
ISN 141      C
ISN 142      RHO = -120.1 + 6.77*AVT50 + 1.146*TI50 + 4.78*FLEXL + 1.32*FTC
ISN 143      BETA = 1.58
ISN 144      C
ISN 145      IF( RHO .GT. 167.0 ) RHO = 167.0
ISN 146      IF( RHO .LT. 21.0 ) RHO = 21.0
ISN 147      C
ISN 148      DIS(11) = 0.0
ISN 149      X   = ( RHO/MTH ) ** BETA
ISN 150      IF ( X .GT. 10.0 ) GOTO 11
ISN 151      DIS(11) = EXP ( -(X) )
ISN 152      11 CONTINUE
ISN 153      C
ISN 154      TRANS AREA
ISN 155      RHO = -66.4 + 2.156*TI50 + 10.12*FLEXL + 0.718*FTC
ISN 156      BETA = 2.059 + 0.0734*FLEXL - 0.06*LL + 0.0607*PI - 0.00375*FTC
ISN 157      IF( RHO .GT. 176.0 ) RHO = 176.0
ISN 158      IF( RHO .LT. 41.0 ) RHO = 41.0
ISN 159      C
ISN 160      IF( BETA .GT. 2.65 ) BETA = 2.65
ISN 161      IF( BETA .LT. 0.61 ) BETA = 0.61
ISN 162      C
ISN 163      DIS(12) = 0.0
ISN 164      X   = ( RHO/MTH ) ** BETA
ISN 165      IF ( X .GT. 10.0 ) GOTO 12
ISN 166      DIS(12) = EXP ( -(X) )
ISN 167      12 CONTINUE
ISN 168      C
ISN 169      TRANS SEV
ISN 170      RHO = 96.3 - 1.04*AVT50 + 1.068*TI50 - 0.318*FTC
ISN 171      BETA = 1.10 + 0.1606*LL - 0.237*PI - 0.0154*FTC

```

LEVEL 1.2.O (SEPT 82) VS FORTRAN DATE : JUL 18. 1983 TIME : 12:38:36 NAME : DAMAGE PAGE : 13

* * * * * 1.....2.....3.....4.....5.....6.....7.....8

ISN 172 IF(RHO .GT. 173.0) RHO = 173.0
ISN 174 C IF(RHO .LT. 33.0) RHO = 33.0
ISN 176 C IF(BETA .GT. 6.65) BETA = 6.65
ISN 178 C IF(BETA .LT. 0.56) BETA = 0.56
ISN 180 C DIS(13) = 0.0
ISN 181 X = (RHO/MTH) ** BETA
ISN 182 IF (X .GT. 10.0) GOTO 13
ISN 183 DIS(13) = EXP (-(X))
ISN 184 13 CONTINUE
C PATCHING
C
ISN 185 C RHO = 0.00799 + 0.00252*AVT50 + 0.000218*T150 + 0.001666*FLEXL
1 - 0.00125*PI
ISN 186 C BETA = 1.75
ISN 187 C IF(RHO .GT. 0.104) RHO = 0.104
ISN 189 C IF(RHO .LT. 0.0036) RHO = 0.0036
ISN 191 C IF(BETA .GT. 5.36) BETA = 5.36
ISN 193 C IF(BETA .LT. 0.63) BETA = 0.63
ISN 195 C DIS(14) = 0.0
ISN 196 X = (RHO/N18) ** BETA
ISN 197 IF (X .GT. 10.0) GOTO 14
ISN 198 DIS(14) = EXP (-(X))
ISN 199 14 CONTINUE
C PATCH SEV
C
ISN 200 RHO = -0.0404 + 0.0035*AVT50 + 0.0029*FLEXL - 0.000424*LL
& + 0.000389*FTC
ISN 201 BETA = -0.158 + 0.0504*AVT50 + 0.0897*FLEXL - 0.0687*LL
1 + 0.0820*PI + 0.0270*FTC
ISN 202 IF(RHO .GT. 0.090) RHO = 0.090
ISN 204 IF(RHO .LT. 0.0027) RHO = 0.0027
ISN 206 C IF(BETA .GT. 3.27) BETA = 3.27
ISN 208 C IF(BETA .LT. 0.527) BETA = 0.527
ISN 210 C DIS(15) = 0.0
ISN 211 X = (RHO/N18) ** BETA
ISN 212 IF (X .GT. 10.0) GOTO 15
ISN 213 DIS(15) = EXP (-(X))
ISN 214 15 CONTINUE
C
ISN 215 C RETURN
ISN 216 END

STATISTICS SOURCE STATEMENTS = 164, PROGRAM SIZE = 5752 BYTES, PROGRAM NAME = DAMAGE

PAGE : 9.

STATISTICS NO DIAGNOSTICS GENERATED.

***** END OF COMPILEATION 2 *****

LEVEL 1.2.0 (SEPT 82)

OPTIONS IN EFFECT: VS FORTRAN

DATE: JUL 18, 1983 TIME: 12:38:37 NAME: MAIN PAGE: 14.

..........1.....2.....3.....4.....5.....6.....7.*.....8
OPTIONS IN EFFECT: NOLIST NOMAP NOXREF GOSTMT NODECK SOURCE TERM OBJECT FIXED NOTEST
OPTIMIZE(O) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60)

```
ISN      1      C      SUBROUTINE SETTAB ( N18, ADT, GROWTH, TRAF )
C      *****
C      THIS SUBROUTINE SETS UP A 120 X 4 ARRAY OF TRAFFIC DATA
C
C      ONE ROW FOR EACH MONTH IN THE ANALYSIS PERIOD 120 MONTHS
C      COL 1 IS USED FOR ACC. ADT
C      COL 2 IS USED FOR ACC. ADT PLUS OILFIELD ADT
C      COL 3 IS USED FOR ACC. N18
C      COL 4 IS USED FOR ACC. N18 PLUS OILFIELD N18
C
C      NOTE OILFIELD TRAFFIC ADDED IN SUBROUTINE ADDOIL
C
C      *****
C
ISN      2      C      DIMENSION TRAF(120,4)
ISN      3      C      REAL N18
ISN      4      C      X1 = ADT * 30.
ISN      5      C      X3 = N18
ISN      6      C      TRAF(1,1) = X1
ISN      7      C      TRAF(1,2) = X1
ISN      8      C      TRAF(1,3) = X3
ISN      9      C      TRAF(1,4) = X3
ISN     10      C      DO 50 I = 2, 120
ISN     11      C      K = I - 1
ISN     12      C      X1 = X1 * ( 1.0 + GROWTH/1200.0 )
ISN     13      C      X3 = X3 * ( 1.0 + GROWTH/1200.0 )
ISN     14      C      TRAF(I,1) = TRAF(K,1) + X1
ISN     15      C      TRAF(I,2) = TRAF(I,1)
ISN     16      C      TRAF(I,3) = TRAF(K,3) + X3
ISN     17      C      TRAF(I,4) = TRAF(I,3)
ISN     18      C      50 CONTINUE
ISN      C      WRITE (6, 69)
ISN      C      69 FORMAT(1H1, 10X, 'I', ' TRAF1 TRAF2 TRAF3 TRAF4 ')
ISN      C      DO 60 I = 1, 120,
ISN      C      WRITE (6, 70) I, (TRAF(I,J), J=1,4)
ISN      C      70 FORMAT(10X, I3, 4F9.0)
ISN      C      60 CONTINUE
ISN      C      RETURN
ISN      C      END
ISN      19      C      *STATISTICS* SOURCE STATEMENTS = 20, PROGRAM SIZE = 584 BYTES, PROGRAM NAME = SETTAB PAGE: 14.
ISN      20      C      *STATISTICS* NO DIAGNOSTICS GENERATED.
ISN      C      **** END OF COMPILED 3 ****
```

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NAME: MAIN PAGE:

LEVEL 1.2.0 (SEPT 82) VS FORTRAN DATE: JUL 18, 1983 TIME: 12:38:37

OPTIONS IN EFFECT: NOLIST NOMAP NOXREF GOSTMT NODECK SOURCE TERM OBJECT FIXED NOTE^ST OPTIMIZE(O) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60)

.......1.....2.....3.....4.....5.....6.....7.....8

ISN 1 1 SUBROUTINE ADDOIL (IDATE, NWELLS, N18OIL, ADTOIL, N18SER,
C ****
C ****
C **** THIS SUBROUTINE ADDS THE OILFIELD DEVELOPMENT AND SERVICING
C TRAFFIC TO THE TRAF ARRAY. COLUMN 2 HAS THE ADT DATA COLUMN 4
C CONTAINS THE N18 DATA.
C ****
C ****ISN 2 DIMENSION TRAF(120,4), ASER(120), BSER(120)
ISN 3 REAL N18OIL, N18SER
ISN 4 X1 = ADTOIL * 30.0
ISN 5 X2 = ADTSER * 30.0
ISN 6 X3 = N18OIL
ISN 7 X4 = N18SER
ISN 8 DO 10 L = IDATE, 120
ISN 9 TRAF(I,2) = TRAF(I,2) + NWELLS*X1
ISN 10 TRAF(I,4) = TRAF(I,4) + NWELLS*X3
ISN 11 10 CONTINUEC ADD ON SECOND MONTHS OIL DEVELOPMENT TRAFFIC
ISN 12 L = IDATE + 1
ISN 13 DO 20 I = L, 120
ISN 14 TRAF(I,2) = TRAF(I,2) + NWELLS*X1
ISN 15 TRAF(I,4) = TRAF(I,4) + NWELLS*X3
ISN 16 20 CONTINUE

C OILFIELD SERVICING TRAFFIC DECREASING 50% EACH YEAR

ISN 17 C L = IDATE + 2
ISN 18 LEFT = 120 - L + 1
ISN 19 DO 30 I = 1, LEFT
ISN 20 ASER(I) = X2 * NWELLS
ISN 21 BSER(I) = X4 * NWELLS
ISN 22 IF (MOD(I,12) .NE. 0) GOTO 25
ISN 23 C 24 WRITE (6, 24) I, X2, X4
ISN 24 C 24 FORMAT (10X, 13, 2F9.0)
ISN 25 X2 = X2 / 2.0
ISN 25 25 CONTINUE
ISN 26 30 CONTINUEC DO 35 J = 2, LEFT
ISN 27 ASER(J) = ASER(J-1) + ASER(J)
ISN 28 BSER(J) = BSER(J-1) + BSER(J)
ISN 29 C 29 WRITE (6, 59)
ISN 29 C 59 FORMAT (1H1, 10X, 'I', 10X, 'ASER', 10X, 'BSER', /)
ISN 29 C 50 DO 50 I = 1, LEFT, 12
ISN 29 C 50 WRITE (6, 60) I, ASER(I), BSER(I)

```

LEVEL 1.2.0 (SEPT 82)   VS FORTRAN      DATE: JUL 18, 1983    TIME: 12:38:37    NAME: ADDOIL PAGE: 16
*.....*.....1.....2.....3.....4.....5.....6.....7.*.....8
C   GO FORMAT( 9X, I3, 5X, F9.0, 5X, F9.0)
C
C
ISN  30      DO 40 I = L, 120
ISN  31      K = I - L + 1
ISN  32      TRAF(I,2) = TRAF(I,2) + ASER(K)
ISN  33      TRAF(I,4) = TRAF(I,4) + BSER(K)
ISN  34      40 CONTINUE
C
ISN  35      RETURN
ISN  36      END
*
*STATISTICS* SOURCE STATEMENTS = 36, PROGRAM SIZE = 2358 BYTES, PROGRAM NAME = ADDOIL PAGE: 15.
*STATISTICS* NO DIAGNOSTICS GENERATED.
***** END OF COMPIRATION 4 ******

```

LEVEL 1.2.O (SEPT 82) VS FORTRAN DATE: JUL 18, 1983 TIME: 12:38:37 NAME: MAIN PAGE: 17

OPTIONS IN EFFECT: NOLIST NOMAP NOXREF GOSTMT NODECK SOURCE TERM OBJECT FIXED NOTEST
OPTIMIZE(O) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60)

* * * * .1.....2.....3.....4.....5.....6.....7.....8

ISN 1 SUBROUTINE CONVER (MON, NYR, TRAF, TR)

```
*****  
C THIS SUBROUTINE LOADS THE TR ARRAY WITH TRAFFIC DATA FOR  
C THE SELECTED REPORTING MONTHS STORED IN MON(15)  
C *****
```

```
ISN 2 DIMENSION MON(15), TRAF(120, 4), TR(15, 4)  
ISN 3 DO 10 I = 1, NYR  
ISN 4 TR(I,1) = TRAF(MON(I),1)  
ISN 5 TR(I,2) = TRAF(MON(I),2)  
ISN 6 TR(I,3) = TRAF(MON(I),3)  
ISN 7 TR(I,4) = TRAF(MON(I),4)  
ISN 8 10 CONTINUE  
ISN 9 RETURN  
ISN 10 END
```

STATISTICS

SOURCE STATEMENTS = 10, PROGRAM SIZE = 586 BYTES, PROGRAM NAME = CONVER PAGE: 17.

STATISTICS

NO DIAGNOSTICS GENERATED.

***** END OF COMPILEATION 5 *****

LEVEL 1.2.0 (SER) 82) VS FORTRAN DATE: JUL 18, 1983 TIME: 12:38:37 NAME: MAIN PAGE: 18
 OPTIONS IN EFFECT: NOLIST NOMAP NOXREF GOSTMT NODECK SOURCE TERM OBJECT FIXED NOTE^T
 OPTIMIZE(0) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60)

* * .1 2 3 4 5 6 7 8

ISN 1 SUBROUTINE TRAFIC (ADT, PCTTRK, PCTLNE, N18)

 C *****
 C THIS SUBROUTINE CALCULATES THE NUMBER OF 18 KIP SINGLE AXLE
 C ASSOCIATED WITH THE ADT , PERCENTAGE TRUCKS AND PERCENTAGE
 C VEHICLES IN DESIGN LANE.

C DETAILS OF THE CALCULATION ARE IN REPORT 299-1

C THE NUMBERS IN THE FOLLOWING ARRAYS ARE TAKEN FROM THE
 C STATES W-4 TABLES.

C PERCNT - CONTAINS THE PERCENTAGE OF EACH TRUCK TYPE IN
 C THE TRAFFIC STREAM
 C SINGLE - CONTAINS THE NUMBER OF SINGLE AXLES BY TRUCK TYPE
 C TANDEM - CONTAINS THE NUMBER OF TANDEM AXLES BY TRUCK TYPE
 C DISTSN - CONTAINS THE SINGLE AXLE LOAD DISTRIBUTIONS AS
 C MEASURED AT WEIGHING STATIONS FOR EACH TRUCK TYPE
 C DISTAN - CONTAINS THE TANDEM AXLE LOAD DISTRIBUTION FOR
 C EACH TRUCK TYPE
 C ESING - CONTAINS EQUIVALENCY FACTORS FOR SINGLE WHEEL LOADS
 C ETAND - CONTAINS EQUIVALENCY FACTORS FOR TANDEM WHEEL LOADS
 C *****
 C *****

ISN 2 C REAL N18, NSING, NTAND, NSINGL, NTANDM, N18SIN, N18TAN, NTRUKS

ISN 3 C DIMENSION DISTSN(10,13), DISTAN(10,16), ESING(13), ETAND(16),
 + NSING(13), NTAND(16), NSINGL(10), NTANDM(10), PERCNT(10),
 * SINGLE(10), TANDEM(10), TTYP(10)

ISN 4 C DATA DISTSN / 6.0, 9.0*0.64, 0.20, 0.13, 0.9, 0.2, 0.8, 0.0, 0.3*22.0,
 + 9.0, 6.0, 10.0, 8.0, 0.7, 0.5, 0.0, 0.3*22.0, 1.1, 0.61, 0.36, 0.46, 0.0, 88.0,
 * 31.0, 44.0, 3*34.0, 4.0, 12.0, 23.0, 14.0, 3.0, 25.0, 34.0, 3*22.0, 3.0,
 8.1.0, 12.0, 0.8, 0.0, 0.12.0, 16.0, 3*0.0, 1.0, 0.2*0.0, 0.2, 0.0, 0.3, 0.4*0.0,
) 1.0, 0.0, 2.0, 0.6, 0.0, 0.8, 0.6, 0.3*0.0, 1.0, 0.0, 0.2, 0.3, 0.0, 0.5, 0.4*0.0,
 (2*0.0, 2.0, 0.4, 0.0, 0.2, 0.4*0.0, 0.5*0.0, 1.0, 0.4*0.0, 1.0*0.0, 0.10*0.0, 0.10*0.0 /

ISN 5 C DATA DISTAN / 10*0.0, 0.0, 0.18, 0.0, 0.16, 0.0, 0.12, 0.0, 0.0, 0.25, 0.0, 0.0, 0.0,
 + 21.0, 0.0, 35.0, 16.0, 0.0, 0.50, 0.0, 0.0, 0.33, 0.0, 0.33, 0.0, 0.0, 0.15, 0.0, 0.30, 0.
 = 13.0, 0.25, 3*0.0, 0.12, 0.0, 13.0, 19.0, 0.0, 0.0, 0.67, 0.67, 0.5, 0.,
 * 1.0, 1.0, 5*0.0, 0.3, 0.1, 3.5*0.0, 0.1, 0.3, 7.5*0.0, 0.10, 0.,
 8.0, 0.9, 5*0.0, 0.5, 0.0, 0.5, 5*0.0, 0.3, 0.0, 0.3, 5*0.0, 0.2, 0.,
) 0.1, 2.0, 5*0.0, 0.2, 0.0, 0.1, 5*0.0, 0.2, 8*0.0, 0.1, 8*0.0, 10*0.0 /

ISN 6 C DATA ESING / 0.0, 0.0, 0.005, 0.025, 0.07, 0.32, 0.795, 1.0, 1.285, 1.98,
 + 2.67, 3.71, 6.085, 0.0 /

ISN 7 C DATA ETAND / 0.0, 0.003, 0.03, 0.11, 0.36, 0.67, 0.76, 0.87, 1.14, 1.47,

LEVEL 1.2.0 (SEPT 82) VS FORTRAN DATE: JUL 18, 1983 TIME: 12:38:37 NAME: TRAFIC PAGE: 19

```
* ..... * ..... 1 ..... 2 ..... 3 ..... 4 ..... 5 ..... 6 ..... 7 ..... 8 ..... .8  
+ 1.875,2.435,3.12,3.86,5.13,0.0 /  
  
ISN 8 C DATA SINGLE / 2.0,1.0,3.0,2.0,1.0,5.0,2.0,3.0,2.0,1.0/  
ISN 9 C DATA TANDEM / 0.0,1.0,0.0,1.0,2.0,0.0,2.0,0.0,1.0,2.0 /  
ISN 10 C DATA PERCENT / 14.0,4.0,1.0,5.0,68.0,2.0,0.0,3*2.0 /  
  
ISN 11 C NTYP = 10  
  
ISN 12 C ADT = ADT * (PCTLNE/100.0)  
ISN 13 C NTRUKS = ADT * 365.0 * (PCTTRK/100.0)  
  
ISN 14 DO 10 I = 1, NTYP  
ISN 15 TTYPE(I) = PERCNT(I) * NTRUKS * 0.01  
ISN 16 NSINGL(I) = TTYPE(I) * SINGLE(I)  
ISN 17 NTANDM(I) = TTYPE(I) * TANDEM(I)  
ISN 18 10 CONTINUE  
  
ISN 19 C DO 14 J = 1, 13  
ISN 20 C 14 NSING(J) = 0.0  
  
ISN 21 DO 15 J = 1, 16  
ISN 22 15 NTAND(J) = 0.0  
  
ISN 23 DO 30 K = 1, 10  
ISN 24 DO 20 J = 1, 13  
ISN 25 20 NSING(J) = NSING(J) + NSINGL(K)*DISTSN(K,J)/100.0  
ISN 26 30 CONTINUE  
  
ISN 27 DO 50 K = 1, 10  
ISN 28 DO 40 J = 1, 16  
ISN 29 40 NTAND(J) = NTAND(J) + NTANDM(K)*DISTAN(K,J)/100.0  
ISN 30 50 CONTINUE  
  
ISN 31 C N18SIN = 0.0  
  
ISN 32 DO 60 J = 1, 13  
ISN 33 60 N18SIN = N18TAN + NTAND(J) * ESING(J)  
  
ISN 34 C N18TAN = 0.0  
ISN 35 DO 70 J = 1, 16  
ISN 36 70 N18TAN = N18TAN + NTAND(J) * ETAND(J)  
ISN 37 C N18 = N18SIN + N18TAN  
  
ISN 34 C WRITE(6,250) ADT, PCTLNK, PCTLNE, N18  
ISN 35 C 250 FORMAT('1H1, 1OX, 'SUBROUTINE TRAFIC', /,2X, 'ADT = ', F7.1, 2X,  
ISN 36 C , 'PCT TRUCKS = ', F5.1, 2X, 'PCT SPLIT = ', F7.1, 2X,
```

LEVEL 1.2.0 (SEPT 82) VS FORTRAN DATE: JUL 18, 1983 TIME: 12:38:37 NAME: TRAFIC PAGE: 20

```

*....*....1.....2.....3.....4.....5.....6.....7.*....8
C = 'N18 = ', G14.5 /////
C WRITE(6,255) N18SIN, N18TAN
C 255 FORMAT( 2X, 'N18 SINGLE = ', F10.3, 'N18 TANDEM = ', F10.3 //)
C RETURN
C END
C
C WRITE(6,260) (NSING(I), I = 1, 13)
C 260 FORMAT( 'NSING = ', 13F8.1 // )
C WRITE(6,262) (NTAND(I), I = 1, 16 )
C 262 FORMAT( 'NTAND = ', 13F8.1 // 9X, 3F8.1 // )
C
ISN 38 N18 = N18 / 12.0
ISN 39
ISN 40
C
C SOURCE STATEMENTS = 40, PROGRAM SIZE = 2876 BYTES, PROGRAM NAME = TRAFIC PAGE: 18.
*STATISTICS*
*STATISTICS* NO DIAGNOSTICS GENERATED.
***** END OF COMPILEATION 6 *****

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EVEL 1.2.0 (SEPT 82)          VS FORTRAN      DATE: JUL 18, 1983    TIME: 12:46:38     NAME: MAIN      PAGE: 21

OPTIONS IN EFFECT: NOLIST NOMAP NOXREF   GOSTMT NODECK   SOURCE TERM OBJECT FIXED  NOTES
OPTIMIZE(O) LANGLVL(77) NOFIPS  FLAG(1) NAME(MAIN) LINECOUNT(60)

*.....* 1.....2.....3.....4.....5.....6.....7.....8

SN      1      C      SUBROUTINE OILDEV ( N18OIL, ADTOIL )
C      ****
C      **** THIS SUBROUTINE RETURNS THE 18 KIP ESAL (N18OIL) AND
C      **** ADT (ADTOIL) ASSOCIATED WITH OILFIELD DEVELOPMENT WORK
C
C      TTYPE - CONTAINS THE NUMBER OF EACH TRUCK TYPE COUNTED AT
C      THE ENTRANCE TO A DRILLING SITE OVER A 73 DAY
C      OILWELL DEVELOPMENT PERIOD.
C      OTHER DATA STATEMENTS ARE AS DESCRIBED IN TRAFIC
C
C      ****
C      REAL N18, NSING, NTAND, NSINGL, NTANDM, N18SIN, N18TAN
ISN     2      C      REAL N18OIL
ISN     3      C      REAL N18OIL
ISN     4      C      DIMENSION DISTSN(10,13), DISTAN(10,16), ESING(13), ETAND(16),
C                  + NSING(13), NTAND(16), NSINGL(10), NTANDM(10),
C                  * SINGLE(10), TANDEM(10), TTYP(10)
ISN     5      C      DATA DISTSN / 6.0, 9*0.0, 64.0, 20.0, 13.0, 9.0, 2.0, 8.0, 0.0, 3*22.0,
C                  + 9.0, 6.0, 10.0, 8.0, 7.0, 5.0, 0.0, 3*22.0, 11.0, 61.0, 36.0, 46.0, 88.0,
C                  * 31.0, 44.0, 3*34.0, 4.0, 12.0, 23.0, 14.0, 3.0, 25.0, 34.0, 3*22.0, 3.0,
C                  8.0, 12.0, 8.0, 0.0, 12.0, 16.0, 3*0.0, 1.0, 2*0.0, 0.0, 2.0, 0.0, 0.3, 0, 4*0.0,
C                  ) 1.0, 0.0, 0.2, 0.6, 0.0, 0.8, 0.6, 0.3*0.0, 1.0, 0.0, 0.2, 0.3, 0.0, 0.5, 0.4*0.0,
C                  ( 2*0.0, 2.0, 4.0, 0.0, 2.0, 4.0, 5*0.0, 1.0, 4*0.0, 10*0.0, 10*0.0, 10*0.0 /
C
C      DATA DISTAN / 10*0.0, 0.0, 18.0, 0.0, 0.16.0, 12.0, 0.0, 0.25.0, 0.3*0.0, 0.0,
C                  + 21.0, 0.0, 35.0, 16.0, 0.0, 0.50, 0.0, 0.0, 0.33, 0.0, 0.0, 15.0, 0.0, 0.30, 0.0,
C                  = 13.0, 0, 25.0, 3*0.0, 12.0, 13.0, 19.0, 0.0, 0.67, 0.0, 5.0, 0.0,
C                  * 1.0, 10.0, 5*0.0, 3.0, 0.1, 3.0, 5*0.0, 0.1, 0.3, 0.7, 5*0.0, 0.10, 0.0,
C                  8.0, 0.0, 9.0, 5*0.0, 0.5, 0.0, 0.5, 5*0.0, 0.0, 3.0, 0.0, 3.0, 5*0.0, 0.0, 2.0,
C                  ) 0.0, 1.0, 2.0, 5*0.0, 0.2, 0.0, 0.1, 5*0.0, 0.0, 2.0, 8*0.0, 0.0, 1.0, 8*0.0, 10*0.0 /
C
C      DATA ESING / 0.0, 0.0, 0.005, 0.025, 0.07, 0.32, 0.795, 1.0, 1.285, 1.98,
ISN     6      C      + 2.67, 3.71, 6.085, 0.0 /
ISN     7      C      DATA ETAND / 0.0, 0.0, 0.003, 0.03, 0.11, 0.36, 0.67, 0.76, 0.87, 1.14, 1.47,
ISN     8      C      + 1.875, 2.435, 3.12, 3.86, 5.13, 0.0 /
ISN     9      C      DATA SINGLE / 2.0, 1.0, 3.0, 2.0, 1.0, 5.0, 2.0, 3.0, 2.0, 1.0 /
ISN    10      C      DATA TANDEM / 0.0, 1.0, 0.0, 0.1, 0.2, 0.0, 0.2, 0.0, 0.1, 0.2, 0.0 /
ISN    11      C      DATA TTYP / 300.0, 150.0, 45.0, 0.0, 655.0, 0.0, 0.0, 90.0, 0.0,
C                  + 125.0 /
ISN    12      C      NTYP = 10
ISN    13      C      ADTOIL = 150.0

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LEVEL 1.2.0 (SEPT 82)

VS FORTRAN

DATUM: JUL 18, 1983 TIME: 12:38:38 NAME: MAIN PAGE: 21

OPTIONS IN EFFECT: NOLIST NOMAP NOXREF GOSTMNT NODECK SOURCE TERM OBJECT FIXED NOTEST
OPTIMIZE(O) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60)

........1.....2.....3.....4.....5.....6.....7.*.....8

ISN 1 C SUBROUTINE OILDEV (N18OIL, ADTOIL)
C ****
C THIS SUBROUTINE RETURNS THE 18 KIP ESAL (N18OIL) AND
C ADT (ADTOIL) ASSOCIATED WITH OILFIELD DEVELOPMENT WORK
C
C TTYPE - CONTAINS THE NUMBER OF EACH TRUCK TYPE COUNTED AT
C THE ENTRANCE TO A DRILLING SITE OVER A 73 DAY
C OILWELL DEVELOPMENT PERIOD.
C OTHER DATA STATEMENTS ARE AS DESCRIBED IN TRAFIC
C ****
C
ISN 2 C REAL N18, NSING, NTAND, NSINGL, NTANDM, N18SIN, N18TAN
ISN 3 C REAL N18OIL
ISN 4 C DIMENSION DISTSN(10,13), DISTAN(10,16), ESING(13), ETAND(16),
+ NSING(13), NTAND(16), NSINGL(10), NTANDM(10),
* SINGLE(10), TANDEM(10), TTYPE(10)
ISN 5 C DATA DISTSN / 6.0, 9*0.0, 64.0, 20.0, 13.0, 9.0, 2.0, 8.0, 0.0, 3*22.0,
+ 9.0, 6.0, 10.0, 8.0, 7.0, 5.0, 0.0, 3*22.0, 11.0, 61.0, 36.0, 0.46, 0.88, 0,
* 31.0, 44.0, 3*34.0, 4.0, 12.0, 23.0, 14.0, 3.0, 25.0, 34.0, 3*22.0, 3.0,
8 1.0, 12.0, 8.0, 0.0, 12.0, 16.0, 3*0.0, 1.0, 2*0.0, 2.0, 0.0, 3.0, 4*0.0,
) 1.0, 0.0, 2.0, 0.6, 0.0, 0.8, 0.6, 0.3*0.0, 1.0, 0.0, 2.0, 3.0, 0.0, 5.0, 4*0.0,
(2*0.0, 2.0, 4.0, 0.0, 2.0, 4*0.0, 0.5*0.0, 1.0, 4*0.0, 10*0.0, 10*0.0, 10*0.0 /
C
ISN 6 C DATA DISTAN / 10*0.0, 0.0, 18.0, 0.0, 16.0, 12.0, 0.0, 0.25, 0.3*0.0, 0.0,
+ 21.0, 0.0, 35.0, 16.0, 0.0, 50.0, 0.0, 33.0, 0.0, 15.0, 0.0, 0.30, 0,
= 13.0, 0.0, 25.0, 3*0.0, 0.0, 12.0, 0.0, 13.0, 19.0, 0.0, 0.0, 67.0, 67.0, 5.0, 0,,
* 1..10..5*0..0..0..3..0..1..1..3..5*0..0..1..0..0..3..7..5*0..0..10..,,
8 0..0..1..9..5*0..0..0..5..0..0..5..5*0..0..3..0..0..3..5*0..0..1..2..,,
) 0..1..1..2..5*0..0..0..2..0..0..1..5*0..0..1..5*0..0..2..8*0..0..1..8*0.., 10*0.0 /
C
ISN 7 C DATA ESING / 0.0, 0.0, 0.005, 0.025, 0.07, 0.32, 0.795, 1.0, 1.285, 1.98,
+ 2.67, 3.71, 6.085, 0.0 /
ISN 8 C DATA ETAND / 0.0, 0.0, 0.003, 0.03, 0.11, 0.36, 0.67, 0.76, 0.87, 1.14, 1.47,
+ 1.875, 2.435, 3.12, 3.86, 5.13, 0.0 /
ISN 9 C DATA SINGLE / 2.0, 1.0, 3.0, 2.0, 1.0, 5.0, 2.0, 3.0, 2.0, 1.0 /
ISN 10 C DATA TANDEM / 0.0, 1.0, 0.0, 1.0, 2.0, 0.0, 2.0, 0.0, 1.0, 2.0 /
ISN 11 C DATA TTYPE / 300.0, 150.0, 45.0, 0.0, 0.655, 0.0, 0.0, 0.90, 0.0, 0,
+ 125.0 /
ISN 12 C NTYP = 10
ISN 13 C ADTOIL = 150.0
C

LEVEL 1.2.0 (SEPT 82) VS FORTRAN DATE: JUL 18, 1983 TIME: 12:38:38 NAME: OILDEV PAGE: 22

..... 1.....2.....3.....4.....5.....6.....7.....8

C C DO 10 I = 1, NTYP
ISN 14 NSINGL(I) = TTYPE(I) * SINGLE(I)
ISN 15 NTANDM(I) = TTYPE(I) * TANDEM(I)
ISN 16 10 CONTINUE
ISN 17 C
C C DO 14 J = 1, 13
ISN 18 14 NSING(J) = 0.0
ISN 19 C
C C DO 15 J = 1, 16
ISN 20 15 NTAND(J) = 0.0
ISN 21 C
C C DO 30 K = 1, 10
ISN 22 DO 20 J = 1, 13
ISN 23 20 NSING(J) = NSING(J) + NSINGL(K)*DISTSN(K,J)/100.0
ISN 24 30 CONTINUE
ISN 25 C
C C DO 50 K = 1, 10
ISN 26 DO 40 J = 1, 16
ISN 27 40 NTAND(J) = NTAND(J) + NTANDM(K)*DISTAN(K,J)/100.0
ISN 28 50 CONTINUE
ISN 29 C
C C N18SIN = 0.0
ISN 30 C
C C DO 60 J = 1, 13
ISN 31 60 N18SIN = N18SIN + NSING(J) * ESING(J)
ISN 32 C
C C N18TAN = 0.0
ISN 33 DO 70 J = 1, 16
ISN 34 70 N18TAN = N18TAN + NTAND(J) * ETAND(J)
ISN 35 C
C C N18 = N18SIN + N18TAN
ISN 36 C
C C N180IL = N18 / 2.0
ISN 37 C
C C WRITE(6,250) N180IL, ADTOIL
ISN 38 C
C C 250 FORMAT(//2X, 'N180IL = ', F10.3, 2X, 'ADTOIL = ', F6.1, //)
ISN 39 C
ISN 40 C
STATISTICS SOURCE STATEMENTS = 40, PROGRAM SIZE = 2748 BYTES, PROGRAM NAME = OILDEV PAGE: 21.
STATISTICS NO DIAGNOSTICS GENERATED.

LEVEL 1.2.0 (SEPT 82)

DATE: JUL 18, 1983

NAME: OILDEV PAGE: 23

TIME: 12:38:38

VS FORTRAN

***** END OF COMPILATION 7 *****

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LEVEL 1.2.0 (SEPT 82)          VS FORTRAN      DATE: JUL 18, 1983   TIME: 12:38:38    NAME: MAIN    PAGE: 24
OPTIONS IN EFFECT: NOLIST NOMAP NOXREF GOSTMT NODECK SOURCE TERM OBJECT FIXED NOTEST
OPTIMIZE(O) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60)
*.....*.....1.....2.....3.....4.....5.....6.....7.....8

ISN      1      C      SUBROUTINE OILSER ( N18SER, ADTSER )
ISN      2      C      ****
ISN      3      C      REAL N18, NSING, NTAND, N18SIN, N18TAN
ISN      4      C      DIMENSION SDISTR(13), TDISTR(16), ESING(13), ETAND(16),
ISN      5      C      + NSING(13), NTAND(16)
ISN      6      C      DATA SDISTR / 0.0, 0.5, 0.0, 0.5, 9*0.0 /
ISN      7      C      DATA TDISTR / 0.0, 1.0, 5*0.0, 1.0, 8*0.0 /
ISN      8      C      DATA ESING / 0.0,0.0005,0.025,0.07,0.32,0.795,1.0,1.285,1.98,
ISN      9      C      + 2.67,3.71,6.085,0.0 /
ISN     10      C      DATA ETAND / 0.0,0.0003,0.03,0.11,0.36,0.67,0.76,0.87,1.14,1.47,
ISN     11      C      + 1.875,2.435,3.12,3.86,5.13,0.0 /
ISN     12      C      ADTSER = 50.0
ISN     13      C      SRVICE = 150.0
ISN     14      C      DO 14 J = 1, 13
ISN     15      C      14 NSING(J) = 0.0
ISN     16      C      DO 15 J = 1, 16
ISN     17      C      15 NTAND(J) = 0.0
ISN     18      C      DO 20 J = 1, 13
ISN     19      C      20 NSING(J) = SRVICE * SDISTR(J)
ISN     20      C      DO 40 J = 1, 16
ISN     21      C      40 NTAND(J) = SRVICE * TDISTR(J)
ISN     22      C      N18SIN = 0.0
ISN     23      C      DO 60 J = 1, 13
ISN     24      C      60 N18SIN = N18SIN + NSING(J) * ESING(J)

ISN      1      C      ****
ISN      2      C      THIS SUBROUTINE RETURNS THE NUMBER OF 18KIP ESAL AND ADT
ISN      3      C      IN DESIGN LANE ASSOCIATED WITH OILFIELD SERVICING.
ISN      4      C      ****
ISN      5      C      ****
ISN      6      C      ****
ISN      7      C      ****
ISN      8      C      ****
ISN      9      C      ****
ISN     10      C      ****
ISN     11      C      ****
ISN     12      C      ****
ISN     13      C      ****
ISN     14      C      ****
ISN     15      C      ****
ISN     16      C      ****
ISN     17      C      ****
ISN     18      C      ****
ISN     19      C      ****
ISN     20      C      ****
ISN     21      C      ****
ISN     22      C      ****
ISN     23      C      ****

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LEVEL 1.2.0 (SEPT 82)          VS FORTRAN          DATE: JUL 18, 1983    TIME: 12:38:38    NAME: OILSER PAGE: 25
*....*...1.....2.....3.....4.....5.....6.....7.*.....8

ISN   24      C   70 N18TAN = N18TAN + NTAND(J) * ETAND(J)
ISN   25      C   N18 = N18$IN + N18TAN
ISN   26      C   N18SER = N18 / 2.0
              C   WRITE(6,250) N18SER, ADTSER
              C   250 FORMAT( //2X, 'N18SER = ', F10.3, 2X, 'ADTSER = ', F6.1, //)
              C   WRITE(6,260) (NSING(I), I = 1, 13)
              C   260 FORMAT( , NSING = ', 13F8.1 //')
              C   WRITE(6,262) (NTAND(I), I = 1, 16 )
              C   262 FORMAT( , NTAND = ', 13F8.1 // 9X, 3F8.1 // )
              C
ISN   27      RETURN
ISN   28      END
              SOURCE STATEMENTS = 28, PROGRAM SIZE = 1104 BYTES, PROGRAM NAME = OILSER PAGE: 24.
*STATISTICS* NO DIAGNOSTICS GENERATED.
***** END OF COMPILED 8 *****

```

LEVEL 1.2.0 (SEPT 82) VS FORTRAN DATE: JUL 18, 1983 TIME: 12:38:38 NAME: MAIN PAGE: 26

OPTIONS IN EFFECT: NOLIST NOMAP NOXREF GOSTMT NODECK SOURCE TERM OBJECT FIXED NOTE^T
OPTIMIZE(O) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60)

```
* .....1.....2.....3.....4.....5.....6.....7.....8  
  
ISN 1      SUBROUTINE FINDA1 ( ADT, AKIP, A1 )  
ISN 2      DIMENSION AUPL(6), EUPL(3)  
ISN 3      ADTF(6), EALF(3)  
ISN 4      DATA AUPL /0.0, 300.0, 750.0, 2000.0, 75000.0, 250000.0/  
ISN 5      DATA ADTF /1.00, 0.96, 0.92, 0.88, 0.84, 0.80/  
ISN 6      DATA EUPL /0.0, 6.0, 12.0/  
ISN 7      DATA EALF /1.00, 0.95, 0.90/  
ISN 8      DO 2100 K = 1, 5  
ISN 9      IF ( ADT .LT. AUPL(K+1) ) GO TO 2200  
ISN 10     CONTINUE  
ISN 11     K = 6  
ISN 12     2200 Z1 = ADTF(K)  
ISN 13     DO 2300 K = 1, 2  
ISN 14     IF ( AKIP .LT. EUPL(K+1) ) GO TO 2400  
ISN 15     2300 CONTINUE  
ISN 16     K = 3  
ISN 17     2400 Z2 = EALF(K)  
ISN 18     A1 = 1.00 / ( Z1 * Z2 )  
ISN 19     RETURN  
ISN 20     END
```

STATISTICS SOURCE STATEMENTS = 20, PROGRAM SIZE = 536 BYTES, PROGRAM NAME = FINDA1 PAGE: 26.

STATISTICS NO DIAGNOSTICS GENERATED.

***** END OF COMPILED 9 *****

LEVEL 1.2.O (SEPT 82)

VS FORTRAN

DATE: JUL 18, 1983 TIME: 12:38:38 NAME: MAIN PAGE: 27

OPTIONS IN EFFECT: NOLIST NOMAP NOXREF GOSTMT NODECK SOURCE TERM OBJECT FIXED NOTE TEST
OPTIMIZE(O) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60)

..........1.....2.....3.....4.....5.....6.....7.....8

```
1      SUBROUTINE FINDRF ( RFAL, FTCC, V )
2      DIMENSION V(8), RUPL(2), FUPL(3), RFFR(2), FTFR(3)
3      DATA RUPL /20.0, 40.0/
4      DATA RFFR /0.97, 0.94/
5      DATA FUPL /10.0, 30.0, 50.0/
6      DATA FTFR /0.973, 0.967, 0.960/
7      RF = 1.0
8      IF ( RFAL .LE. RUPL(1) ) GO TO 1200
9      RF = RFFR(2)
10     IF ( RFAL .GT. RUPL(2) ) GO TO 1200
11     RF = RFFR(1)
12     1200 CONTINUE
13     FF = 1.00
14     IF ( FTCC .LE. FUPL(1) ) GO TO 1500
15     FF = FTFR(3)
16     IF ( FTCC .GT. FUPL(3) ) GO TO 1500
17     FF = FTFR(2)
18     IF ( FTCC .GT. FUPL(2) ) GO TO 1500
19     FF = FTFR(1)
20     1500 CONTINUE
21     V(1) = 1.00 / RF
22     V(2) = V(1)
23     V(3) = 1.0
24     V(4) = V(1)
25     V(5) = V(1) / FF
26     V(6) = V(5)
27     V(7) = V(5)
28     V(8) = V(5)
29     RETURN
30     END
```

STATISTICS SOURCE STATEMENTS = 30, PROGRAM SIZE = 524 BYTES, PROGRAM NAME = FINDRF PAGE: 27.

STATISTICS NO DIAGNOSTICS GENERATED.

***** END OF COMPILED 10 *****

LEVEL	1.2.O (SEPT 82)	VS FORTRAN	DATE: JUL 18, 1983	TIME: 12:38:38	NAME: MAIN	PAGE:
OPTIONS IN EFFECT:	NOLIST NOMAP NOXREF GOSTMT NODECK OPTIMIZE(O) LANGLVL(77) NOFIPS	SOURCE TERM FLAG(I)	OBJECT FIXED NAME(MAIN)	NOTE TEST LINECOUNT(60)		
*123456
					7 *
					8

```

C C C C
      1      SUBROUTINE UTILITY1 ( RX,V,Z )
      2      DIMENSION A(8), B(8), U(8), V(8), RX(8)
      3      DATA   A /-0.2540, -0.3396, -0.6703, -0.8106,
      4      1       -1.4918, -0.8607, -1.0000, -0.7408 /
      5      DATA   B /- 18.940, - 9.770, - 42.580, - 59.700,
      6      1       - 6.2044, - 43.750, -191.200, - 8.892/
      7      U(1)    = 1.00
      8      DO 1100 I = 1, 8
      9      IF ( RX(I) .GT. 0.5 ) GOTO 1000
      10     U(I)    = 1.0
      11     GOTO 1100
      12     U(I)    = 1.0 + A(I) * EXP( B(I) / RX(I) )
      13     1000 CONTINUE
      14     1100 CONTINUE
      15     1200 CONTINUE
      16     Z        = 1.0
      17     DO 1500 K = 1, 8
      18     Z        = Z * U(K) ** V(K)
      19     1500 CONTINUE
      20     RETURN
END

```

STATISTICS SOURCE STATEMENTS = 18, PROGRAM SIZE = 732 BYTES, PROGRAM NAME = UTILITY1 PAGE: 28.

STATISTICS NO DIAGNOSTICS GENERATED.

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END OF COMMISSION

LEVEL 1.2.O (SEPT 82)

DATUM: JUL 18, 1983 TIME: 12:38:38 NAME: MAIN PAGE: 29

OPTIONS IN EFFECT: NOLIST NOMAP NOXREF GOSTMT NODECK SOURCE TERM OBJECT FIXED NOTEST
OPTIMIZE(O) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60)

..........1.....2.....3.....4.....5.....6.....7.....8

C
C
C
C
C
C

```
      1      SUBROUTINE UTLTY2 ( X, Y, Z )
      2      DIMENSION A(3,3), B(3)
      3      DATA A /0.8, 1.3, 1.8, 2.0, 2.5, 3.0, 3.0, 3.5/
      4      DATA B /-0.26666, -0.55833, -0.85000/
      5      Z = 0.0
      6      IF ( Y .LT. 0.0 ) GO TO 2000
      7      NC = 3
      8      IF ( X .GT. 165000 ) GO TO 1300
      9      NC = 2
     10      IF ( X .GT. 27500 ) GO TO 1200
     11      NC = 1
     12      1200 CONTINUE
     13      Z = 1.00
     14      IF ( Y .GE. A(NC,3) ) GO TO 2000
     15      IF ( Y .LT. A(NC,2) ) GO TO 1500
     16      Z = 1.00 - 0.4 * ( A(NC,3) - Y ) ** 2
     17      GO TO 2000
     18      1500 IF ( Y .LT. A(NC,1) ) GO TO 1600
     19      Z = B(NC) + 0.58333 * Y
     20      GO TO 2000
     21      1600 Z = 0.20 * ( Y / A(NC,1) ) ** 2
     22      2000 CONTINUE
     23      RETURN
     24
```

STATISTICS

SOURCE STATEMENTS = 24. PROGRAM SIZE = 670 BYTES. PROGRAM NAME = UTLTY2 PAGE: 29.

STATISTICS

NO DIAGNOSTICS GENERATED.

***** END OF COMPILED 12 *****

LEVEL 1.2.O (SEPT 82) VS FORTRAN DATE: JUL 18, 1983 TIME: 12:38:38 NAME: MAIN PAGE: 30
OPTIONS IN EFFECT: NOLIST NOMAP NOXREF GOSTMT NODECK SOURCE TERM OBJECT FIXED NOTESI
OPTIMIZE(O) LANGLVL(77) NOFIPS FLAG(I) NAME(MAIN) LINECOUNT(60)
* * * .1.....2.....3.....4.....5.....6.....7.....8

C
C
C
C
C
C
C
C

ISN 1 C SUBROUTINE UTILITY4 (Y, Z)
C Y = AREA OF ROAD COVERED BY PATCHING
C THIS SUBROUTINE
C A) CALCULATES THE COST ASSOCIATED WITH Y
C B) CALCULATES A UTILITY SCORE FOR THAT COST (REFER PES)
C
C IF Y = 10% COST ASSUMED EQUAL TO \$1400 (WHERE U DECR)
C IF Y = 75% COST ASSUMED EQUAL TO \$3100 (U = 0)
C LINEAR INTERPOLATION USE FOR Y BETWEEN 10 AND 100
C
ISN 2 IF (Y .GT. 10) GOTO 1000
ISN 3 Z = 1.0
ISN 4 GOTO 2000
ISN 5 CONTINUE
ISN 6 COST = 1400.0 + 26.15 * (Y - 10.0)
ISN 7 Z = 1.0 - 0.13*((COST - 1400.0)/700.0) ** 2
ISN 8 IF (COST .GT. 2100.0) Z = 2.69 - 0.00087 * COST
ISN 10 IF (Z .LT. 0.0) Z = 0.0
ISN 12 CONTINUE
ISN 13 RETURN
ISN 14 END

STATISTICS SOURCE STATEMENTS = 12, PROGRAM SIZE = 422 BYTES, PROGRAM NAME = UTILITY4 PAGE: 30.
STATISTICS NO DIAGNOSTICS GENERATED.
***** END OF COMPILATION 13 *****

OILFIELD TRAFFIC MODEL -- SURFACE TREATED PAVEMENT

STRUCTURAL VARIABLES

FLEXIBLE LAYER THICKNESS	6.00
W1, MEAN DEFLECTION	1.55
SUBGRADE PLASTICITY INDEX	12.00
SUBGRADE LIQUID LIMIT	41.63

ENVIRONMENTAL VARIABLES FOR COUNTY 21

MEAN TEMPERATURE	67.70
THORNTONWAITE INDEX	4.59
FREEZE /THAW CYCLES	24.84

DISTRESS LIMITS AREA SEV.

PSI	1.5
RUTTING	50.0
RAVELING	30.0
FLUSHING	30.0
ALLIGTR + PATCH	50.0
LONGITUD CRK	30.0
TRANSVERSE CRK	30.0

** MINIMUM PAVEMENT SCORE ALLOWED = 35 **

TRAFFIC ANALYSIS DATA

N18/MTH =	376.	ADT/LANE =	250.
% TRUCKS =	5.00	% GROWTH =	5.00

MONTH	ADT(N)	ADT(O)	N18(N)	N18(O)
1	7500.	12000.	376.	645.
6	45471.	109971.	2282.	5924.
12	92091.	278091.	4622.	14566.
24	188893.	738643.	9481.	37524.
36	290648.	1292272.	14588.	64742.
60	510040.	2525568.	25600.	124988.
72	628224.	2986731.	31531.	146598.
84	752454.	3281695.	37767.	160606.
96	883039.	3497645.	44321.	171047.
108	1020305.	3677592.	51210.	179879.
120	1164589.	3843217.	58452.	188093.

OILFIELD DAMAGE PROJECT ---- NORMAL TRAFFIC

MONTH	RIDE	RUTTING		RAVELING		FLUSHING		ALLIGATOR		LONGITUDNL.		TRANSVERSE		PATCHING		PAVEMENT SCORE (PES)			
		AREA	SEV.	AREA	SEV.	AREA	SEV.	AREA	SEV.	AREA	SEV.	AREA	SEV.	AREA	SEV.	VISUAL	PSI	MCOST	TOTAL
1	4.20	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	0.0	100	100	100	100
6	4.20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	1.9	100	100	100	100
12	4.19	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	6.6	100	100	100	100
24	4.06	32.9	1.2	0.0	0.1	0.0	0.0	0.0	0.0	0.2	0.0	5.3	0.0	0.0	15.5	73	100	100	73
36	3.77	62.9	12.9	0.6	1.7	1.2	1.1	0.4	0.0	1.9	0.1	10.4	0.0	0.0	22.6	69	100	100	69
60	3.15	86.2	47.1	8.2	15.6	11.5	14.3	7.7	3.0	11.2	4.3	19.5	0.0	1.3	33.1	67	100	100	67
72	2.90	90.8	59.5	14.8	25.0	19.0	24.2	14.5	14.1	16.9	9.5	23.3	0.0	4.8	37.1	60	100	100	60
84	2.68	93.5	68.6	21.9	34.1	26.7	33.8	22.0	30.5	22.6	15.8	26.7	0.1	10.9	40.6	48	100	99	48
96	2.49	95.3	75.3	29.0	42.3	34.0	42.6	29.5	46.8	27.9	22.5	29.8	2.3	18.8	43.7	38	99	98	37
108	2.32	96.4	80.3	35.8	49.5	40.8	50.3	36.6	60.2	32.8	28.9	32.5	11.2	27.3	46.4	12	98	94	11
120	2.18	97.3	84.1	42.0	55.8	46.8	57.0	43.2	70.4	37.3	35.0	34.9	25.8	35.7	48.9	10	95	88	8

TIME TO FAILURE UNDER NORMAL TRAFFIC = 96.9 MTHS

OILFIELD DAMAGE PROJECT ----- NORMAL PLUS OILFIELD TRAFFIC

MONTH	RIDE	RUTTING		RAVELING		FLUSHING		ALLIGATOR		LONGITUDNL.		TRANSVERSE		PATCHING		PAVEMENT		SCORE (PES)	
		AREA	SEV.	AREA	SEV.	AREA	SEV.	AREA	SEV.	AREA	SEV.	AREA	SEV.	AREA	SEV.	VISUAL	PSI	MCOST	TOTAL
1	4.20	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	0.0	100	100	100	100
6	4.18	5.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	9.2	99	100	100	99
12	3.77	62.8	12.8	0.4	1.3	0.9	0.8	0.4	0.0	0.0	0.0	1.0	0.0	0.0	22.6	69	100	100	69
24	2.68	93.4	68.3	21.1	33.1	25.9	32.8	21.7	29.9	0.2	0.0	5.3	0.0	10.7	40.5	49	100	99	49
36	2.08	97.8	86.6	46.8	60.4	51.4	61.8	48.1	76.8	1.9	0.1	10.4	0.0	42.3	50.8	22	92	73	15
60	1.55	99.4	95.6	72.5	82.1	75.3	83.8	74.0	95.9	11.2	4.3	19.5	0.0	76.2	61.9	12	63	0	0
72	1.45	99.6	96.7	77.1	85.5	79.5	87.2	78.4	97.3	16.9	9.5	23.3	0.0	81.4	64.4	11	58	0	0
84	1.40	99.6	97.2	79.4	87.2	81.6	88.8	80.7	97.9	22.6	15.8	26.7	0.1	83.9	65.7	11	55	0	0
96	1.37	99.7	97.5	80.9	88.2	82.9	89.8	82.1	98.3	27.9	22.5	29.8	2.3	85.4	66.6	11	53	0	0
108	1.35	99.7	97.7	81.9	89.0	83.9	90.5	83.1	98.5	32.8	28.9	32.5	11.2	86.6	67.3	4	51	0	0
120	1.33	99.7	97.9	82.8	89.6	84.7	91.0	84.1	98.7	37.3	35.0	34.9	25.8	87.5	67.9	4	50	0	0

TIME TO FAULTIVE UNDER NORMAL + ON FIELD TRAFFIC = 28.9 MIHS

22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60

OILFIELD TRAFFIC MODEL -- SURFACE TREATED PAVEMENT

STRUCTURAL VARIABLES

FLEXIBLE LAYER THICKNESS	6.00
W1, MEAN DEFLECTION	1.55
SUBGRADE PLASTICITY INDEX	12.00
SUBGRADE LIQUID LIMIT	41.63

ENVIRONMENTAL VARIABLES FOR COUNTY 21

MEAN TEMPERATURE	67.70
THORNTHTWAITE INDEX FREEZE /THAW CYCLES	4.59 24.84

DISTRESS LIMITS AREA SEV.

PSI		1.5
RUTTING	50.0	30.0
RAVELLING	80.0	30.0
FLUSHING	80.0	30.0
ALLIGTR + PATCH	50.0	50.0
LONGITUD CRK	70.0	30.0
TRANSVERSE CRK	70.0	30.0

** MINIMUM PAVEMENT SCORE ALLOWED = 35 **

TRAFFIC ANALYSIS DATA

N18/MTH = 376. ADT/LANE = 250.
% TRUCKS = 5.00 % GROWTH = 5.00

MONTH	ADT(N)	ADT(O)	N18(N)	N18(O)
1	7500.	21000.	376.	1184.
6	45471.	238971.	2282.	13209.
12	92091.	650091.	4622.	34452.
24	188893.	1838143.	9481.	93609.
36	290648.	3295522.	14588.	165050.
60	510040.	6556628.	25600.	323773.
72	628224.	7703759.	31531.	376739.
84	752454.	8340210.	37767.	406292.
96	883039.	8726901.	44321.	424504.
108	1020305.	8992215.	51210.	437221.
120	1164589.	9200518.	58452.	44376.

OILFIELD DAMAGE PROJECT ----- NORMAL TRAFFIC

MONTH	RIDE	RUTTING AREA SEV.	RAVFLING AREA SEV.	FLUSHING AREA SEV.	ALLIGATOR AREA SEV.	LONGITUDNL AREA SEV.	TRANSVERSE AREA SEV.	PATCHING AREA SEV.	PAVEMENT SCORE (PES)		TOTAL
									VISUAL	PSI	
1	4.20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100	100
6	4.20	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	100	100
12	4.19	0.8	0.0	0.0	0.0	0.0	0.0	1.0	0.0	6.6	100
24	4.06	32.9	1.2	0.0	0.1	0.0	0.0	0.2	0.0	15.5	73
36	3.77	62.9	12.9	0.6	1.7	1.2	1.1	0.4	0.0	22.6	69
60	3.15	86.2	47.1	8.2	15.6	11.5	14.3	7.7	3.0	11.2	4.3
72	2.90	90.8	59.5	14.8	25.0	19.0	24.2	14.5	14.1	16.9	9.5
84	2.68	93.5	68.6	21.9	34.1	26.7	33.8	22.0	30.5	22.6	15.8
96	2.49	95.3	75.3	29.0	42.3	34.0	42.6	29.5	46.8	27.9	22.5
108	2.32	96.4	80.3	35.8	49.5	40.8	50.3	36.6	60.2	32.8	28.9
120	2.18	97.3	84.1	42.0	55.8	46.8	57.0	43.2	70.4	37.3	35.0

TIME TO FAILURE UNDER NORMAL TRAFFIC = 96.9 MONTHS

OILFIELD DAMAGE PROJECT ---- NORMAL PLUS OILFIELD TRAFFIC

MONTH	RIDE AREA	RUTTING AREA SEV.	RAVELING AREA SEV.	FLUSHING AREA SEV.	ALLIGATOR AREA SEV.	LONGITUDNL AREA SEV.	TRANSVERSE AREA SEV.	PATCHING AREA SEV.	PAVEMENT SCORE (PES)
									MCCST TOTAL
1	4.20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.4
6	3.85	56.7	8.7	0.1	0.5	0.3	0.2	0.0	100
12	2.79	92.2	64.2	16.0	26.7	20.4	25.9	18.0	100
24	1.75	98.9	92.8	61.7	73.5	65.4	75.3	64.1	100
36	1.39	99.7	97.3	79.5	87.3	81.7	88.9	81.3	100
60	1.13	99.9	99.2	90.9	94.9	91.9	95.9	92.0	100
72	1.09	99.9	99.4	92.6	95.9	93.3	96.7	93.4	100
84	1.07	99.9	99.5	93.3	96.4	94.0	97.1	94.0	100
96	1.06	100.0	99.5	93.6	96.6	94.3	97.3	94.4	100
108	1.05	100.0	99.5	93.9	96.7	94.5	97.4	94.6	100
120	1.05	100.0	99.5	94.0	96.8	94.7	97.5	94.7	100

TIME TO FAILURE UNDER NORMAL + OILFIELD TRAFFIC = 16.8 MTHS

OIL WELL DEVELOPMENT MONTH NO. WELLS

1	3
2	3
3	3
4	3
5	3
6	3
7	3
8	3
9	3
10	3
11	3
12	3
13	3
14	3
15	3
16	3
17	3
18	3
19	3
20	3
21	3

OILFIELD TRAFFIC MODEL -- SURFACE TREATED PAVEMENT

STRUCTURAL VARIABLES

FLEXIBLE LAYER THICKNESS	6.00
W ₁ , MEAN DEFLECTION	1.55
SUBGRADE PLASTICITY INDEX	12.00
SUBGRADE LIQUID LIMIT	41.63

ENVIRONMENTAL VARIABLES FOR COUNTY 21

MEAN TEMPERATURE	67.70
THORNTONWAITE INDEX	4.59
FREEZE /THAW CYCLES	24.84

DISTRESS LIMITS AREA SEV.

PSI	1.5
RUTTING	50.0
RAVELLING	30.0
FLUSHING	30.0
ALLIGTR + PATCH	50.0
LONGITUD CRK	30.0
TRANSVERSE CRK	30.0

** MINIMUM PAVEMENT SCORE ALLOWED = 35 **

TRAFFIC ANALYSIS DATA

N18/MTH =	376.	ADT/LANE =	250.
% TRUCKS =	5.00	% GROWTH =	5.00

MONTH	ADT(N)	ADT(O)	N18(N)	N18(O)
1	7500.	34500.	376.	1991.
6	45471.	432471.	2282.	24135.
12	92091.	1208091.	4622.	64282.
24	188893.	3487393.	9481.	177737.
36	290648.	63000397.	14588.	315512.
60	510040.	12603225.	25600.	621947.
72	628224.	14779311.	31531.	721948.
84	752454.	15927988.	37767.	774820.
96	883039.	16570795.	44321.	804692.
108	1020305.	16964160.	51210.	823239.
120	1164589.	17236464.	58452.	836309.

OILFIELD DAMAGE PROJECT ----- NORMAL TRAFFIC

MONTH	RIDE	RUTTING		RAVELLING		FLUSHING		ALLIGATOR		LONGITUDNL.		TRANSVERSE		PATCHING		PAVEMENT SCORE (PES)		
		AREA	SEV.	AREA	SEV.	AREA	SEV.	AREA	SEV.	AREA	SEV.	AREA	SEV.	VISUAL	PSI	MCOST	TOTAL	
1	4.20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	100	100	100	100	
6	4.20	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0	100	100	100	100	
12	4.19	0.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	0.0	0.0	6.6	100	100	100	
24	4.06	32.9	1.2	0.0	0.1	0.0	0.0	0.0	0.0	0.2	0.0	5.3	0.0	0.0	15.5	73	100	73
36	3.77	62.9	12.9	0.6	1.7	1.2	1.1	0.4	0.0	1.9	0.1	10.4	0.0	0.0	22.6	69	100	69
60	3.15	86.2	47.1	8.2	15.6	11.5	14.3	7.7	3.0	11.2	4.3	19.5	0.0	1.3	33.1	67	100	67
72	2.90	90.8	59.5	14.8	25.0	19.0	24.2	14.5	14.1	16.9	9.5	23.3	0.0	4.8	37.1	60	100	60
84	2.68	93.5	68.6	21.9	34.1	26.7	33.8	22.0	30.5	22.6	15.8	26.7	0.1	10.9	40.6	48	100	99
96	2.49	95.3	75.3	29.0	42.3	34.0	42.6	29.5	46.8	27.9	22.5	29.8	2.3	18.8	43.7	38	99	98
108	2.32	96.4	80.3	35.8	49.5	40.8	50.3	36.6	60.2	32.8	28.9	32.5	11.2	27.3	46.4	12	98	94
120	2.18	97.3	84.1	42.0	55.8	46.8	57.0	43.2	70.4	37.3	35.0	34.9	25.8	35.7	48.9	10	95	88

TIME TO FAILURE UNDER NORMAL TRAFFIC = 96.9 MONTHS

MONTH	RIDE	RUTTING		RAVELLING		FLUSHING		ALLIGATOR		LONGITUDNL		TRANSVERSE		PATCHING		PAVEMENT SCORE (PES)		
		AREA	SEV.	AREA	SEV.	AREA	SEV.	AREA	SEV.	AREA	SEV.	AREA	SEV.	AREA	SEV.	VISUAL	MCOST	TOTAL
1	4.20	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	1.4	100	100	100
6	3.23	84.6	43.4	4.6	9.7	6.9	8.3	6.3	1.6	0.0	0.0	0.1	0.0	0.8	32.0	68	100	100
12	2.09	97.7	86.4	43.7	57.4	48.5	58.7	47.7	76.4	0.0	0.0	1.0	0.0	41.8	50.6	23	93	74
24	1.35	99.7	97.6	80.8	88.2	82.8	89.7	82.9	98.4	0.2	0.0	5.3	0.0	86.3	67.2	11	52	0
36	1.14	99.9	99.1	90.5	94.7	91.5	95.6	91.7	99.7	1.9	0.1	10.4	0.0	94.8	74.5	9	39	0
60	0.99	100.0	99.7	96.0	97.9	96.4	98.4	96.6	100.0	11.2	4.3	19.5	0.0	98.4	81.4	8	30	0
72	0.97	100.0	99.8	96.7	98.3	97.0	98.8	97.2	100.0	16.9	9.5	23.3	0.0	98.7	82.7	8	29	0
84	0.96	100.0	99.8	97.0	98.5	97.3	98.9	97.5	100.0	22.6	15.8	26.7	0.1	98.9	83.3	8	29	0
96	0.95	100.0	99.8	97.1	98.6	97.4	99.0	97.6	100.0	27.9	22.5	29.8	2.3	99.0	83.6	8	28	0
108	0.95	100.0	99.8	97.2	98.6	97.5	99.0	97.7	100.0	32.8	28.9	32.5	11.2	99.0	83.7	3	28	0
120	0.95	100.0	99.8	97.3	98.7	97.6	99.0	97.7	100.0	37.3	35.0	34.9	25.8	99.0	83.9	3	28	0

TIME TO FAILURE UNDER NORMAL + OILFIELD TRAFFIC = 9.8 MTHS

OIL WELL DEVELOPMENT MONTH NO. WELLS

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