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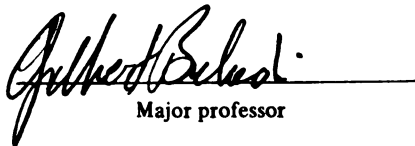
MECHANISTIC EVALUATION OF A SECTION OF THE
NATIONAL HIGHWAY (N5),
BETWEEN KARACHI AND HYDERABAD IN PAKISTAN

presented by

ANWAR-UL-HAQ CHAUDHRY

has been accepted towards fulfillment
of the requirements for

Master of Science degree in Civil Engineering


Major professor

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ABSTRACT

MECHANISTIC EVALUATION OF A SECTION OF THE NATIONAL HIGHWAY (N5), BETWEEN KARACHI AND HYDERABAD IN PAKISTAN

BY

ANWAR UL HAQ CHAUDHRY

A newly constructed portion of the National Highway (N5) between Hyderabad and Karachi, Pakistan, showed signs of pavement distress and failure as a result of heavy rainfall and hail storm soon after it was opened to traffic in April 1994. The National Highway Authority (NHA), decided to perform a pavement investigation which included nondestructive falling weight deflectometer (FWD) tests and test pits for material characteristics and quality control. The data from FWD tests was used for mechanistic evaluation of pavement layers using the MICHBACK and MICHPAVE computer programs. The statistical analysis of the NDT data and the backcalculated layer moduli using the MICHBACK computer program showed considerable variations along the length of the road. These variations in the deflection data and the layer moduli can be attributed to construction practices and, perhaps, to poor quality control. These layer moduli and the pavement layer thicknesses were then used to determine the remaining service life of various pavement sections and required overlay thicknesses to improve the structural capacity of the pavement using the MICHPAVE computer program and the Asphalt Institute method. It can be concluded from this study that parts of the National Highway N5 were severely underdesigned.

**I dedicate this work to my biggest supporters in this world; my family; my
parents, brothers, sisters, and wife.**

ACKNOWLEDGMENTS

I am thankful to the Pakistan Army and the National University of Science and Technology (NUST), Pakistan, for sponsoring this study at Michigan State University.

I would like to express my deep thanks and sincere appreciation to all persons who have contributed by inspiration, counseling, and assistance in the completion of this study. The advice, professional guidance, and supervision of Dr. Gilbert Y. Baladi have been invaluable in the completion of this study. Also, I would like to extend my deepest thanks to my Graduate Committee; Dr. William C. Taylor and Dr. Thomas Wolff for their comments and interest. I wish to sincerely appreciate the cooperation extended to me by Dr. Zafar Iqbal Raja, Director Design National Highway Authority, Pakistan, in provision of deflection data and other information required for this study. I also want to convey my special thanks to Muhammad Jamal Khattak, graduate student at MSU, for helping me in the data preparation and his sincere advice during the course of this study.

My deepest love and thanks to my parents, who brought me up in a best manner, for their unconditional support from the day I was born, and for their prayers that do not stop. My wife deserves special thanks for her continuous moral support and prayers.

Above all, I deeply believe that my accomplishment and success are bestowed upon me by the Almighty to whom I am very thankful.

Anwar ul Haq Chaudhry

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CHAPTER 1

INTRODUCTION

1.1 GENERAL.

Historically, the economy of Pakistan has relied heavily upon an extensive railway network for the movement of people and freight. Because of this extensive network, the highway system in Pakistan was neglected. Since the mid 1980's, the country has witnessed enormous economic growth (7 to 8 percent per year). This economic growth and the strategic geographical location of Pakistan (it provides a link between the warm water of the Indian Ocean and the land locked Asian Republics) have precipitated a tremendous growth in the number of trucks and buses operating on an inferior highway network. In response to such a demand, the National Highway Board (the agency responsible for the design, maintenance, and construction of highways) was elevated to the rank of an authority in 1986 and hence, the National Highway Authority (NHA) was born [1].

Since the day of its creation, the new NHA, with a very limited staff and experience, faced a disproportionate problem to upgrade and expand the existing highway network. The problem was compounded due to the lack of pavement performance data, truck loading data, material property data, and even environmental data. As with any other new agency faced with a tremendous problem, the NHA staff undertook a crash course to review the experience of highway agencies of other countries such as Britain, and the USA. Based on that review, new standard specifications were issued for the construction of roads and bridges. However, the continuous high growth in traffic volume and load neutralized the effectiveness of such

specifications in a short time period. In 1991, the NHA published general specifications which enhanced the earlier specifications based on experience and pavement performance. Unfortunately, because of the continued growth in traffic volume and load, the new specifications have not prevented premature failure of many roads [1].

The life and performance of flexible pavement structures in Pakistan are affected by many factors including:

1. **Axle load.** The average truck axle load in Pakistan is about 7 times higher than that in Great Britain or in the USA. Hence, road design and construction practices in Pakistan must be based on observations made on Pakistani highways not on those made in USA or other countries[2].
2. **Materials.** The highway material in Pakistan are unique to Pakistan and they change from one location to another. For example, in some areas the roadbed soil consists of a deep deposit of clay material while in other areas it consists of sand and large boulders. Hence, the properties of the material to be used in highway construction must be characterized and their impacts on the life and performance of pavements must be assessed prior to their use. Therefore, the properties of the materials used in USA or Britain should not be used to represent the properties of the materials in Pakistan.
3. **Construction practices.** The poor performance of flexible pavements in Pakistan is also a result of poor construction practices and quality control. The areas which require special attention include production of aggregates, production of asphalt,

storage of the bitumen mix, excessive heating of asphalt mixes, and the placement and compaction techniques.[1]

4. **Environment.** The environment of Pakistan is very peculiar and diverse. It ranges from snow covered mountains in the North to the very high temperature deserts in the South-East, from rugged and dry mountains of Baluchistan in the South-West to the agriculture plains of Punjab in the East. This diversity of environment and terrain should be considered while designing the roads in Pakistan rather than borrowing and implementing standard design procedures from other countries.

1.2 **PROBLEM STATEMENT**

The efficient and safe transportation system is very important for the progress and prosperity of any country. The system consists of roads, rail, and air. In Pakistan, presently over 88% of passengers and about 80% of goods are transported by roads[3]. The only major road, National Highway N-5 (the location of this highway is shown in Figure 1.1), which connects Karachi Port in the South to Lahore and Islamabad in the North, carries about 56% of all road traffic. Since this road passes through the most densely populated agricultural and industrial areas of Pakistan, it was felt necessary to upgrade and maintain this road so that it can fulfill the transportation requirements of the country. This task was undertaken with the assistance of the World Bank under various Highway Projects. Under the Fourth Highway Project, the World Bank agreed to finance more than 50 percent of the cost of a phased upgradation of N-5 to a dual carriageway.



Figure 1.1 : The general layout of road network of Pakistan [After National Highway Authority].

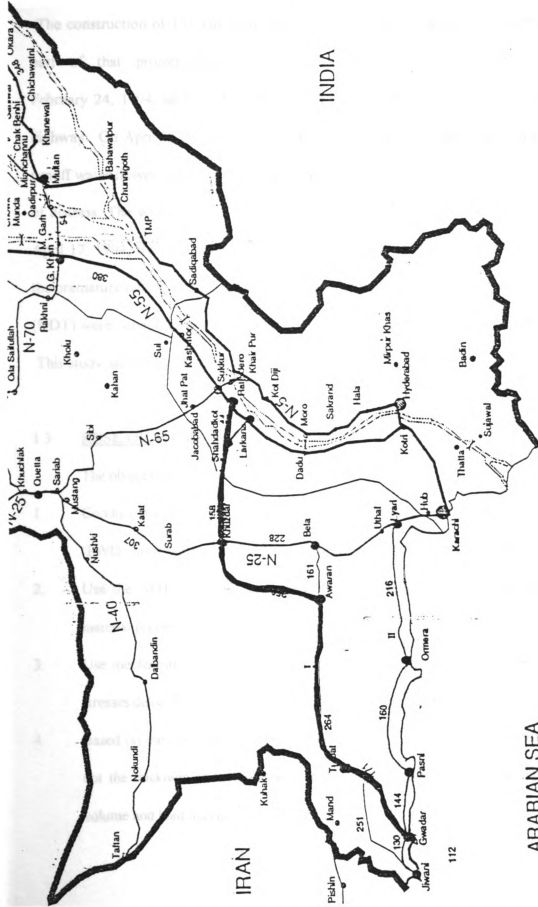


Figure 1.2 : The location of National Highway N5 in Southern part of Pakistan [After National Highway Authority].

The construction of 135 km additional carriageway from Karachi to Hyderabad was a part of that project which started in 1989 and was opened to traffic in 1994. On February 24, 1994, all Karachi bound traffic began using a 65.1 km stretch of the new highway. On April 5, 1994, some area of the new road experienced heavy rainfall where runoff water flowed over the road. On April 7, 1994, the pavement showed various signs of distress. The severity of the pavement distresses increased at a high rate such that on April 17, 1994, the road was closed to traffic. Several teams were formed to investigate the premature failure of N5. As a part of the investigation, nondestructive deflection tests (NDT) were conducted along 52.4 km of N5 between February 26, and March 8, 1995[4]. This study addresses the analysis and discussion of the NDT data.

1.3 **RESEARCH OBJECTIVES**

The objectives of this study are:

1. Conduct nondestructive deflection tests (NDT) using a falling weight deflectometer (FWD) along parts of the N5 highway between Karachi and Hyderabad.
2. Use the NDT data and the pavement layer thicknesses to backcalculate the insitu material properties of the various pavement layers.
3. Use mechanistic analysis to determine the magnitudes of the deflection, strains, and stresses delivered to the pavement by 18-kip and 33-kip axle loads.
4. Based on the mechanistic outputs (stresses, strains, and deflections) verify whether or not the thickness of the pavement on N5 was adequate to carry the expected traffic volume and load during its design life.

5. Based on the results of item 4, determine the expected service life of the pavement and the deficiency in the overlay thickness.
6. Verify the design inputs (material properties) used in Pakistan.
7. Address the variability of the deflection data along the test sections on N5 highway.

CHAPTER 2

LITERATURE REVIEW

2.1 GENERAL

As the roads and highways in Pakistan are subjected to ever increasing loads and volume of traffic, they are deteriorating and failing prematurely, so they require some type of treatment to be able to provide a safe and serviceable facility for the users. The types of treatments that are appropriate to maintain pavement serviceability can range from relatively simple maintenance to complete reconstruction, depending on the circumstances. For pavements subjected to moderate and heavy traffic, the most appropriate treatment is to overlay the pavement with asphalt concrete. Resurfacing or rehabilitation of a pavement, including overlays, grinding, and recycling, may be required for one or more of the following reasons [5]:

1. Inadequate ride quality
2. Excessive pavement distress
3. Reduced coefficient of friction between tire and pavement
4. Excessive maintenance requirements
5. Unacceptable user costs
6. Inadequate structural capacity for planned use.

The application of a properly designed overlay can provide a cost effective way of correcting these pavement deficiencies. For selecting the rehabilitation or resurfacing treatment, factors considered include[5]:

1. Present condition with regard to both smoothness and distress.
2. Traffic, both past and future in terms of volume and weight of vehicles.
3. Structural evaluation of existing pavement.
4. Environment, usually as represented by rainfall and temperature.
5. Drainage of both surface and subsurface water.
6. Terrain with respect to general topography; mountainous, flat or cut etc.
7. Constraints imposed by contiguous structures; bridges, drainage structures, and shoulders etc.
8. Design life required for treatment.
9. Materials used in original construction and planned for overlays.
10. Age of pavement.
11. Maintenance history e.g., frequency and cost.

The knowledge of the structural condition of the pavement provides a valuable information regarding the structural adequacy of the pavement sections. This information can be used to determine the rate of deterioration and to select and design proper rehabilitation alternatives. Nondestructive deflection test (NDT) is the most efficient and reliable means of determining the structural condition of an existing pavement. The nondestructive deflection testing and the devices used for this purpose are discussed below.

2.2 NONDESTRUCTIVE DEFLECTION TESTING

The measure of structural capacity of a pavement is made to obtain an estimate of the remaining life of pavement and to provide information to use in the design of

rehabilitation measures. Equipment currently in use to evaluate structural capacity, generally use a measure of surface deflection under a slow-moving, vibrating, or falling load. Because of the fairly lengthy process associated with destructive testing of pavements, a number of procedures and associated equipment for measuring the structural response of pavements nondestructively have been developed in recent years. The use of nondestructive deflection testing has been an integral part of the structural evaluation and rehabilitation process for many decades. In its earliest applications, the total measured pavement deflection under a particular load arrangement was used as a direct indicator of structural capacity. But now the results of nondestructive testing can be used for several purposes such as[5]:

1. Measuring the pavement surface deflection under an applied dynamic load for backcalculation of layer moduli and determination of the structural capacity of the pavement section.
2. Evaluating the load transfer efficiency at joints in jointed concrete pavements.
3. Assessing the need for and designing the thickness of an overlay to increase the structural capacity of the pavement section and enhance its performance under traffic loading.
4. Determine the rate of deterioration of the pavement structure.
5. Analyzing the effects of heavier axle load and higher tire pressure on the remaining life of the pavement structure.

6. Assessing the rate of deterioration of the pavement section and hence determine the critical time for rehabilitation.
7. Determine the location and extent of voids in the pavement structure.

2.3 **NONDESTRUCTIVE DEFLECTION TESTING DEVICES**

Nondestructive pavement testing devices are generally categorized into two types depending on how their load is applied to the pavement. Vibratory devices apply a steady state sinusoidal load to the pavement surface where as those known as impact, drop mass, or falling weight devices, apply an impulse load to the pavement. The devices included in these two major categories are Static Deflection Equipment, Automated Beam Deflection Equipment, Steady-State Dynamic Deflection Equipment, and Impulse Deflection Equipment[6,7]. Since the KUAB Falling Weight Deflectometer was used to measure the pavement deflection data to backcalculate the pavement layer properties in this study, details regarding the properties and method to use the impulse deflection equipment are only discussed in the next section. However the characteristics of commonly used nondestructive testing devices are given in Table 2.1.

2.4 **IMPULSE DEFLECTION EQUIPMENT**

All devices which deliver a transient force impulse to the pavement surface are included in this group. They use a weight which is lifted to a given height on a guide system and is then dropped. The falling weight strikes a plate, which transmits the force to the pavement. By varying the amount of weight and the drop height, the impulse force

can be varied. The major advantage of the impulse loading device is the ability to accurately model a moving wheel load in both magnitude and duration. The resulting deflection closely simulates deflections caused by a moving wheel load. The impulse equipment has a relatively small preload compared to the actual loading. The actual preload prior to releasing the weights varies with equipment. It is usually in range of 8 to 18 percent of the maximum impulse load which is 9,000 to 24,000 pounds (40 to 105KN). The geophone configuration and deflection basin of a typical FWD is shown in Figure 2.1.

2.5 KUAB FALLING WEIGHT DEFLECTOMETER (FWD)

The KUAB FWD is mounted in a trailer which can be towed by a standard sized automobile. The equipment may be operated by a one person crew. The impulse force is created by dropping a set of two weights from different heights. By varying the drop height and weights, the impulse force can be varied from 3,000 to 35,000 pounds (12 to 150 KN). The load is transferred through a 11.8 inch (300 mm) diameter sectionalized loading plate. A two mass falling weight system is used to create a smoother rise of the force pulse on the pavements with both stiff and soft subgrade support. The normal sequence of operation is to move the device to the test point and hydraulically lower the loading plate and transducers to the pavement. A test sequence is then completed using the number of drops at each height selected. The loading plate and sensors are then hydraulically lifted, and the device is ready to move to the next site.

TABLE 2.1: Nondestructive Testing Device Characteristics[8]

Device name	Dynamic Force Range, lbf	Load Transmitted by	Number and Type of Deflection Sensors	Deflection Sensor Spacing
KUAB FWD	3,000 to 15,000	Sectionalized circular plate 11.8 inches diameter	7 seismometers	Variable, 0 to 72 inches
Dynatest HWD	10,000 to 55,000	Circular plate 11.8 or 17.7 inches diameter	7 geophones	variable, 12 to 96 inches
Dynaflect	1000 peak to peak	Two 16 inches diameter and 2 inches wide urethane-coated steel wheels	5 geophones	Variable, 0 to 48 inches
Dynatest FWD	1,500 to 27,000	Circular plate 11.8 or 17.7 inches diameter	7 geophones	Variable, 12 to 96 inches
Road Rater 2008	500 to 700 peak to peak	Circular plate 18 inches diameter	4 geophones	Variable, 24 to 48 inches
WES 16-Kip	500 to 30,000 peak to peak	circular plate 18 inches diameter	5 geophones	Variable, 12 to 60 inches
Phonix FWD	2,300 to 23,000	Circular plate 11.8 inches diameter	6 geophones	Variable, 8.3 to 58 inches

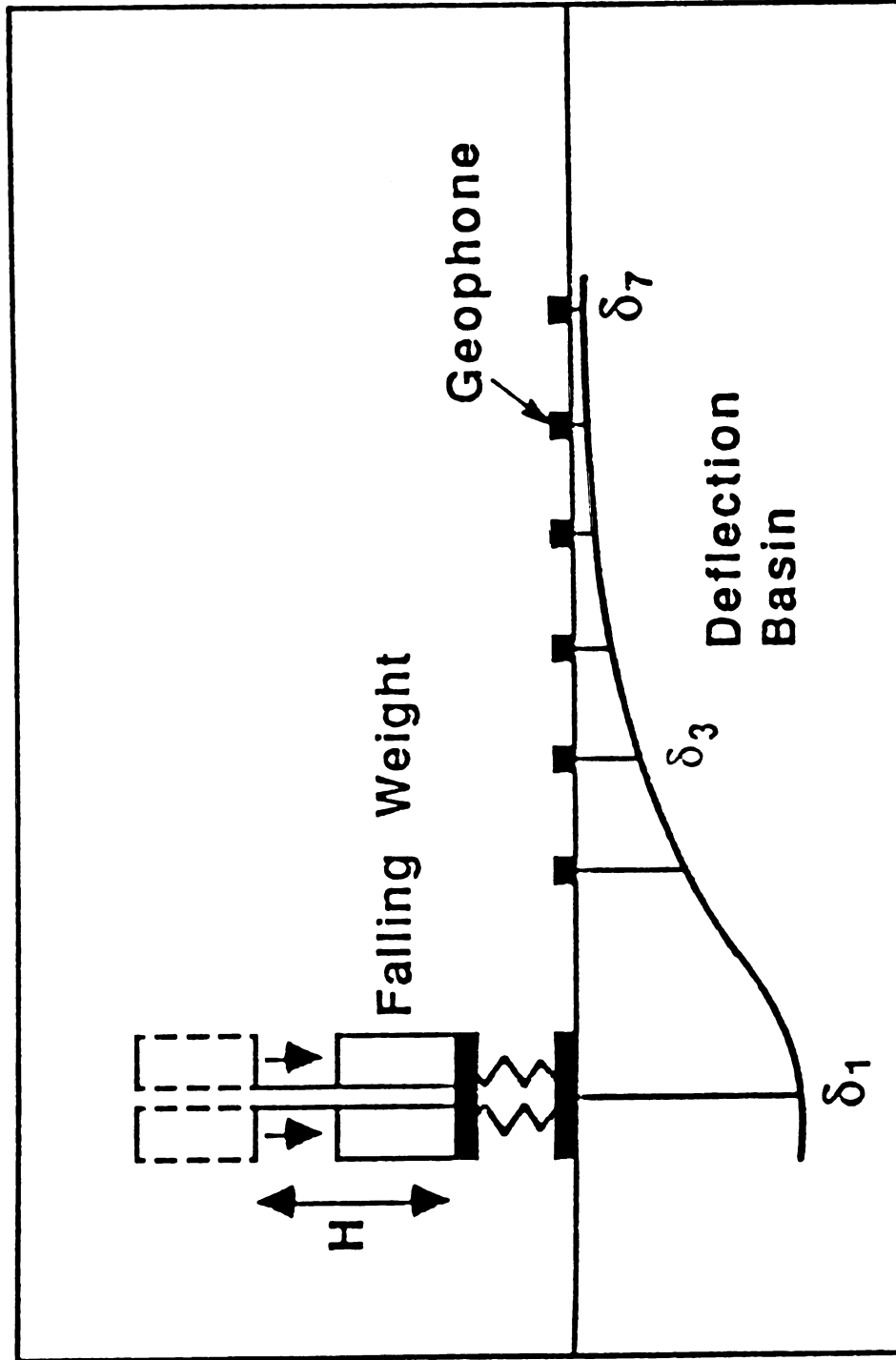


Figure 2.1 : The geophone configuration and deflection basin for a typical FWD equipment.

Bentsen, et al. (1989) and De Beer, et al. (1989) carried out NDT testing using various devices to check their reliability, accuracy, and repeatability. From their study it can be concluded that both Dynatest FWD and KUAB FWD are capable of producing and collecting nondestructive pavement test data consistently, reliably, and accurately within the range of 38 μm (1.496 mils) to 2000 μm (78.74 mils). Below 38 μm (1.496 mils), the geophones used on the Dynatest provide better repeatability where as above 2000 μm (78.74 mils) KUAB seismometers are more accurate[8].

2.6 **BACKCALCULATION METHODS**

The analysis of the FWD data is an inverse process in which instead of predicting the pavement response, the deflection is measured and the pavement properties are backcalculated. The backcalculation of pavement layer properties from the surface deflection measurements can be carried out using various methods and the computer programs. The three general classes of backcalculation methods are:

2.6.1 **Iterative Method**. In this method, the deflection calculations are performed by the CHEVRON [9] and BISAR [10] programs etc. The gradient search technique is used and the layer moduli are repeatedly adjusted so that the measured and the calculated deflections are within the acceptable limits. The programs included in this method are CHEVDEF/BISDEF/ELSDEF series [11], EVERCALC [12], and MICHBACK [7]. These programs are slow because they require numerous calls to a mechanistic analysis program and sensitive to the initial seed moduli except

the MICHBACK which is fast in nature and is not sensitive to the initial seed moduli.

2.6.2 **Deflection Data Base Methods.** In this method, before the actual backcalculation process, a series of normalized deflection basins are computed using the BISAR program with layer moduli that cover the range of anticipated values in the field. The deflection basins are stored in a data base for subsequent comparison with measured deflection basins. MODULUS [13] is one of the examples of data base backcalculation program.

2.6.3 **Statistical Regression Equation Methods.** These programs use a statistical regression equations for calculating layer moduli. This is a very fast method but it does not have acceptable accuracy. LOADRATE [14] is one of such programs which uses a regression equation for calculating layer moduli.

2.7 **MICHBACK MODIFIED NEWTON ALGORITHM**

The program used in this study for backcalculating pavement layer properties is MICHBACK which is a menu-driven program. It uses a modified Newton method for the backcalculation of flexible and composite pavement layer moduli, thickness, and stiff layer depth from the measured surface deflections. The backcalculation procedure is an iterative process which requires several forward calculations. MICHBACK (DOS Version 1.0) [15] uses the data files created by KUAB FWD or an ASCII file having a specified format. Some of the important features and requirements of MICHBACK are given in the subsequent paragraphs.

2.7.1 **Backcalculation and Convergence Control.** The present version of MICHBACK uses the modified Newton method, in which the gradient matrix is not upgraded after each iteration rather it is upgraded after every three iterations. This process continues till the time the calculated layer moduli are within certain acceptable limits. The iterative process stops when one of the following conditions are met:

- a. The root-mean-square (RMS) percentage error between the measured and the calculated surface deflection is smaller than the specified limit. The default value for this RMS is 1.0 % which can be changed as per the requirement.
- b. The percentage error in each successive moduli calculated by the MICHBACK is less than the specified. Its default value is also 1.0 %, which can be altered. Normally it is recommended that, if required, the value of RMS may be changed (increased) and not the value of percentage error in successive moduli.

2.7.2 **System Requirements.** The present version of MICHBACK requires the following hardware and software for its operation:

- a. MS-DOS Version 3.0 or higher.
- b. 640 KGB of random access memory (RAM).
- c. A hard disk, and
- d. A color graphic adapter and compatible monitor.

2.7.3 **Required Amount of Free Memory.** The MICHBACK program requires about 475 KB of free memory to run. If there is insufficient memory to load the program then a message, *Program too big to fit in memory*, will be displayed on the screen.

The other details regarding the operation and use of MICHBACK can be found out in the MICHBACK User's Manual (DOS Version 1.0)[15].

2.8 **OVERLAY DESIGN PROCEDURES**

The traditional approaches used before 1960 for the design of asphalt overlay was based on engineer judgment or component analysis. Since 1960 the use of nondestructive (deflection based) procedures has gained wide acceptance and in the mid 1970s several mechanistic procedures have been developed for overlay design. Presently the various methods developed for asphalt overlay design can be categorized into three types: Component analysis, Deflection based, and analytically based(mechanistic) [5].

2.8.1 **Component-Analysis Procedures.** The component analysis procedures use laboratory testing and in-situ testing to determine the structural strength of each individual layer of the existing pavement system separately. Figure 2.2 gives the detailed outline procedure used for component analysis.

2.8.2 **Deflection Based Procedures.** The deflection based procedures use the nondestructive testing to measure the surface deflection or the structural response of all pavement layers including the subgrade as one system. These methods typically use the surface deflection as an indicator of the load-carrying capacity of

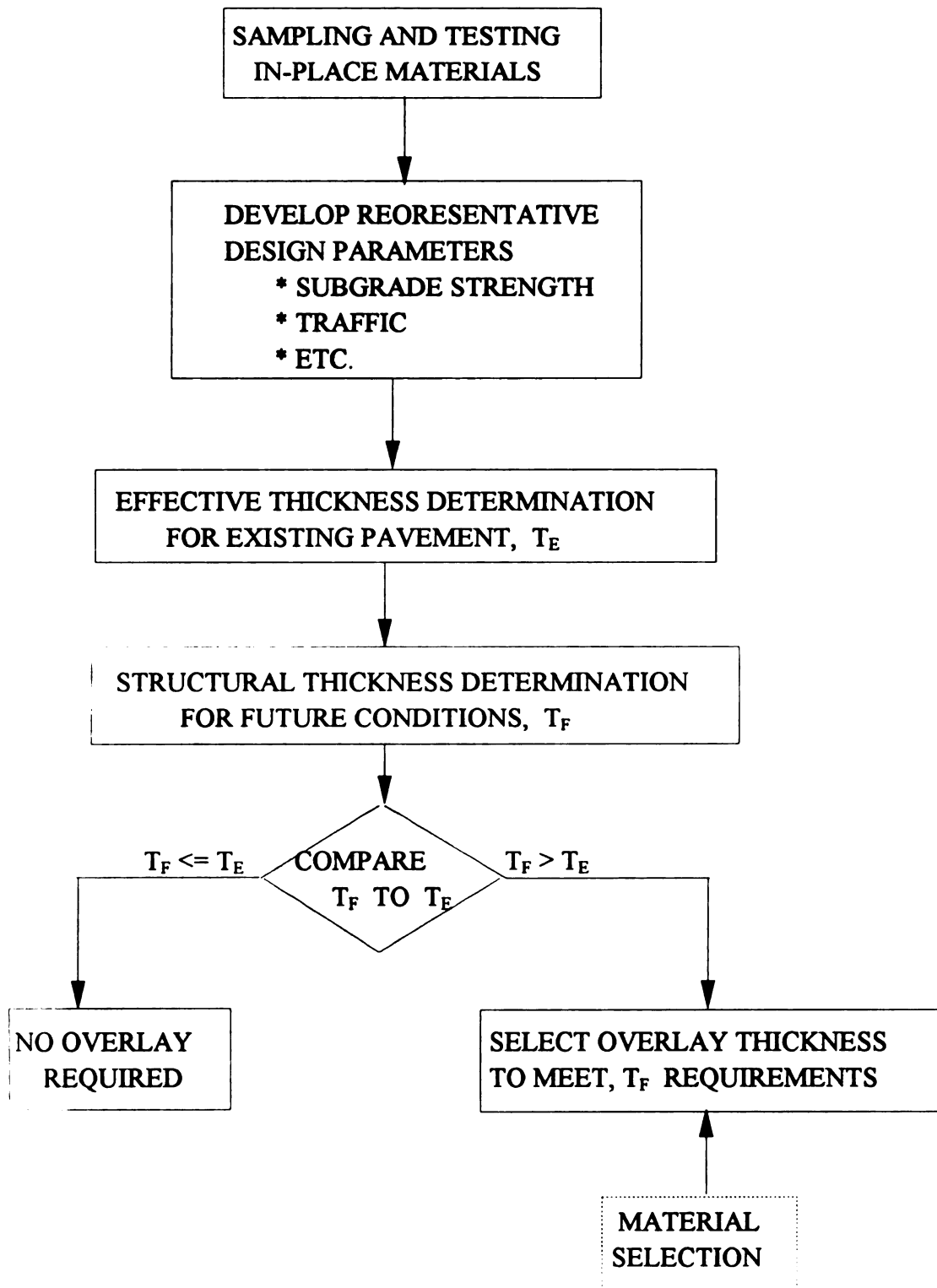


Figure 2.2 : Overlay design by component analysis[4].

the pavement. Figure 2.3 outlines the general approach used in most nondestructive overlay design procedures based on deflection measurements. The three basic elements of such design procedure are deflection measurements, pavement condition, and traffic. The Deflection based procedures include, The Asphalt Institute Method, California Department of Transportation procedure, Roads and Transportation Association of Canada (RTAC) procedure, Transport and Road Research Laboratory (TRRL) of Great Britain Method, US Army Engineer Waterways Experiment Station (WES) procedure, and Virginia Highway and Transportation Research Council [5].

- 2.8.3 **Analytically Based Procedures.** As in the deflection-based procedures, nondestructive evaluation, condition surveys, and traffic are required as input to this type of design methodology. In addition, some measure of the stiffness properties and distress characteristics of various materials comprising the specific pavement structure are required. A general mechanistic procedure is explained in figure 2.4. The methods included in this procedure are, The Shell Research Procedure, Federal Highway Administration Austin Research Engineers (ARE) Procedure, Federal Highway Administration Resource International Incorporated (RII) Procedure, and Kentucky Department of Highway Procedure [5].

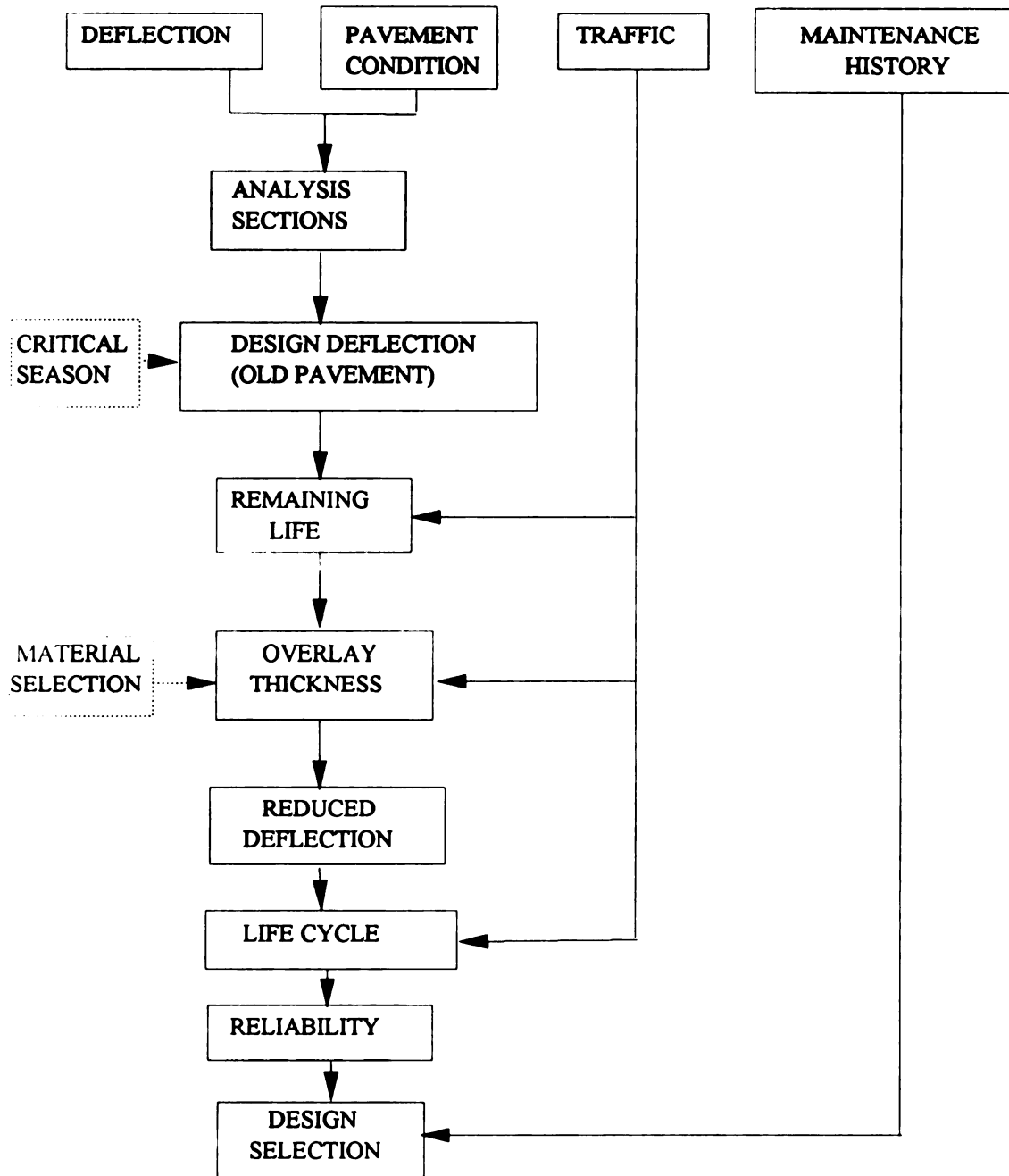


Figure 2.3 : Overlay design using deflection measurements[4].

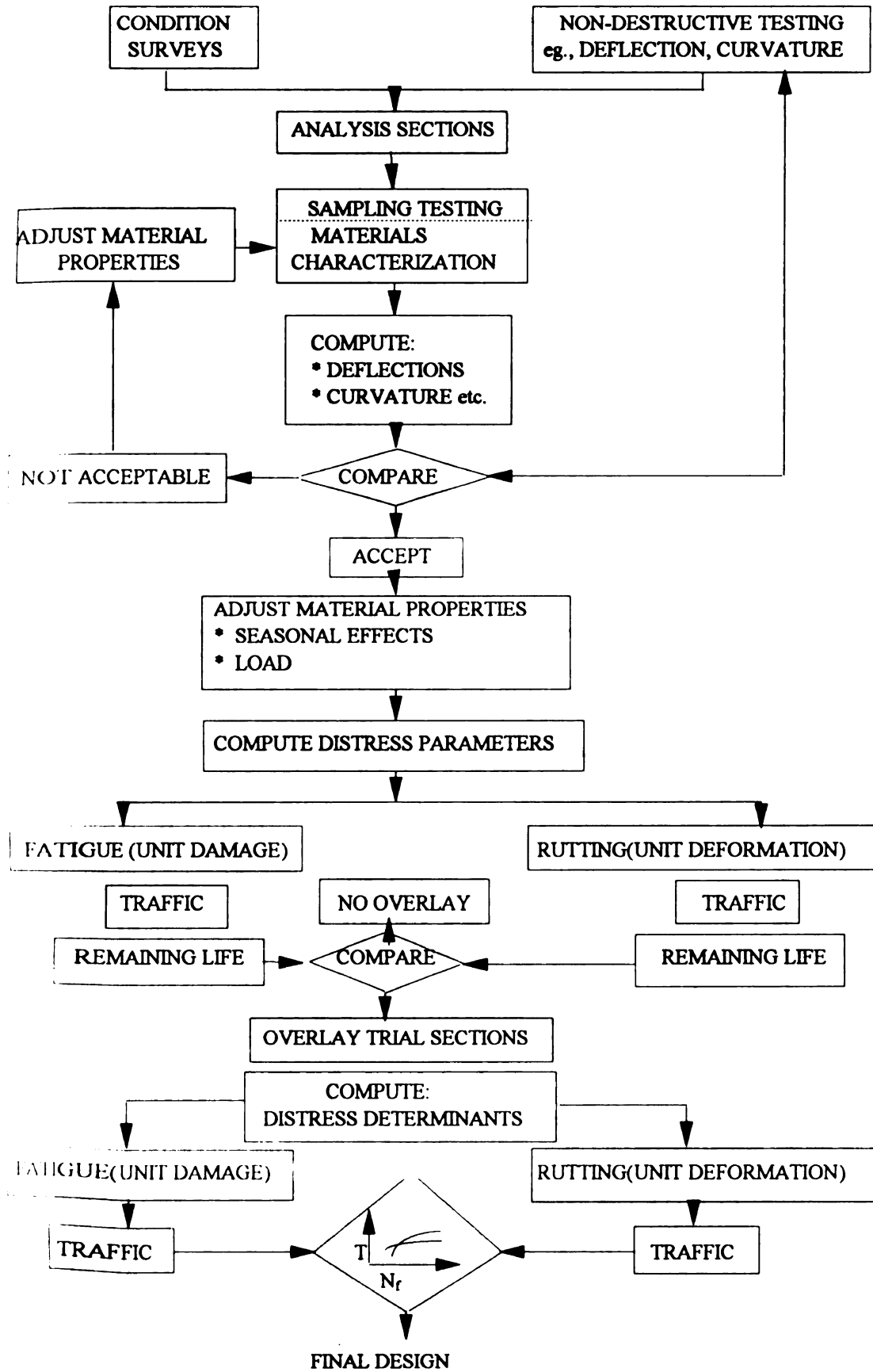


Figure 2.4 : Overlay design based on analytical (mechanistic) analysis [4].

CHAPTER 3

FIELD INVESTIGATION AND METHODOLOGY

3.1 GENERAL

Nondestructive deflection test (NDT) data and its engineering interpretation are universally recognized tools for the structural evaluation of road and airfield pavements. In the early development of pavement evaluation, the interpretation of NDT data was based on a single center-deflection measurement and on empirical correlations between the allowable deflection and pavement performance. At present, NDT data consists of a series of deflection measurements defining a deflection basin, and they are interpreted in terms of the material moduli of the different layers of the pavement structure and the roadbed soil. The moduli are then used in a mechanistic-based structural evaluation of the pavement and the design of an overlay. In general, the NDT based overlay design process includes the following steps:

1. Conduct NDT's at various locations along the candidate project.
2. Determine the existing layer thicknesses, traffic volume and distribution, and types of existing materials.
3. Analyze the variation of the deflection data along the project (unit delineation) to determine whether or not the data indicates possible division of the project into several subprojects.
4. Backcalculate the elastic properties of the pavement layers using the NDT data and adjust the properties to standard temperature and moisture conditions.

5. Use the adjusted values of elastic properties and layer thicknesses to assess the structural capacity of the pavement and its remaining service life.
6. For a given axle load, determine the required overlay thickness so that the levels of induced stresses, strains, and deflections are within tolerable limits.

NDT tests were conducted along the National Highway N5 in Pakistan to investigate the causes of premature failure of the road. A historical background leading to the failure of N5 is presented in the next section.

3.2 **FAILURE OF N5**

On June 18, 1989, the National Highway Authority (NHA), authorized the construction of a 66.6 Km stretch of the National Highway N5 between kilometer post 81 near Dadabhoy Cement Factory and kilometer post 148 near Hyderabad. The work started on October 28, 1989 and the road was opened to traffic on February 24, 1994 before completing the drainage system. As stated in chapter 1, on April 5, 1994 that area of N5 received a very heavy rainfall. N5 was covered with runoff water, water pools and ponds were observed on the road sides and median. On April 7, 1994, distress in the forms of cracks were noticed along certain stretches of N5. On April 17, the road was closed to traffic due to severe distress and failure. Several teams were formed to investigate the causes of failure. Results of the investigation showed that the premature pavement distress and failure may be attributed to several factors including [4]:

1. Saturation of the aggregate base course. Rain water had entered the base course from the still under construction drainage ditches.

2. Traffic induced pumping, which caused corrosion in the base and subbase layers.

3.3 **SITE INVESTIGATION**

During the investigation of the causes of the premature failure of N5, several types of data were collected. In the following subsections, those types of data that are relevant to the analysis of the NDT data and to the mechanistic determination of the required overlay thickness are presented.

3.3.1 **Deflection Data.** As a part of the investigative efforts of the premature pavement failure of N5, nondestructive tests (NDT) were conducted along several sections of this highway as shown in Figure 1.1, and 1.2. The KUAB falling weight deflectometer (FWD), model 150 was used for carrying out the deflection measurements. Each NDT consisted of four drops in which the first drop was not recorded (a seating drop). The deflection data was recorded for the last three drops for target loads of 5500, 9000, and 16500 pounds, respectively. The tests were conducted at about 100 meter intervals. The NDT data was compiled in four files created on February 26, 27, and 28, and March 8, 1995. The data are listed in Tables A-1 through A-4 of Appendix A.

For a proper NDT data analysis, the asphalt temperature during the test must be known. The most direct way to determine the temperature of the asphalt layer during a deflection test is to physically measure its temperature. This can be accomplished by using either a temperature sensor placed at the pavement surface or by drilling a 1.25 cm diameter by 5 cm deep hole and filling it with a suitable

fluid such as oil and to determine the oil temperature to the nearest degree after it has been stabilized [16]. The time interval between temperature measurements can vary considerably, depending upon weather conditions, time of day, and the length of testing time. At the very minimum, the temperature should be measured at the start and at the end of each test section, if testing exceeds one hour. For overcast conditions with relatively constant air temperature, this interval may be extended to 2 hours [17]. In this study both the air and pavement temperatures were measured at each test location using temperature sensors and are reported in the data files in Table A-1 through A-4.

- 3.3.2 **Layer Thicknesses.** The analysis of NDT data requires an accurate knowledge of the pavement layer thicknesses. Typically, layer thicknesses are determined from pavement cores. Unfortunately, such data was not available to this study. Consequently, the layer thicknesses were obtained from the as-built road cross-section contained in the pavement failure report [4]. The report states that the asphalt concrete (AC) thickness is 12 cm (4.8 inches), consisting of 5 cm asphalt concrete wearing course and 7 cm asphalt concrete base course; the crushed aggregate base layer thickness is 20 cm (7.9 inches); and the granular subbase layer thickness is 15 cm (5.9 inches). In the NDT data analysis, however, the base and subbase layers were treated as one granular layer, the thickness of which was taken as 35 cm (13.8 inches). The reasons for this include:
- a) Both, the base and the subbase layers are granular material and hence the boundary between the two layers is very hard to define even during

construction. Therefore, the base and subbase thicknesses cannot be verified in the field.

- b) In a typical backcalculation program, the accuracy of the backcalculated layer moduli decreases as the number of layers increases. Since the objective of the analysis is to examine the differences between the values of each layer moduli along the project, accuracy of the results becomes more important than artificially fixing the boundary between the base and subbase layers.

3.3.3 Traffic Volume. Traffic volume is one of the inputs required for the design of a new pavement structure or the required overlay thickness. Since the traffic consists of a variety of vehicles, it is required to convert all traffic to 80 KN (18 kip) equivalent single axle loads (ESAL). In this study, the number of ESAL used in the design of overlay thickness were obtained from the NHA traffic study. The study provided the number of ESAL for two time periods as follows:

- a) Six years performance period (1996-2002) = 55 million ESAL
- b) Eight years performance period (1996-2004) = 80 million ESAL

Both ESAL predictions were used in this study. Given the ESAL predictions and the two performance periods of 6 and 8 years, the initial ESAL and the growth rate were calculated using the following formula[18]:

$$ESAL_n = \{ESAL_i (1 + I)^n - 1\} / I \quad (3.1)$$

Where:

$ESAL_n$ = Number of ESAL after “n” number of years;

$ESAL_i$ = Number of ESAL at the end of the first year ;

I = Growth Rate; and

and n = Number of years.

Substituting the predicted number of ESAL for 6-year and 8-year performance periods yield:

$$80,000,000 = \{ESAL_i (1 + I)^8 - 1\} / I \quad (3.2)$$

$$55,000,000 = \{ESAL_i (1 + I)^6 - 1\} / I \quad (3.3)$$

Solving the two simultaneous equations yielded a growth rate of 8.29 percent and an initial ESAL of 7,442,595. These results were then used for the calculation of ESAL for other time periods that correspond to the remaining service lives of the pavement in terms of years.

3.3.4 **Pavement Conditions.** As a part of the pavement evaluation process, the conditions of the existing pavement are typically documented. The data is then used in the interpretation of the NDT data and in the design of the overlay. Unfortunately, such condition data was not collected and hence, it is not available to this study. Further, when deflection data is collected along a project, the general practice is not to collect data over bridges, culverts, and other infrastructure elements. If data at such locations is collected, then a proper reference in the data files should be recorded. In the NDT survey of N5, some of the deflection data was collected over culverts and bridges and was recorded in the data files without giving a proper location reference point.

The presence of concrete bridges and culverts at shallow depth affects the magnitude of the deflection data in a similar way as the presence of a shallow bedrock or stiff layer. Consequently, in this study, the NDT data analysis was conducted by allowing the presence of a shallow stiff layer and by using the option in MICHBACK to mechanistically calculate the stiff layer depth. This and other issues related to the data analysis are presented in the next chapter.

CHAPTER 4

ANALYSIS AND DISCUSSION

4.1 GENERAL

As stated in Chapter 1, about 66 km section of the National Highway (N5) in Pakistan was designed and constructed for a ten-year performance period. Less than two months after opening the pavement to traffic, premature failure was observed in several locations and the highway was closed to traffic. Several investigative teams were formed to study the causes of the premature failure. This study was undertaken to investigate the possible causes of failure using nondestructive deflection test (NDT) data. Hence the objectives of the study are:

1. Conduct nondestructive deflection tests (NDT) using a falling weight deflectometer (FWD) along parts of the N5 highway between Karachi and Hyderabad.
2. Use the NDT data and the pavement layer thicknesses to backcalculate the insitu material properties of the various pavement layers.
3. Use mechanistic analysis to determine the magnitudes of the deflection, strains, and stresses delivered to the pavement by 18-kip and 33-kip axle loads.
4. Based on the mechanistic outputs (stresses, strains, and deflections) verify whether or not the thickness of the pavement on N5 was adequate to carry the expected traffic volume and load during its design life.
5. Based on the results of item 4, determine the expected service life of the pavement and the deficiency in the overlay thickness.
6. Verify the design inputs (material properties) used in Pakistan.

7. Address the variability of the deflection data along the test sections on N5 highway.

To accomplish the above stated objectives, a research plan was drawn. The plan consists of two parts; field investigation and analysis schemes. As stated in Chapter 3, the field investigation consisted of three parts as follows:

1. Nondestructive deflection tests (NDT) data which were collected by a private contractor along a 52.3 km section of the National Highway N5 in Pakistan using the KUAB (model 150) falling weight deflectometer (FWD). The NDT tests were conducted at 100 meter intervals. Each test consisted of four drops as follows:
 - a) Seating drop for a target load of 5500 pounds which was not recorded,
 - b) Second drop for a target load of 5500 pounds,
 - c) Third drop for a target load of 9000 pounds, and
 - d) The fourth drop for a target load of 16500 pounds.

The NDT data recorded for the last three drops is presented in Appendix A.

2. Traffic data collection which was based on a recent study conducted by the National Highway Authority (NHA) in Pakistan and is presented in Chapter 3.
3. Pavement layer thicknesses which were obtained from the as-built road cross section contained in the NHA's pavement failure report [4]. The layer thicknesses used in the analysis are presented in Chapter 3.

To accomplish the rest of the objectives of this study, a multi step analysis plan was drawn and is presented in the next section.

4.2 ANALYSIS PLAN

To accomplish the objectives of this study, the analysis of the NDT data was carried out in several steps as follows:

1. Format of the NDT data.
2. Statistical analysis of the NDT data along the 52.3 km section of N5 highway.
3. Backcalculation of layer properties using the NDT data, layer thicknesses and the MICHBACK computer program.
4. Forward mechanistic analysis of the pavement sections along the 52.3 km length of N5 using the MICHPAVE computer program, the layer properties from the previous step and the layer thicknesses.
5. Prediction of the pavement performance in terms of the remaining service life (RSL) of the pavement using the results of the NDT data analysis.
6. Comparison of the design life of highway N5 with the predicted RSL values.

The data analysis was accomplished by following the above steps. Results of the analysis and discussion of the results obtained from each step are presented in detail in the remaining sections of this chapter.

4.3 FORMAT OF THE NDT DATA

Unfortunately, the NDT data received from Pakistan was not compatible with the data format of MICHBACK (a FORTRAN-based computer program for the backcalculation of layer moduli). MICHBACK can accept three data formats: the old KUAB FWD data format, the new KUAB FWD data format, and a prespecified and preformatted ASCII file. Although

the KUAB FWD was used in this study, the on-board computer had a data format that is different than both the old and the new KUAB formats. Consequently, the NDT data was reformatted to the MICHBACK specified ASCII file. This ASCII deflection data file has two parts: the first part contains comments and the second part contains the required data. The two parts are separated by a line consisting of at least 20 equal “=” signs. The data before the line is optional and is not required for analysis. The data after the line is used by MICHBACK for analysis and it must be formatted as follows:[15]

1. An E for English or S for SI units must be typed as the first non-blank character of the first line. The data in the file may be in either system of units and if this is different from the system of units being used in MICHBACK, then the data is converted appropriately. Any comments entered after the first character are ignored.
2. The number of FWD drops per test must be typed at the beginning of the second line. Any comments entered after this number are ignored. Up to 5 FWD drops may be recorded at each test location, but the number of drops must be the same for all test locations and all the drops must be for the same target load.
3. The target load must be typed at the beginning of the third line. Any comments entered after the load are ignored. It should be noted that for each drop, the actual load delivered to the pavement may differ slightly from the target load. Hence, each measured deflection data was adjusted by multiplying it by the ratio of the target load to the actual one. This linear scaling of the deflection data allows the user to study the variation of the deflection data along the project.

4. The fourth, fifth, and sixth lines are ignored and may contain optional headers identifying the columns of data.
5. The deflection data is entered in columns separated by spaces and/or tabs. Up to 10 deflection sensors may be used, and in addition to the sensor readings, the station location, pavement temperature, and the magnitude of the measured actual load per drop must be entered. Deflections for each test location are grouped together. The station location and pavement temperature must be entered on the first line of the group along with the deflections measured for the first drop. Deflections for the subsequent drops must be entered on consecutive lines. Deflections for different test locations must be separated by one blank line.

The deflection data formatted using these steps is presented in Table B-1 and B-2 of Appendix B. Table B-1 provides a list of the formatted data files of the first 11 stations in which the sensor locations are different than the sensor locations of Table B-2. The reason for this difference in sensor locations is explained in the next paragraph.

The deflection data collected using the KUAB FWD, Model 150 for the load ranges of 5500, 9000, and 16500 pounds is presented in Table A-1 through A-4 of Appendix A. The sensor locations for the first eleven stations (Table A-1) are different than the rest of the stations. The difference is only in the location of sensors 5 and 7. Initially the sensors were set at 0 cm, 20 cm (7.87 inches), 30 cm (11.81 inches), 45 cm (17.72 inches), 60 cm (23.62 inches), 120 cm (47.24 inches), and 180 cm (70.87 inches) from the center of the load plate. For this setting, the magnitudes of the deflection measured by the outer sensors are very low for the target loads of 5500, and 9000 pounds.

For some tests, the low deflection values were within the accuracy of the deflection sensors. To obtain a more accurate data, the locations of sensors 5 & 7 were changed to 90 cm (35.43 inches) instead of 60 cm, and to 150 cm (59.06 inches) instead of 180 cm from the center of the load. The new sensor locations produced better results from the outer sensors. Therefore, the new setting was used for the subsequent deflection measurements. While plotting the deflections at various sensor locations vs. the test locations, the deflection data for sensors 5 and 7 of the first eleven test stations were not plotted separately because of the different sensor locations. This did not have a significant impact on the deflection profile. Further, in the backcalculation, only the deflection data due to a target load of 9000 pounds was used. Finally the data which was collected in International Units was converted into English Units.

The cross-section data, number of sensors, and other pertinent information are entered directly into MICHBACK. Only then the MICHBACK can read the ASCII deflection files, plot deflection profiles, enable segments to be selected for backcalculation, and allow data manipulations.

4.4 STATISTICAL ANALYSIS OF THE NDT DATA

Any pavement system subjected to vehicular or other load inputs produces an output response in the form of deflection. Hence, pavement deflections represent an overall “system response” of the paving layers and the roadbed soil to an applied load. A load applied at a point or an area on the pavement surface will attenuate with depth and radial distance thereby, causing all pavement layers to deflect and creating strains and

stresses in all supporting layers. Stronger pavements (good quality materials and thick layers) deflect less under a given load than do weaker pavements. For the same stress value applied to an equal surface area, weaker pavements develop higher stresses & strains in all pavement layers and roadbed soil[20]. It means that the pavement deflection is directly related to the thicknesses and stiffnesses of the pavement layers. Further, deflection measured directly under the load is proportional to the compressive strains induced in all pavement layers including the roadbed soil. Deflections measured at increasing lateral distance from the center of the load are due to compressive strains induced in lower layers only. Hence, at a certain lateral distance (depending upon the layer thicknesses and stiffnesses), the deflection is contributed by the roadbed soil only as shown in Figure 4.1.

The NDT deflection data is collected at various sensor locations, so that the deflection contributed by various layers can be studied. By plotting this data along the length of the road, the variability in the as-constructed pavement layer quality can be assessed. The variation in deflection profiles of various sensors along the length of the road can be attributed to various reasons such as;

- a) variation in layer thicknesses;
- b) variation in material quality; and
- c) the construction quality.

To study this variability in the construction of the National Highway, N5, the NDT data collected using the KUAB FWD was plotted along the road and is discussed below.

As discussed earlier, the NDT data was collected for the target loads of 5500, 9000, and 16500 pounds. Since the target load of 9000 pounds represents half of the 18-kip standard axle load, the deflection data for this target load was normalized to the target load of 9000 pounds by multiplying the deflection measured at each sensor location by the ratio of the target load to the measured load. This normalization was done to ensure that the variation in the deflection is only due to pavement layer components and not due to load variation.

For each sensor location, these normalized deflection was plotted along the length of the road and are shown in Figures 4.2 through 4.8. Figure 4.2 shows the variation in the peak pavement deflection (deflection measured at the center of the load) along the road. Recall that the peak pavement deflection is proportional to the compressive strains induced in all pavement layers. It can be seen from this figure that the peak pavement deflection varies from 3.32 mils to 28.67 mils (a factor of about 8). Although the average peak deflection is 12.02 mils which is quite normal, the variation in the deflection is too high. The total variation in peak surface deflection is more than 200 % from the mean. This variation may be due to various reasons such as; variations in the thicknesses of the AC, base, and/or subbase layers, variations in the materials used in each layer, non uniform compaction of these layers, and/or the roadbed soil was not prepared properly before placing the subbase layer. Either of these variables can result into variation in deflection profile of the sensor directly under the load. Since about 85-90 % of the pavement peak surface deflection is contributed by the roadbed soil[21], the variation in deflection due to the AC, base, and subbase layers can be within few mils. But the deflection in the present case varies from 3.32 mils to 28.67 mils. Therefore, it can be said that this variation in

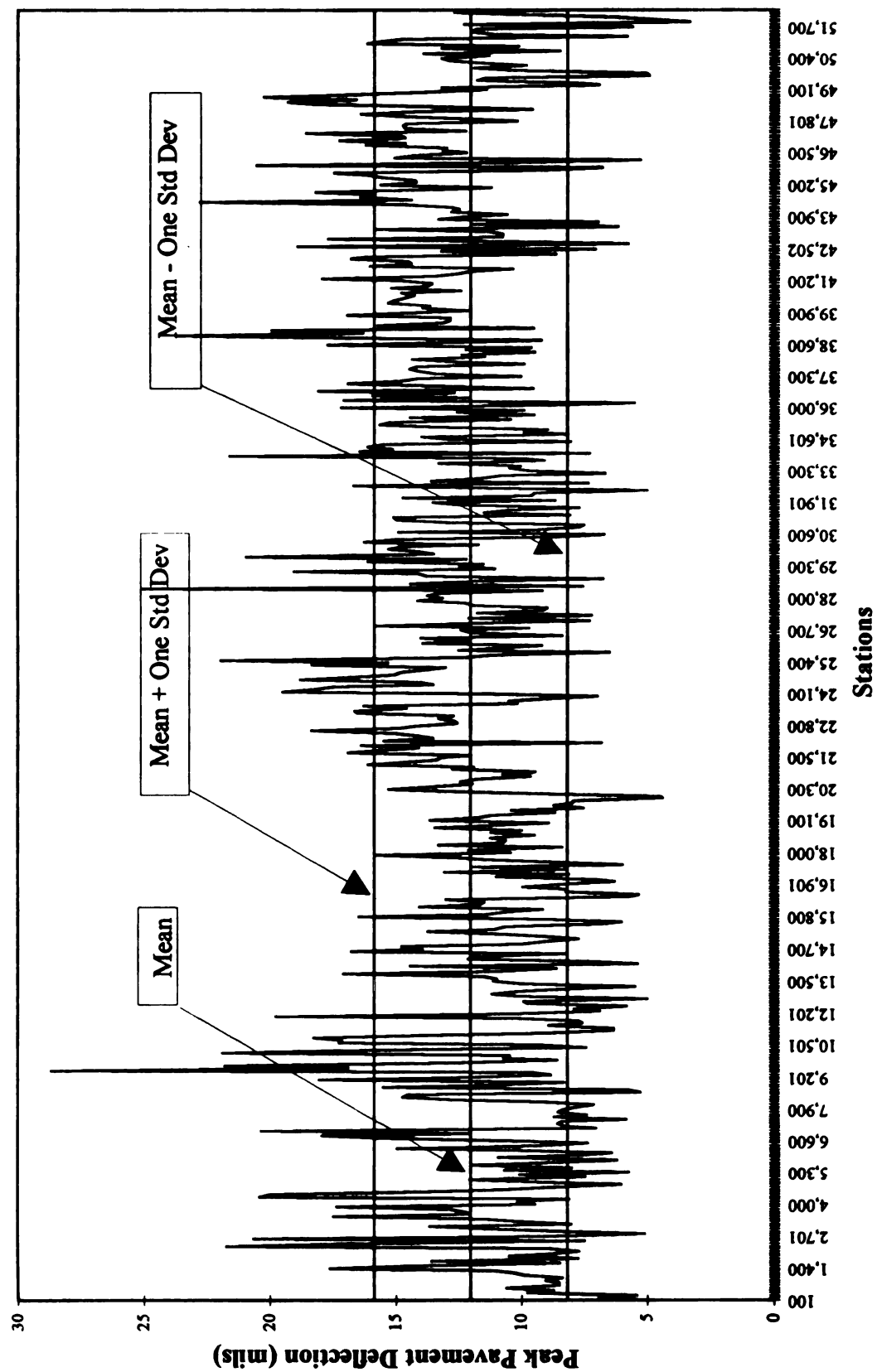


Figure 4.2 : Variation of the peak pavement deflection along the tested section of the National Highway, N5.

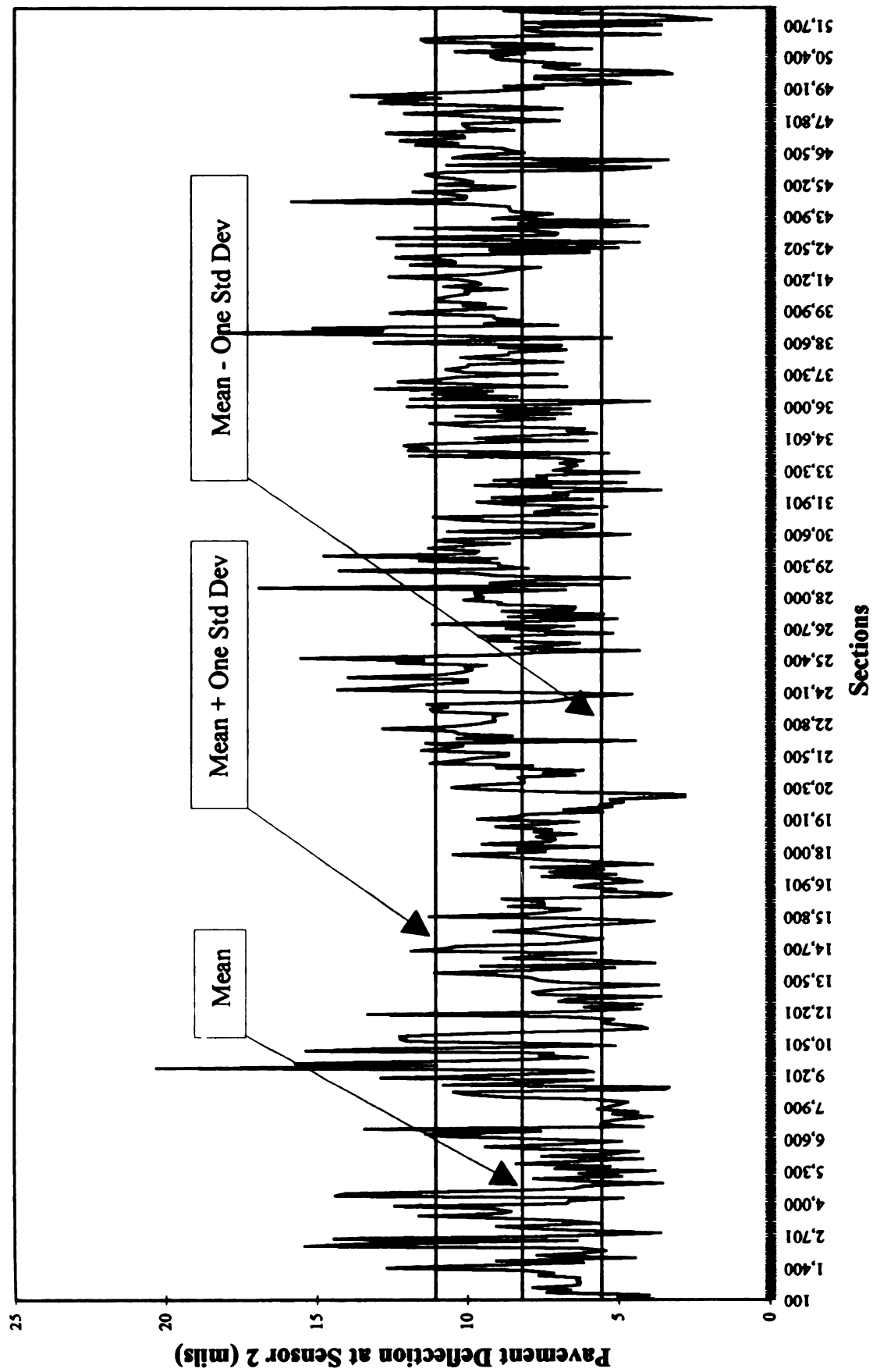


Figure 4.3 : Variation of the pavement deflection at sensor 2 along the tested section of the National Highway, N5.

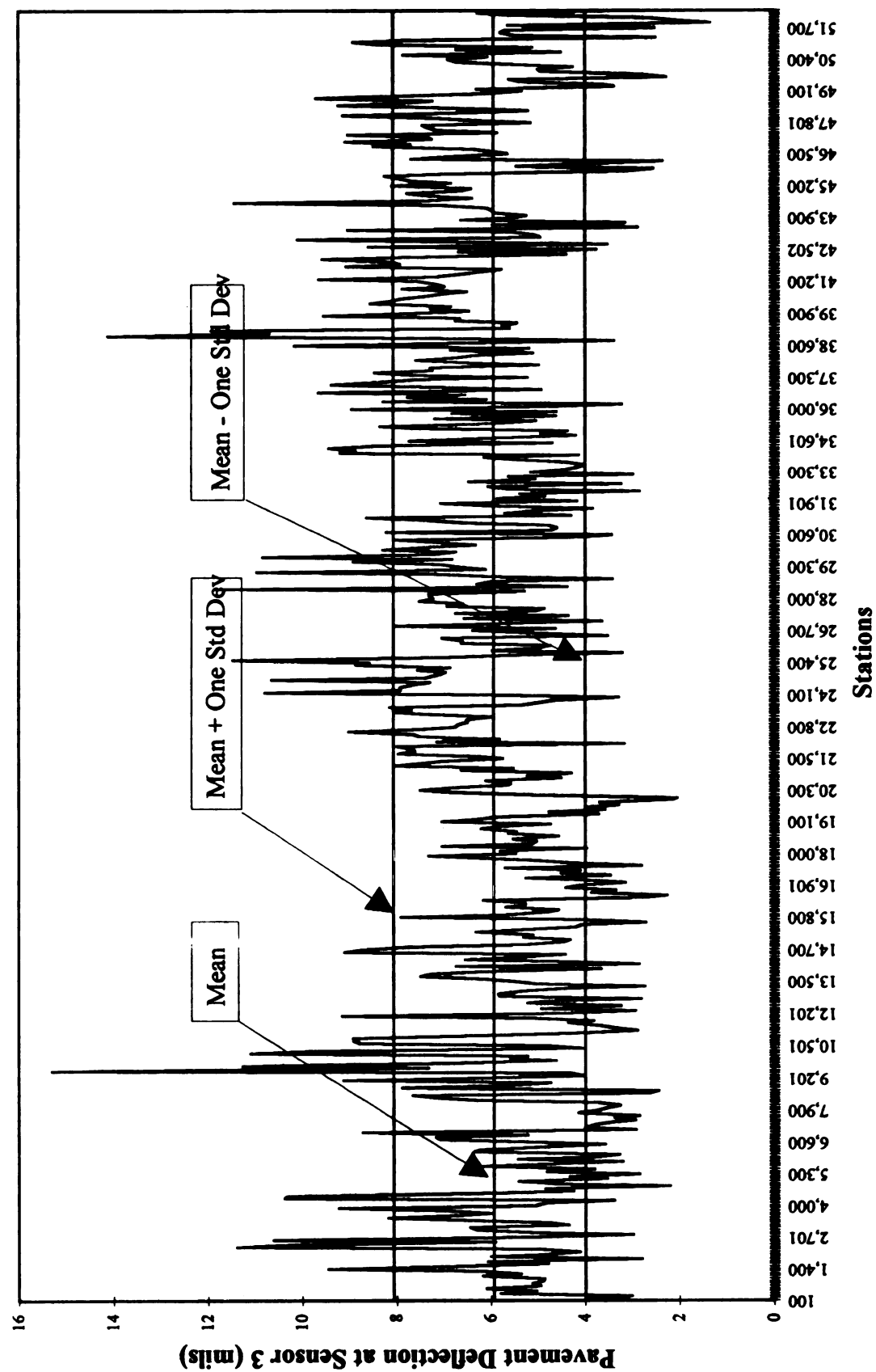


Figure 4.4 : Variation of the pavement deflection at sensor 3 along the tested section of the National Highway, N5.

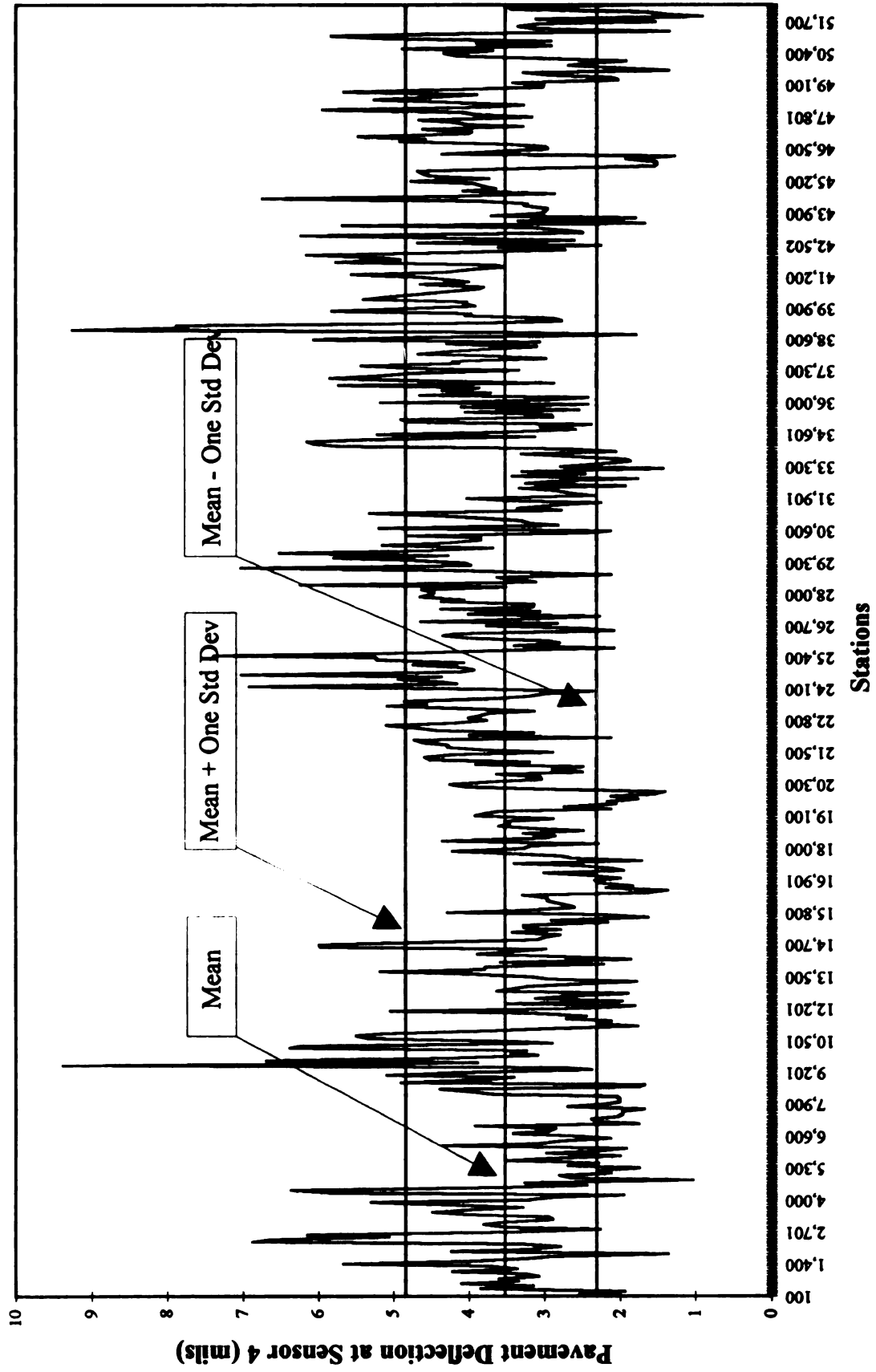


Figure 4.5 : Variation of the pavement deflection at sensor 4 along the tested section of the National Highway, N5.

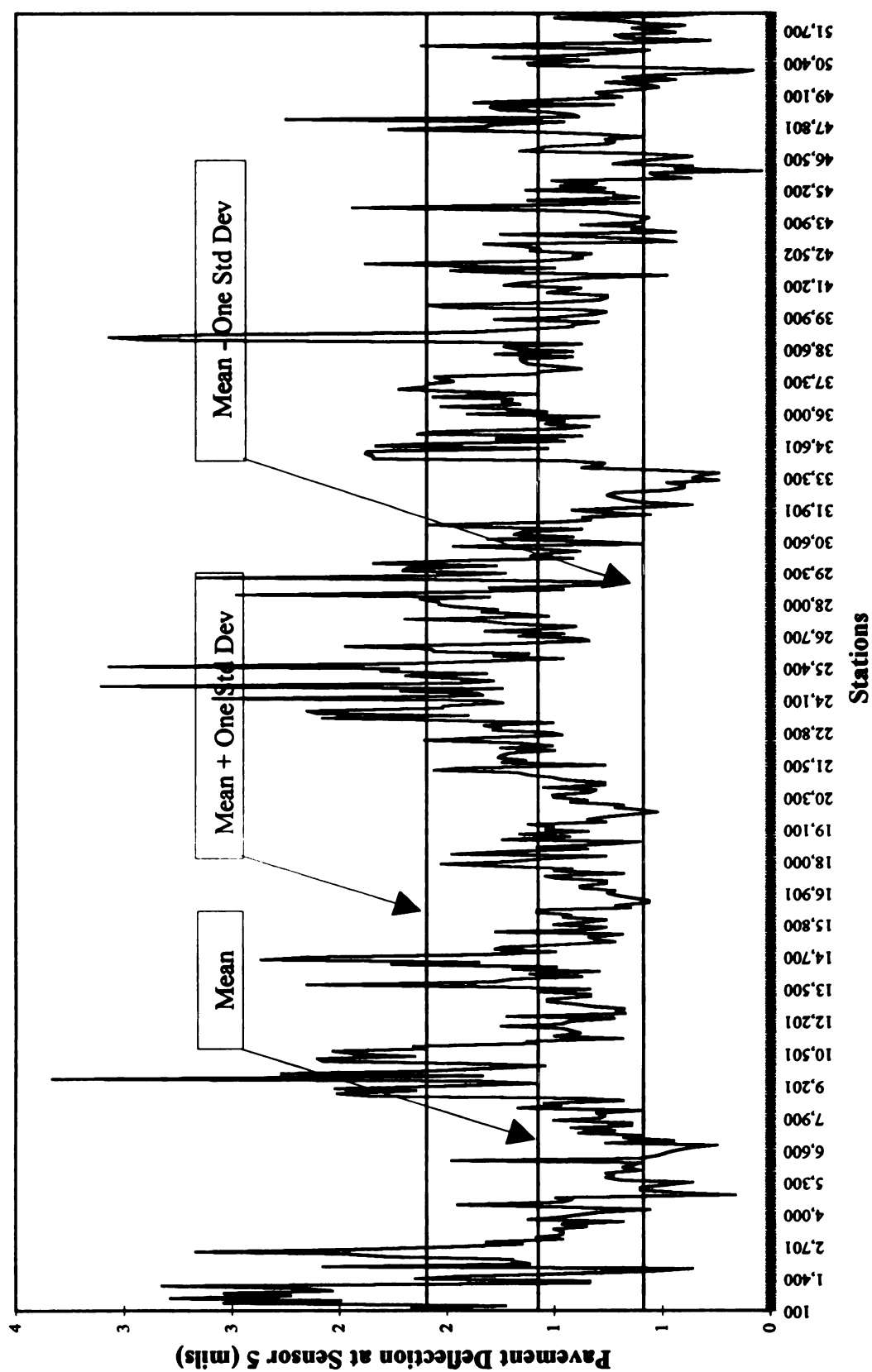


Figure 4.6 : Variation of the pavement deflection at sensor 5 along the tested section of the National Highway, N5.

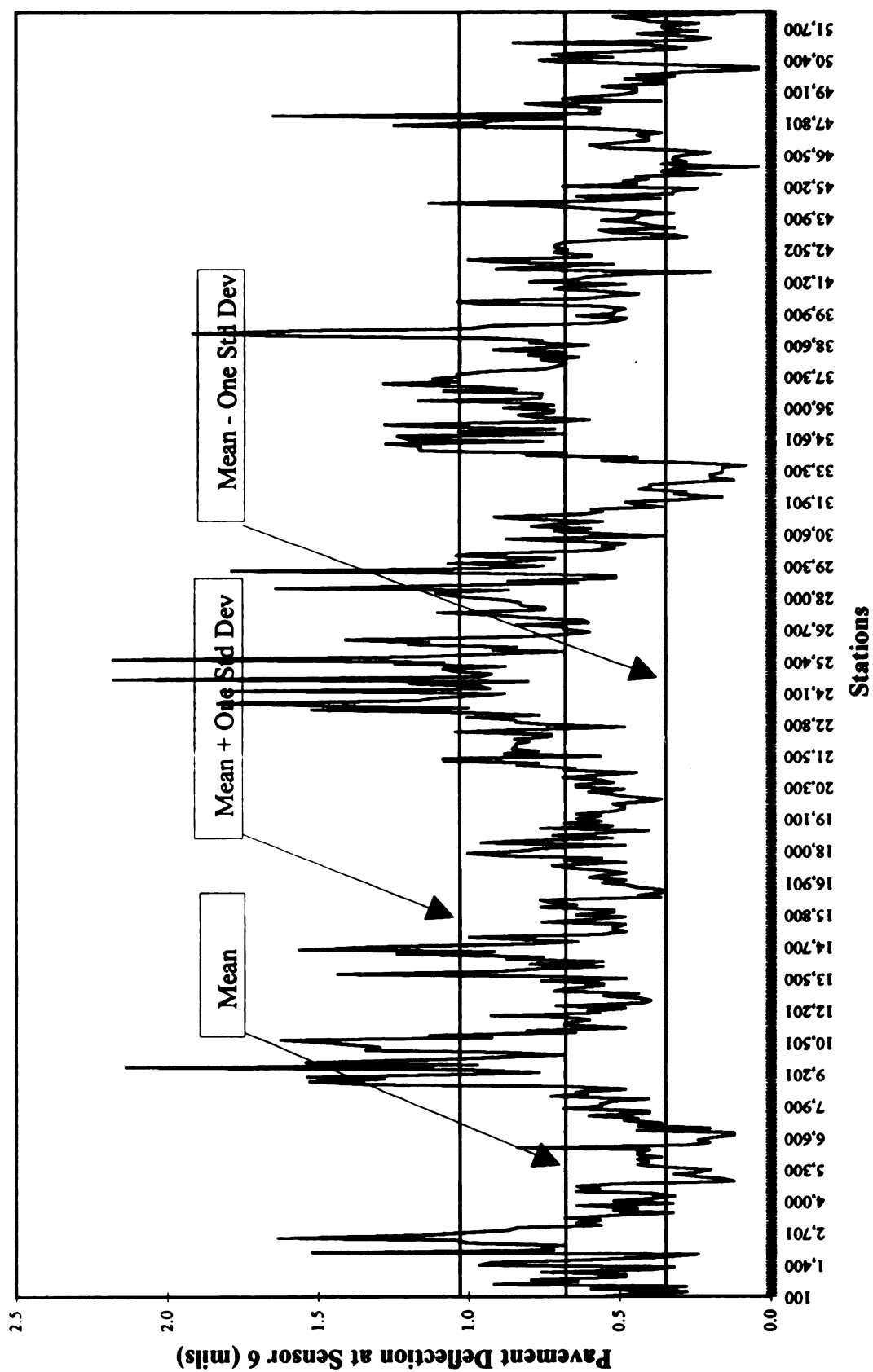


Figure 4.7 : Variation of the pavement deflection at sensor 6 along the tested section of the National Highway, N5.

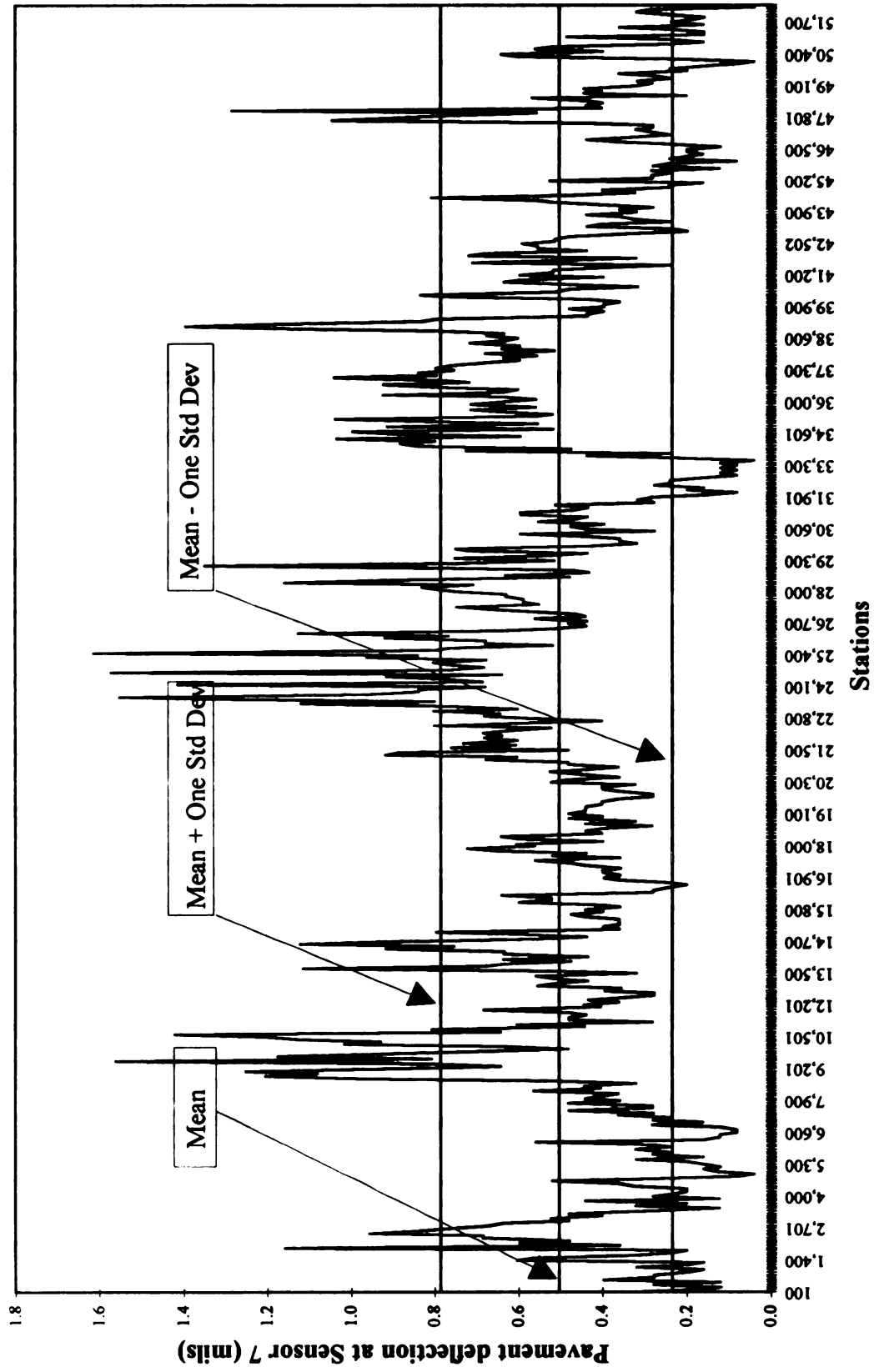


Figure 4.8 : Variation of the pavement deflection at sensor 7 along the tested section of the National Highway, N5.

deflection is mainly due to roadbed soil. And the variation in deflection of roadbed soil can be due to either poor compaction practice during its preparation or due to variation in moisture content.

Because of the pressure distribution with depth (see figure 4.1), the deflection measured at sensor location number 7 is due, for most flexible pavements, to the compressive strains induced in the roadbed soil. The AC, base, and subbase layers along a vertical line under sensor 7 are not subjected to any externally induced stresses or strains. Figure 4.8 shows the variation in the deflection of sensor 7 along the project. As it can be seen from the figure, the deflection varies from 0.0397 mils to 1.6157 mils (a factor of about 40). Given that at this lateral distance from the center of the load, the roadbed soil is being subjected to about one tenth of the stress delivered to the roadbed soil located under the center of the load, one can conclude that the variation in the deflection of the roadbed under the load is similar to that under sensor 7. Such a variation supports the argument stated above that the roadbed soil is contributing the majority of the variation in the deflection of the other sensors. Once again, this variation is due mainly to variation in roadbed compaction or moisture content.

A summary of the results of the statistical analysis of the normalized deflection for the target load of 9000 pounds for all the seven sensors is listed in Table 4.1. For each sensor, the data includes the maximum and minimum deflections, the average, standard deviation, and the coefficient of variation (the ratio between the standard deviation and the average or mean presented in percentage). The value of the coefficient of variation indicates the percent of the deflection data that vary from the mean within one standard

Table 4.1: A summary of statistics of the measured deflection along the N5 highway.

Sensor Number	1	2	3	4	5	6	7
Sensor Location in cm (inches)	0 (0)	20 (7.87)	30 (11.81)	45 (17.72)	90 (35.43)	120 (47.24)	150 (59.06)
Minimum Deflection (mils)	3.3204	1.9369	1.3439	0.9091	0.0403	0.0399	0.0397
Maximum Deflection (mils)	28.6655	20.3168	15.2993	9.377	3.3313	2.1812	1.6157
Average Deflection (mils)	12.0177	8.3086	6.0225	3.5723	1.0892	0.6874	0.5101
Standard Deviation (mils)	3.8352	2.7497	2.0356	1.2676	0.5029	0.3416	0.2766
Coefficient of Variation (%)	31.91	33.1	33.8	35.49	46.17	49.69	54.24
Max / Min Deflection	8.63	10.5	11.38	10.31	82.66	54.67	40.7
Max / Average (%)	238.5	244.5	254	264.4	305.8	317.31	316.7
Min / Average (%)	27.6	23.3	22.3	25.4	3.7	58.05	7.78

Typical values of the coefficient of variation for three roads in the State of Michigan, USA.

M44 East Bound	4.40	5.51	6.05	7.98	9.48	11.56	11.04
US27 North Bound	7.40	3.16	1.68	1.31	1.09	1.85	3.32
M99 North Bound	15.20	13.42	13.30	12.21	11.38	8.91	4.91

deviation. The higher the standard deviation and the coefficient of variation, the greater is the variation in the data. As a rule of thumb, a coefficient of variation below 10 % is thought to be low, between 15 and 30 % is moderate, and greater than 30 %, is high[22]. Since the coefficient of variation of all the seven sensors is more than 30 %, the variation in the deflection data can be considered high to very high. For comparison, typical values of the coefficient of variation of deflection data collected on three roads; a thin (less than 4 inches AC layer), a medium thick (4 to 8 inches AC layer), and a thick (more than 8 inches AC layer) are also listed in Table 4.1. These roads, which are located in the State of Michigan, are; M 44 east bound (a thin road), US 27 north bound (a medium thick), and M 99 north bound (a thick road). It can be seen from this table that the coefficient of variation for all three roads varies from 1.09 to 15.20 percent [7]. These values of the coefficient of variation are less than half of those of the NDT data of the N5 highway.

Examination of the values of the coefficient of variation listed in Table 4.1 and shown in Figure 4.9 indicates that the values for the first four sensors are significantly different than the last three sensors. The coefficient of variation of the first four sensors varies from about 32 to 35 percent, whereas the coefficient of variation for the last three sensors is from about 46 to 54 percent. This observation implies that there is more variation in the deflection of the outer sensors (which normally show the deflection contributed by the roadbed soil only). Once again, for most flexible pavements, the deflection of sensor 7 is due to the deflection of the roadbed soil only and the deflection of sensor 1 is due to the compressive strains induced in all layers. This implies that the coefficient of variation of sensor 1 should be higher than that of sensor 7 due to the

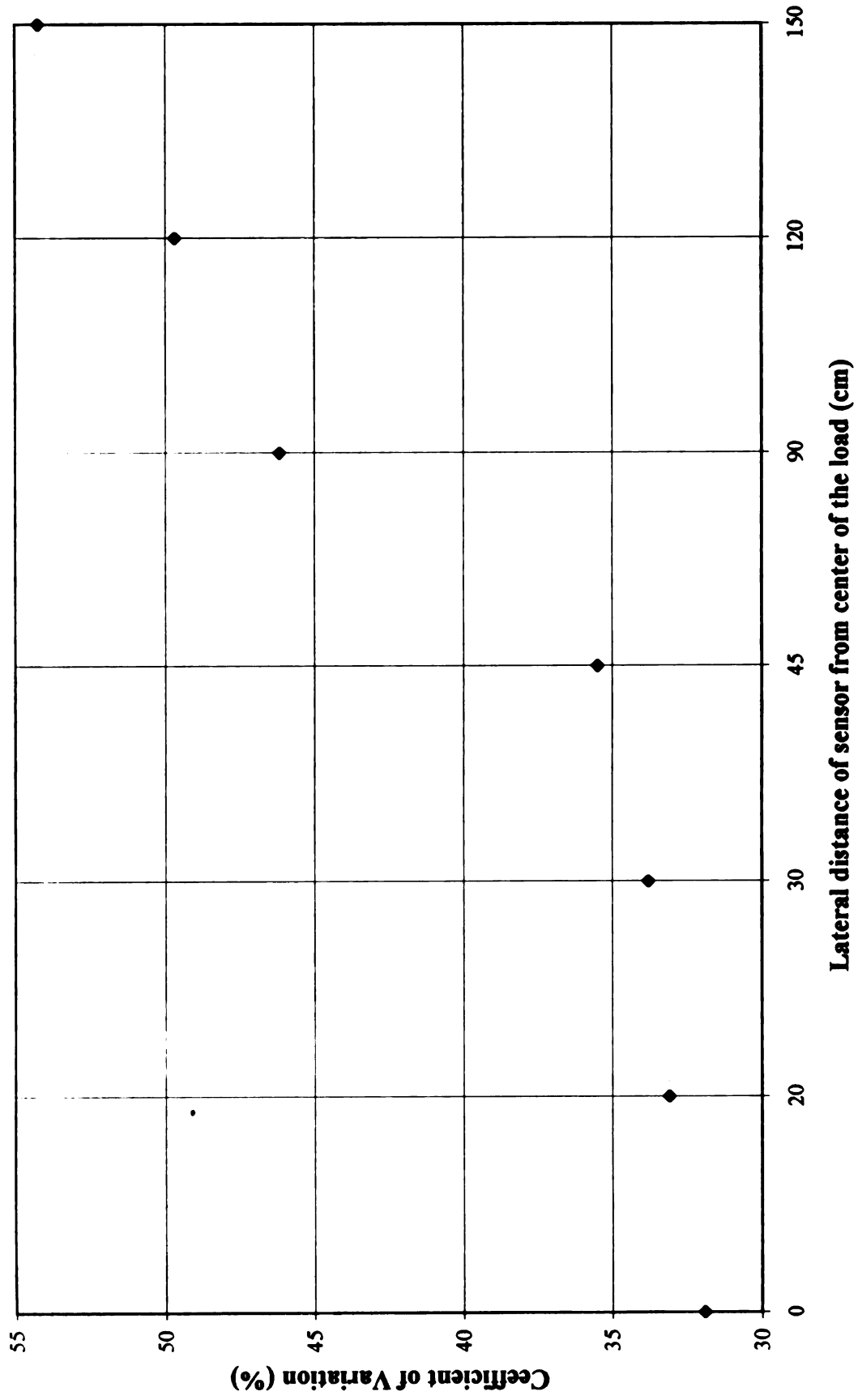


Figure 4.9: Coefficient of variation of deflection for different sensor locations.

cumulative effects of variations in all layers. The data however shows sensor 7 with the highest variation. This difference may be due to the compensating effect of the AC, base, and the subbase layers. The locations of high and low deflection in the roadbed soil may not correspond to the high and the low deflection locations of the upper lying layers, therefore the low deflection (strong pavement) of the upper layers may reduce the effect of high deflection (weak roadbed soil) of roadbed, and vice versa.

The deflection at each sensor location was normalized to its mean and plotted against the test stations as shown in Figure 4.10 through 4.16. Figure 4.16 shows the normalized deflection of the roadbed soil. It can be seen that there are stations with as high deflection as 3 times that of the mean, and stations with as low deflection as about 1 times from the mean. But the same stations in Figure 4.10 have variation within about 50 % of the mean. From this it can be concluded that the decrease in the variation of deflection, as one move closer to the center of the load, may be related to the compensating effect of the upper layers.

Further, the variation of the deflection of sensors 1 through 4 along the road (see Figures 4.10 through 4.13) is much different than that of the outer three sensors (see Figures 4.14 through 4.17). For each sensor location, these differences are also listed in Table 4.1 as the ratio of maximum to minimum deflections, maximum to average deflections, and minimum to average deflections. Once again, it can be seen that significant differences exist between the variations of sensors 1,2,3,4 (the inner sensors) and those of the outer three sensors. These differences can be attributed to the

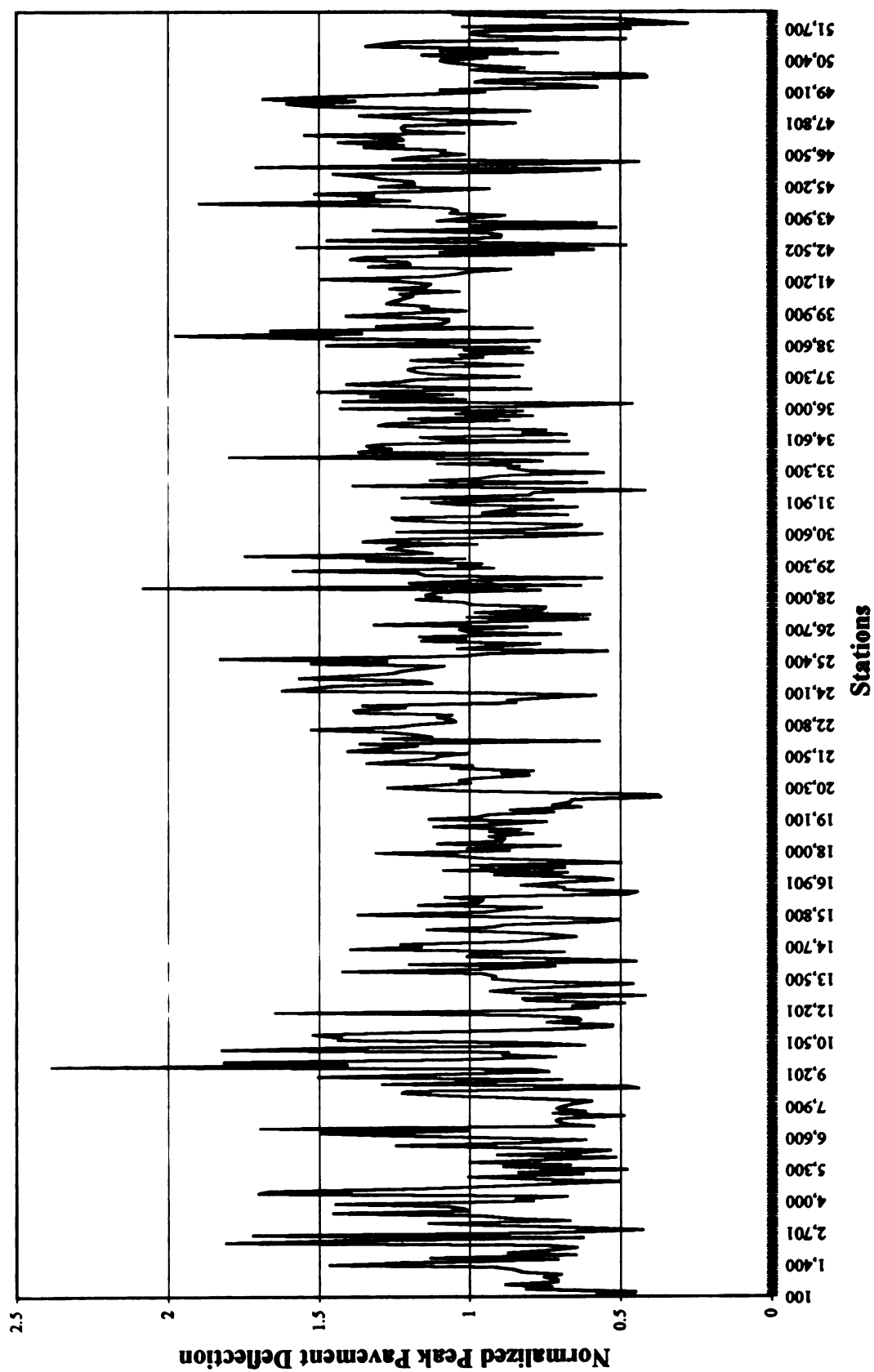


Figure 4.10: Variation of the peak pavement deflection (normalized relative to its mean) along the length of N5.

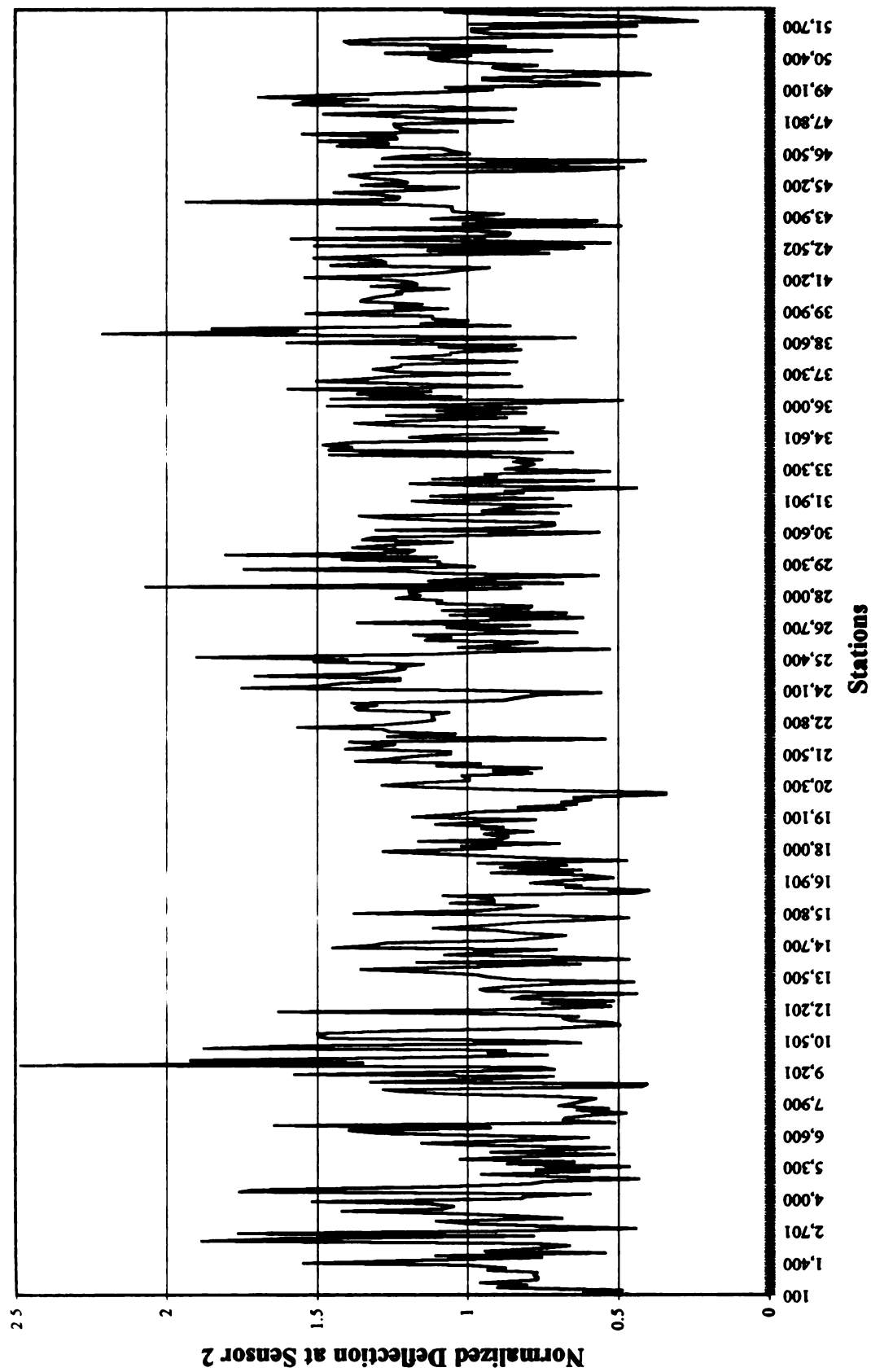


Figure 4.11: Variation of pavement deflection at sensor 2, (normalized relative to its mean) along the length of N5.

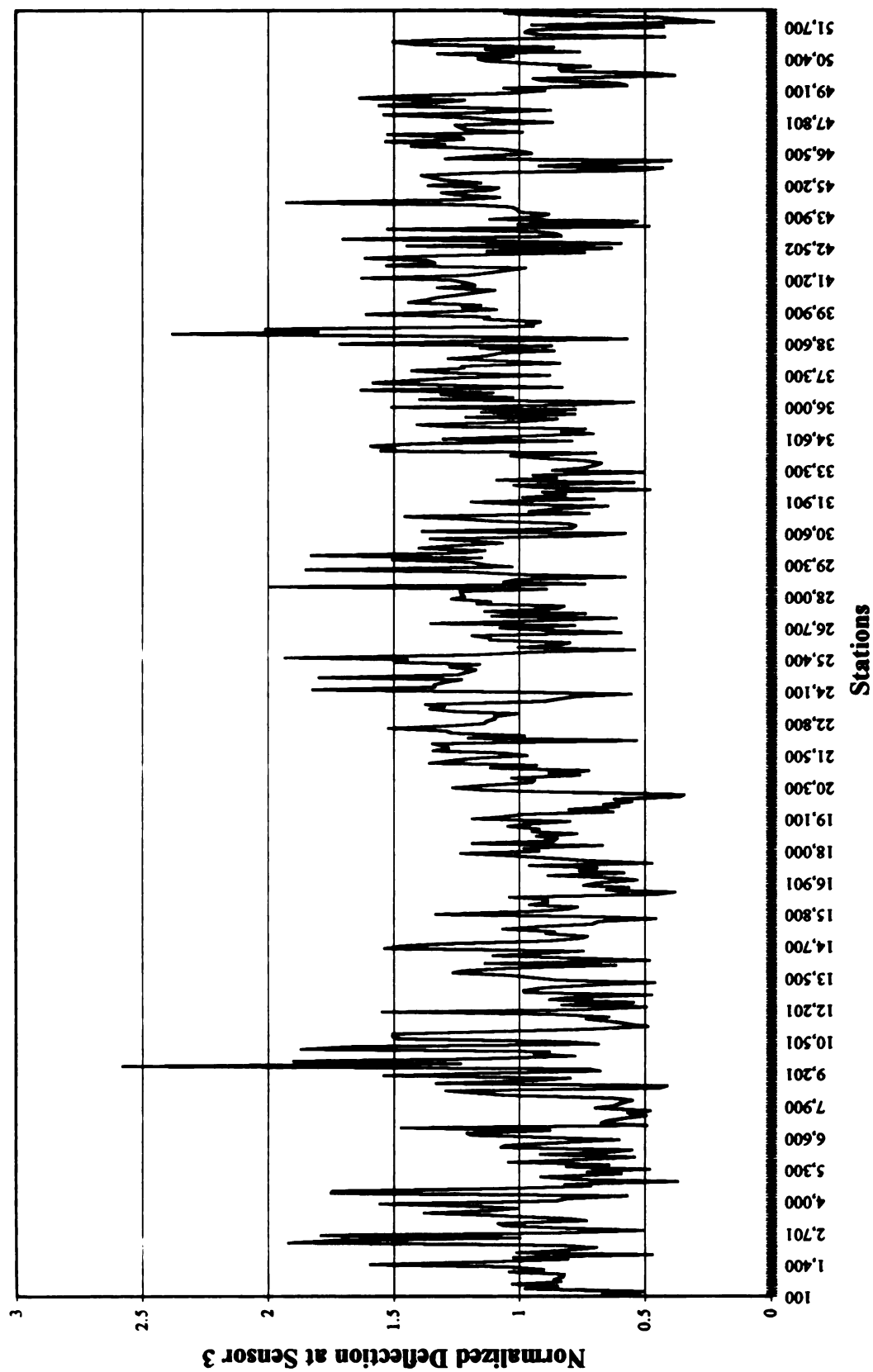


Figure 4.12: Variation of pavement deflection at sensor 3 (normalized relative to its mean) along the length of N5.

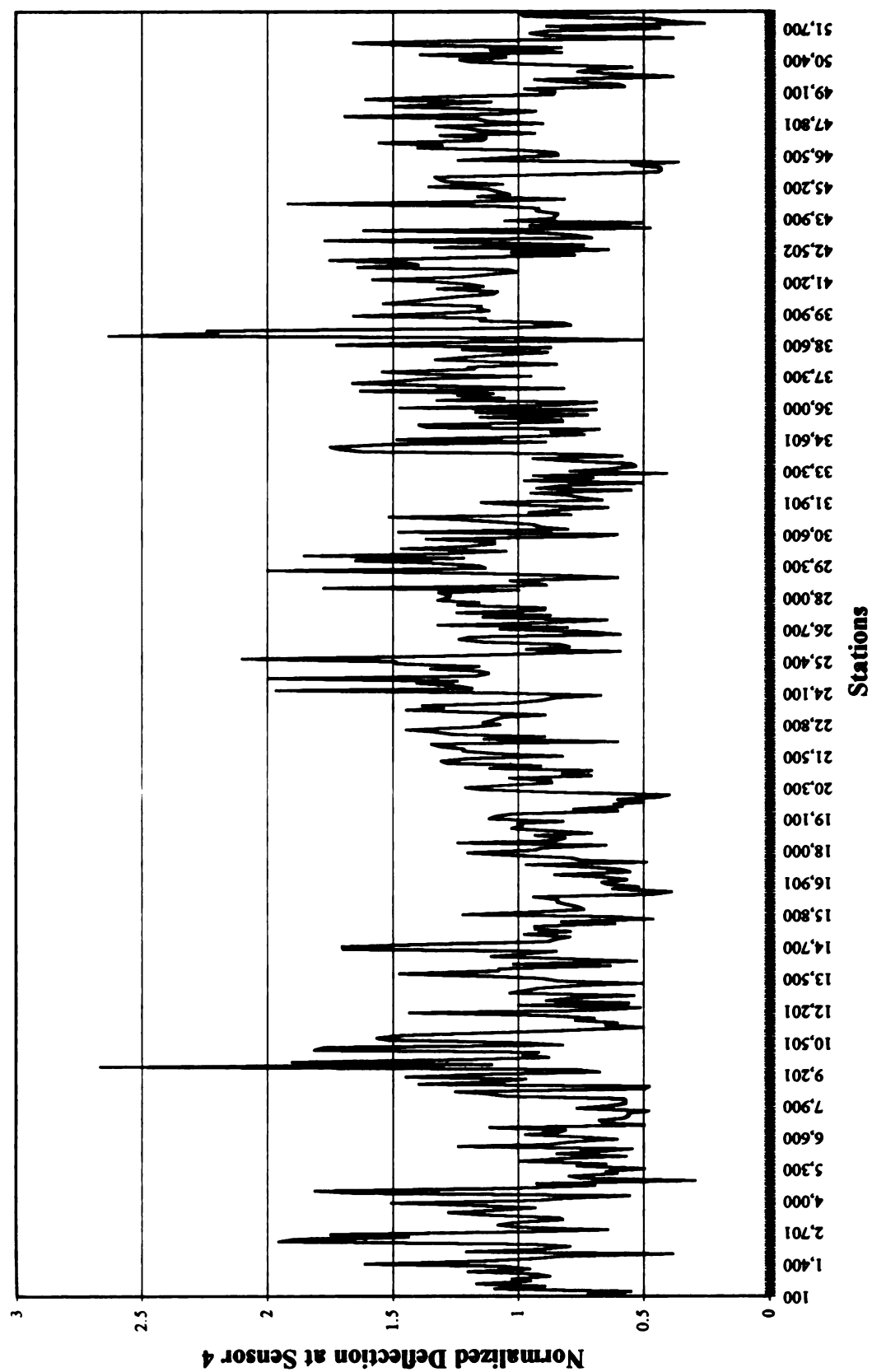


Figure 4.13: Variation of pavement deflection at sensor 4, (normalized relative to its mean) along the length of N5.

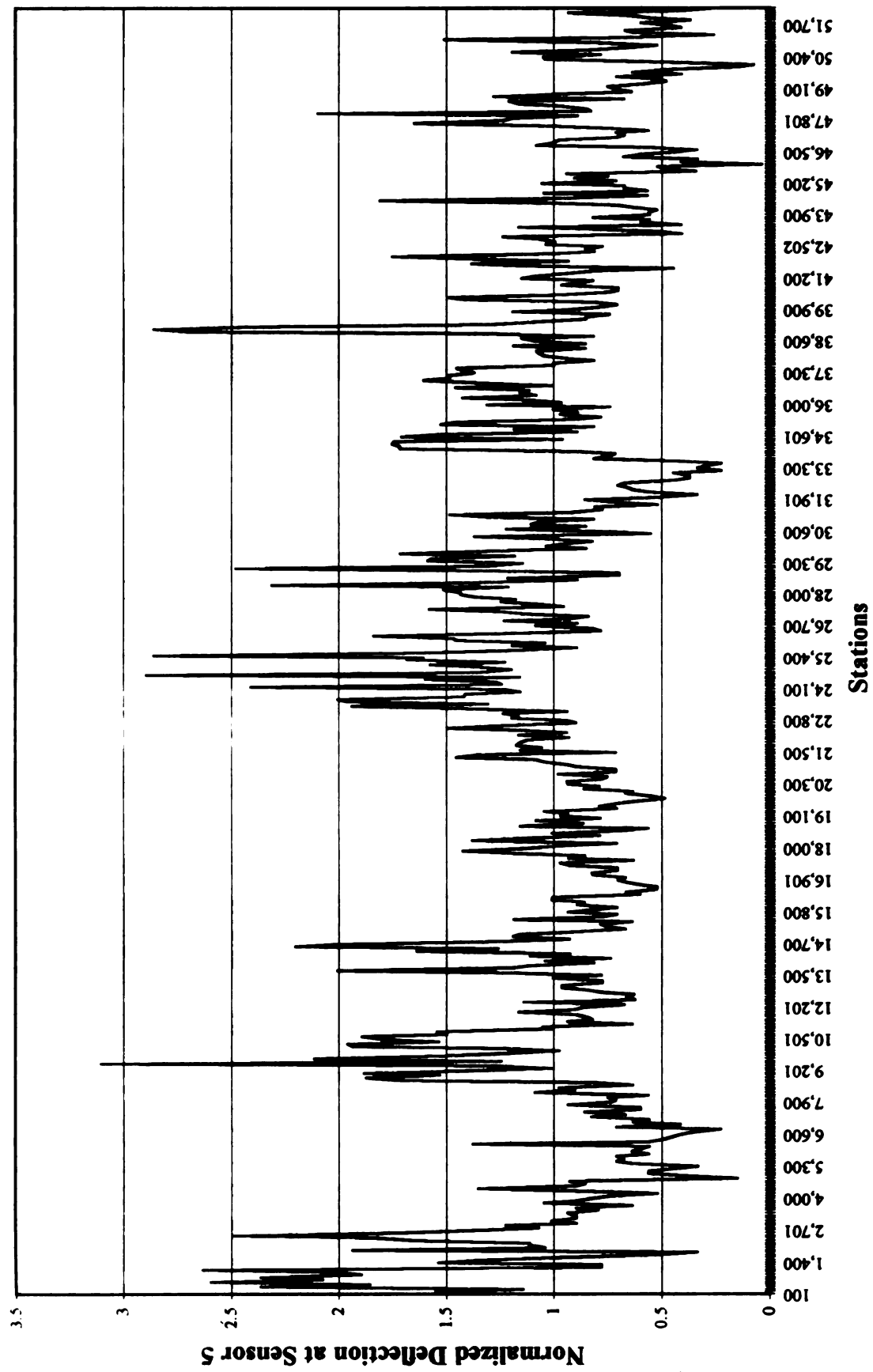


Figure 4.14: Variation of pavement deflection at sensor 5, (normalized relative to its mean) along the length of N5.

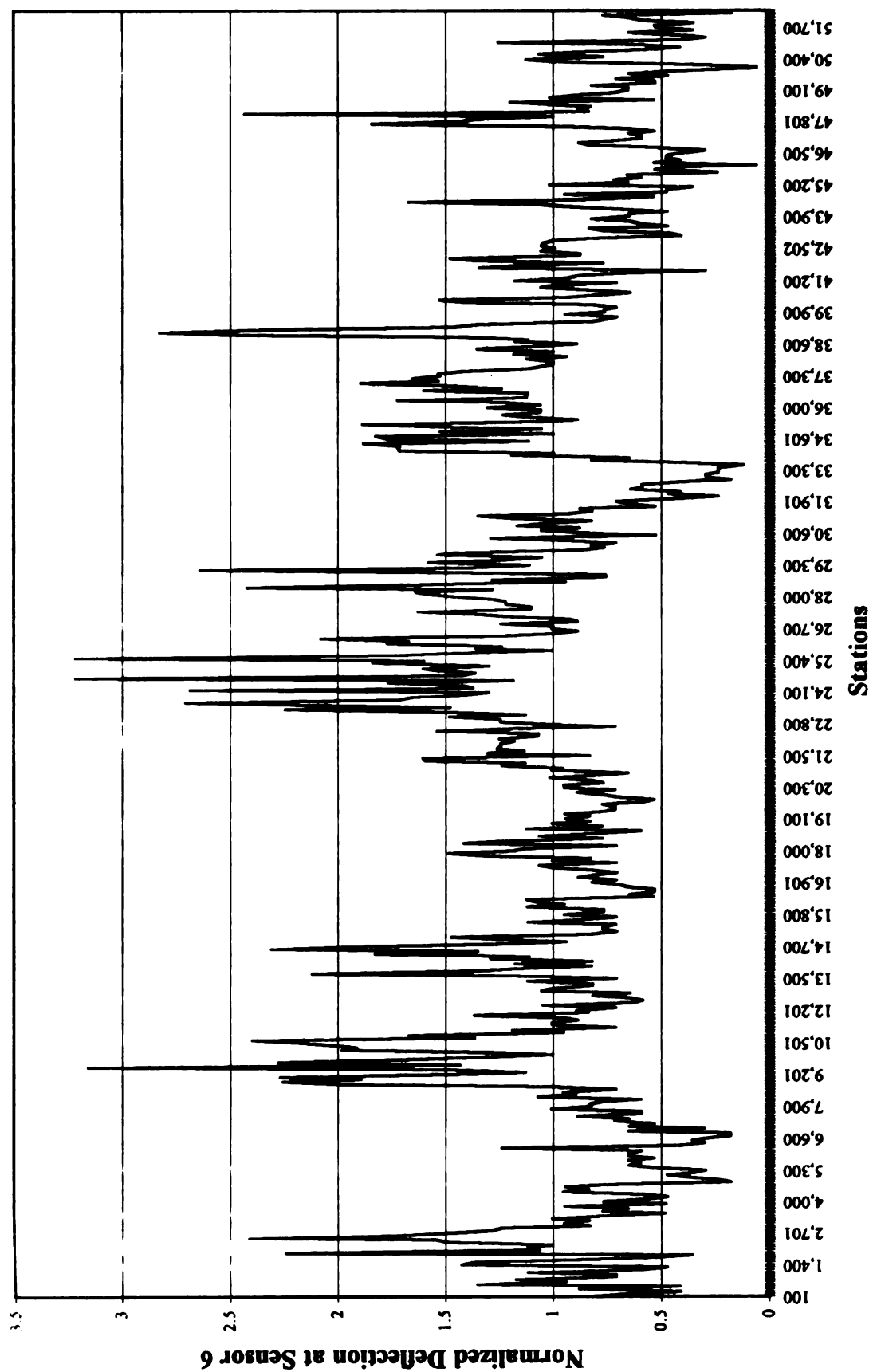


Figure 4.15: Variation of pavement deflection at sensor 6, (normalized relative to its mean) along the length of N5.

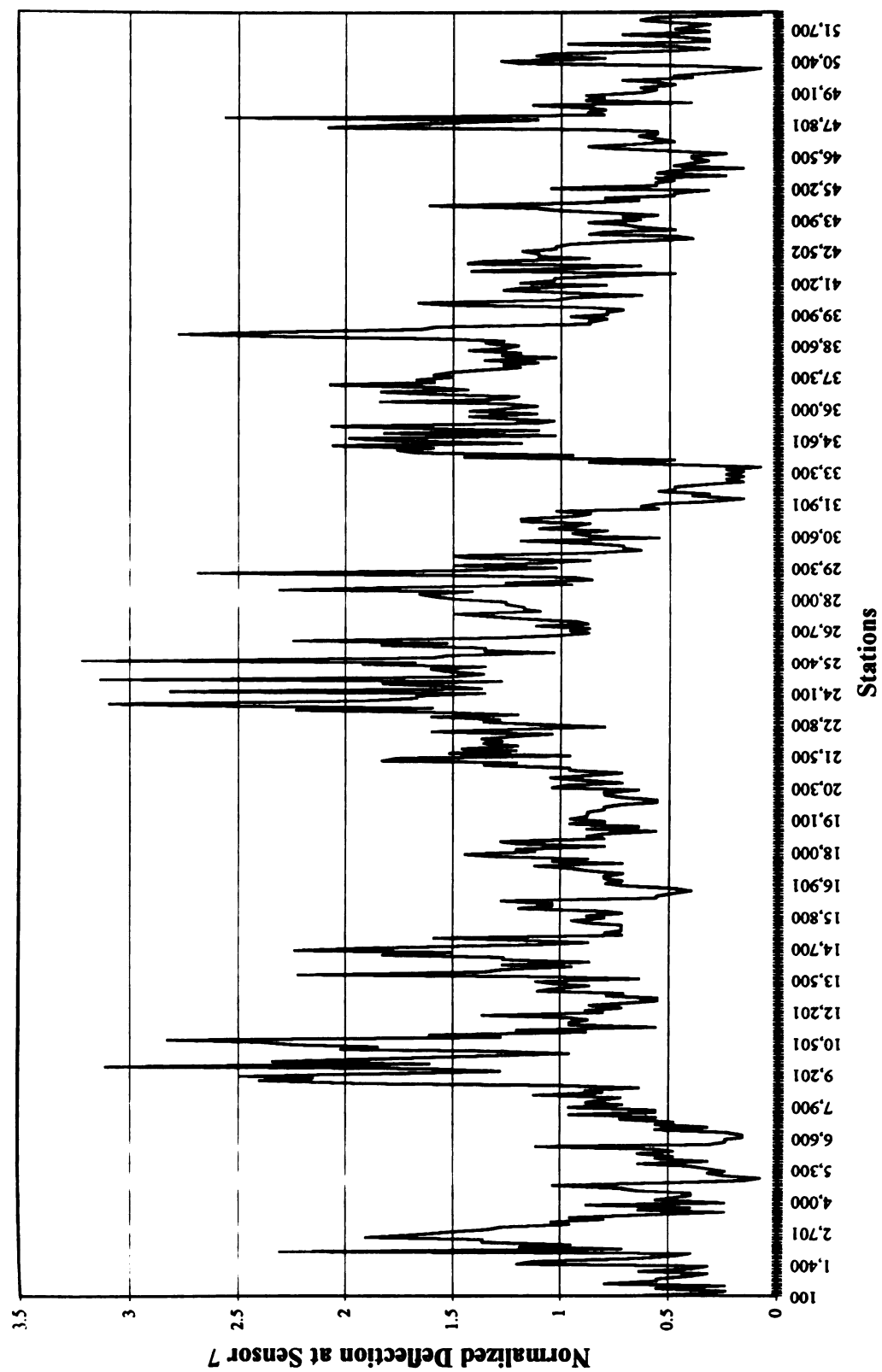


Figure 4.16: Variation of pavement deflection at sensor 7, (normalized relative to its mean) along the length of N5.

compensating effect of the outer layers and they show that the roadbed soil is contributing a significant portion of these variations.

The pavement peak surface deflection (deflection under the center of the load) data was divided into groups. Each deflection group ranges by 1.0 mil. Based on this division, the frequency distribution of the peak surface deflection was obtained and it is shown in Figure 4.17. It can be seen that the majority of the pavement sections have deflection between 8 and 14 mils. Only two pavement sections have lower deflection than 4.5 mils, and only four pavement sections have deflection higher than 22.49 mils. Several observations can be made from Figure 4.17 including;

1. The distribution is almost normal, which means that there is no systematic error in the data collection. Since there is no indication of error in data collection, the variability in the deflection can be attributed to variations in construction.
2. The lower side of the deflection distribution indicates that the deflection may have been taken on bridges and/or over culverts. Indeed, such observations were later verified through a telephone conversation with NHA personnel in Pakistan.
3. The higher side of the deflection distribution may be due to the fact that these deflection were taken near cracks (recall that the deflection data was collected after the failure of N5).

Since the collected data lacks the required details in the form of proper location reference points at which these measurements were taken, it is difficult to comment, with certainty, on the condition of the pavement looking at deflection alone. In order to further

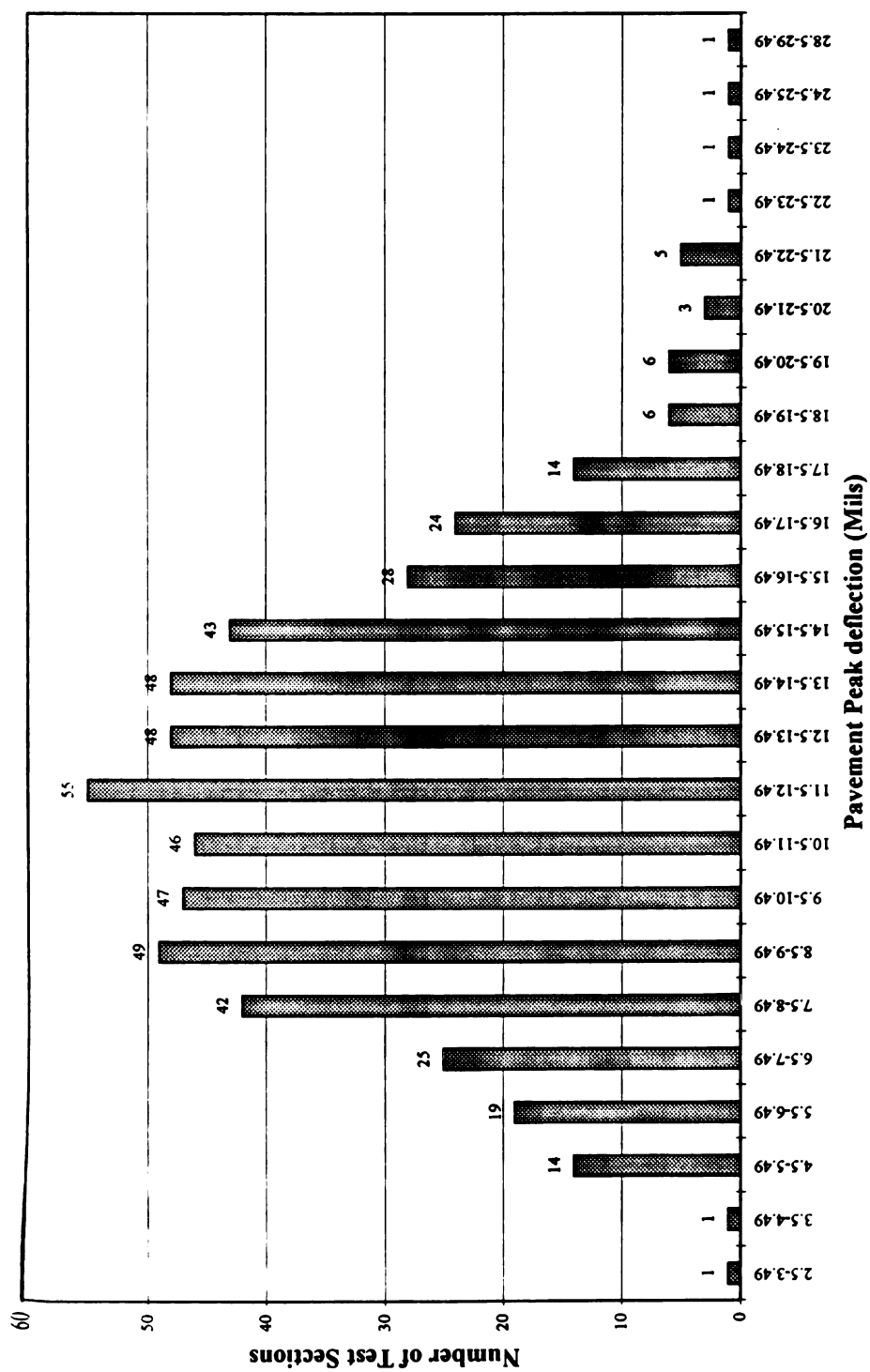


Figure 4.17 : Frequency distribution of pavement peak deflection.

investigate the causes of this variation, mechanistic analysis of this data was carried out which is presented in the next sections.

4.5 **BACKCALCULATION OF LAYER PROPERTIES**

There are two basic approaches to estimate the elastic moduli of each of the pavement layers. One is laboratory testing and the other is through backcalculation of layer moduli using NDT data. For existing pavements, laboratory testing is generally considered expensive and destructive in nature because the pavement structure must be disturbed in order to obtain test samples. A laboratory test method for the determination of the resilient modulus (defined as the ratio of the deviator stress to the recoverable axial strain) of paving materials is described in AASHTO T274-82 [23]. The laboratory tests are typically performed under simulated stress conditions expected in the pavement due to repeated vehicular loading. Since the field coring process causes disturbance in the AC layer and remolding of the granular base materials, the test results (resilient moduli) may not represent the true field values. The backcalculation of material properties of an existing pavement structure using NDT data is a very practical and efficient method. The moduli values obtained from the backcalculation, on the other hand, are more representative because the deflection data is collected under field conditions (the boundary values are not affected by sampling and/or remolding). Therefore, when comparing the laboratory and backcalculated moduli, perfect agreement between the two should not be expected.

To determine the pavement layer moduli in the field, various computer programs have been developed. MICHBACK is one of the computer programs which can be used for backcalculating the pavement layer moduli from the FWD deflection data. In this study, the backcalculation of layer moduli was accomplished by using the MICHBACK computer program and the deflection data and the actual load delivered to the pavement section during the NDT tests. In the subsequent subsections, details of the backcalculation of the layer moduli are presented.

4.5.1 Data Analysis Options. The MICHBACK computer program uses a modified Newton algorithm to backcalculate pavement layer moduli from the measured surface deflections and to mechanistically correct the thickness of one of the pavement layers or the depth to the stiff layer. Several parameters control the backcalculation procedure and the convergence checks. In the modified Newton method, a gradient matrix is used to determine how to change the current estimates of the layer moduli. The gradient matrix is constructed based on three consecutive estimates of the layer moduli. The three consecutive estimates that are required to calculate all the elements of the gradient matrix are labeled as one program iteration. The maximum number of iterations specified in this study were ten. The two criteria used to check the convergence are:

- a) The root-mean-square (RMS) - The RMS is the cumulative percent error between the measured and the calculated surface deflection. The RMS can be expressed in the following equation:

$$\text{RMS (\%)} = 1/n \left[\sum_{i=1}^n \left\{ (d_{ci} - d_{mi})/d_{mi} \right\}^2 \right]^{1/2} \quad 4.1$$

where:

- n = number of measured deflections;
- d_{ci} = calculated surface deflection at sensor i ; and
- d_{mi} = measured surface deflection at sensor i .

In this study, the RMS convergence criteria was set at 1 %. That is when the RMS value between the measured and calculated deflection is equal to or less than one percent, then the solution is considered to converge on the true values of the layer moduli.

- b) Based on the gradient matrix, the percent change in the moduli in each successive iteration is less than 1.0 %. This criterion is expressed as:

$$\Delta \text{Moduli (\%)} = 100 \times (E_k^{i+1} - E_k^i) / E_k^i \quad 4.2$$

where:

- E_k^i = Estimated modulus of layer k at iteration i .

This criterion indicates that the iterative scheme has stabilized and that the moduli are not changing significantly from one iteration to another.

When one of these two criteria is fulfilled, the MICHBACK program uses the final set of the modulus values in two ways;

- a) The final modulus values are assigned to the various layers at the test location in question.
- b) The final modulus values are assigned as seed moduli for the next test location.

If neither of these two criteria is met, the program will automatically terminate after 10 iterations and the layer moduli corresponding to the minimum of the two criteria will be stored as the layer moduli at that test station with a no convergence message.

Using the above criteria, various options available in the MICHBACK program were tried. These include;

- a) backcalculation of layer moduli without correcting the thickness of any layer, and without including a stiff layer.
- b) correction of the AC layer thickness; and
- c) the inclusion of a stiff layer and the correction of the depth to stiff layer

The three options are detailed below.

- a) **Option 1.** In this option, the layer moduli were backcalculated without modifying the thickness of any layer, and keeping the depth to stiff layer constant. Based on a statistical equation, MICHBACK predicted the stiff layer depth at the first test station at 123.1 inches. This depth was kept constant for all the test stations. For the first eleven test locations, the program converged for only three stations. The average moduli of the AC, base, and roadbed soil were 2308098, 15053, and 89480 psi respectively. The results are listed in Table 4.2.
- b) **Option 2.** Recall that the layer thicknesses were obtained from the as-built design record and they were not confirmed by pavement coring. This option was used to mechanistically correct the AC layer thickness along

Table 4.2 : A summary of the results of three backcalculation options.

OPTION 1 (Stiff Layer 123.1 inches)										OPTION 2					OPTION 3				
SL	AC Moduli (psi)	Base Moduli (psi)	Roadbed Moduli (psi)	Stiff Layer (inches)	Conv. or Not	AC Moduli (psi)	Base Moduli (psi)	Roadbed Moduli (psi)	AC Thickness (inches)	Conv. or Not	AC Moduli (psi)	Base Moduli (psi)	Roadbed Moduli (psi)	Stiff Layer (inches)	Conv. or Not				
100	1610606	48659	97077	123.1	yes	1342567	54965	89965	4.8	no	1194759	70662	72152	278	yes				
201	2713736	14868	100000	123.1	no	231982	13799	100000	12.48	no	1025400	42832	57112	113	yes				
301	3000900	19703	100000	123.1	no	287520	24143	100000	11.93	no	1467244	43315	88053	125	yes				
400	1895174	10000	85274	123.1	no	217298	10000	89050	10.72	no	998901	20841	47828	162	yes				
501	1840115	10000	100000	123.1	no	244895	10000	100000	10.17	no	1118665	18893	73504	124	yes				
601	1875484	10230	62304	123.1	yes	153883	10000	66004	12.92	no	639283	32434	32239	148	yes				
701	2372997	11527	86535	123.1	yes	209335	11380	91430	12.2	yes	929517	32421	44446	144	yes				
800	3000900	10000	84629	123.1	no	261387	10000	87919	12.21	no	814771	29041	51012	113	yes				
901	2245137	10593	100000	123.1	no	181972	11627	100000	12.21	no	1065947	29041	51012	129	yes				
1001	2666175	10000	100000	123.1	no	181972	11627	100000	12.21	no	1065947	29041	51012	109	yes				
1101	2052810	10000	74832	123.1	no	218647	10000	77654	11.09	no	1010517	23180	37054	143	yes				
Average	2308998	15053	89480			321042	16138	91002	11.18		1020222	35204	52867	144					
Std Dev	481681	11551	12481			340922	13518	11079	2.27		210222	14756	18298	47					

with the layer moduli. In this case, for the first eleven test stations, the convergence occurred at one test location only. The results of this option are also shown in Table 4.2.

- c) **Option 3.** Since the depth to stiff layer was not known, this option was tried by keeping the layer thicknesses constant and the depth to stiff layer was adjusted based on mechanistic analysis. In this case, convergence occurred on all eleven test stations and the layer moduli were within acceptable limits as shown in Table 4.2.

Recall that “no convergence” implies that neither the RMS criterion of 1% nor the percent change in layer moduli of 1% is satisfied.

By comparing the results obtained from the three options which are listed in Table 4.2, it was decided to use option 3 (Backcalculating the layer moduli and the depth to stiff layer). Therefore, for the rest of the test stations, the option to calculate the stiff layer depth was used.

MICHBACK is capable of backcalculating the moduli of 5 pavement layers. However, the accuracy of the results decreases as the number of layers increases especially when the option to calculate the thickness of one of the layers is used. Since, in this study, the option to calculate the depth to stiff layer was used, different layers of similar materials were combined together to form one layer. For example, all asphalt courses (AC wearing course, and AC base course) were combined into one asphalt layer. All unbound granular base and subbase layers were also combined into one layer. The subgrade (roadbed) soil was considered to

be one layer and its depth was calculated using the MICHBACK option of determining the stiff layer depth. Hence, only 3 layers (asphalt concrete, base, and roadbed soil) were used in the analysis.

4.5.2 Layer Moduli. The formatted deflection data was used to backcalculate the layer moduli using the MICHBACK computer program. In addition to the deflection data, other input variables used in MICHBACK are listed below.

Number of Layers	3	
Load plate radius	5.91 inches	
Number of sensors	7	
Material Properties:	Layer Thickness	Poisson's Ratio (μ)
a) Asphalt Concrete	4.8 inches	0.35
b) Granular Base	13.8 inches	0.40
c) Roadbed Soil	-	0.45

Deflection data for up to 400 test locations may be read from a deflection file by MICHBACK. For convenience, in this study, the data was analyzed for 50 stations at a time. The results were combined into one file for the entire length of the project. The backcalculated layer moduli at each test station are listed in Table C-1 (attached as Appendix C). It should be noted that for about ten percent of the test locations (56 test stations), the program did not converge for the selected convergence control criteria. For those stations, the moduli values were taken as the average of the two adjacent stations. To study the variation of layer moduli

along the length of the road, the moduli of each layer was plotted against the test stations. Figures 4.18, 4.24, and 4.26 show the variations in the AC, base, and roadbed moduli along the N5 highway. Figure 4.19, 4.25, and 4.27 show the variation in the AC, base, and roadbed moduli normalized relative to the average modulus value of each layer. The frequency distribution of the backcalculated layer moduli is shown in figure 4.28. Finally, a summary of the statistics of the AC, base, and roadbed soil moduli is listed in Table 4.3. For each pavement layer, the data in the table includes the minimum and the maximum moduli, the average modulus, the standard deviation, and the coefficient of variation. The results are discussed below.

AC Modulus. The variation in the AC modulus along the length of the road is shown in Figure 4.18. The AC modulus varies from 55,114 psi to 1,614,521 psi with a mean value of 498,745 psi (Table 4.3). Although the average moduli is within standard values, the range of the data is too high, which may be due to variation in the layer thickness, materials, pavement temperature, and/or variations in the construction. There is only one station at which the modulus value is 55,114 psi, on all other test stations the AC modulus is more than 123,234 psi. Since the test location is not referenced relative to cracks, bridges, or culvert locations, one can speculate that;

- a) The extremely low value of 55,114 psi may be due to the deflection that was taken near a crack.

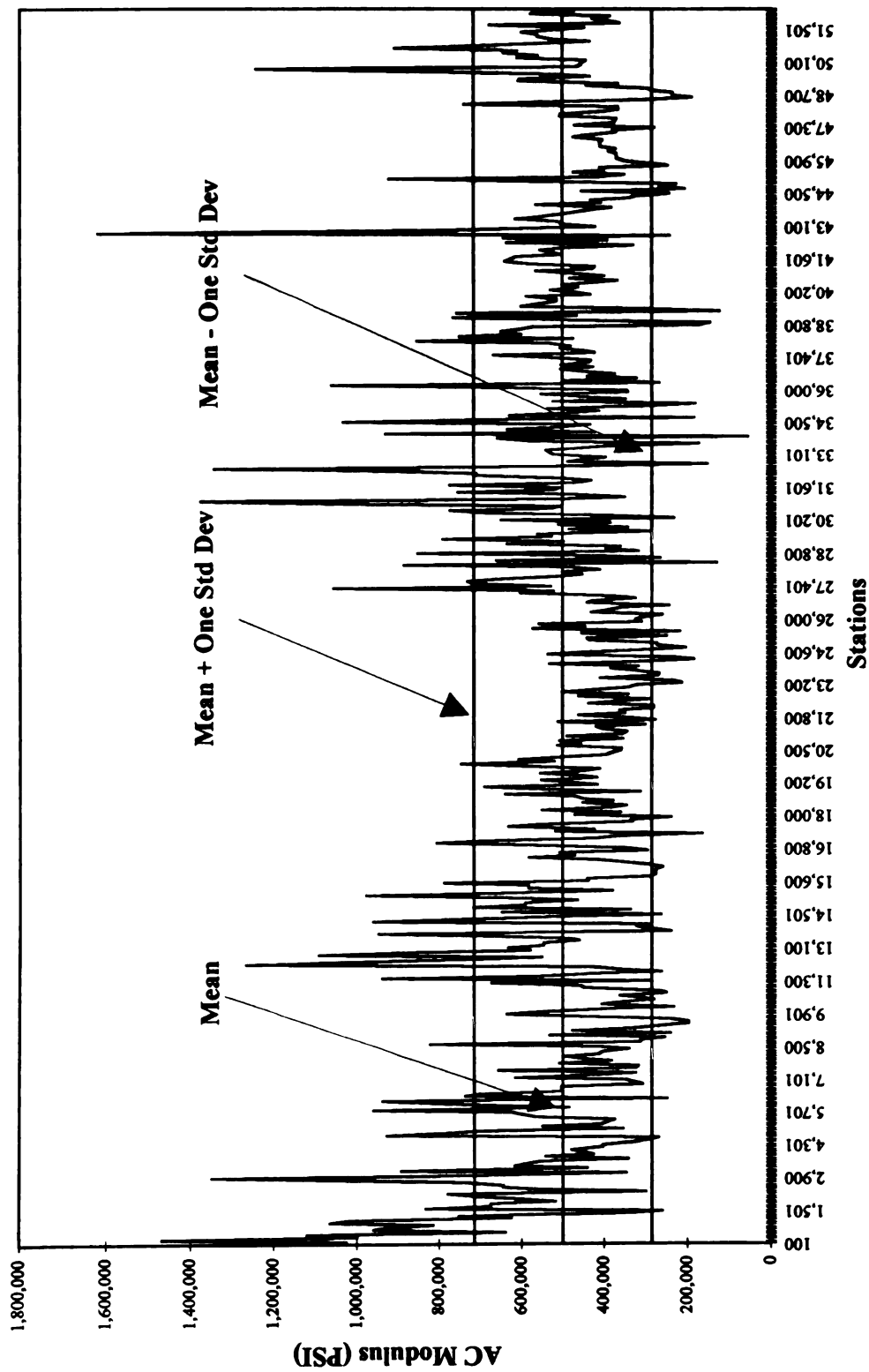


Figure 4.18 : Variation of the AC modulus along the tested section of the National Highway, N5.

Table 4.3: A summary of the statistics of the backcalculated layer moduli.

Layer	AC(psi)	Base(psi)	Roadbed(psi)
Minimum Moduli	55114	10185	16601
Maximum Moduli	1614521	157102	100000
Average Moduli	498754	30471	54561
Standard Deviation	214666	20377	16742
Coefficient of Variation(%)	43.04	66.87	30.68

- b) The higher modulus values may be due to the deflection tests at those locations were conducted over bridges and culverts.

A cross-examination of Figures 4.2 and 4.18 indicates that the variation in the AC modulus along the road corresponds to the variation in the peak pavement deflection. This implies that the MICHBACK program produced relatively accurate modulus values relative to the measured deflection data.

By normalizing the AC moduli with respect to the mean it was found that the total variation in the AC modulus is more than 300 % from the mean (Figure 4.19). The coefficient of variation is about 43 % which is also an indication of a very high variation (Table 4.3). It should be noted that, in this analysis, neither the deflection data nor the AC modulus are corrected relative to the test temperature. This issue of the analysis is discussed below.

As discussed earlier, the majority of the pavement deflection is contributed by the roadbed soil. Therefore, the variation in deflection due to the AC layer alone cannot be more than a few mils. This variation in deflection of the AC layer may be due to pavement temperature, variation in the AC layer thickness, and/or material properties. The pavement layer moduli, which are the function of the measured pavement deflections, are influenced by seasonal variations in moisture and temperature. The moisture variation influences the stiffness of the base and subbase layers and the roadbed soil. The temperature variation, on the other hand, affects the stiffness of the AC layer. Thus the effect of temperature on the AC modulus must be carefully studied for better interpretation of the backcalculated results. The temperature of the pavement varies during the day and with depth.

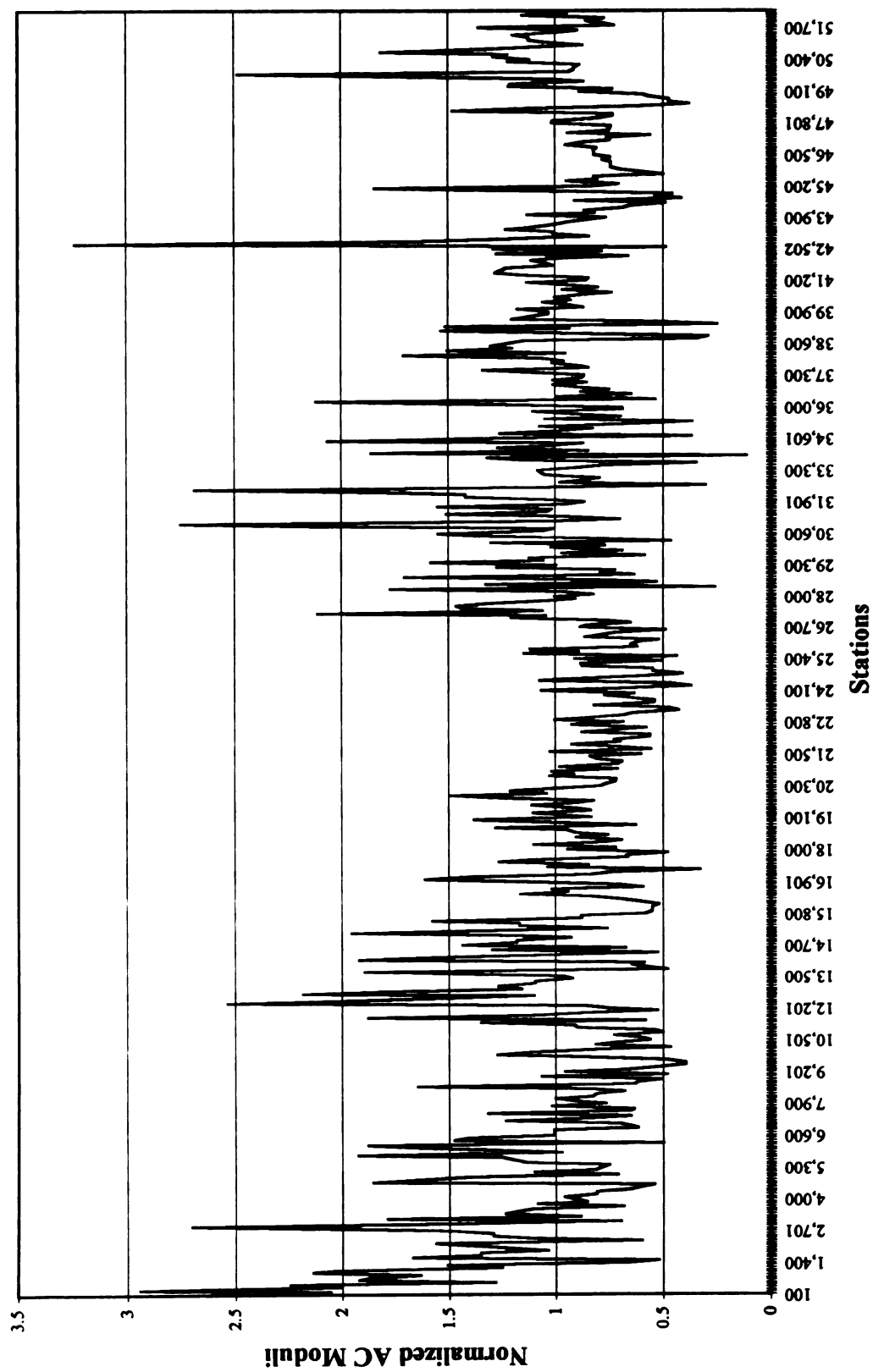


Figure 4.19: Variation of the normalized AC modulus along the tested section of the National Highway, N5.

During the morning hours, when the pavement is warming up (warming cycle), the temperature at the top of the AC layer is more than that at the bottom of the layer (positive temperature gradient). This implies that the stiffness of the AC layer increases with depth and that the temperature effect is minimum. Around noon time when the air temperature is maximum, the temperature gradient is still positive, although, the temperature at the bottom of the AC layer is high. At this time, the effect of temperature on the stiffness of the AC layer is much higher than that during the morning hours. After reaching a maximum value, the air temperature starts to decrease and the top of the AC layer becomes cooler than the bottom (the cooling cycle). This temperature difference in the AC layer is known as negative temperature gradient. At this time, the pavement acts as if a stiff top layer is lying over a relatively soft bottom layer. Thus, for the same pavement average temperature, the behavior of the AC layer during the warming cycle (stiffness increases with depth) is much different than that during the cooling cycle (stiffness decreases with depth). Moreover, regardless of the type of temperature cycle (warming or cooling), higher pavement temperatures cause lower stiffness.

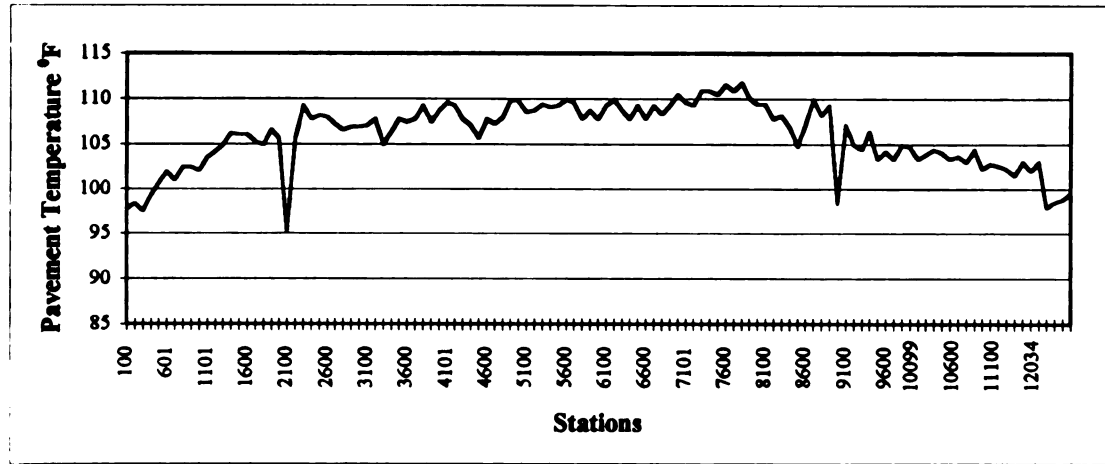
For this study, the deflection data was collected on four different days. For each day, the measured temperature of the pavement varied from one test station to another as shown in Tables A-1 through A-4 (Appendix A). A summary of the temperature range, during which the NDT data was collected is shown in Table 4.4. It can be seen that, during each testing day, the pavement was subjected to both warming and cooling cycles and that the temperature range for each day is

Table 4.4: Temperature range during each of the four days of NDT data collection.

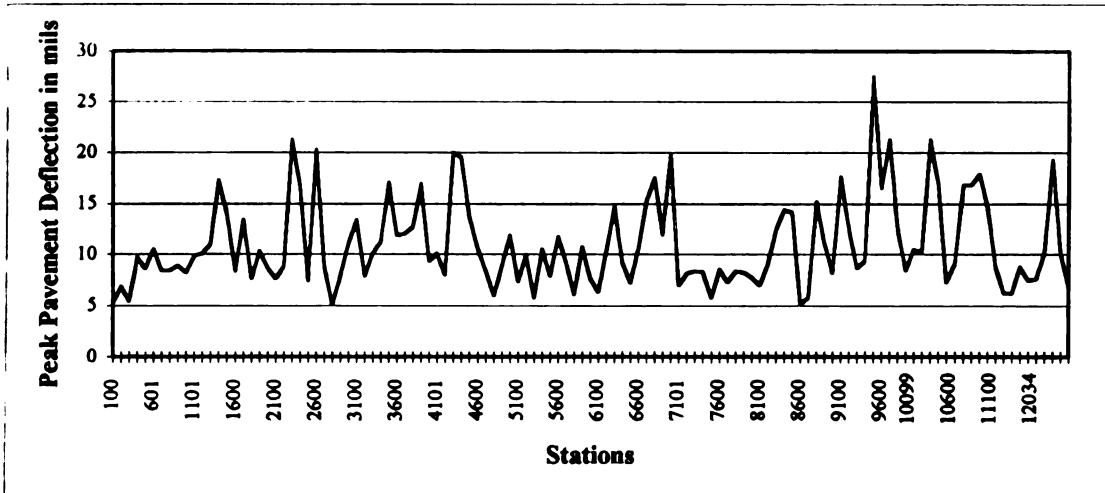
Test Stations		Start		Maximum		Finish		Date
From	To	Temp °C (°F)	Time(hh:mm)	Temp °C (°F)	Time(hh:mm)	Temp °C (°F)	Time(hh:mm)	
100	12300	36.5 (97.7)	12:11	43.8 (110.84)	14:50	37.5 (99.5)	16:36	2/26/95
12400	27000	32.1 (89.78)	10:14	44.8 (112.64)	14:02	38.2 (100.76)	16:17	2/27/95
27100	42800	30.8 (87.44)	10:12	42.1 (107.78)	13:17	31 (87.8)	15:58	2/28/95
42900	52400	37.2 (98.96)	13:37	45 (113)	14:08	35.5 (95.9)	17:18	3/8/95

different. For this reason, the AC modulus data was divided into four groups. Each group represents those adjacent test stations where the deflection data was collected during one day. The four modulus groups are discussed below.

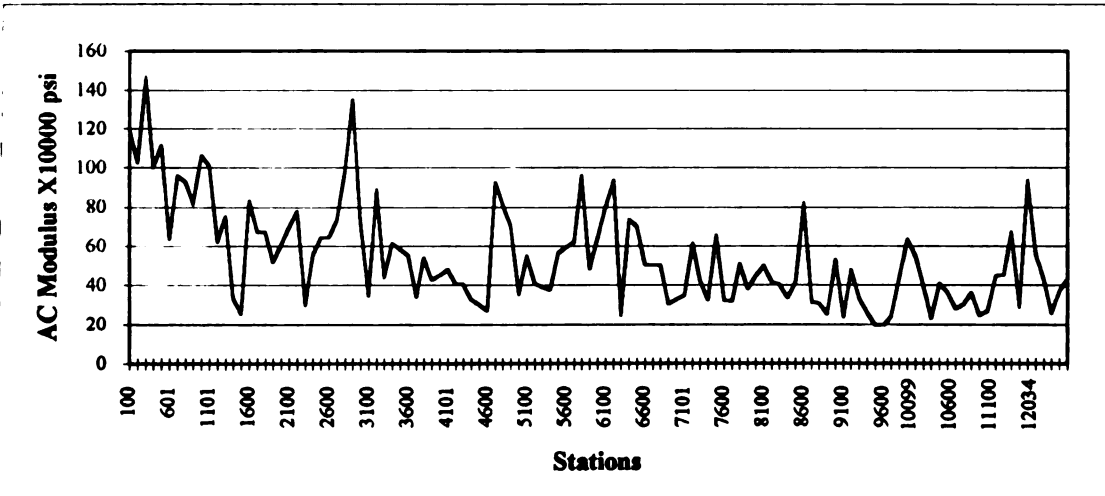
Group 1 - Test Stations 100 to 12300 - The NDT data for test stations 100 to 12300 was collected on February 26, 1995 as shown in table 4.4. At the start of the tests (around 12:00 noon), the pavement temperature was about 98 °F. During the tests, the pavement temperature increased from about 98 °F to over 110 °F and then it decreased to around 100 °F. Hence, the tests were conducted during the warming (positive temperature gradient) and cooling (negative temperature gradient) cycles. As it can be seen from figure 4.20, the value of the backcalculated AC modulus is high at the beginning of the tests and it decreased as the pavement temperature increased. This observation was expected and it agrees with the results reported in the literature (higher pavement temperature causes lower AC modulus). Further examination of part (a) of figure 4.20 indicates that at test stations 2100 and 9000, the pavement temperature dropped to 95 and 98 °F, respectively. Unfortunately, the NDT data file does not provide any explanation as to the causes of this sudden decrease in the pavement temperature. One can speculate however that the decrease in the pavement temperature may be due to a shaded area (cloud or parked vehicle) or to an error in the temperature measurement. Thus, the warming and cooling cycles at test stations 2100 and 9000 may have been temporarily interrupted or reversed. Nevertheless, for test stations 100 to 12300, the average backcalculated AC modulus is 547,311 psi, the standard deviation is 258,446 psi, and the coefficient of variation is 47 percent. At this point, no conclusion can be made regarding the statistical data of the measured



a) Variation of the pavement temperature.



b) Variation of the peak pavement deflection.

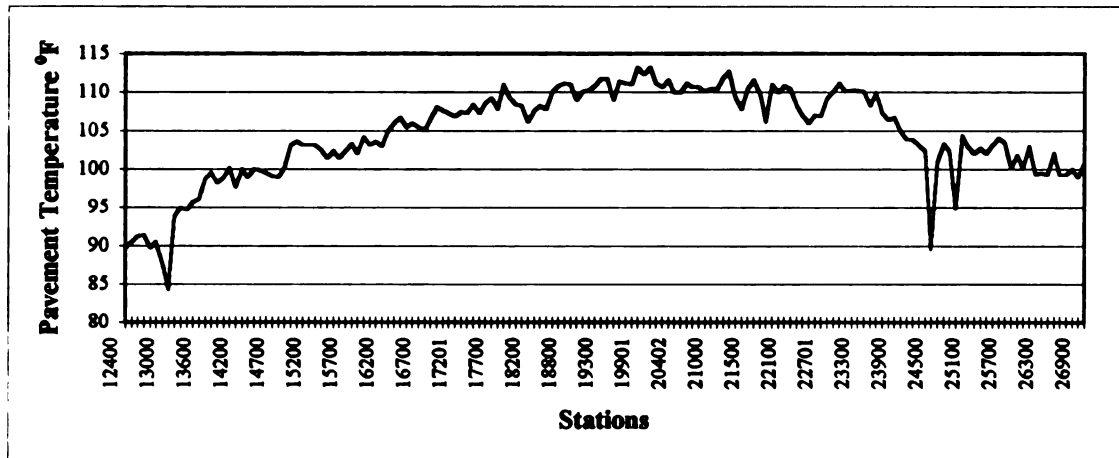


c) Variation of the AC layer modulus.

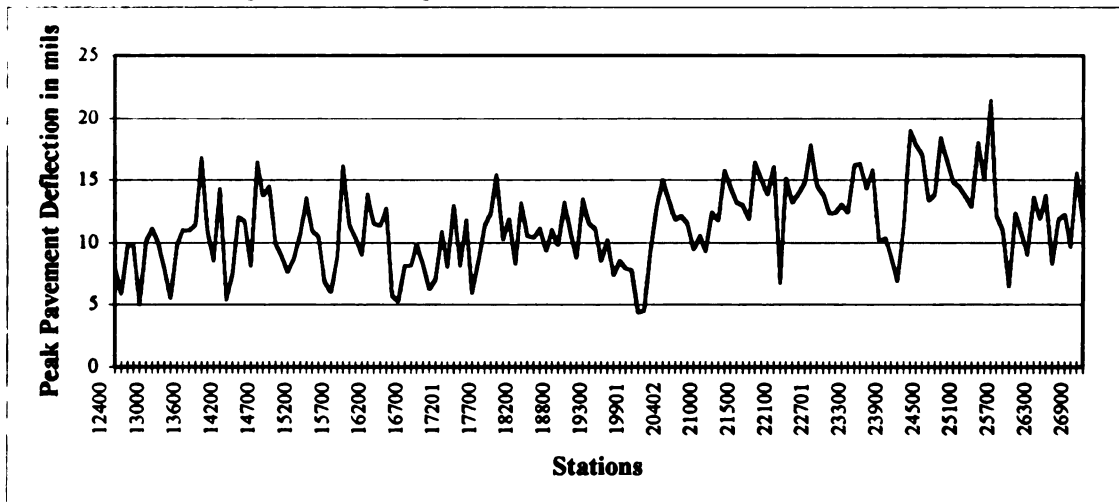
Figure 4.20: Variation of the pavement temperature, deflection, and the AC layer modulus along the length of N5 (test stations 100-12300).

pavement deflection and the backcalculated AC layer modulus. The reason is that the measured deflection data or the backcalculated AC layer modulus must be corrected to a common standard temperature before the variation of the AC modulus along the test section can be assessed. More on this topic is presented after the four deflection data groups are discussed.

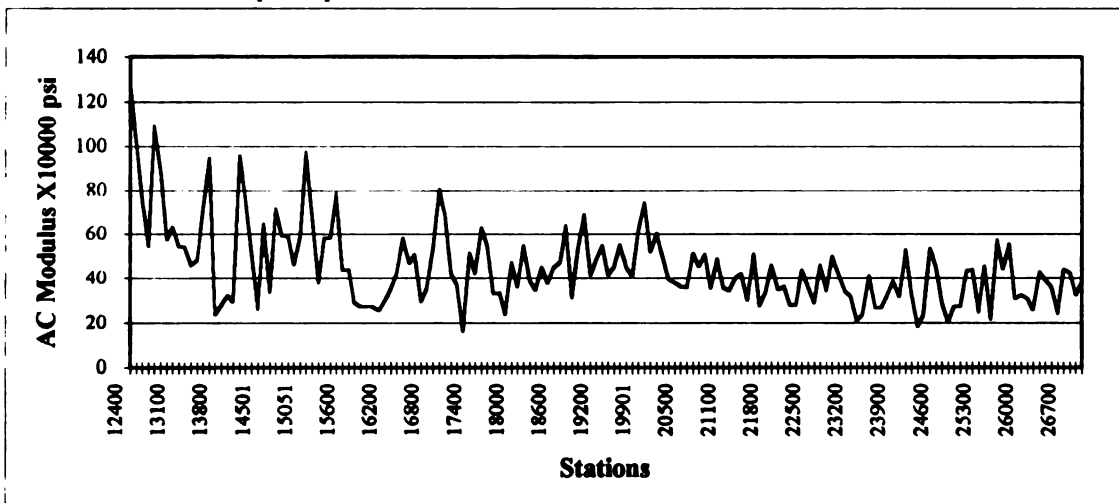
Group 2 - Test Stations 12400 to 27000 - The NDT data for test stations 12400 to 27000 was collected on February 27, 1995 as shown in table 4.4. At the start of the tests (around 10:00 a.m.), the pavement temperature was about 90 °F. During the tests, the pavement temperature increased from about 90 °F to over 110 °F and then it decreased to around 100 °F. Once again, the tests were conducted during the warming (positive temperature gradient) and cooling (negative temperature gradient) cycles. As it can be seen from figure 4.21, the value of the backcalculated AC modulus is high at the beginning of the tests and it decreased as the pavement temperature increased. In this group of NDT data (see part (a) of figure 4.21), the measured pavement temperature at three test stations was much lower than the adjacent test stations. Once again, the NDT data file does not provide any explanation as to the causes of this sudden decrease in the pavement temperature. If one assumes that the measured pavement temperature is correct then it implies that the warming and cooling cycles at the three test stations may have been temporarily interrupted or reversed. Nevertheless, for test stations 12400 to 27000, the average backcalculated AC modulus is 452,309 psi, the standard deviation is 183,693 psi, and the coefficient of variation is 40.6 percent.



a) Variation of the pavement temperature.



b) Variation of the peak pavement deflection.

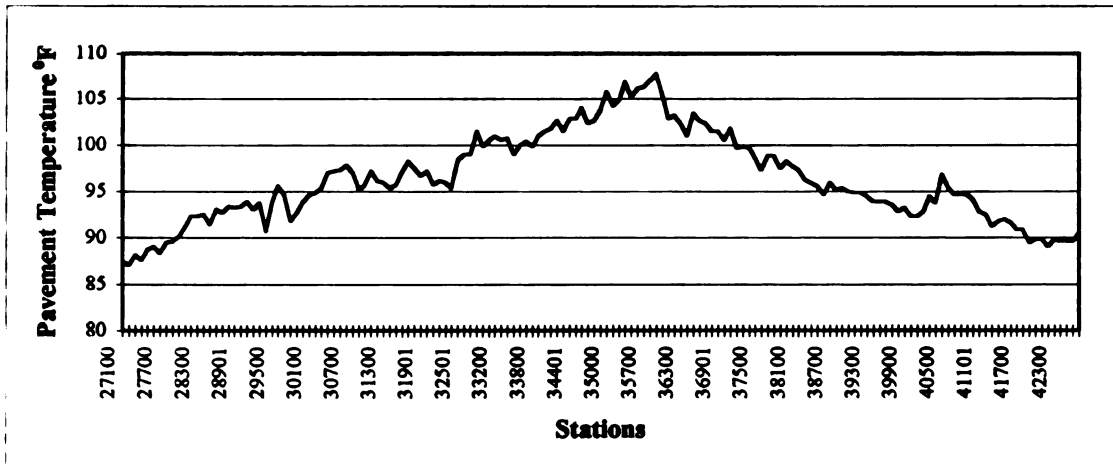


c) Variation of the AC layer modulus.

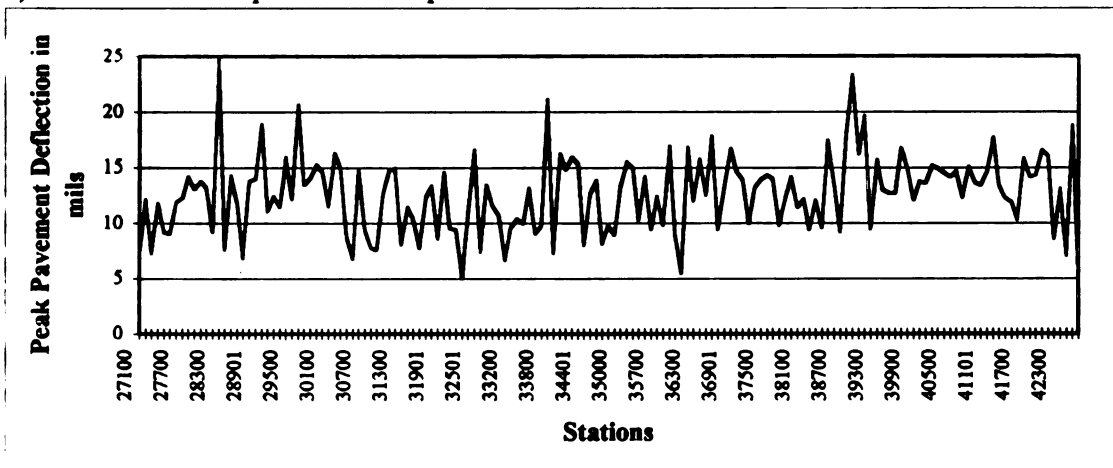
Figure 4.21: Variation of the pavement temperature, deflection, and the AC layer modulus along the length of N5 (test stations 12400-27000).

Group 3 - Test Stations 27100 to 42800 - The NDT data for test stations 27100 to 42800 was collected on February 28, 1995 as shown in table 4.4. At the start of the tests (around 10:00 a.m.), the pavement temperature was about 87 °F. During the tests, the pavement temperature increased from about 87 °F to about 108 °F and then it decreased to around 90 °F. Once again, the tests were conducted during the warming (positive temperature gradient) and cooling (negative temperature gradient) cycles. Examination of figure 4.22 indicates that, for this group of NDT data, the pavement temperature has no significant effect on the values of the backcalculated AC modulus. One of the possible explanation for this departure is that, after reaching its peak value of about 108 °F, the pavement temperature started to decrease immediately. That is, because the warming cycle was followed immediately by the cooling one, not enough time was available for the pavement temperature to rise. Nevertheless, for these test stations, the average backcalculated AC modulus is 529,775, the standard deviation is 222,707 psi, and the coefficient of variation is 42 percent.

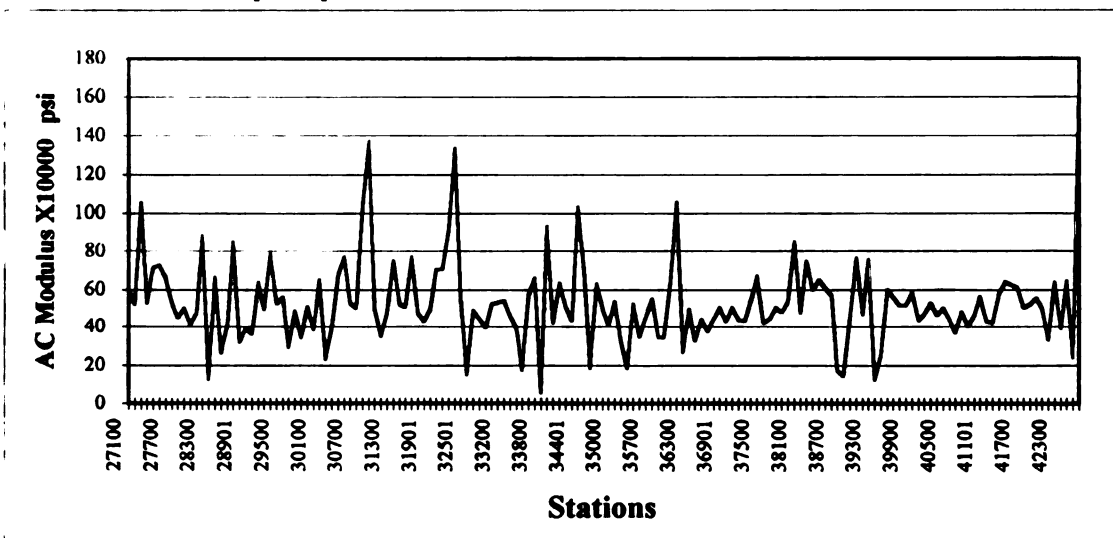
Group 4 - Test Stations 42900 to 52400 - The NDT data for test stations 42900 to 52400 was collected on March 8, 1995 as shown in table 4.4. At the start of the tests (around 1:37 p.m.), the pavement temperature was about 110 °F. During the tests, the pavement temperature decreased to around 95 °F. Hence, most tests were conducted during the cooling (negative temperature gradient) cycle. Examination of figure 4.23 indicates that, for this group of NDT data, the value of the backcalculated AC modulus increases as the pavement temperature decreases. Once again, this was expected and it agrees with the observations reported in the literature. For these test stations, the



a) Variation of the pavement temperature.

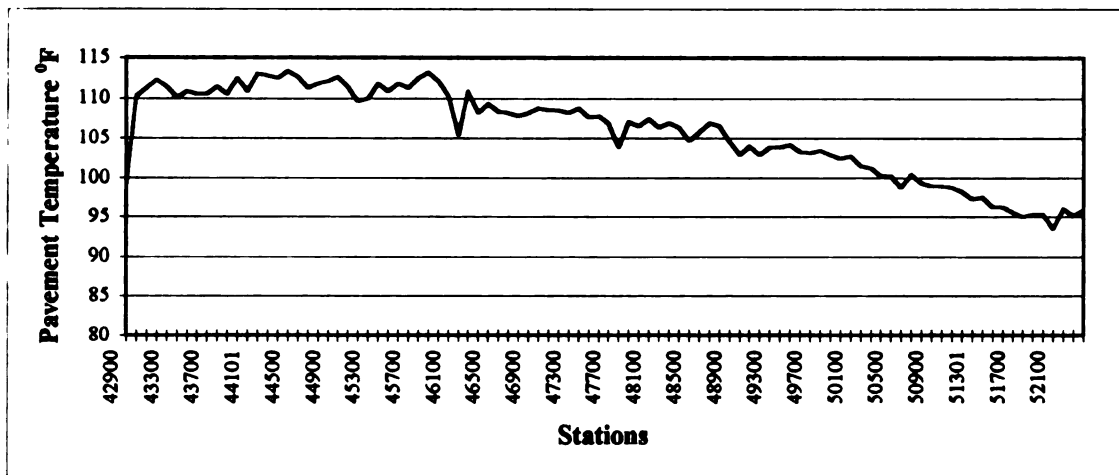


b) Variation of the peak pavement deflection.

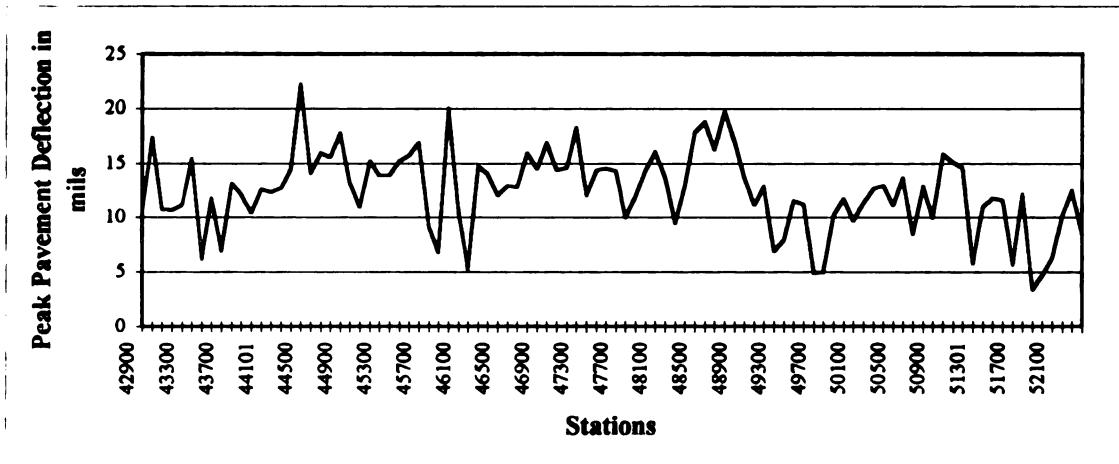


c) Variation of the AC layer modulus.

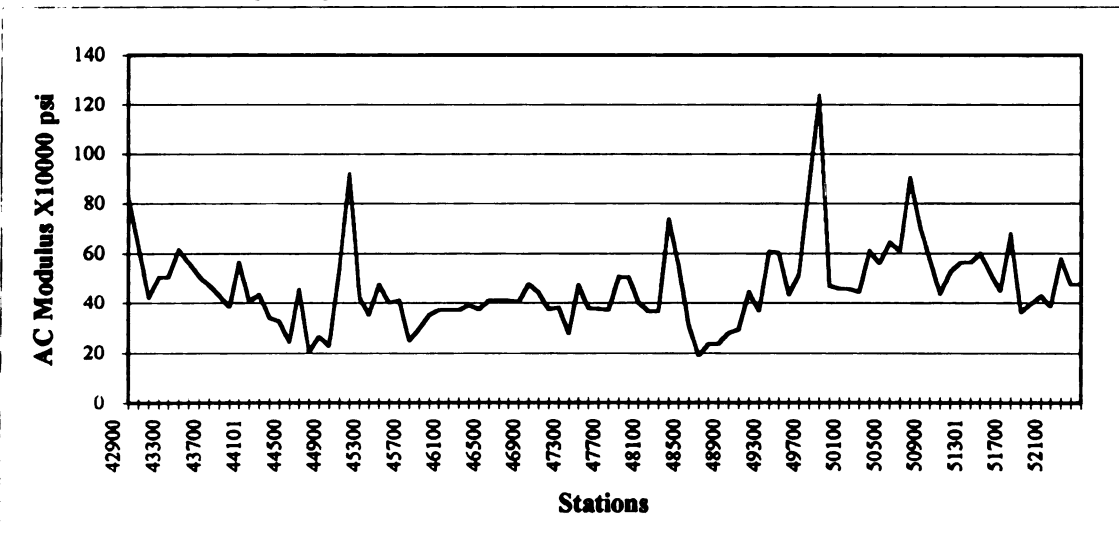
Figure 4.22: Variation of the pavement temperature, deflection, and the AC layer modulus along the length of N5 (test stations 27100-42800).



a) Variation of the pavement temperature.



b) Variation of the peak pavement deflection.



c) Variation of the AC layer modulus.

Figure 4.23: Variation of the pavement temperature, deflection, and the AC layer modulus along the length of N5 (test stations 42900-52400).

average backcalculated AC modulus is 464,920, the standard deviation is 165,016 psi, and the coefficient of variation is 35.5 percent.

To this point, it is clear that the values of the backcalculated AC layer modulus must be corrected to a standard temperature before the data can be properly discussed. Two methods of temperature correction can be found. The Asphalt Institute (AI) and the AASHTO method. The AASHTO method calls for the correction of the measured pavement peak deflection, whereas the AI method corrects the backcalculated AC modulus to a standard temperature of 77 °F. A study carried out at Michigan State University on three pavement sections showed [7]:

- a) The pavement behavior during the warming cycle (positive temperature gradient) is different than that during the cooling cycle (negative temperature gradient). Hence, the proper temperature correction method must include the effect of the temperature gradient.
- b) The pavement sections considered, showed less sensitivity to temperature than that predicted by the AI and the AASHTO methods.
- c) Pavement characteristics such as AC thickness and stiffness, and the asphalt grade affect the AC response to temperature change. These characteristics are not considered in the AI or the AASHTO methods.

Since the temperature gradient in the pavement was not measured during the NDT tests and since the characteristics of the pavement along the N5 highway are not known, it was decided not to include temperature correction in this study.

However, it is strongly recommended that a study be conducted to develop temperature correction models for pavements in Pakistan according to its own environment.

Base Moduli. The variation in the base modulus along the N5 highway is depicted in Figure 4.24. It can be seen that most of the test sections have modulus values between 10,000 and 40,000 psi. Few test stations have a modulus value over 100,000 psi. The distribution of the values of the base modulus is not normal as shown in Figure 4.28. The higher modulus values suggest that the deflection data may have been collected over bridges and culverts. Nevertheless, more than 66 % of the test stations have base modulus values between 30,000 and 10,000 psi. This more or less represents a typical range of modulus of base materials. For a high class road (such as the N5 highway), the base materials should have been chosen and prepared or compacted to possess a modulus value of 25,000 psi or better. Unfortunately, a significant number of test locations showed a base modulus value of less than 20,000 psi. Given that the base material consisted of 100 percent crushed lime stone, the modulus value of a properly compacted crushed hard lime stone is about 40,000 psi, and given the significant variation in the values of the base modulus along the road, one can conclude that, during construction, the base material was not properly compacted. Table 4.3 provides a summary of the statistic of the base modulus of the National Highway N5. It can be seen that the coefficient of variation in the values of the base modulus is 66 %. The high value

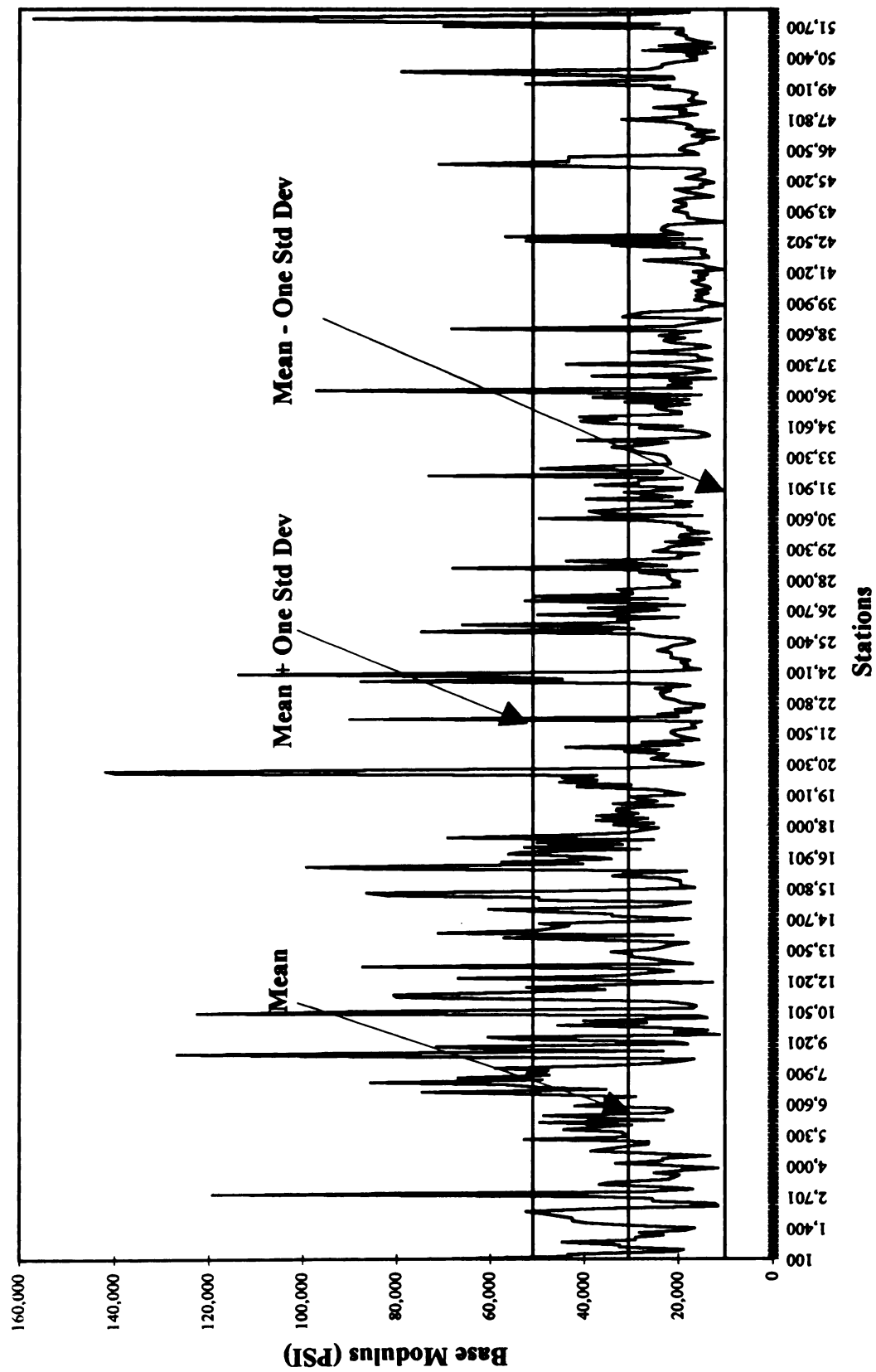


Figure 4.24 : Variation of the base modulus along the tested section of the National Highway, N5.

of the coefficient of variation is due to the fact that few of the test locations have very high modulus values relative to other locations.

By normalizing the base modulus with respect to its mean, it was found that on the high side, the base modulus is more than 400 percent from the mean, whereas on the low side it is about 50 percent from the mean as shown in Figure 4.25.

As discussed earlier, the stiffness of the base layer is affected by moisture variations in the base. Moisture can enter the pavement layers either by infiltration through pavement cracks, it can seep from a higher ground or from water standing in the drainage ditches, or it may rise to the base layer from the roadbed soil by capillary action. The stiffness of a granular base material decreases significantly as the moisture content in the base approaches the saturation point (typically 85 percent moisture content is considered an acceptable level). The summary of the statistical data presented in the Table 4.3 suggests that the high variation in the granular base modulus along the N5 highway can be related to:

- a) Compaction practices during construction (e.g., low number of passes, the vibrator was not on for a sufficient time etc.).
- b) During the NDT, the base material was exposed to a various moisture levels.

A cross-examination of the variation of the base modulus with that of the roadbed soil (presented in the next section) indicates that moisture contents is not the main cause of the low values of the base modulus. The reason for this is that if the base material is exposed to moisture then the roadbed soil is also exposed to an equal or

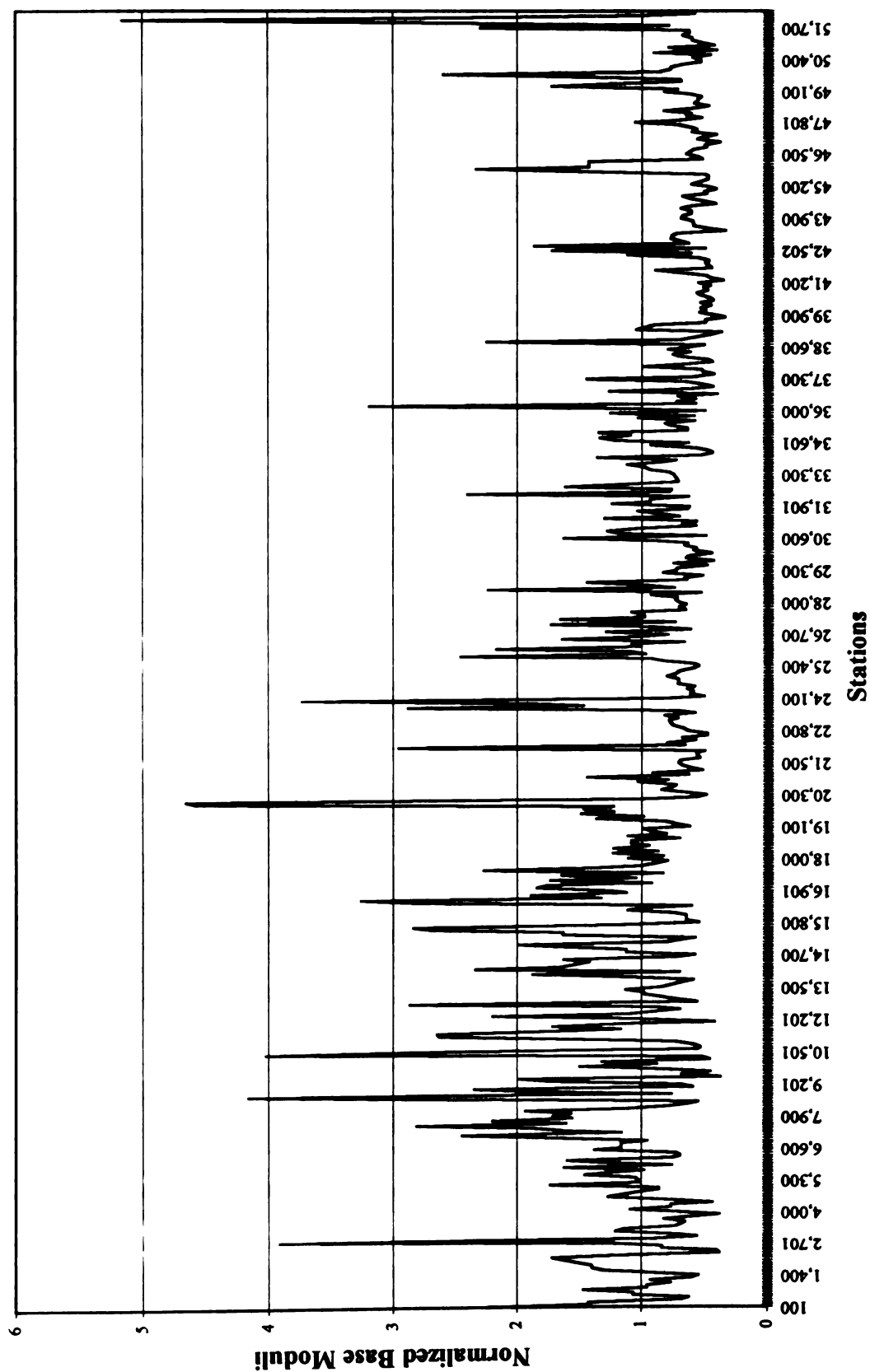


Figure 4.25: Variation of the normalized base modulus along the tested section of the National Highway, N5.

more severe moisture problem. Given the range and the variation in the roadbed modulus (see Figure 4.26) along the 52.4 km stretch of N5, one can rule out the moisture as the cause. Hence compaction of the base material during the construction is, perhaps, the main cause of the high variation in the base modulus.

Roadbed Moduli. The roadbed modulus is also variable along the length of the road as shown in Figure 4.26 having values from 16,601 psi to 100,000 psi with a mean value of 54,561 psi (Table 4.3). The variation in the roadbed soil modulus (normalized relative to its average) is about 180 % from the mean value (shown as 1.0 in the figure) as shown in Figure 4.27, and the coefficient of variation is about 30 %. The modulus values of the roadbed soil are mostly greater than the base modulus. The variation in the roadbed modulus, which corresponds to the variation in deflection profile at sensor 7, may be due to the variations in moisture contents or poor construction practices .

The roadbed soil modulus is very sensitive to moisture contents. A slight variation in the moisture content can result in a high variation in stiffness. As it can be seen from Figure 4.26, there is no special trend in the roadbed modulus, rather it varies from station to station all along the length of the road. That is, the local (station to station) variation in the roadbed modulus is similar to the global (along the entire road) variation. This shows that either the roadbed soil was not prepared properly at the time of its construction or the variation in its moisture content during the NDT survey has affected its modulus. Such a variation in moisture content could be attributed to a poor drainage. However, since the NDT

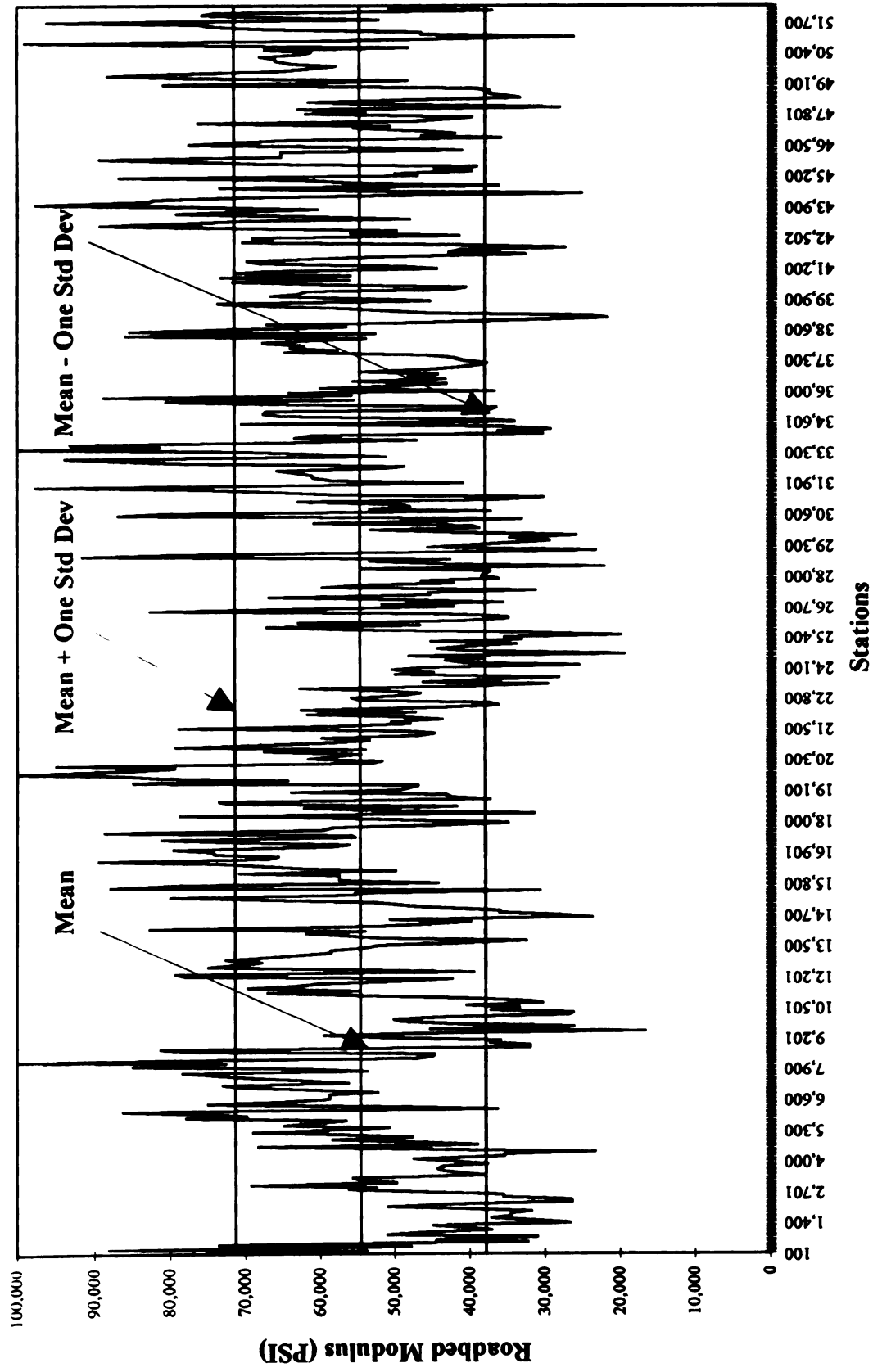


Figure 4.26 : Variation of the roadbed modulus along the tested section of the National Highway, N5.

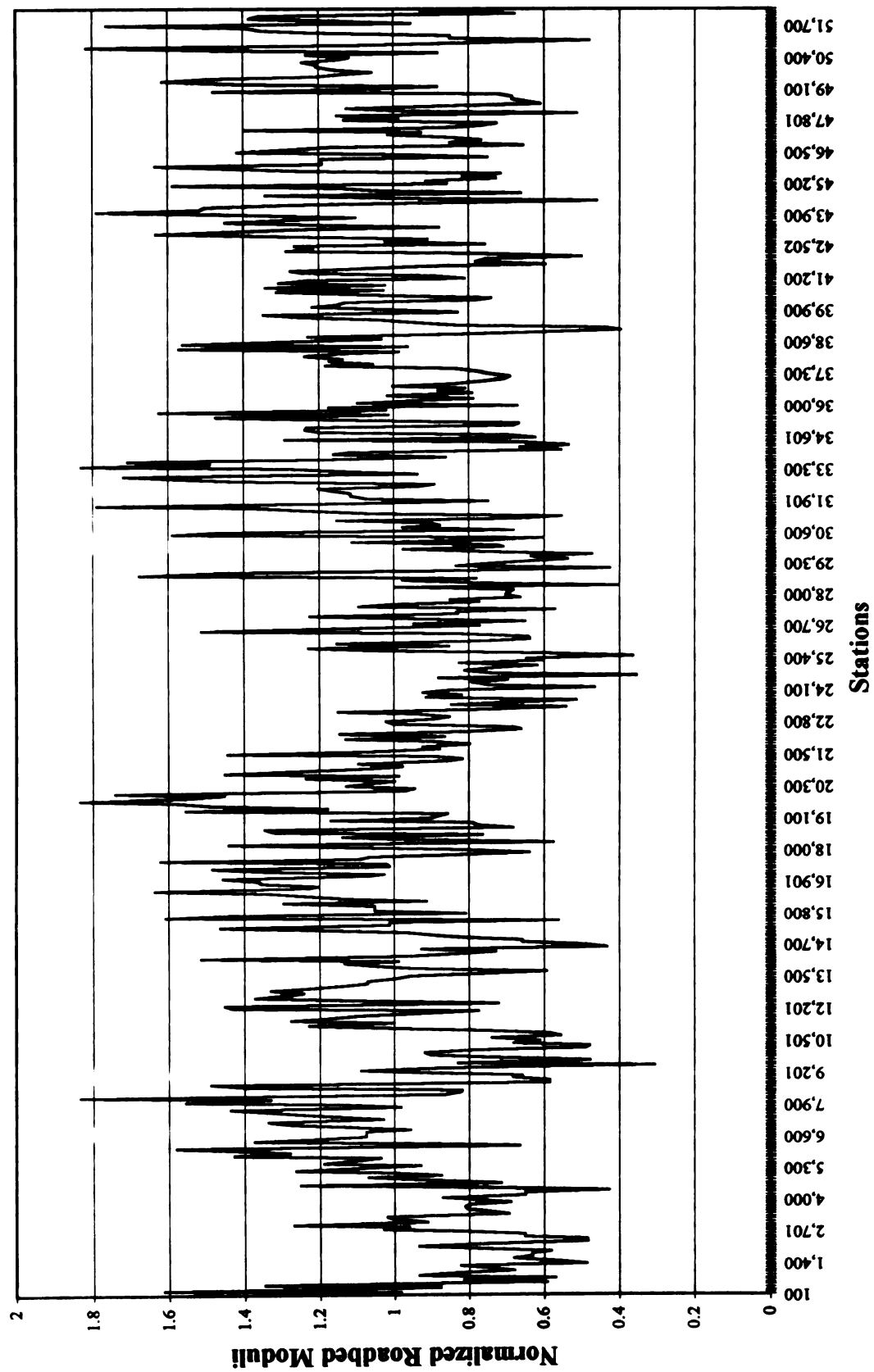


Figure 4.27: Variation of the normalized roadbed modulus along the tested section of the National Highway, N5.

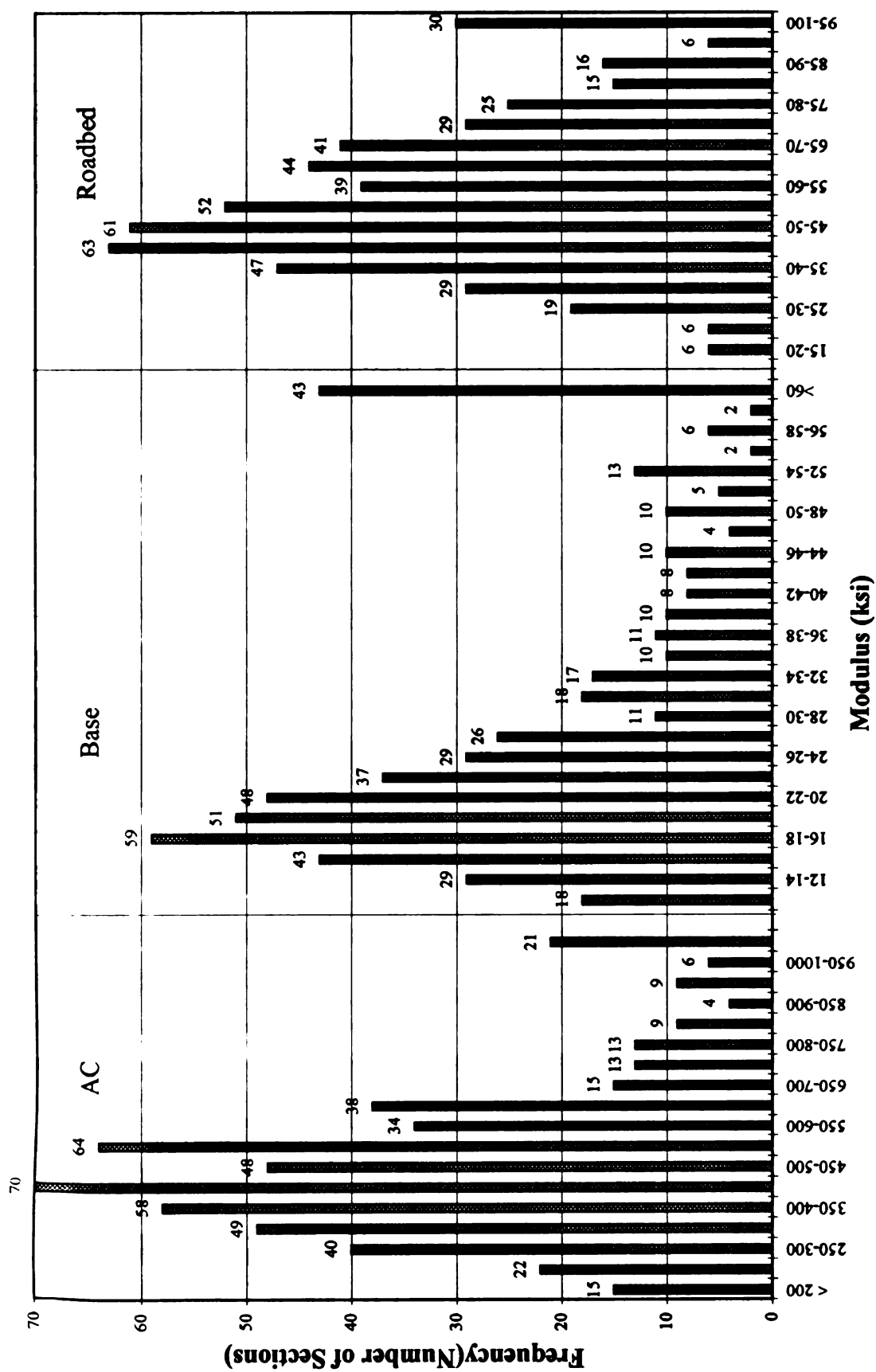


Figure 4.28: Frequency distribution of the backcalculated layer moduli.

survey was conducted during the dry season, variations in the moisture content are minimized. Therefore, the most likely scenario for this variation is poor construction practices (e.g., uneven compaction).

Effect of Layer Moduli on Pavement Performance. The moduli of the pavement layers affect the various pavement responses to load including;

- a) The horizontal tensile strain at the bottom of the asphalt concrete layer.
- b) The vertical compressive strain at the top of the AC layer.
- c) The vertical compressive strain at the top of the granular base and subbase layer.
- d) The vertical compressive strain at the top of the roadbed soil.
- e) The pavement surface deflection.

Lower moduli values cause higher deflection in the pavement layers, and higher stresses and the strains (load being distributed over a smaller area). In a pavement system, the upper stronger layers are typically provided to protect the lower weaker layers, so that the load is distributed over a larger area in the weaker layers. In order to distribute the load to the roadbed soil, the modulus of the base layer must be higher than the roadbed's. Otherwise, there is no need of the base layer. As it can be seen from the layer moduli data, the moduli of the base layer are lower than the roadbed soil. This indicates that there is a relatively softer layer between the AC and the roadbed soil. Due to this soft base layer under the AC layer, the AC will deflect more under the load, and hence, the slope of the deflection basin will be high which means that more energy is transferred to the

pavement structure in the vicinity of the load. On the other hand, if the base is stiff, the shape of the deflection basin will be rather flat, and the load will be distributed over a larger area, thus reducing the concentration of load over a small area. This deflection of the AC results in excessive horizontal tensile strain at the bottom of the AC layer. When the amount of this tensile strain exceeds the allowable limit, fatigue cracks will be initiated at the bottom of the AC layer. With increasing traffic volume, these cracks will propagate to the top surface resulting in an ultimate fatigue failure of the pavement structure. Also, a relatively soft base layer can result in shear failure of the base. This type of failure causes shear cracks in the AC layer which can be seen on the surface of the pavement. Thus the presence of fatigue and shear cracks on N5 can be due the soft base layer over a relatively hard roadbed soil.

4.5.3 Adjustment of Layer Moduli due to Seasonal Variations. The deflection data correspond to the pavement and climatic conditions (moisture and temperature) existed during the time of testing, and must, therefore, be adjusted to the average/standard climatic conditions used in the design procedure. As discussed before, such corrections were not carried out in this study. However, for calculating the remaining service life and overlay thickness using the AI method, temperature and seasonal corrections were applied to the pavement peak surface deflection as described in the subsequent sections.

4.6 **MECHANISTIC ANALYSIS**

After determining the pavement layer properties (layer moduli) using the MICHBACK computer program, the next objective of this study was to carry out the forward mechanistic analysis of the pavement structure. Forward mechanistic analysis of the pavement was carried out to determine the magnitude of deflections, strains, and stresses delivered to the pavement by 18-kip, and 33- kip single axle loads. These deflections, strains, and stresses are considered as the major pavement responses to the applied load. Each material used in the pavement system has a specific tensile, compressive, and shear strength. When a load is applied to the pavement, vertical stresses are induced in the structure. The compressive stresses cause compression which in turn causes rutting in the pavement. Similarly, the loading of the pavement structure causes deformation in the pavement materials producing a radial tensile strain at the bottom of the asphalt layer. This tensile strain causes fatigue cracking in the pavement.

MICHPAVE is a finite element program used to calculate the mechanistic outputs (stresses, strains, and deflections). These mechanistic outputs can be used for evaluation of the adequacy of the pavement structures. MICHPAVE uses the predicted vertical strains throughout the pavement structure to predict the rut depth in various layers. It considers the asphalt mix properties such as percent air voids and the kinematic viscosity, and the environmental temperature for predicting the rut depth and the fatigue life of the pavement. Thus, based on the material inputs, the MICHPAVE determines the number of ESAL that the pavement will be able to endure before the development of fatigue cracking or exceeding the allowable rut depth. However, in this study, the number of ESAL were

determined for fatigue only because they were to be compared with the results from the Asphalt Institute (AI) method. It should be noted here that the MICHPAVE gives the remaining service life of a pavement structure at the initiation of fatigue cracks, whereas the AI method determines the remaining service life of the pavement when 20 % of the area has developed fatigue cracks. Therefore, the remaining service life calculated by both methods may not be the same rather MICHPAVE should give a shorter remaining service life than the AI method.

In this study, to draw the comparison with the Asphalt Institute method, the input parameters for the MICHPAVE were kept the same as those for the Asphalt Institute Method. The road under study was divided into a number of sub-sections depending upon the magnitude of deflection (the detail of these sub-sections in given is the next section). Each sub-section was analyzed for fatigue cracking using the layer moduli calculated by MICHBACK. The thicknesses of the layers were the same as those taken for MICHBACK with the only difference that the base layer was split into two layers (6-inches base and 7.8-inches subbase) of the same modulus. To ensure that the peak pavement deflection calculated by the MICHPAVE becomes equal to the deflection used in the Asphalt Institute method for calculation of the number of ESAL, the AC, base, subbase, and the roadbed moduli were adjusted in an equal proportion. This was done to ensure that the remaining service life calculated by both methods is for the same amount of deflection. Other input parameters used in the MICHPAVE are:

- | | | |
|-----|-------------------------|-------|
| (a) | Average air temperature | 70 °F |
| (b) | Air voids | 5 % |

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(c) Kinematic Viscosity 212 centistoke

(d) Tire Pressure

1) 9000 lb. load 90 psi

2) 16500 lb. load 130 psi

		<u>AC</u>	<u>Base</u>	<u>Subbase</u>	<u>Roadbed</u>
(e)	K ₀	2.0	1.5	1.0	0.5
(f)	Density(lb./ft ³)	150	120	120	110
(g)	Poisson Ratio	0.30	0.35	0.35	0.45

Using these input parameters, the MICHPAVE was run for each sub-section to determine the remaining fatigue life of the N5. The results of this analysis are presented in Table 4.6.

4.7 REMAINING SERVICE LIFE OF N5

In order to determine the required overlay thickness for a pavement structure to serve the predicted future traffic, it is necessary to know the number of load repetitions that a pavement can take before it is below the acceptable standard. The remaining service life of the existing pavement in terms of ESAL prior to overlay is a difficult parameter to accurately determine. There are various methods that can be used to evaluate the remaining service life of the existing pavement. The Asphalt Institute method was used to determine the remaining service life and the results were compared with the remaining life calculated using the MICHPAVE computer program.

4.7.1 **The Asphalt Institute Method.** The Asphalt Institute (AI) Method [19] uses the pavement rebound deflection measured using the Benkleman beam. The rebound deflection used in the AI method is the mean rebound deflection plus two standard deviation of the deflections measured at different locations. If the deflection data is collected using a device other than Benkleman beam, then a device correction factor must also be applied to this deflection. The deflection data corresponds to the pavement and climatic conditions (moisture and temperature) existed during the time of testing, and must therefore be adjusted to the average/standard climatic conditions appropriate for each season in the design procedure. To use the AI method, the deflection data must be corrected to the standard temperature of 68 °F and to standard moisture conditions for which the AI charts are made. This corrected rebound deflection is known as representative rebound deflection (RRD). Only then this RRD may be used to determine the remaining service life of the pavement using the AI method. For converting the FWD data into RRD, the road section under consideration was divided into number of sub-sections having a peak deflection within a range of one mil. That is, pavement sections with a peak deflection of 2.5 to 3.49 mils were grouped into one sub-section. The other sub-sections were made with a subsequent increment of one mil deflection. The average peak deflection of each sub-section was then used to determine the RRD as follows:

$$RRD = (\bar{X} + 2S) \times TF \times SF \times DF \quad (4.3)$$

Where: $\bar{X}$ = the arithmetic mean of the measured pavement peak deflection;

S = standard deviation;

TF = temperature correction factor;

$$= 1.4911 - 0.0072222(\text{Measured Air Temperature} + 75)/2$$

(Figure 4.29);

SF = seasonal adjustment factor = 1.25; and

DF = device adjustment factor = 1.45.

Temperature Correction. The pavement temperature changes from time to time and from one location to another. This temperature change greatly effects the asphalt concrete layer. Hence, it is necessary that the measured pavement peak surface deflection be corrected for temperature. In this study, the AASHTO temperature adjustment chart (Figure 4.29) was used to convert the measured deflection to a standard temperature of 68 °F.

Device Correction. The Asphalt Institute method uses the Benkleman beam for measurement of pavement rebound deflection, therefore it is necessary to apply a device correction for FWD test deflections. The device correction factor ranges from 1.1 to 1.5 depending on the pavement cross-section. In this study, a correction factor of 1.45 was used.

Seasonal Adjustment Factor. The critical period is the interval during which the pavement materials are expected to be saturated or near their saturation points. In USA, the critical period is the spring thaw period. Whereas in Pakistan, the most critical period is the *moon soon* rainy season (July-August), when the

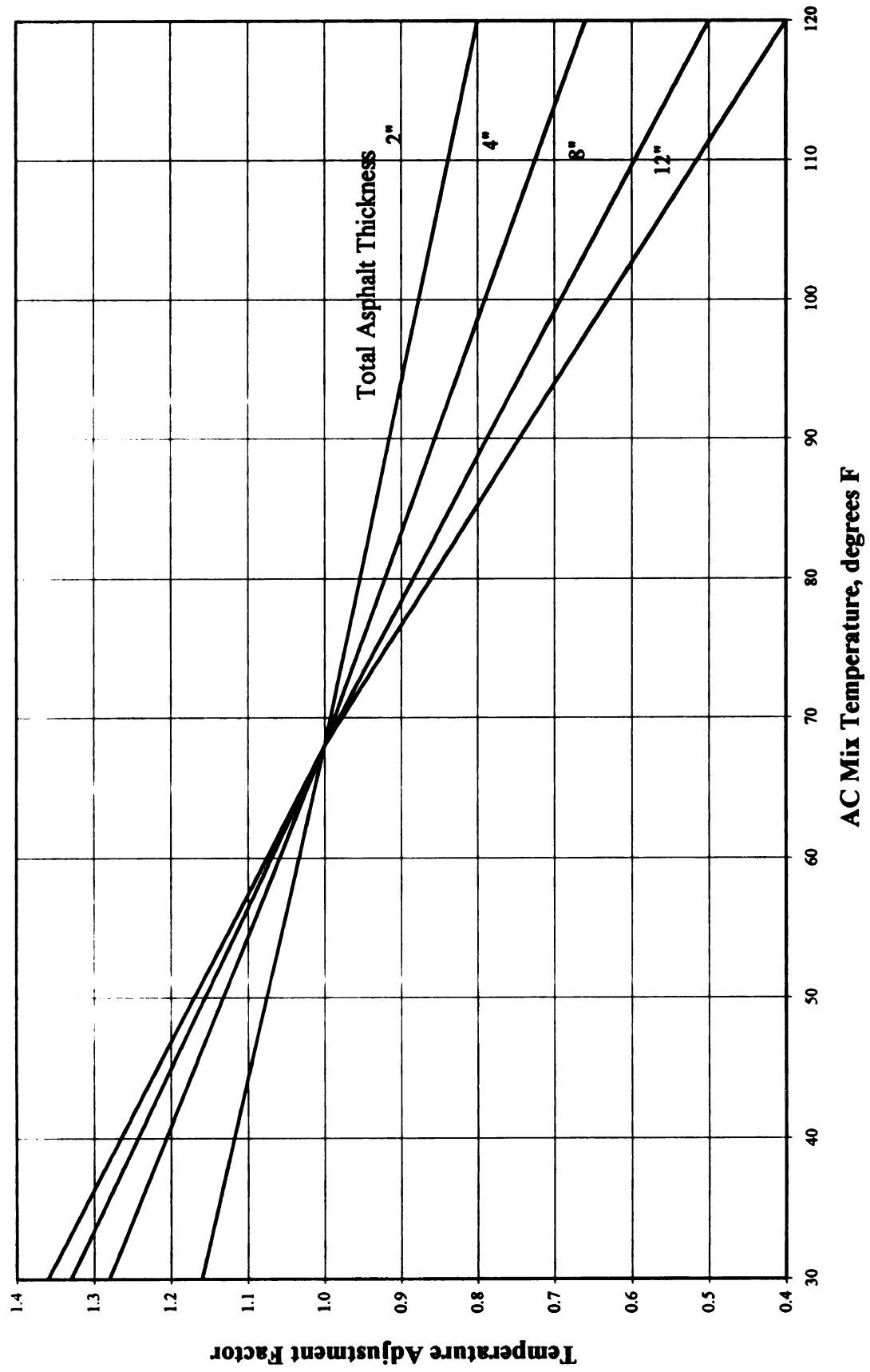


Figure 4.29 : Temperature correction factor for asphalt pavement with granular or asphalt treated base (after AASHTO Guide 1993).

pavement is exposed to a heavy sustained rains. If deflection measurement are made during the critical period, the adjustment factor is one, if not then this factor should be greater than one. In this study, since the February-March period during which the NDT's were conducted are relatively dry months compared to the rainy season, a seasonal correction factor of 1.25 was used.

Using equation 4.3, the values of RRD for 18-kip load were calculated which were then used to calculate the RRD for 33-kip load using the following relationship:

$$(\delta_{33\text{-kip}}) / (\delta_{18\text{-kip}}) = (33/18)^\alpha \quad (4.4)$$

Where $\alpha = 0.9304$

The conversion factor “ α ” was calculated by selecting, at random 20 test locations from the given NDT data for target loads of 9000 pounds and 16500 pounds. The conversion factor was taken as the mean of the conversion factors of the 20 test locations. The average value of the conversion factor of 0.9304 shows that the relationship between load and deflection is slightly not linear (for linear relationship this factor should have been one). A summary of the RRD for 18- and 33-kip single axle loads, and the average backcalculated layer moduli is shown in Table 4.5.

After calculating the representative rebound deflection (RRD) for various sub-sections, the Asphalt Institute rebound deflection chart (Figure 4.30) was used to determine the number of 18 and 33 kip equivalent axle loads (EAL) that the

Table 4.5: A summary of the RRD and the backcalculated layer moduli.

Deflection Group Mils	Number of Sections	Average Peak Deflection (Mils)	Standard Deviation (Mils)	Average Air Temperature °F	RRD (mils)		Average Moduli		
					18-kip	33-kip	AC (psi)	Base (psi)	Roadbed (psi)
2.5-3.49	1	3.32043	0.2773	90.78	6.2682	11.0167	395,262	90,572	63,763
3.5-4.49	1	4.38050	0.2773	90.78	7.9830	14.0305	744,022	139,353	79,230
4.5-5.49	14	5.12444	0.2783	90.78	9.1896	16.1513	878,478	82,119	72,236
5.5-6.49	19	5.98258	0.2765	90.78	10.5720	18.5809	704,225	63,255	69,326
6.5-7.49	25	7.06370	0.2780	90.78	12.3257	21.6631	594,969	58,687	64,067
7.5-8.49	42	8.03998	0.2965	90.78	13.9646	24.5437	691,713	42,416	61,270
8.5-9.49	49	9.00351	0.3065	90.78	15.5557	27.3401	554,578	38,288	61,246
9.5-10.49	47	10.04248	0.2989	90.78	17.2118	30.2507	541,570	32,104	57,863
10.5-11.49	46	11.00547	0.2892	90.78	18.7379	32.9330	512,295	27,188	58,909
11.5-12.49	55	12.03332	0.2797	90.78	20.3699	35.8012	479,678	23,720	56,280
12.5-13.49	48	13.03188	0.2953	90.78	22.0358	38.7293	445,143	20,570	56,070
13.5-14.49	48	14.01788	0.2911	90.78	23.6170	41.5083	420,283	19,691	52,304
14.5-15.49	43	14.92938	0.2698	90.78	25.0228	43.9790	417,116	18,201	44,505
15.5-16.49	28	16.00570	0.3151	90.78	26.9103	47.2965	383,620	17,708	40,452
16.5-17.49	24	17.03740	0.2892	90.78	28.4954	50.0823	332,186	17,090	39,633
17.5-18.49	14	18.07381	0.2635	90.78	30.0886	52.8824	339,654	18,064	45,193
18.5-19.49	6	19.02114	0.3340	90.78	31.8491	55.9766	281,477	16,288	32,498
19.5-20.49	6	20.12341	0.2640	90.78	33.4055	58.7122	336,511	21,442	37,149
20.5-21.49	3	20.71945	0.2222	90.78	34.2345	60.1691	434,631	27,230	42,093
21.5-22.49	5	21.80586	0.1434	90.78	35.7369	62.8098	208,616	15,814	32,463
22.5-23.49	1	22.78747	0.2773	90.78	37.7581	66.3620	242,962	12,531	25,023
23.5-24.49	1	23.73381	0.2773	90.78	39.2889	69.0525	453,915	17,330	33,693
24.5-25.49	1	25.04692	0.2773	90.78	41.4129	72.7857	128,039	15,979	21,996
28.5-29.49	1	28.66554	0.2773	90.78	47.2664	83.0735	196,705	11,188	16,601

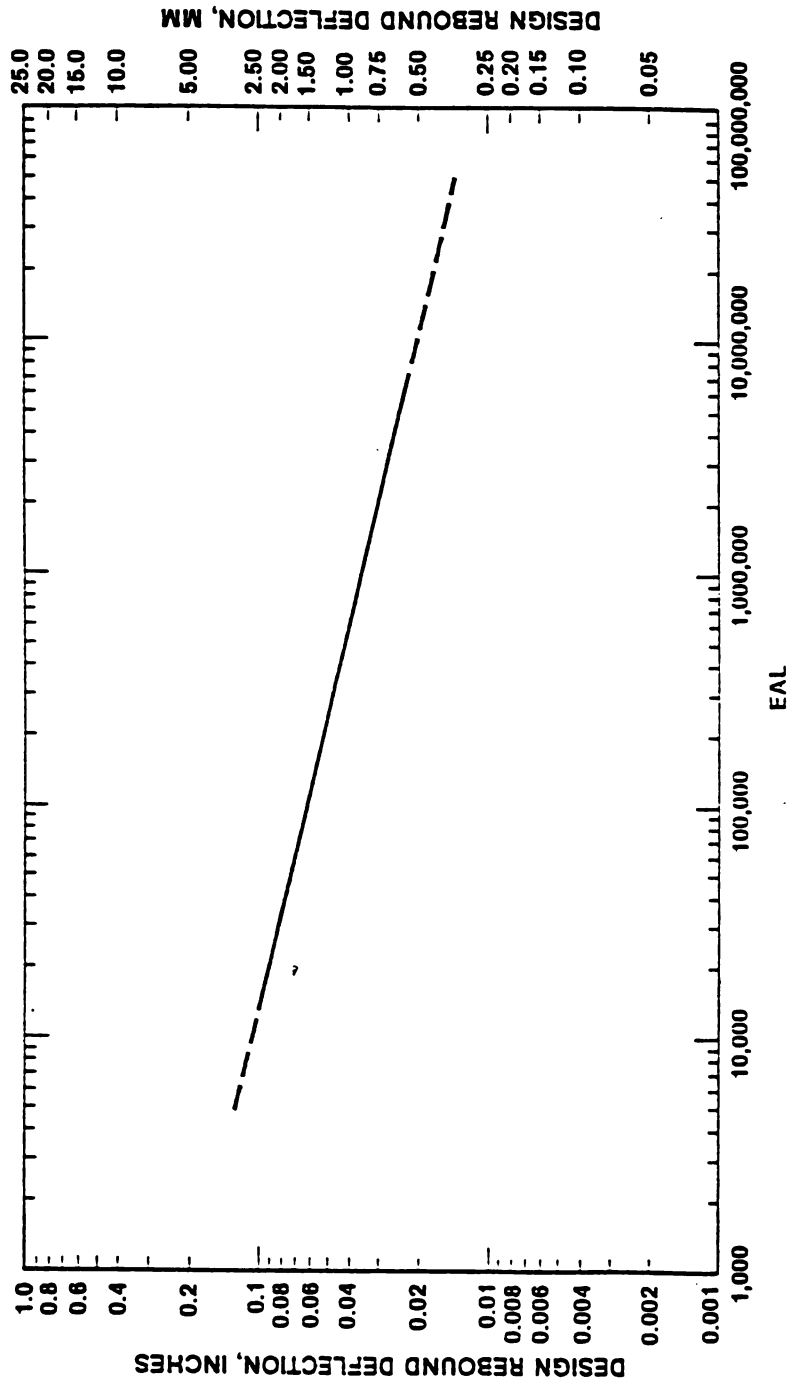


Figure 4.30: Design rebound deflection chart [19].

pavement can support. For this purpose, the formula derived from Figure 4.30 is as follows:

$$\text{Log}_{10} (\text{EAL}) = -0.38662 - (4.38662) * \text{Log}_{10} (\text{RRD}) \quad (4.5)$$

Using this formula, and the calculated RRD, the remaining service life of each pavement sub-sections in terms of EAL was calculated and are listed in Table 4.6.

4.7.2 **MICHPAVE.** It is a good engineering practice, that an alternative method may be used to check and ensure the accuracy of a particular method. For this purpose, the computer program MICHPAVE was used to estimate the remaining service life of the pavement sections relative to fatigue as discussed above under mechanistic analysis.

The resulting remaining service lives (fatigue life) calculated by MICHPAVE for each pavement sub-section are listed in Table 4.6. To draw a comparison between the remaining service lives calculated by using the Asphalt Institute method and the MICHPAVE, the results for 18- and 33-kip loads for the various pavement subsections are shown in Figures 4.31 and 4.32.

For both the 18- and 33-kip loads and for low deflection values, the remaining service lives given by the MICHPAVE program are lower than those obtained from the AI method. Whereas for most moderate to high deflection values the MICHPAVE produced shorter remaining service lives than the AI method. This is due to the fact that the MICHPAVE program calculates the remaining service life based on the time of fatigue crack initiation whereas the AI method estimates the remaining service life of the pavement when 20 % of the area

Table 4.6 : A summary of the remaining service life (RSL) both in load repetitions and years.

Deflection Group Mills	Number of Sections	Avg. Peak Deflection Mills	Remaining Service Life(Load Repetitions)				Remaining Service Life(Years)			
			Asphalt Institute		MICHPAVE		Asphalt Institute		MICHPAVE	
			ESAL 18-kip	SAL 33-kip	ESAL 18-Kip	SAL 33-Kip	18-Kip	33-Kip	18-Kip	33-Kip
2.5-3.49	1	3.32043	1,890,092,823	159,277,940	13,070,000,000	2,756,000,000	39	13	63	43
3.5-4.49	1	4.38050	654,322,351	55,139,681	1,284,000,000	260,800,000	27	6	34	17
4.5-5.49	14	5.12444	352,874,077	29,736,664	265,700,000	51,220,000	20	4	17	6
5.5-6.49	19	5.98258	190,832,428	16,081,430	152,800,000	29,670,000	14	2	12	4
6.5-7.49	25	7.06370	97,334,493	8,202,368	60,150,000	11,790,000	9	1	6	2
7.5-8.49	42	8.03998	56,290,179	4,743,568	23,270,000	4,413,000	6	1	3	1
8.5-9.49	49	9.00351	35,064,665	2,954,896	15,830,000	3,050,000	4	0	2	0
9.5-10.49	47	10.04248	22,497,942	1,895,899	8,257,000	1,577,000	3	0	1	0
10.5-11.49	46	11.00547	15,498,717	1,306,075	5,510,000	1,049,000	2	0	1	0
11.5-12.49	55	12.03332	10,745,012	905,481	3,584,000	680,400	1	0	0	0
12.5-13.49	48	13.03188	7,611,030	641,381	2,514,000	476,900	1	0	0	0
13.5-14.49	48	14.01788	5,615,983	473,258	1,792,000	340,100	1	0	0	0
14.5-15.49	43	14.92938	4,357,876	367,238	965,500	181,500	1	0	0	0
15.5-16.49	28	16.00570	3,167,582	266,932	706,600	133,200	0	0	0	0
16.5-17.49	24	17.03740	2,464,325	207,668	635,700	121,000	0	0	0	0
17.5-18.49	14	18.07381	1,941,133	163,579	565,900	108,400	0	0	0	0
18.5-19.49	6	19.02114	1,512,606	127,467	488,200	94,370	0	0	0	0
19.5-20.49	6	20.12341	1,226,950	103,395	343,100	60,900	0	0	0	0
20.5-21.49	3	20.71945	1,101,871	92,855	241,500	46,030	0	0	0	0
21.5-22.49	5	21.80586	912,651	76,909	311,700	62,330	0	0	0	0
22.5-23.49	1	22.78747	716,965	60,419	141,000	26,690	0	0	0	0
23.5-24.49	1	23.73381	602,263	50,753	83,380	15,370	0	0	0	0
24.5-25.49	1	25.04692	478,056	40,286	238,100	48,460	0	0	0	0
28.5-29.49	1	28.66554	267,679	22,557	52,500	99,010	0	0	0	0

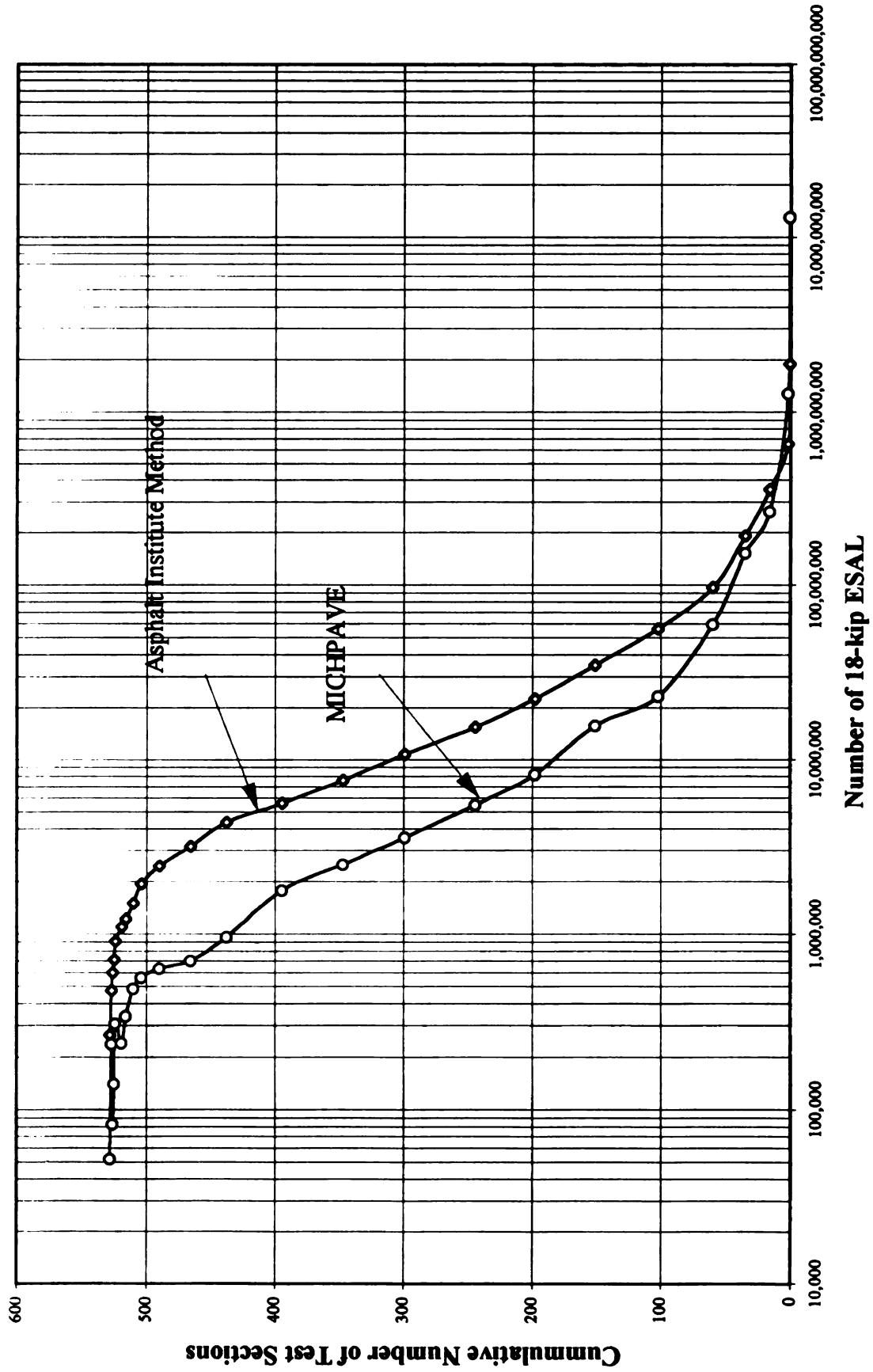


Figure 4.31: The remaining service life of the pavement sections in number of 18-kip load repetitions.

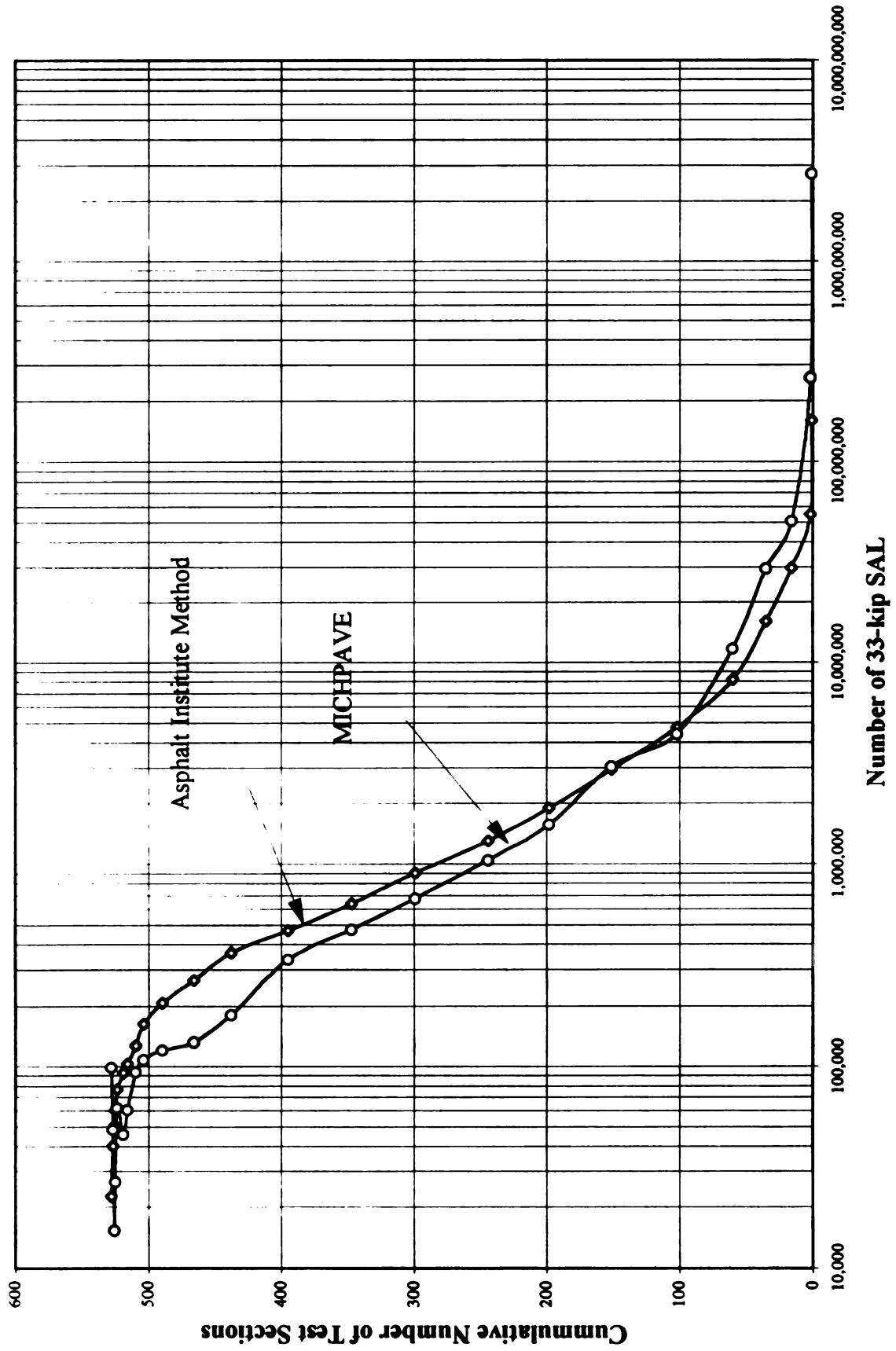


Figure 4.32: The remaining service life of the pavement sections in number of 33-kip load repetitions.

has fatigue cracks. It shows that in general, the result from MICHPAVE are more conservative than from the AI method.

The remaining service life of a pavement may be determined either in terms of the number of load repetitions to failure, or in number of years. If the traffic data, such as the growth rate and the initial number of ESAL are known, then the remaining service life of the pavement can be calculated in either terms. In this study, since the traffic data was available, the remaining service life in years was calculated using the following formula[16]:

$$ESAL_n = [ESAL_i \{(1 + I)^n - 1\}] / I \quad (4.6)$$

Where:

$ESAL_n$ = Number of ESAL after n number of years (the remaining service life in terms of ESAL);

$ESAL_i$ = Number of ESAL at the end of the first year, 7,442,595;

I = Growth Rate of 8.29 %; and

n = Number of years.

A summary of the remaining service lives of the 528 pavement sections in terms of ESAL and years that were estimated by using the AI method and the MICHPAVE program are listed in Table 4.6. The distribution of the pavement life in years is shown in Figures 4.33 and 4.34.

It can be seen from Figure 4.33 that for 18-kip ESAL only 35 pavement sections out of 528 sections have remaining service life more than 10 years (design life). Further, the AI method and the MICHPAVE program estimate that 181 and

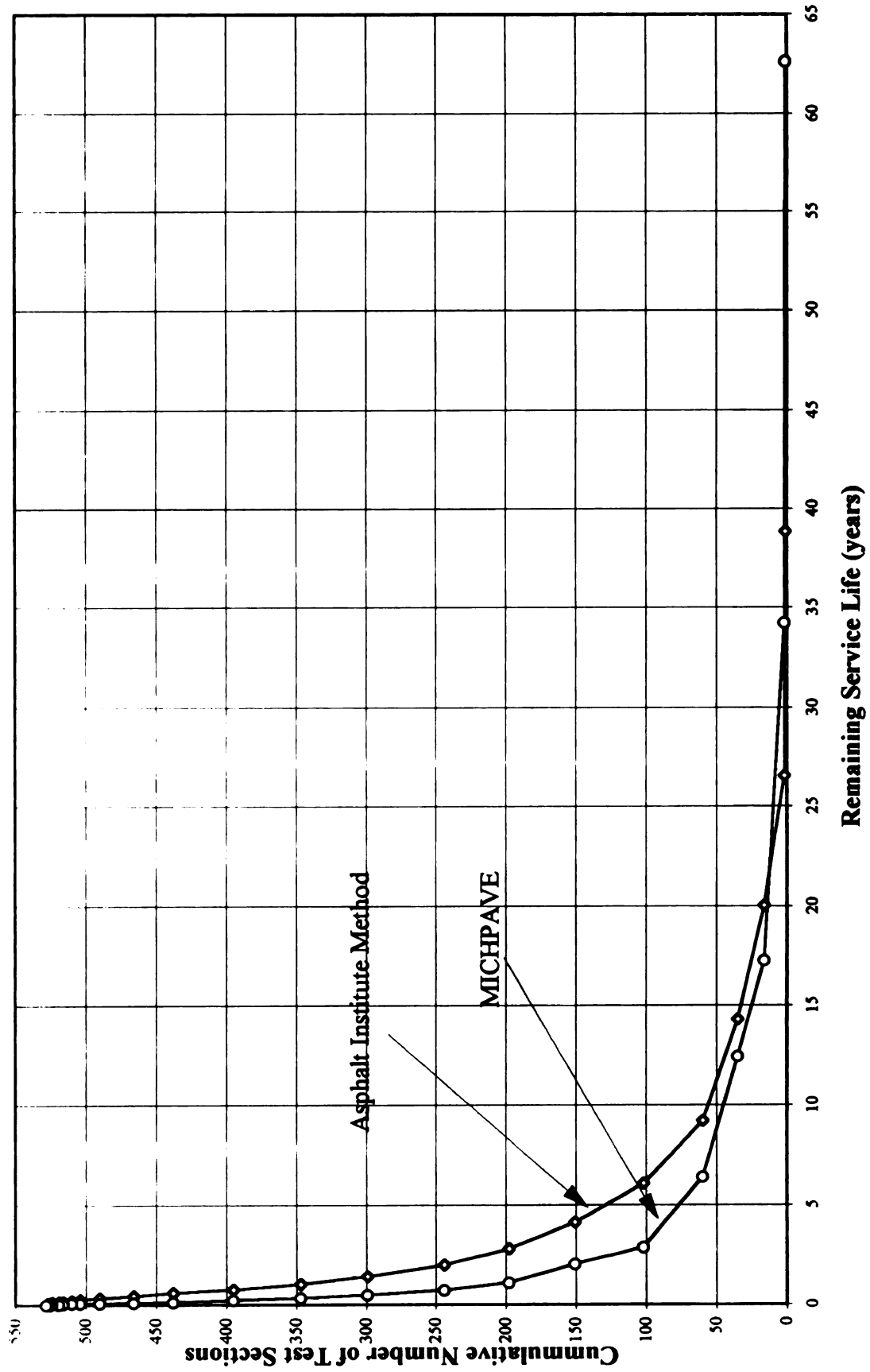


Figure 4.33: The remaining service life of 528 pavement sections for 18-kip ESAL.

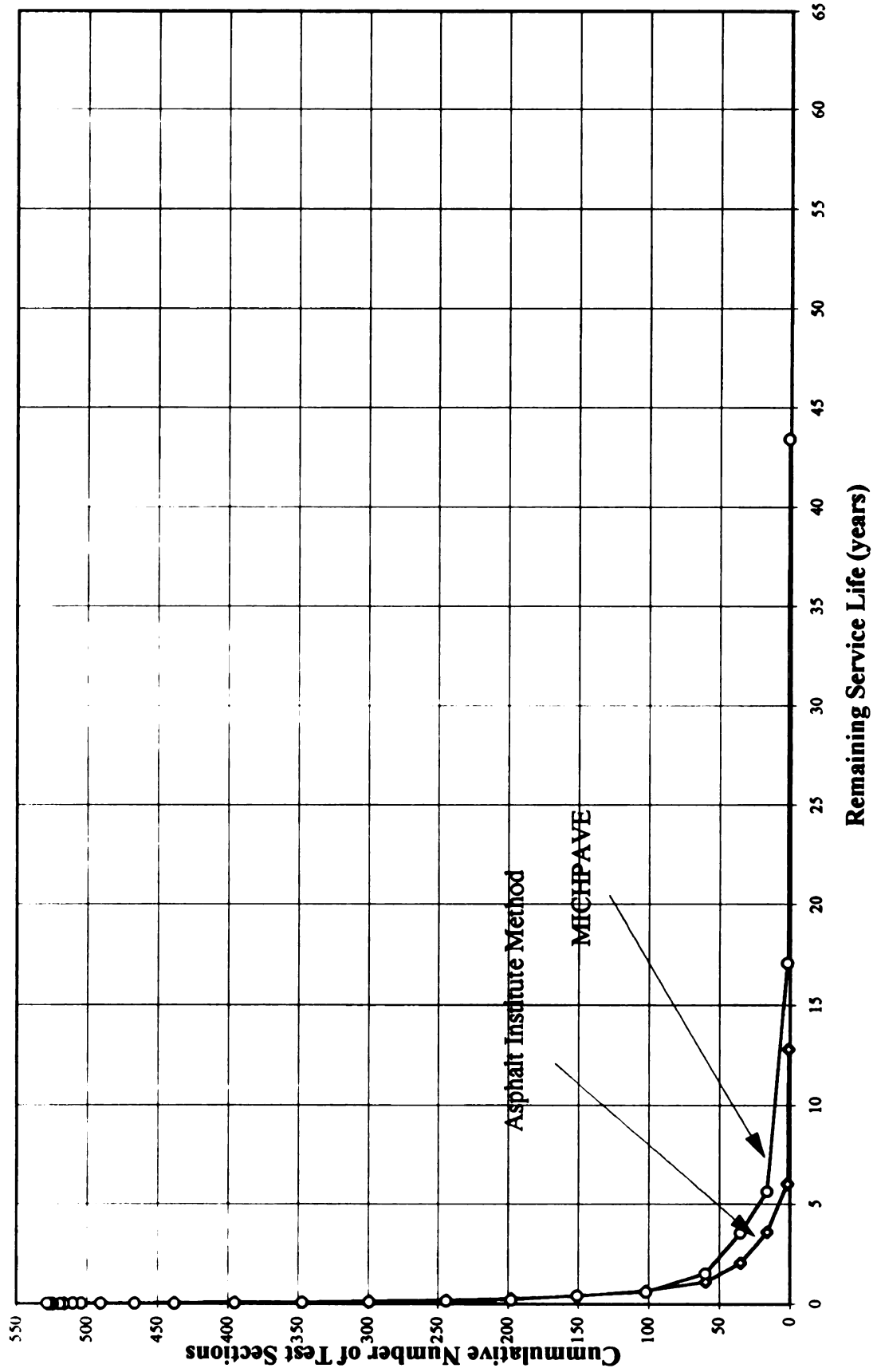


Figure 4.34: The remaining service life of 528 pavement sections for 33-kip SAL.

330 pavement sections have remaining service life of less than one year, respectively.

The distribution of remaining service life in years for the 33-kip single axle load is shown in Figure 4.34. It can be seen that only one and only two pavement sections have remaining service life of more than 10 years as predicted by the AI method and the MICHPAVE program, respectively. Further, both methods predict that 468 pavement sections out of 528 sections have remaining service life of less than one year.

The results of the analysis of the remaining service life are listed in Table 4.7 and shown in Figures 4.31 through 4.34. It can be seen that for an 18-kip ESAL, the AI methods predicts that 426 and 468 pavement sections will fail prior to the design performance periods of 6 and 8 years, respectively. The corresponding number of sections obtained from the MICHPAVE program are 468 and 493 respectively. For the 33-kip single axle load, the AI method predicts that 526 and 527 pavement sections out of a total of 528 sections will fail prior to their design performance periods of 6 and 8 years, respectively. Once again, the two corresponding numbers obtained from the MICHPAVE program are 523 and 526, respectively. Examination of the results shown in Table 4.7 and Figures 4.31 through 4.34 indicates that:

1. The MICHPAVE computer program and the AI method produce compatible results.

Table 4.7. Number of pavement sections that are expected to fail prior to 6 and 8 year performance periods.

Method	Performance Period (years)			
	6		8	
	Axle Load (kip)		Axle Load (kip)	
	18	33	18	33
MICHAPVE	468	512	493	526
Asphalt Institute	426	526	468	527

2. The National Highway N5 is severely underdesigned and that the bulk of the highway (about 45 km out of 52 km) will experience premature failure.
3. It is the opinion of this author that those few pavement sections that will survive beyond the design performance period are not typical pavement cross-sections. It is believed that the NDT data at those locations were taken over bridges.

4.8 CALCULATION OF OVERLAY THICKNESS

One of the objectives of this study was to determine the expected service life of the pavement and the deficiency in the AC thickness. The remaining service lives, both in terms of ESAL and number of years, have been calculated and presented in the previous sections. In this section, the thicknesses of the AC overlay that is required to enhance the structural capacity of the pavement and to increase its remaining service life to the design life are presented and discussed. Recall that the main reason for fatigue cracking is the tensile strains induced at the bottom of AC layer due to a moving wheel load. Since, both the AI and the MICHPAVE methods predict that most of the 528 pavement sections have short fatigue lives, the pavement structure must be reinforced to reduce the tensile strain at the bottom of the AC layer. For an existing pavement, the most effective way to reduce the tensile strain at the bottom of the AC layer is to increase the AC thickness by means of an overlay.

In this study, the Asphalt Institute Method [19] was used to determine the required overlay thickness. In this method the overlay is provided to reduce the pavement surface

deflection, stresses, and strains to within acceptable limits. The AI method gives the overlay thickness which is required to reduce the pavement deflections from a measured value to a design deflection value. The AI design chart for the overlay is shown in Figure 4.35. From this chart, the maximum allowable RRD for each traffic level and the required thickness of the overlay for each calculated RRD were determined and are shown in Figure 4.36. The chart requires that the future traffic prediction and the RRD are known. For each of the 528 pavement sections, the ESAL used for the design of the overlay thickness were calculated as the mathematical difference between the design ESAL (obtained from the NHA, Pakistan) and the remaining service life in ESAL predicted by the AI and the MICHPAVE methods. Hence, for each pavement section, two overlay thicknesses were obtained; one by using the Figure 4.36 and the remaining service life predicted by the AI method and the other by using the same figure and the remaining service life predicted by the MICHPAVE program. Nevertheless, using Figure 4.36 (the AI method), the required overlay thicknesses for 6 and 8 year performance periods were estimated and the results are shown in Tables 4.8 through 4.11 and Figures 4.37 through 4.44.

Table 4.8 and Figures 4.37, and 4.38 show the distribution of pavement sections which are predicted to fail prior to the application of 55 millions 18-kip ESAL (the design ESAL for 6 year performance period), and their overlay thickness that are required to sustain 55 millions of 18-kip ESAL. It can be seen that 377 pavement sections out of 528 sections require an overlay thickness based on the remaining service life estimated by the AI method, and 468 pavement sections require overlay thickness based on the estimates of

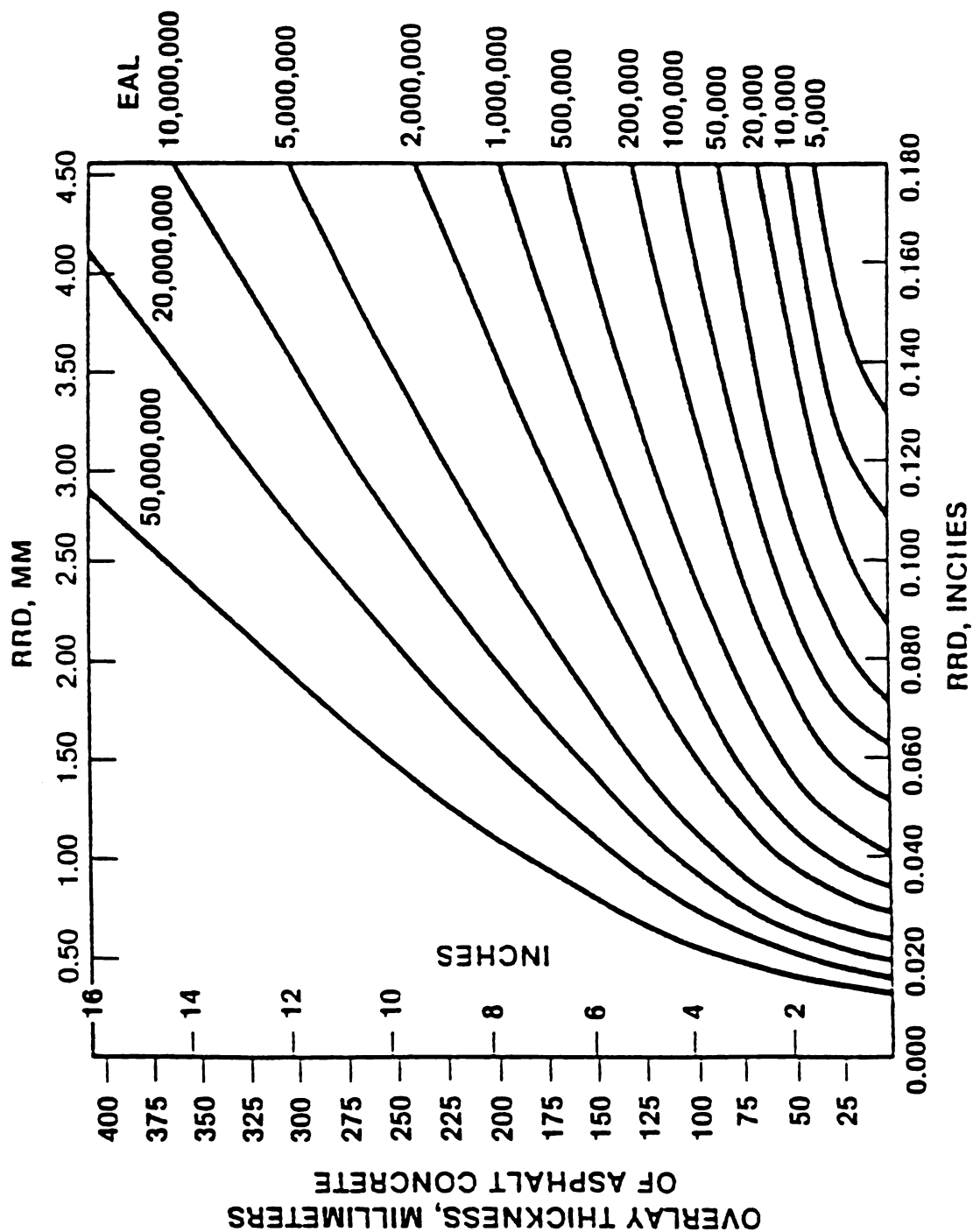


Figure 4.35: Asphalt concrete overlay thickness required to reduce pavement deflections from a measured to a design deflection value[18].

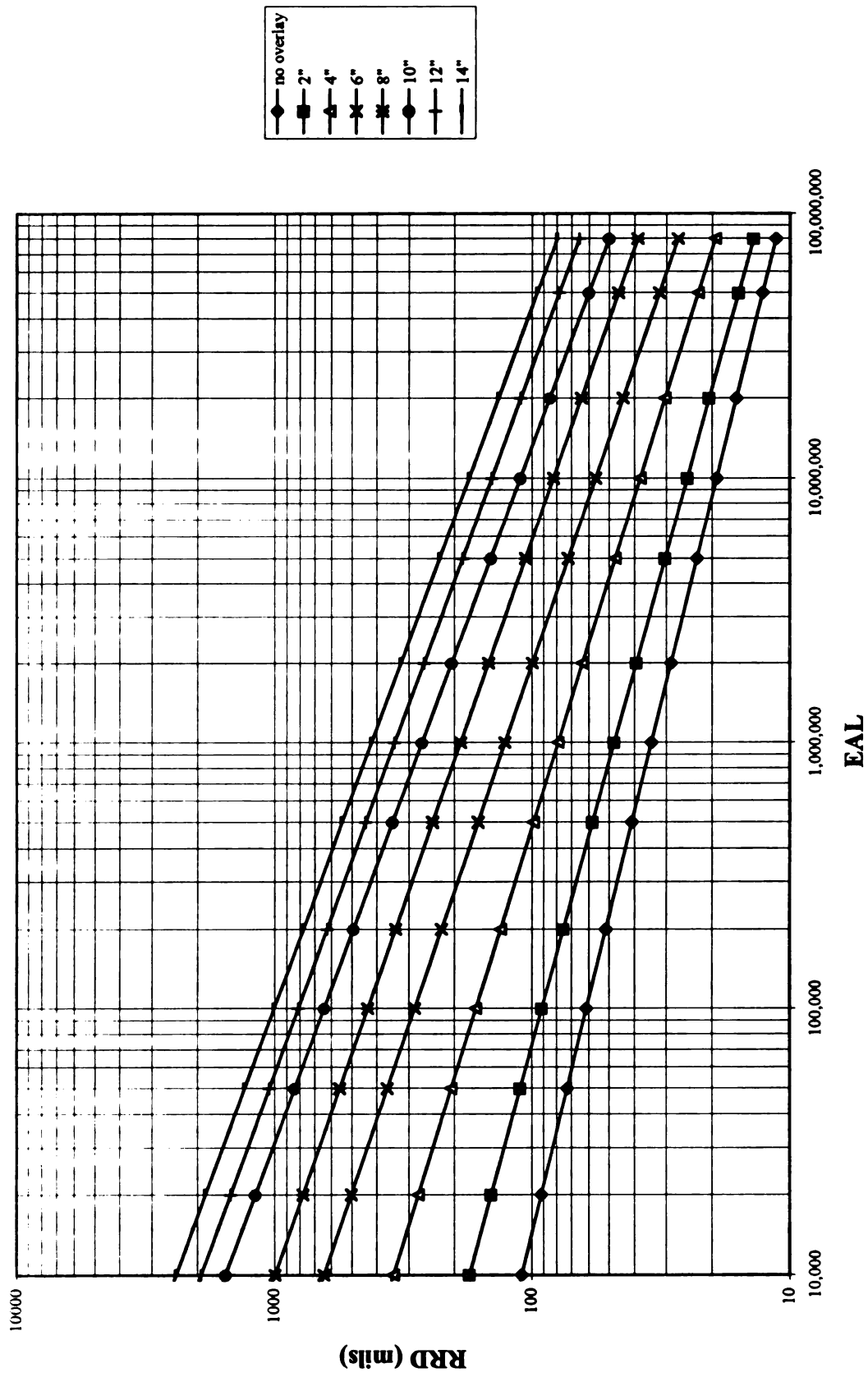


Figure 4.36 : Asphalt overlay thickness design chart (after Asphalt Institute).

Table 4.8: A summary of the overlay thicknesses required for the six year performance period (18-kip ESAL).

Deflection Group (Mils)	Number of Sections	Avg. Peak Deflection (Mils)	Std Dev (Mils)	RRD 18-kip (Mils)	Asphalt Institute			MICHPAVE		
					Remaining service life 18-Kip ESAL	ESAL for Overlay	Overlay Thickness (in)	Remaining service life 18-Kip ESAL	ESAL for Overlay	Overlay Thickness (in)
2.5-3.49	1	3.32043	0.2773	6.2682	1,890,092,823	-	-	13,070,000,000	-	-
3.5-4.49	1	4.38050	0.2773	7.9830	654,322,351	-	-	1,284,000,000	-	-
4.5-5.49	14	5.12444	0.2783	9.1896	352,874,077	-	-	265,700,000	-	-
5.5-6.49	19	5.98258	0.2765	10.5720	190,832,428	-	-	152,800,000	-	-
6.5-7.49	25	7.06370	0.2780	12.3257	97,334,493	-	-	60,150,000	-	-
7.5-8.49	42	8.03998	0.2965	13.9646	56,290,179	-	-	23,270,000	31,730,000	1.0
8.5-9.49	49	9.00351	0.3065	15.5557	35,064,665	19,935,335	-	15,830,000	39,170,000	2.0
9.5-10.49	47	10.04248	0.2989	17.2118	22,497,942	32,502,058	2.0	8,257,000	46,743,000	2.5
10.5-11.49	46	11.00547	0.2892	18.7379	15,498,717	39,501,283	2.5	5,510,000	49,490,000	3.0
11.5-12.49	55	12.03332	0.2797	20.3699	10,745,012	44,254,988	3.5	3,584,000	51,416,000	3.5
12.5-13.49	48	13.03188	0.2953	22.0358	7,611,030	47,388,970	3.5	2,514,000	52,486,000	4.0
13.5-14.49	48	14.01788	0.2911	23.6170	5,615,983	49,384,017	4.0	1,792,000	53,208,000	4.5
14.5-15.49	43	14.92938	0.2698	25.0228	4,357,876	50,642,124	4.5	965,500	54,034,500	5.0
15.5-16.49	28	16.00570	0.3151	26.9103	3,167,582	51,832,418	4.5	706,600	54,293,400	5.0
16.5-17.49	24	17.03740	0.2892	28.4954	2,464,325	52,535,675	4.5	635,700	54,364,300	5.5
17.5-18.49	14	18.07381	0.2635	30.0886	1,941,133	53,058,867	5.5	565,900	54,434,100	5.5
18.5-19.49	6	19.02114	0.3340	31.8491	1,512,606	53,487,394	6.0	488,200	54,511,800	6.0
19.5-20.49	6	20.12341	0.2640	33.4055	1,226,950	53,773,050	6.5	343,100	54,656,900	6.5
20.5-21.49	3	20.71945	0.2222	34.2345	1,101,871	53,898,129	6.5	241,500	54,758,500	6.5
21.5-22.49	5	21.80586	0.1434	35.7369	912,651	54,087,349	7.0	311,700	54,688,300	7.0
22.5-23.49	1	22.78747	0.2773	37.7581	716,965	54,283,035	7.5	141,000	54,859,000	7.5
23.5-24.49	1	23.73381	0.2773	39.2889	602,263	54,397,737	7.5	83,380	54,916,620	7.5
24.5-25.49	1	25.04692	0.2773	41.4129	478,056	54,521,944	7.5	238,100	54,761,900	7.5
28.5-29.49	1	28.66554	0.2773	47.2664	267,679	54,732,321	8.5	52,500	54,947,500	8.5

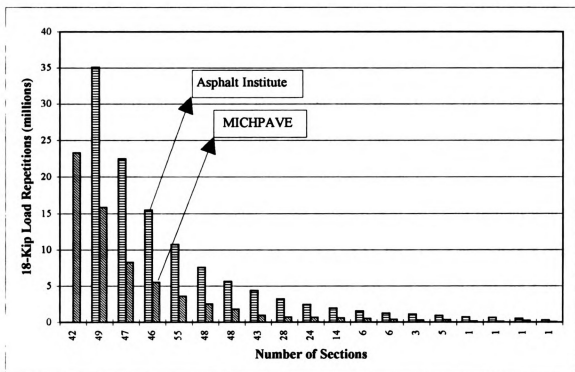


Figure 4.37 : Distribution of pavement sections that will fail prior to 55 millions of 18-kip ESAL.

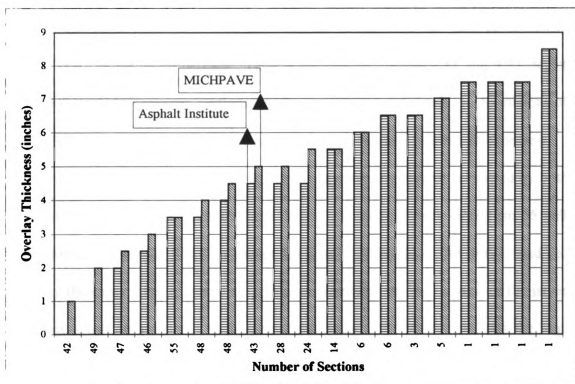


Figure 4.38: The distribution of the pavement sections and their overlay thicknesses that are required to sustain 55 millions of 18-kip ESAL.

the MICHPAVE. These overlay thicknesses vary from one inch to 8.5 inches. Since the MICHPAVE estimates the remaining service life based on the initiation of fatigue cracks, the required overlay thicknesses are greater than those based on the AI estimates for low deflection groups. Whereas, for higher deflections, the overlay thicknesses by both methods are similar.

Similar analysis was conducted for the distribution of pavement sections which are predicted to fail prior to 80 millions ESAL (18-kip ESAL for 8 years performance period). The results (overlay thicknesses) are shown in Table 4.9, and Figures 4.39 and 4.40. For this performance period, 426 pavement sections out of 528 sections require an overlay based on the AI estimates of the remaining service life, and 468 pavement sections require an overlay based on the MICHPAVE estimates.

The requirement of overlay thickness for 33-kip SAL was also calculated for 6, and 8 years performance periods. Table 4.10, and the Figures 4.41 and 4.42 depict the distribution of the pavement sections which are predicted to fail prior to 55 millions of 33-kip SAL (6 years performance period), and the required overlay thicknesses. The remaining service life in terms of 33-kip single axle load repetitions estimated by both the AI and the MICHPAVE methods show that only 2 sections have more than 55 millions SAL remaining service life. So except for these two sections, the entire road require overlay thickness ranging from 1 to 13 inches. Similarly, the distribution of the pavement sections which are predicted to fail prior to 80 millions of 33-kip SAL and the required overlay thickness are listed in Table 4.11, and shown in Figures 4.43 and 4.44.

Table 4.9: A summary of the overlay thicknesses required for the eight year performance period (18-kip ESAL).

Deflection Group (Mils)	Number of Sections	Avg. Peak Deflection (Mils)	Std Dev (Mils)	RRD 18-kip (Mils)	Asphalt Institute		MICHPAVE	
					Remaining service life 18-Kip ESAL	ESAL for Overlay	Overlay Thickness (in)	ESAL for Overlay
2.5-3.49	1	3.32043	0.2773	6.2682	1,890,092,823	-	-	-
3.5-4.49	1	4.38050	0.2773	7.9830	654,322,351	-	-	-
4.5-5.49	14	5.12444	0.2783	9.1896	352,874,077	-	-	-
5.5-6.49	19	5.98258	0.2765	10.5720	190,832,428	-	-	-
6.5-7.49	25	7.06370	0.2780	12.3257	97,334,493	-	-	19,850,000
7.5-8.49	42	8.03998	0.2965	13.9646	56,290,179	23,709,821	-	56,730,000
8.5-9.49	49	9.00351	0.3065	15.5557	35,064,665	44,935,335	2.0	64,170,000
9.5-10.49	47	10.04248	0.2989	17.2118	22,497,942	57,502,058	2.5	71,743,000
10.5-11.49	46	11.00547	0.2892	18.7379	15,498,717	64,501,283	3.5	74,490,000
11.5-12.49	55	12.03332	0.2797	20.3699	10,745,012	69,254,988	4.0	76,416,000
12.5-13.49	48	13.03188	0.2953	22.0358	7,611,030	72,388,970	4.5	77,486,000
13.5-14.49	48	14.01788	0.2911	23.6170	5,615,983	74,384,017	4.5	78,208,000
14.5-15.49	43	14.92938	0.2698	25.0228	4,357,876	75,642,124	5.5	79,034,500
15.5-16.49	28	16.00570	0.3151	26.9103	3,167,582	76,832,418	5.5	79,293,400
16.5-17.49	24	17.03740	0.2892	28.4954	2,464,325	77,535,675	6.0	79,364,300
17.5-18.49	14	18.07381	0.2635	30.0886	1,941,133	78,058,867	6.5	79,434,100
18.5-19.49	6	19.02114	0.3340	31.8491	1,512,606	78,487,394	6.5	79,511,800
19.5-20.49	6	20.12341	0.2640	33.4055	1,226,950	78,773,050	6.5	79,656,900
20.5-21.49	3	20.71945	0.2222	34.2345	1,101,871	78,898,129	7.0	79,758,500
21.5-22.49	5	21.80586	0.1434	35.7369	912,651	79,087,349	7.5	79,688,300
22.5-23.49	1	22.78747	0.2773	37.7581	716,965	79,283,035	7.5	79,859,000
23.5-24.49	1	23.73381	0.2773	39.2889	602,263	79,397,737	8.0	79,916,620
24.5-25.49	1	25.04692	0.2773	41.4129	478,056	79,521,944	8.0	79,761,900
28.5-29.49	1	28.66554	0.2773	47.2664	267,679	79,732,321	9.5	79,947,500

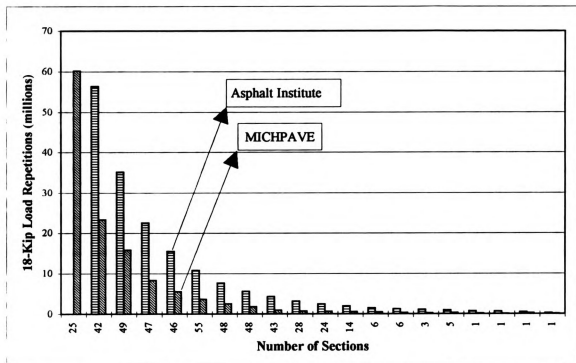


Figure 4.39 : Distribution of pavement sections that will fail prior to 80 millions of 18-kip ESAL.

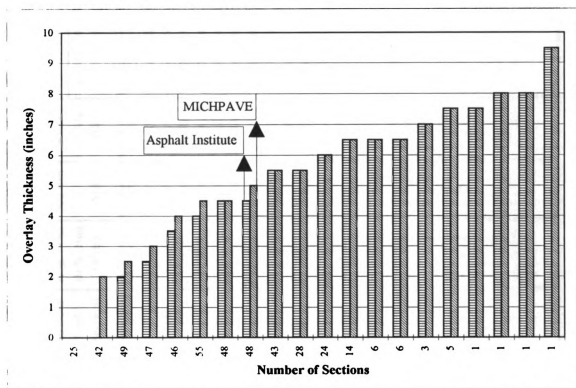


Figure 4.40: The distribution of the pavement sections and their overlay thicknesses that are required to sustain 80 millions of 18-kip ESAL.

Table 4.10: A summary of the overlay thicknesses required for the six year performance period (33-kip SAL).

Deflection Group (Mils)	Number of Sections	Avg. Peak Deflection (Mils)	Std Dev (Mils)	RRD 33-kip (Mils)	Asphalt Institute		MICHPAVE			
					Remaining service Life 33-kip SAL	33-kip SAL for Overlay	Overlay Thickness (in)	Remaining service Life 33-kip SAL	33-kip SAL for Overlay	Overlay Thickness (in)
2.5-3.49	1	3.32043	0.2773	11.0167	159,277,940	-	-	2,756,000,000	-	-
3.5-4.49	1	4.38050	0.2773	14.0305	55,139,681	-	-	260,800,000	-	-
4.5-5.49	14	5.12444	0.2783	16.1513	29,736,664	25,263,336	1.0	51,220,000	3,780,000	-
5.5-6.49	19	5.98258	0.2765	18.5809	16,081,430	38,918,570	2.5	29,670,000	25,330,000	1.5
6.5-7.49	25	7.06370	0.2780	21.6631	8,202,368	46,797,632	3.5	11,790,000	43,210,000	3.5
7.5-8.49	42	8.03998	0.2965	24.5437	4,743,568	50,256,432	4.5	4,413,000	50,587,000	4.5
8.5-9.49	49	9.00351	0.3065	27.3401	2,954,896	52,045,104	5.0	3,050,000	51,950,000	5.0
9.5-10.49	47	10.04248	0.2989	30.2507	1,895,899	53,104,101	5.5	1,577,000	53,423,000	5.5
10.5-11.49	46	11.00547	0.2892	32.9330	1,306,075	53,693,925	6.0	1,049,000	53,951,000	6.0
11.5-12.49	55	12.03332	0.2797	35.8012	905,481	54,094,519	6.5	680,400	54,319,600	6.5
12.5-13.49	48	13.03188	0.2953	38.7293	641,381	54,358,619	7.0	476,900	54,523,100	7.0
13.5-14.49	48	14.01788	0.2911	41.5083	473,258	54,526,742	7.5	340,100	54,659,900	7.5
14.5-15.49	43	14.92938	0.2698	43.9790	367,238	54,632,762	8.0	181,500	54,818,500	8.0
15.5-16.49	28	16.00570	0.3151	47.2965	266,932	54,733,068	8.5	133,200	54,866,800	8.5
16.5-17.49	24	17.03740	0.2892	50.0823	207,668	54,792,332	9.0	121,000	54,879,000	9.0
17.5-18.49	14	18.07381	0.2635	52.8824	163,579	54,836,421	9.5	108,400	54,891,600	9.5
18.5-19.49	6	19.02114	0.3340	55.9766	127,467	54,872,533	10.0	94,370	54,905,630	10.0
19.5-20.49	6	20.12341	0.2640	58.7122	103,395	54,896,605	10.5	60,900	54,939,100	10.5
20.5-21.49	3	20.71945	0.2222	60.1691	92,855	54,907,145	10.5	46,030	54,953,970	10.5
21.5-22.49	5	21.80586	0.1434	62.8098	76,909	54,923,091	11.0	62,330	54,937,670	11.0
22.5-23.49	1	22.78747	0.2773	66.3620	60,419	54,939,581	11.0	26,690	54,973,310	11.0
23.5-24.49	1	23.73381	0.2773	69.0525	50,753	54,949,247	11.5	15,370	54,984,630	11.5
24.5-25.49	1	25.04692	0.2773	72.7857	40,286	54,959,714	12.0	48,460	54,951,540	12.0
28.5-29.49	1	28.66554	0.2773	83.0735	22,557	54,977,443	13.0	99,010	54,900,990	13.0

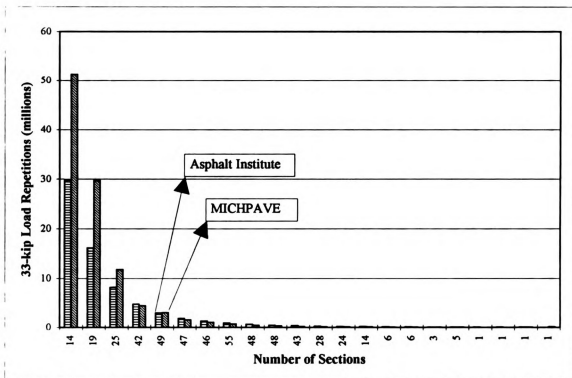


Figure 4.41 : Distribution of pavement sections that will fail prior to 55 millions of 33-kip SAL.

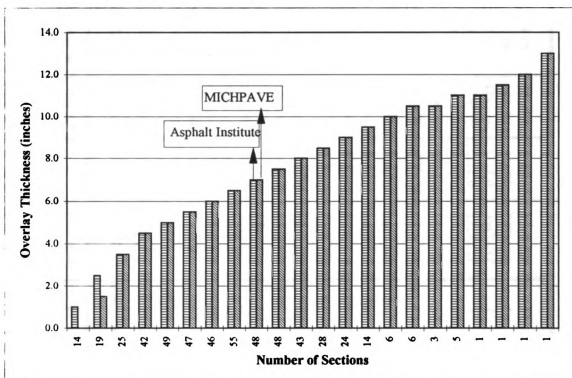


Figure 4.42: The distribution of the pavement sections and their overlay thicknesses that are required to sustain 55 millions of 33-kip SAL.

Table 4.11: A summary of the overlay thicknesses required for the eight year performance period (33-kip SAL).

Deflection Group (Mils)	Number of Sections	Avg. Peak Deflection (Mils)	Std Dev (Mils)	RRD 33-kip (Mils)	Asphalt Institute			MICHPAVE		
					Remaining service Life 33-kip SAL	33-kip SAL for Overlay	Overlay Thickness (in)	Remaining service Life 33-kip SAL	33-kip SAL for Overlay	Overlay Thickness (in)
2.5-3.49	1	3.32043	0.2773	11.0167	159,277,940	-	-	2,756,000,000	-	-
3.5-4.49	1	4.38050	0.2773	14.0305	55,139,681	24,860,319	-	260,800,000	-	-
4.5-5.49	14	5.12444	0.2783	16.1513	29,736,664	50,263,336	2.5	51,220,000	28,780,000	1.5
5.5-6.49	19	5.98258	0.2765	18.5809	16,081,430	63,918,570	3.5	29,670,000	50,330,000	3.0
6.5-7.49	25	7.06370	0.2780	21.6631	8,202,368	71,797,632	4.0	11,790,000	68,210,000	4.0
7.5-8.49	42	8.03998	0.2965	24.5437	4,743,568	75,256,432	5.5	4,413,000	75,587,000	5.5
8.5-9.49	49	9.00351	0.3065	27.3401	2,954,896	77,045,104	6.0	3,050,000	76,950,000	6.0
9.5-10.49	47	10.04248	0.2989	30.2507	1,895,899	78,104,101	6.5	1,577,000	78,423,000	6.5
10.5-11.49	46	11.00547	0.2892	32.9330	1,306,075	78,693,925	7.0	1,049,000	78,951,000	7.0
11.5-12.49	55	12.03332	0.2797	35.8012	905,481	79,094,519	7.5	680,400	79,319,600	7.5
12.5-13.49	48	13.03188	0.2953	38.7293	641,381	79,358,619	8.0	476,900	79,523,100	8.0
13.5-14.49	48	14.01788	0.2911	41.5083	473,258	79,526,742	8.0	340,100	79,659,900	8.0
14.5-15.49	43	14.92938	0.2698	43.9790	367,238	79,632,762	9.0	181,500	79,818,500	9.0
15.5-16.49	28	16.00570	0.3151	47.2965	266,932	79,733,068	9.5	133,200	79,866,800	9.5
16.5-17.49	24	17.03740	0.2892	50.0823	207,668	79,792,332	10.0	121,000	79,879,000	10.0
17.5-18.49	14	18.07381	0.2635	52.8824	163,579	79,836,421	10.5	108,400	79,891,600	10.5
18.5-19.49	6	19.02114	0.3340	55.9766	127,467	79,872,533	11.0	94,370	79,905,630	11.0
19.5-20.49	6	20.12341	0.2640	58.7122	103,395	79,896,605	11.0	60,900	79,939,100	11.0
20.5-21.49	3	20.71945	0.2222	60.1691	92,855	79,907,145	11.5	46,030	79,953,970	11.5
21.5-22.49	5	21.80586	0.1434	62.8098	76,909	79,923,091	11.5	62,330	79,937,670	11.5
22.5-23.49	1	22.78747	0.2773	66.3620	60,419	79,939,581	12.0	26,690	79,973,310	12.0
23.5-24.49	1	23.73381	0.2773	69.0325	50,753	79,949,247	13.0	15,370	79,984,630	13.0
24.5-25.49	1	25.04692	0.2773	72.7857	40,286	79,959,714	13.0	48,460	79,951,540	13.0
28.5-29.49	1	28.66554	0.2773	83.0735	22,557	79,977,443	14.0	99,010	79,900,990	14.0

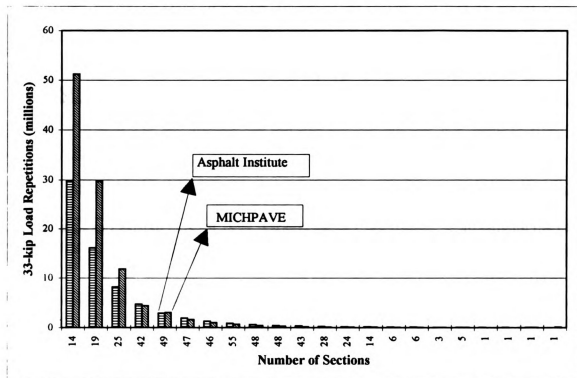


Figure 4.43 : Distribution of pavement sections that will fail prior to 80 millions of 33-kip SAL.

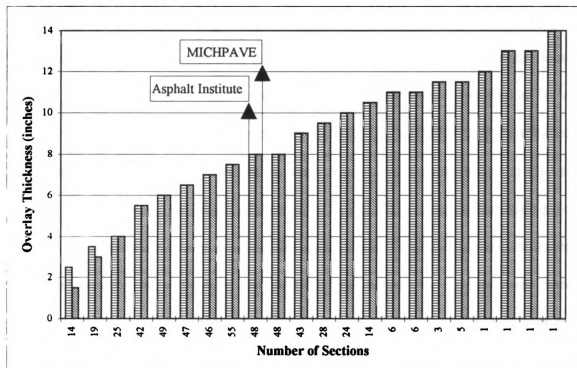


Figure 4.44: The distribution of the pavement sections and their overlay thicknesses that are required to sustain 80 millions of 33-kip SAL.

CHAPTER 5

SUMMARY, CONCLUSIONS, AND RECOMMENDATIONS

5.1 SUMMARY

After the premature failure of the National Highway (N5) between Karachi and Hyderabad in Pakistan in April 1994, various teams were formed to investigate the causes of failure. As a part of these investigative efforts, the nondestructive deflection test (NDT) data was collected along 52.4 km section of this highway using the KUAB falling weight deflectometer (FWD) during February and March 1995. This study deals with the analysis and discussion of the NDT data. The statistical analysis of the NDT data indicates that although the average peak surface deflection along the length of the road is quite normal, the variation in deflection at various sensor locations along the length of the road is very high. The coefficient of variation of deflection at various sensor locations varies from about 32 to about 54 percent. The outer most sensor (located at 70 inches from the center of the load), which measures the deflection contributed by the roadbed soil only, has the maximum coefficient of variation. This variation in deflection at the various sensor locations along the length of the road is due partly to poor construction practices during the preparation (compaction) of the roadbed soil. To further investigate the causes of this variation in deflection, the MICHBACK computer program was used to backcalculate the moduli of the various pavement layers. The backcalculated layer moduli also showed considerable variations along the length of the road. This variation in the layer moduli can also be attributed to construction practices and, perhaps, to a poor

quality control. For each deflection group, the backcalculated layer moduli and the layer thicknesses were used in the MICHPAVE computer program to analyze the pavement structure and to calculate its remaining service life for that deflection group. The Asphalt Institute method was also used to determine the remaining service life of the pavement and to calculate the required overlay thickness for performance periods of six and eight years.

Based upon the NDT data and the results of the mechanistic analysis using the MICHBACK and the MICHPAVE computer programs, and the Asphalt Institute method, several conclusions were drawn and are presented in the next section.

5.2 CONCLUSIONS

As stated above, based on the NDT data, statistical analysis of the data, backcalculation of pavement layer properties using the MICHBACK computer program, mechanistic analysis using the MICHPAVE computer program, and the Asphalt Institute method to determine the remaining service life and the required overlay thickness, the following conclusions are drawn:

1. The quality and structural capacity of the pavement of the National Highway N5 vary considerably from one test location to another.
2. The variation in the deflection at various sensor locations along the length of the road is due partly to poor construction practices.
3. The MICHBACK results (layer moduli) are accurate relative to the measured deflection data.

4. The temperature correction of the AC modulus is a function of the temperature gradient in the AC layer, and not the temperature at the top of the AC layer only.
5. The remaining service life calculated by both MICHPAVE and the Asphalt Institute method shows that parts of the National Highway N5 are severely under-designed.
6. The assumption of the AC layer coefficient (a_1) of 0.42, causes the pavement design engineers in Pakistan to underestimate the required AC thickness. A 0.42 layer coefficient corresponds to an AC modulus value of about 450 ksi. At various locations along the N5 highway, the AC modulus was considerably less than 450 ksi.
7. For the design performance periods of six and eight years, the National Highway N5 is considerably under-designed. A structural improvement by means of an AC overlay is required.

5.3 **RECOMMENDATIONS**

The following recommendations are appropriate for improving the quality of the pavement structures in Pakistan:

1. The accuracy and the authenticity of the mechanistic analysis depends upon the accuracy and the comprehensiveness of the deflection data. The NDT data that was collected as a part of this study is not comprehensive neither is complete. It is strongly recommended that the NDT data includes location reference points and pavement surface distress data.

2. To reduce the time involved in data reduction and conversion, a more automated software package could be utilized. Although the KUAB FWD was used for data collection, the format of the NDT data written by the on board computer software was not compatible with the MICHBACK computer program.
3. To ensure and improve the quality control measures, NDT's could be conducted after construction to assess the pavement variability along the project.
4. It is strongly recommended that the highway authority in Pakistan establishes, for each class of road, a maximum acceptable value of the pavement peak surface deflection. This value can be used as a part of the quality control measures and for acceptance/rejection of the pavement in question.
5. The correction of the AC modulus for temperature requires data regarding the temperature gradient in the AC layer. A study should be conducted to develop temperature correction methods based on the effect of temperature on the AC modulus during the warming and cooling cycles.
6. Similar studies should be conducted on other roads in Pakistan to check and improve the structural adequacy of the pavements.

APPENDIX A

Appendix A

Table A-1 : Measured FWD deflection data for stations 100-1101.

IFWD DATA FILE : A:\N5S2D1.FWD

HProject : N5

HSection : 2

HLocation : start from hyd tol plaza

HRoad clas. : Flex

HNo of lanes : 2

HMeasured lane : outer

H :

HSurface type : asphalt

HLane width : 12

HDirection(NSWE) : s

HShoulder type : ST

HOffset side dist.: 3 ft

HWeather : Sunny

H :

HOperator : almani

IDate Created : 02-26-1995

HMachine Type : KUAB FWD Model 150

HSoftware Version : 4.23

ILoad Mode : 1 (6+6 large buffers, 3 stack weights)

IPlate Radius : 15.0 (cm)

HPlate Cal Factor : 11050.00

HPlate Cal Add : 150

HPlate Gain Factor: 1.00000

HPlate Cal Date : 11-27-1994

HPlate Cal Time : 12:23:02

IAir Cal Factor : 0.073666

HAir Cal Add : -273

HAir Cal Date : 11-26-1994

HAir Cal Time : 15:03:10

IDMI Cal Factor : 0.696384

HDMI Last Cal Date: 02-26-1995

HDMI Last Cal Time: 09:57:59

IDrop Sequence : 2123

IRecord Drop? : YYYY

IChannel : 0 1 2 3 4 5 6

ISensor ID : 0- 1- 2- 3- 4- 5- 6-

IDistance : 0.0 20.0 30.0 45.0 60.0 120.0 180.0 (cm)

IPosition : CENTER BEHIND BEHIND BEHIND BEHIND BEHIND BEHIND

HStatic Cal Factor: 0.5642 0.2884 0.2816 0.2865 0.1399 0.1376 0.1396

HDyn Cal Factor : 1.050 1.050 1.050 1.050 1.050 1.050 1.050

HGain Factor : 1.000 1.000 1.000 1.000 1.000 1.000 1.000

HChannel Cal Date : 02-24-95 02-24-95 02-24-95 02-24-95 02-24-95 02-24-95 02-24-95

HChannel Cal Time : 14:22:24 14:22:24 14:22:24 14:22:24 14:22:24 14:22:24 14:22:24

H

Table A-1 (cont'd).

J	Station	Imp	Load	D0	D20	D30	D45	D60	D120	D180	Air	Pave	Time
J	m	Num	kgf	æm	æm	æm	æm	æm	æm	æm	°C	°C	hh:mm:ss
D	100	2	2592	79	56	43	29	21	9	5	32.5	36.5	12:11:31
D	100	3	4052	133	94	75	50	36	14	8	32.5	36.5	12:11:39
D	100	4	7436	254	190	150	103	75	29	15	32.5	36.5	12:11:50
D	201	2	2598	105	73	57	37	24	7	3	32.7	36.8	12:14:10
D	201	3	4061	175	127	100	64	42	11	4	32.7	36.8	12:14:19
D	201	4	7447	339	256	204	137	91	22	8	32.7	36.8	12:14:30
D	301	2	2589	85	61	45	29	18	4	3	35.1	36.4	12:16:43
D	301	3	4070	137	101	76	49	31	7	3	35.1	36.4	12:16:51
D	301	4	7505	249	185	144	96	63	12	5	35.1	36.4	12:17:02
D	400	2	2589	149	109	85	56	35	8	4	32	37.4	12:18:46
D	400	3	4053	246	186	146	97	64	15	7	32	37.4	12:18:55
D	400	4	7475	464	361	289	200	136	33	13	32	37.4	12:19:06
D	501	2	2585	132	97	74	45	27	4	2	32.3	38.1	12:20:42
D	501	3	4034	219	165	126	79	50	7	3	32.3	38.1	12:20:51
D	501	4	7459	411	319	247	159	102	16	5	32.3	38.1	12:21:01
D	601	2	2577	161	114	90	58	39	13	6	31.5	38.8	12:22:28
D	601	3	4039	266	197	153	103	70	23	10	31.5	38.8	12:22:37
D	601	4	7436	508	386	306	211	148	48	21	31.5	38.8	12:22:48
D	701	2	2596	127	92	72	47	32	9	4	31.2	38.3	12:24:39
D	701	3	4041	214	159	124	84	56	16	7	31.2	38.3	12:24:47
D	701	4	7514	412	315	249	172	120	32	14	31.2	38.3	12:24:58
D	800	2	2572	127	91	72	49	35	10	4	34.1	39.1	12:26:24
D	800	3	4056	214	158	129	91	64	20	7	34.1	39.1	12:26:32
D	800	4	7461	419	325	264	194	139	41	16	34.1	39.1	12:26:42
D	901	2	2562	134	91	70	42	27	7	4	33.2	39.1	12:28:10
D	901	3	4032	227	160	123	77	51	12	5	33.2	39.1	12:28:18
D	901	4	7456	437	325	253	166	109	28	10	33.2	39.1	12:28:29
D	1001	2	2595	127	92	72	45	30	6	3	33.1	38.9	12:30:00
D	1001	3	4039	210	158	122	82	54	12	4	33.1	38.9	12:30:08
D	1001	4	7483	406	312	248	172	117	27	9	33.1	38.9	12:30:18
D	1101	2	2572	156	117	93	63	41	10	6	35.7	39.7	12:31:47
D	1101	3	4039	249	192	155	106	71	19	8	35.7	39.7	12:31:55
D	1101	4	7483	456	357	289	203	141	38	18	35.7	39.7	12:32:06

Table A-2 : Measured FWD deflection data for stations 1101-27000.**IFWD DATA FILE : C:\SFWD\DATA\N5S2D1A.FWD**

HProject : N5
 HSection : 2
 HLocation : start from hyd tol plaza
 HRoad clas. : Flex
 HNo of lanes : 2
 HMeasured lane : outer
 H :
 HSurface type : asphalt
 HLane width : 12
 HDirection(NSWE) : s
 HShoulder type : ST
 HOffset side dist.: 3 ft
 HWeather : Sunny
 H :
 HOperator : almani

 IDate Created : 02-26-1995

 HMachine Type : KUAB FWD Model 150
 HSoftware Version : 4.23

 ILoad Mode : 1 (6+6 large buffers, 3 stack weights)
 IPlate Radius : 15.0 (cm)
 HPlate Cal Factor : 11050.00
 HPlate Cal Add : 150
 HPlate Gain Factor: 1.00000
 HPlate Cal Date : 11-27-1994
 IIPlate Cal Time : 12:23:02

 HAir Cal Factor : 0.073666
 HAir Cal Add : -273
 HAir Cal Date : 11-26-1994
 HAir Cal Time : 15:03:10
 HDMI Cal Factor : 0.696384
 HDMI Last Cal Date: 02-26-1995
 HDMI Last Cal Time: 09:57:59
 IDrop Sequence : 2123
 IRecord Drop? : NYYY
 IChannel : 0 1 2 3 4 5 6
 ISensor ID : 0- 1- 2- 3- 4- 5- 6-
 IDistance : 0.0 20.0 30.0 45.0 90.0 120.0 150.0 (cm)
 IPosition : CENTER BEHIND BEHIND BEHIND BEHIND BEHIND BEHIND
 HStatic Cal Factor: 0.5642 0.2884 0.2816 0.2865 0.1399 0.1376 0.1396
 HDyn Cal Factor : 1.050 1.050 1.050 1.050 1.050 1.050 1.050
 HGain Factor : 1.000 1.000 1.000 1.000 1.000 1.000 1.000
 HChannel Cal Date : 02-24-95 02-24-95 02-24-95 02-24-95 02-24-95 02-24-95 02-24-95
 HChannel Cal Time : 14:22:24 14:22:24 14:22:24 14:22:24 14:22:24 14:22:24 14:22:24
 H

Table A-2 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 sem	D20 sem	D30 sem	D45 sem	D90 sem	D120 sem	D150 sem	Air °C	Pave °C	Time hh:mm:ss
D	1101	2	2607	148	110	88	60	18	11	6	32.3	33.8	12:46:06
D	1101	3	4064	235	180	146	100	32	17	10	32.3	33.8	12:46:14
D	1101	4	7470	437	341	278	196	65	34	22	32.3	33.8	12:46:25
D	1201	2	2558	153	104	77	48	11	6	3	35.2	40.1	12:48:20
D	1201	3	4023	256	179	134	84	21	10	5	35.2	40.1	12:48:28
D	1201	4	7483	498	358	272	177	46	20	10	35.2	40.1	12:48:39
D	1300	2	2582	165	118	89	54	11	3	3	35.1	40.5	12:50:18
D	1300	3	4037	278	205	155	94	21	8	4	35.1	40.5	12:50:27
D	1300	4	7483	541	409	313	195	43	17	7	35.1	40.5	12:50:37
D	1400	2	2576	258	179	131	76	21	13	8	32.9	41.2	12:52:12
D	1400	3	3998	438	315	235	141	41	24	15	32.9	41.2	12:52:21
D	1400	4	7382	844	635	487	308	91	49	30	32.9	41.2	12:52:32
D	1501	2	2549	217	140	97	56	20	12	9	32	41.1	12:53:58
D	1501	3	3996	359	244	173	101	36	23	14	32	41.1	12:54:06
D	1501	4	7413	683	488	361	222	80	49	32	32	41.1	12:54:16
D	1600	2	2572	127	89	69	46	14	8	5	32.9	41.1	12:55:51
D	1600	3	4041	213	155	120	82	25	14	8	32.9	41.1	12:55:58
D	1600	4	7503	405	309	242	168	56	29	17	32.9	41.1	12:56:09
D	1701	2	2577	216	138	92	43	8	5	4	33.4	40.7	12:57:33
D	1701	3	4028	340	227	152	73	14	9	6	33.4	40.7	12:57:41
D	1701	4	7451	585	403	280	142	28	17	12	33.4	40.7	12:57:52
D	1800	2	2578	123	69	42	20	6	4	4	33.6	40.5	12:59:57
D	1800	3	4042	195	112	70	34	9	6	5	33.6	40.5	13:00:07
D	1800	4	7516	344	207	134	65	17	11	8	33.6	40.5	13:00:17
D	1900	2	2581	158	115	88	63	30	24	19	34	41.4	13:01:41
D	1900	3	4022	262	193	150	106	52	38	29	34	41.4	13:01:50
D	1900	4	7478	495	377	298	216	105	75	59	34	41.4	13:02:00
D	2001	2	2577	130	89	68	45	16	9	6	34	40.9	13:03:26
D	2001	3	4036	220	157	121	80	28	18	9	34	40.9	13:03:34
D	2001	4	7473	431	323	253	173	64	36	21	34	40.9	13:03:45
D	2100	2	2566	117	77	58	38	16	13	9	34	35.1	13:17:08
D	2100	3	4042	194	136	103	70	30	19	15	34	35.1	13:17:18
D	2100	4	7461	380	276	214	149	63	42	31	34	35.1	13:17:29
D	2201	2	2582	133	89	72	47	16	10	7	33.4	40.8	13:19:16
D	2201	3	4031	225	158	124	83	30	17	12	33.4	40.8	13:19:24
D	2201	4	7469	444	323	256	176	62	36	24	33.4	40.8	13:19:39
D	2301	2	2545	324	220	160	94	25	15	10	33.8	42.9	13:21:06
D	2301	3	3993	540	383	283	171	44	25	17	33.8	42.9	13:21:14
D	2301	4	7303	1043	768	584	371	97	55	37	33.8	42.9	13:21:25
D	2400	2	2551	246	182	141	90	27	18	10	34.3	42.1	13:22:50
D	2400	3	3992	421	324	253	165	49	26	17	34.3	42.1	13:22:58
D	2400	4	7358	838	664	532	364	115	62	38	34.3	42.1	13:23:10
D	2500	2	2584	111	92	85	73	38	23	14	36.8	42.3	13:24:30
D	2500	3	4033	188	160	148	127	67	41	24	36.8	42.3	13:24:39
D	2500	4	7472	386	338	310	269	148	92	53	36.8	42.3	13:24:50
D	2600	2	2551	311	208	149	84	26	17	13	34.8	42.2	13:26:08

Table A-2 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 sem	D20 sem	D30 sem	D45 sem	D90 sem	D120 sem	D150 sem	Air °C	Pave °C	Time hh:mm:ss
D	2600	3	3999	514	359	264	153	46	29	21	34.8	42.2	13:26:16
D	2600	4	7328	969	707	535	329	97	57	40	34.8	42.2	13:26:28
D	2701	2	2566	136	96	76	49	19	15	12	36.7	41.8	13:27:50
D	2701	3	4032	225	166	130	86	36	25	19	36.7	41.8	13:27:59
D	2701	4	7521	445	336	264	177	72	48	38	36.7	41.8	13:28:10
D	2800	2	2599	82	55	46	32	17	14	10	36.5	41.4	13:29:39
D	2800	3	4056	129	91	75	57	29	22	17	36.5	41.4	13:29:46
D	2800	4	7622	244	174	143	111	61	44	35	36.5	41.4	13:29:57
D	2900	2	2573	118	88	72	50	18	12	9	32.3	41.6	13:31:12
D	2900	3	4039	201	153	126	88	33	21	16	32.3	41.6	13:31:21
D	2900	4	7542	395	302	251	181	69	42	29	32.3	41.6	13:31:31
D	3000	2	2557	179	128	96	56	14	8	7	36	41.6	13:33:28
D	3000	3	4017	281	204	157	95	24	14	12	36	41.6	13:33:36
D	3000	4	7495	495	374	293	188	51	30	23	36	41.6	13:33:47
D	3100	2	2561	204	129	92	50	15	9	7	35.1	41.7	13:35:09
D	3100	3	3999	340	225	160	89	27	16	13	35.1	41.7	13:35:18
D	3100	4	7426	643	441	326	190	55	32	23	35.1	41.7	13:35:29
D	3200	2	2563	123	83	62	40	14	9	6	34.3	42.1	13:36:48
D	3200	3	4008	200	140	108	72	24	14	10	34.3	42.1	13:36:55
D	3200	4	7539	375	275	216	148	52	30	22	34.3	42.1	13:37:06
D	3300	2	2574	155	95	67	40	14	10	8	35.6	40.5	13:38:34
D	3300	3	4022	255	166	119	74	24	17	12	35.6	40.5	13:38:42
D	3300	4	7521	499	338	249	157	54	35	25	35.6	40.5	13:38:53
D	3400	2	2552	171	120	91	56	14	8	4	37.2	41.3	13:40:15
D	3400	3	4003	286	210	159	100	25	13	7	37.2	41.3	13:40:23
D	3400	4	7487	562	426	329	215	58	28	15	37.2	41.3	13:40:34
D	3500	2	2538	262	168	113	62	11	5	2	35.3	42.1	13:42:16
D	3500	3	3972	432	287	202	111	21	8	3	35.3	42.1	13:42:25
D	3500	4	7436	807	556	404	234	44	17	7	35.3	42.1	13:42:35
D	3600	2	2538	178	127	93	53	13	7	5	32.9	41.9	13:43:57
D	3600	3	4008	301	222	167	98	24	13	8	32.9	41.9	13:44:05
D	3600	4	7504	581	449	347	212	52	27	17	32.9	41.9	13:44:16
D	3701	2	2548	184	122	84	46	10	5	3	33.3	42.1	13:46:25
D	3701	3	4017	306	214	149	82	17	11	5	33.3	42.1	13:46:34
D	3701	4	7497	581	421	302	177	37	18	11	33.3	42.1	13:46:44
D	3801	2	2540	191	129	97	58	16	9	7	34.2	42.9	13:48:05
D	3801	3	4013	321	230	173	106	28	16	11	34.2	42.9	13:48:12
D	3801	4	7462	630	465	360	228	63	34	22	34.2	42.9	13:48:24
D	3900	2	2543	259	177	129	71	12	5	2	34	41.9	13:50:09
D	3900	3	3973	429	307	228	131	24	8	3	34	41.9	13:50:17
D	3900	4	7425	830	613	468	285	52	17	6	34	41.9	13:50:28
D	4000	2	2573	148	101	74	46	13	7	4	35.6	42.6	13:51:58
D	4000	3	4030	237	169	127	81	22	13	7	35.6	42.6	13:52:06
D	4000	4	7558	448	330	254	168	50	25	16	35.6	42.6	13:52:17
D	4101	2	2580	150	96	70	40	11	6	4	35.7	43.1	13:53:46
D	4101	3	4033	255	166	121	72	20	10	6	35.7	43.1	13:53:55

Table A-2 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 sem	D20 sem	D30 sem	D45 sem	D90 sem	D120 sem	D150 sem	Air °C	Pave °C	Time hh:mm:ss
D	4101	4	7544	501	342	255	158	42	21	11	35.7	43.1	13:54:06
D	4200	2	2572	124	71	48	28	9	6	3	33.2	42.9	13:55:26
D	4200	3	4042	204	122	85	49	14	8	5	33.2	42.9	13:55:34
D	4200	4	7585	396	246	175	105	30	16	9	33.2	42.9	13:55:45
D	4301	2	2572	309	209	147	79	14	7	4	32.2	42.1	13:57:05
D	4301	3	3996	508	358	258	144	25	10	5	32.2	42.1	13:57:13
D	4301	4	7420	969	709	524	308	54	23	12	32.2	42.1	13:57:24
D	4400	2	2539	301	203	146	87	19	9	4	31.8	41.7	13:59:18
D	4400	3	3988	496	348	256	158	36	16	8	31.8	41.7	13:59:26
D	4400	4	7418	964	703	530	343	80	35	16	31.8	41.7	13:59:37
D	4501	2	2544	217	134	93	49	14	8	6	31.6	40.9	14:01:49
D	4501	3	3985	349	228	160	89	24	14	9	31.6	40.9	14:01:58
D	4501	4	7506	653	444	326	189	51	28	19	31.6	40.9	14:02:09
D	4600	2	2566	168	95	61	34	12	10	9	35.8	42.1	14:03:47
D	4600	3	4026	268	162	106	61	23	16	13	35.8	42.1	14:03:55
D	4600	4	7574	509	325	221	133	46	31	25	35.8	42.1	14:04:07
D	4700	2	2567	124	87	68	45	13	8	5	35.4	41.8	14:05:25
D	4700	3	4044	213	154	122	82	25	13	7	35.4	41.8	14:05:37
D	4700	4	7580	425	321	254	174	54	26	15	35.4	41.8	14:05:48
D	4800	2	2566	94	52	33	14	3	2	2	34.3	42.2	14:07:09
D	4800	3	4042	152	89	55	26	4	3	2	34.3	42.2	14:07:17
D	4800	4	7640	272	163	105	51	9	6	5	34.3	42.2	14:07:27
D	4901	2	2565	134	90	65	37	6	1	2	36.5	43.2	14:08:50
D	4901	3	4022	227	157	115	66	11	4	1	36.5	43.2	14:08:58
D	4901	4	7571	443	317	232	136	24	6	2	36.5	43.2	14:09:09
D	5000	2	2547	179	110	75	37	8	5	2	34.5	43.2	14:10:33
D	5000	3	4011	301	195	135	70	15	6	3	34.5	43.2	14:10:41
D	5000	4	7519	583	399	287	159	30	13	7	34.5	43.2	14:10:51
D	5100	2	2552	114	72	52	30	8	3	3	37.6	42.5	14:12:13
D	5100	3	4017	187	122	88	53	15	8	4	37.6	42.5	14:12:22
D	5100	4	7588	347	238	175	109	29	14	9	37.6	42.5	14:12:33
D	5200	2	2566	152	92	62	32	8	5	2	34.7	42.6	14:13:52
D	5200	3	4019	252	158	108	57	12	6	3	34.7	42.6	14:14:00
D	5200	4	7585	474	312	217	120	25	12	7	34.7	42.6	14:14:11
D	5300	2	2580	92	60	44	26	5	2	2	34.3	43	14:15:41
D	5300	3	4063	145	96	72	44	9	5	4	34.3	43	14:15:50
D	5300	4	7671	260	180	136	87	21	10	7	34.3	43	14:16:02
D	5400	2	2558	162	103	69	37	10	6	4	36.3	42.8	14:17:18
D	5400	3	4006	266	177	120	67	17	9	5	36.3	42.8	14:17:26
D	5400	4	7564	511	353	250	148	39	19	11	36.3	42.8	14:17:36
D	5500	2	2561	124	77	56	31	10	7	5	36.7	42.9	14:18:53
D	5500	3	4019	200	132	95	57	19	11	8	36.7	42.9	14:19:02
D	5500	4	7570	379	260	193	122	40	24	17	36.7	42.9	14:19:13
D	5600	2	2567	185	124	91	47	11	5	4	34	43.3	14:20:30
D	5600	3	4004	299	209	154	87	18	10	4	34	43.3	14:20:38
D	5600	4	7540	558	404	307	181	41	19	12	34	43.3	14:20:49

Table A-2 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 sem	D20 sem	D30 sem	D45 sem	D90 sem	D120 sem	D150 sem	Air °C	Pave °C	Time hh:mm:ss
D	5701	2	2566	143	95	69	39	11	7	5	35.3	43.1	14:22:05
D	5701	3	4011	233	164	120	72	19	11	7	35.3	43.1	14:22:15
D	5701	4	7566	456	332	247	153	41	24	15	35.3	43.1	14:22:25
D	5800	2	2570	94	61	46	29	9	5	4	34.7	42.1	14:23:51
D	5800	3	4020	155	105	80	50	15	9	6	34.7	42.1	14:23:59
D	5800	4	7590	296	208	159	101	30	17	12	34.7	42.1	14:24:10
D	5901	2	2559	168	111	79	42	10	6	4	34.8	42.6	14:25:30
D	5901	3	4001	272	188	135	74	17	11	8	34.8	42.6	14:25:39
D	5901	4	7571	508	362	266	153	37	21	15	34.8	42.6	14:25:54
D	6000	2	2567	117	78	55	32	10	6	4	36.5	42.1	14:27:24
D	6000	3	4028	194	134	97	58	16	11	6	36.5	42.1	14:27:33
D	6000	4	7584	377	268	199	123	34	19	13	36.5	42.1	14:27:43
D	6100	2	2548	101	66	48	29	7	5	4	38.2	42.9	14:29:01
D	6100	3	4036	161	109	82	48	15	10	7	38.2	42.9	14:29:10
D	6100	4	7628	297	201	151	94	27	17	12	38.2	42.9	14:29:21
D	6201	2	2585	153	115	92	62	20	13	9	36.3	43.3	14:30:41
D	6201	3	4025	261	200	159	109	37	21	14	36.3	43.3	14:30:49
D	6201	4	7564	519	410	332	234	80	46	31	36.3	43.3	14:30:59
D	6300	2	2558	236	144	92	44	9	5	4	34.6	42.6	14:32:19
D	6300	3	4009	373	235	155	77	15	7	4	34.6	42.6	14:32:28
D	6300	4	7518	665	439	301	160	31	14	9	34.6	42.6	14:32:39
D	6401	2	2566	143	97	72	41	7	3	2	34.7	42.1	14:33:59
D	6401	3	4001	234	164	122	69	13	5	3	34.7	42.1	14:34:07
D	6401	4	7532	438	313	236	141	25	11	7	34.7	42.1	14:34:17
D	6501	2	2552	114	72	52	30	7	3	2	34.7	42.9	14:35:29
D	6501	3	4011	184	122	89	53	12	6	3	34.7	42.9	14:35:38
D	6501	4	7602	347	236	176	106	25	10	5	34.7	42.9	14:35:49
D	6600	2	2558	169	110	75	37	6	2	2	36.5	42.1	14:37:01
D	6600	3	4009	269	182	125	63	11	5	2	36.5	42.1	14:37:09
D	6600	4	7551	489	335	232	123	20	9	5	36.5	42.1	14:37:20
D	6701	2	2559	256	169	109	51	6	2	2	35.7	42.9	14:38:34
D	6701	3	4003	389	264	176	85	9	3	2	35.7	42.9	14:38:43
D	6701	4	7495	662	459	310	155	15	6	3	35.7	42.9	14:38:54
D	6800	2	2549	298	186	114	45	4	2	1	33.4	42.4	14:40:12
D	6800	3	3976	444	282	177	73	6	3	3	33.4	42.4	14:40:20
D	6800	4	7538	752	482	306	133	11	8	5	33.4	42.4	14:40:31
D	6900	2	2566	188	115	78	40	10	7	5	37.9	42.9	14:41:50
D	6900	3	4014	303	189	130	71	19	11	7	37.9	42.9	14:41:59
D	6900	4	7588	541	351	248	141	37	22	15	37.9	42.9	14:42:09
D	7001	2	2561	321	203	126	56	7	3	2	35.7	43.6	14:43:28
D	7001	3	3984	505	333	216	97	11	5	4	35.7	43.6	14:43:36
D	7001	4	7531	888	609	411	198	22	9	6	35.7	43.6	14:43:47
D	7101	2	2572	108	61	42	25	10	7	5	35.1	43.1	14:45:16
D	7101	3	4033	177	105	73	44	17	11	7	35.1	43.1	14:45:26
D	7101	4	7626	340	209	147	90	35	23	15	35.1	43.1	14:45:36
D	7200	2	2566	130	84	59	35	9	5	4	35.8	42.9	14:47:01

Table A-2 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 œm	D20 œm	D30 œm	D45 œm	D90 œm	D120 œm	D150 œm	Air œC	Pave œC	Time hh:mm:ss
D	7200	3	4023	207	140	100	58	15	9	6	35.8	42.9	14:47:09
D	7200	4	7612	389	271	197	120	32	17	11	35.8	42.9	14:47:20
D	7300	2	2561	129	79	54	34	12	8	5	36	43.8	14:48:43
D	7300	3	3992	213	137	95	59	22	12	9	36	43.8	14:48:52
D	7300	4	7584	413	281	203	128	43	26	17	36	43.8	14:49:03
D	7400	2	2570	132	72	50	28	10	7	5	36.9	43.8	14:50:22
D	7400	3	4036	211	124	87	51	18	11	7	36.9	43.8	14:50:30
D	7400	4	7609	406	248	177	108	38	23	15	36.9	43.8	14:50:41
D	7500	2	2572	88	57	42	29	13	10	8	36.2	43.6	14:52:10
D	7500	3	4015	146	97	73	49	23	15	12	36.2	43.6	14:52:19
D	7500	4	7633	286	197	149	104	46	32	24	36.2	43.6	14:52:29
D	7600	2	2551	136	76	47	28	9	6	4	36.1	44.2	14:53:50
D	7600	3	4011	217	130	84	49	16	10	7	36.1	44.2	14:53:58
D	7600	4	7625	416	264	177	106	35	22	15	36.1	44.2	14:54:09
D	7702	2	2557	116	63	40	25	9	7	5	38.1	43.8	14:55:33
D	7702	3	4015	185	109	71	42	16	10	7	38.1	43.8	14:55:42
D	7702	4	7598	355	225	149	93	34	21	14	38.1	43.8	14:55:53
D	7800	2	2561	129	81	59	38	15	11	8	36.7	44.3	14:57:20
D	7800	3	4006	213	142	103	67	25	17	12	36.7	44.3	14:57:28
D	7800	4	7585	418	290	217	143	54	36	26	36.7	44.3	14:57:39
D	7900	2	2566	130	80	54	30	11	9	5	35.7	43.4	14:58:59
D	7900	3	4042	210	134	93	55	20	14	9	35.7	43.4	14:59:08
D	7900	4	7629	396	262	186	112	42	27	19	35.7	43.4	14:59:20
D	8000	2	2552	124	75	52	30	12	9	6	36.3	43	15:01:18
D	8000	3	4006	197	126	88	50	19	14	11	36.3	43	15:01:26
D	8000	4	7612	367	243	175	103	41	29	24	36.3	43	15:01:37
D	8100	2	2552	111	68	48	29	12	8	5	36	43	15:02:58
D	8100	3	4006	178	117	81	50	20	13	10	36	43	15:03:08
D	8100	4	7615	344	233	169	106	43	29	21	36	43	15:03:19
D	8200	2	2538	139	85	55	29	8	6	5	37.6	42.1	15:04:42
D	8200	3	4001	229	144	93	51	15	10	9	37.6	42.1	15:04:50
D	8200	4	7603	421	276	185	103	29	20	17	37.6	42.1	15:05:01
D	8300	2	2551	198	129	92	51	17	11	7	38.2	42.3	15:06:25
D	8300	3	3992	315	216	155	91	29	18	14	38.2	42.3	15:06:34
D	8300	4	7570	584	410	306	187	59	37	26	38.2	42.3	15:06:45
C Testing Comment: patching													
D	8402	2	2527	229	149	105	57	14	8	9	37.6	41.6	15:08:22
D	8402	3	3984	365	248	177	99	24	15	10	37.6	41.6	15:08:31
D	8402	4	7520	674	471	349	205	50	29	21	37.6	41.6	15:08:42
D	8500	2	2530	221	154	110	62	15	10	7	34.9	40.4	15:10:02
D	8500	3	3988	360	260	190	109	26	16	11	34.9	40.4	15:10:10
D	8500	4	7521	691	511	386	232	55	33	22	34.9	40.4	15:10:21
D	8600	2	2556	85	54	41	26	10	7	5	37.4	41.7	15:11:40
D	8600	3	4023	132	87	66	44	17	12	8	37.4	41.7	15:11:48
D	8600	4	7669	245	165	127	88	34	23	18	37.4	41.7	15:11:58
C Testing Comment: bridge started													

Table A-2 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 sem	D20 sem	D30 sem	D45 sem	D90 sem	D120 sem	D150 sem	Air °C	Pave °C	Time hh:mm:ss
D	8700	2	2538	88	48	35	25	11	9	8	37.4	43.3	15:13:30
D	8700	3	4032	145	83	61	42	22	17	13	37.4	43.3	15:13:39
D	8700	4	7655	280	168	123	88	43	34	26	37.4	43.3	15:13:50
C Testing Comment: bride centre													
D	8800	2	2533	230	157	112	71	28	20	16	36.3	42.3	15:15:09
D	8800	3	3995	385	269	196	122	46	33	24	36.3	42.3	15:15:19
D	8800	4	7533	739	539	403	261	94	63	49	36.3	42.3	15:15:30
C Testing Comment: patching													
D	8900	2	2549	179	117	85	57	29	23	20	37.1	42.9	15:16:47
D	8900	3	3998	282	192	140	96	50	38	30	37.1	42.9	15:16:56
D	8900	4	7570	526	373	283	197	100	75	61	37.1	42.9	15:17:07
C Testing Comment: patching													
D	9000	2	2570	130	89	70	49	25	21	17	35.3	36.8	15:36:38
D	9000	3	4014	208	146	118	85	41	32	27	35.3	36.8	15:36:49
D	9000	4	7546	393	284	229	170	84	64	52	35.3	36.8	15:37:03
D	9100	2	2551	267	184	128	72	29	24	20	36.5	41.7	15:39:03
D	9100	3	3979	447	319	226	126	50	38	31	36.5	41.7	15:39:12
D	9100	4	7454	857	629	458	264	98	77	63	36.5	41.7	15:39:22
D	9201	2	2543	191	130	95	58	22	18	15	36.5	40.5	15:40:44
D	9201	3	3987	320	222	167	102	36	25	22	36.5	40.5	15:40:54
D	9201	4	7502	604	434	332	211	73	50	42	36.5	40.5	15:41:05
D	9301	2	2564	137	87	59	35	15	12	11	36	40.2	15:42:25
D	9301	3	4001	220	145	100	59	27	19	16	36	40.2	15:42:32
D	9301	4	7593	403	278	198	123	51	36	31	36	40.2	15:42:43
D	9400	2	2552	149	93	65	42	20	16	13	36	41.3	15:44:03
D	9400	3	3989	238	154	107	68	34	25	20	36	41.3	15:44:13
D	9400	4	7543	435	297	214	141	72	51	39	36	41.3	15:44:24
D	9501	2	2492	432	299	221	130	45	32	22	36.5	39.6	15:46:11
D	9501	3	3908	697	494	372	228	81	52	38	36.5	39.6	15:46:20
D	9501	4	7289	1304	960	741	480	167	107	74	36.5	39.6	15:46:31
D	9600	2	2524	269	168	107	55	19	15	14	36.3	40.1	15:47:54
D	9600	3	3978	418	273	181	96	33	24	20	36.3	40.1	15:48:05
D	9600	4	7517	739	500	346	194	66	47	39	36.3	40.1	15:48:16
C Testing Comment: patching													
D	9701	2	2536	340	236	162	91	32	22	16	36.9	39.6	15:49:37
D	9701	3	3965	538	388	278	165	56	38	29	36.9	39.6	15:49:45
D	9701	4	7462	980	734	546	342	116	75	53	36.9	39.6	15:49:57
D	9800	2	2545	200	138	102	61	24	18	14	36	40.5	15:51:25
D	9800	3	4003	318	231	170	106	41	29	23	36	40.5	15:51:33
D	9800	4	7547	595	443	338	221	85	59	46	36	40.5	15:51:44
D	9901	2	2559	130	87	67	45	19	13	11	36.2	40.4	15:53:05
D	9901	3	4013	214	150	115	77	33	23	18	36.2	40.4	15:53:13
D	9901	4	7601	409	296	232	159	68	46	35	36.2	40.4	15:53:24
D	9999	2	2563	165	111	83	48	15	10	8	35.2	39.6	15:54:50
D	9999	3	4005	267	190	139	86	26	17	12	35.2	39.6	15:54:59
D	9999	4	7595	506	371	279	178	54	34	25	35.2	39.6	15:55:09

Table A-2 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 sem	D20 sem	D30 sem	D45 sem	D90 sem	D120 sem	D150 sem	Air °C	Pave °C	Time hh:mm:ss
D	10099	2	2539	161	104	75	46	18	14	9	36.3	39.9	15:56:28
D	10099	3	3982	259	177	129	80	33	22	16	36.3	39.9	15:56:40
D	10099	4	7538	499	350	263	169	67	46	34	36.3	39.9	15:56:51
D	10201	2	2539	337	227	157	87	29	20	15	36	40.2	15:58:13
D	10201	3	3955	539	378	273	157	51	33	25	36	40.2	15:58:21
D	10201	4	7412	992	720	538	330	109	71	50	36	40.2	15:58:32
D	10301	2	2525	256	183	138	88	29	20	13	35.3	40	16:00:01
D	10301	3	3974	429	317	241	154	52	32	23	35.3	40	16:00:10
D	10301	4	7483	825	624	489	328	109	67	46	35.3	40	16:00:22
D	10400	2	2533	111	73	58	43	25	22	18	35.3	39.6	16:01:53
D	10400	3	4002	185	127	101	72	41	34	28	35.3	39.6	16:02:01
D	10400	4	7603	366	260	205	150	83	65	53	35.3	39.6	16:02:12
D	10501	2	2563	148	94	72	49	29	24	20	35.7	39.8	16:03:31
D	10501	3	4006	233	159	120	85	48	37	30	35.7	39.8	16:03:40
D	10501	4	7606	443	313	244	175	100	77	60	35.7	39.8	16:03:51
D	10600	2	2529	267	180	128	77	30	27	22	35.7	39.4	16:05:15
D	10600	3	3958	425	295	216	131	50	40	35	35.7	39.4	16:05:22
D	10600	4	7496	771	552	412	261	100	78	66	35.7	39.4	16:05:33
D	10700	2	2543	258	177	126	74	23	14	10	35.8	40.2	16:06:53
D	10700	3	4004	427	305	222	137	40	23	16	35.8	40.2	16:07:02
D	10700	4	7516	801	599	450	287	87	49	33	35.8	40.2	16:07:12
D	10800	2	2549	285	186	128	73	23	17	13	36	39	16:08:30
D	10800	3	3984	453	304	221	127	41	28	20	36	39	16:08:38
D	10800	4	7505	813	574	431	266	91	59	42	36	39	16:08:49
D	10900	2	2561	239	149	99	54	15	11	7	36	39.3	16:10:21
D	10900	3	3998	372	244	169	93	27	16	11	36	39.3	16:10:30
D	10900	4	7569	653	449	323	192	57	33	22	36	39.3	16:10:41
D	11000	2	2547	137	86	62	39	16	12	8	35.1	39.2	16:12:11
D	11000	3	3998	223	144	107	69	28	20	15	35.1	39.2	16:12:18
D	11000	4	7640	427	285	215	142	58	40	29	35.1	39.2	16:12:29
D	11100	2	2558	98	59	42	26	10	6	4	36.7	39	16:15:26
D	11100	3	4015	159	101	72	44	17	12	7	36.7	39	16:15:34
D	11100	4	7644	297	197	144	93	35	23	16	36.7	39	16:15:45
D	11210	2	2552	97	64	48	34	14	11	8	35.3	38.6	16:19:52
D	11210	3	4015	158	107	82	57	25	17	12	35.3	38.6	16:20:00
D	11210	4	7599	305	213	167	120	52	33	24	35.3	38.6	16:20:10
D	11300	2	2565	140	81	54	30	12	10	7	36.9	39.4	16:22:00
D	11300	3	4018	223	134	92	53	22	17	12	36.9	39.4	16:22:08
D	11300	4	7611	408	258	181	111	46	32	24	36.9	39.4	16:22:23
C Testing Comment: centre													
D	11401	2	2577	116	83	64	40	14	10	7	35.7	38.9	16:24:03
D	11401	3	4032	190	140	109	68	23	15	11	35.7	38.9	16:24:11
D	11401	4	7662	367	281	219	142	49	29	22	35.7	38.9	16:24:22
D	11500	2	2562	118	74	55	35	14	11	9	36	39.4	16:25:46
D	11500	3	4018	194	129	95	61	24	16	12	36	39.4	16:25:54
D	11500	4	7626	368	261	197	128	51	34	25	36	39.4	16:26:07

Table A-2 (cont'd)

J J	Station m	Imp Num	Load kgf	D0 mm	D20 mm	D30 mm	D45 mm	D90 mm	D120 mm	D150 mm	Air °C	Pave °C	Time hh:mm:ss
D	12034	2	2539	153	101	72	43	17	13	9	34.6	36.6	16:29:12
D	12034	3	3995	257	180	129	79	31	23	17	34.6	36.6	16:29:20
D	12034	4	7574	500	362	266	171	68	46	32	34.6	36.6	16:29:31
C Testing Comment: bulhari river abut.A end side													
D	12100	2	2539	298	194	131	67	13	8	5	34.3	36.9	16:31:28
D	12100	3	3982	490	330	227	125	24	14	10	34.3	36.9	16:31:38
D	12100	4	7475	901	627	446	256	49	29	20	34.3	36.9	16:31:48
D	12201	2	2558	156	94	63	34	12	9	6	36.3	37.1	16:33:47
D	12201	3	3993	257	163	110	61	23	15	11	36.3	37.1	16:33:55
D	12201	4	7588	488	322	225	134	48	32	24	36.3	37.1	16:34:06
D	12300	2	2583	107	64	43	26	9	5	6	36.7	37.5	16:36:07
D	12300	3	4016	172	107	73	45	18	12	9	36.7	37.5	16:36:17
D	12300	4	7642	318	206	146	95	37	25	19	36.7	37.5	16:36:28
C Testing Comment: end of day one													
D	12300	2	2610	75	51	39	26	10	7	6	30.3	30.1	10:10:24
D	12300	3	2623	76	52	40	28	10	8	6	30.3	30.1	10:10:31
D	12300	4	2625	78	52	41	29	11	8	6	30.3	30.1	10:10:38
D	12300	5	4097	127	90	68	46	19	13	9	30.3	30.1	10:10:46
D	12300	6	4088	129	89	68	45	18	12	9	30.3	30.1	10:10:54
D	12300	7	4097	126	89	69	45	19	13	9	30.3	30.1	10:11:02
D	12300	8	7477	238	174	134	92	37	24	18	30.3	30.1	10:11:15
D	12300	9	7465	238	173	134	91	37	24	19	30.3	30.1	10:11:28
C Testing Comment: selected mode was pre test. discard above results													
C Testing Comment: for station 12300													
D	12300	2	2623	73	50	38	26	10	7	5	29.8	28.4	10:14:36
D	12300	3	4092	123	89	67	45	18	12	8	29.8	28.4	10:14:46
D	12300	4	7481	238	173	135	92	37	25	18	29.8	28.4	10:14:57
C Testing Comment: above was the reading at last point of day-1													
D	12400	2	2596	117	87	70	49	18	11	7	29.2	32.1	10:17:10
D	12400	3	4080	201	156	125	89	31	18	11	29.2	32.1	10:17:18
D	12400	4	7447	408	322	261	186	67	37	24	29.2	32.1	10:17:28
C Testing Comment: above reading taken at first point													
D	12501	2	2623	91	64	48	30	9	7	6	29.8	32.5	10:19:00
D	12501	3	4084	148	107	82	50	17	11	9	29.8	32.5	10:19:09
D	12501	4	7525	283	211	162	103	33	23	19	29.8	32.5	10:19:20
D	12601	2	2613	152	105	78	45	10	7	5	30	32.9	10:20:49
D	12601	3	4071	247	177	132	79	18	10	7	30	32.9	10:20:57
D	12601	4	7475	456	332	251	153	36	21	14	30	32.9	10:21:11
C Testing Comment: pipe culvert													
D	12700	2	2600	153	97	71	39	10	7	4	30.2	33	10:23:28
D	12700	3	4056	250	168	121	69	17	11	7	30.2	33	10:23:36
D	12700	4	7467	450	314	230	138	35	20	14	30.2	33	10:23:47
D	12800	2	2600	75	50	40	27	12	9	7	29.7	32.1	10:27:28
D	12800	3	4083	127	91	71	48	21	14	10	29.7	32.1	10:27:39
D	12800	4	7526	251	186	147	101	45	29	20	29.7	32.1	10:27:50
C Testing Comment: patching													

Table A-2 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 sem	D20 sem	D30 sem	D45 sem	D90 sem	D120 sem	D150 sem	Air °C	Pave °C	Time hh:mm:ss
D	12900	2	2576	161	116	88	54	13	8	5	30	32.5	10:30:02
D	12900	3	4065	257	193	147	92	23	11	9	30	32.5	10:30:10
D	12900	4	7440	463	352	271	175	47	25	17	30	32.5	10:30:20
D	13000	2	2569	174	117	86	49	16	13	9	28.7	31	10:31:56
D	13000	3	4051	282	198	147	87	26	18	14	28.7	31	10:32:04
D	13000	4	7434	505	366	277	171	53	34	26	28.7	31	10:32:15
D	13100	2	2617	156	107	79	48	15	11	9	29.5	29.3	10:37:02
D	13100	2	2589	159	108	78	47	15	12	8	30.5	30.3	10:44:44
D	13100	2	2613	152	105	77	46	16	11	9	31.2	29	10:47:59
D	13100	3	4049	255	180	134	81	26	17	13	31.2	29	10:48:07
D	13100	4	7483	466	341	256	161	51	34	26	31.2	29	10:48:18
D	13200	2	2591	124	87	65	37	12	9	8	30.3	34.3	10:50:40
D	13200	3	4065	200	146	109	66	21	14	11	30.3	34.3	10:50:49
D	13200	4	7519	359	270	205	128	44	30	22	30.3	34.3	10:51:00
D	13300	2	2597	88	58	40	26	12	11	8	30.3	35	10:52:44
D	13300	3	4072	139	93	69	45	21	14	13	30.3	35	10:52:52
D	13300	4	7527	246	175	134	91	43	32	25	30.3	35	10:53:03
D	13400	2	2562	158	104	73	43	16	12	9	30.3	34.8	10:54:55
D	13400	3	4030	250	174	126	74	27	19	14	30.3	34.8	10:55:03
D	13400	4	7447	447	327	243	153	56	38	28	30.3	34.8	10:55:14
D	13500	2	2585	171	114	82	47	12	8	6	30.5	35.4	10:56:54
D	13500	3	4037	279	192	139	80	21	12	8	30.5	35.4	10:57:02
D	13500	4	7442	493	354	261	159	42	24	18	30.5	35.4	10:57:13
D	13600	2	2584	169	120	92	58	18	13	9	30.5	35.6	10:58:48
D	13600	3	4058	277	200	155	100	32	18	13	30.5	35.6	10:58:56
D	13600	4	7494	499	374	293	197	66	38	26	30.5	35.6	10:59:07
D	13700	2	2572	175	137	111	75	29	22	18	31.2	37.1	11:00:51
D	13700	3	4034	289	230	188	130	54	36	28	31.2	37.1	11:01:00
D	13700	4	7409	522	426	352	252	104	73	58	31.2	37.1	11:01:11
D	13800	2	2570	279	172	108	54	19	14	10	30.5	37.5	11:02:41
D	13800	3	4015	427	277	181	95	32	23	17	30.5	37.5	11:02:49
D	13800	4	7418	711	485	328	181	64	44	33	30.5	37.5	11:02:59
D	13900	2	2580	174	126	95	57	17	13	10	30.9	36.8	11:04:40
D	13900	3	4042	277	206	155	95	30	20	16	30.9	36.8	11:04:48
D	13900	4	7447	488	367	281	177	61	41	33	30.9	36.8	11:04:58
D	14000	2	2576	134	74	51	32	13	9	7	30.8	37.2	11:06:30
D	14000	3	4058	217	129	92	56	22	14	12	30.8	37.2	11:06:39
D	14000	4	7467	390	245	178	112	46	31	23	30.8	37.2	11:06:49
D	14100	2	2564	233	151	105	54	15	13	15	31.7	37.9	11:08:44
D	14100	3	4037	362	240	169	90	28	20	16	31.7	37.9	11:08:52
D	14100	4	7425	627	429	308	175	56	38	30	31.7	37.9	11:09:03
D	14200	2	2596	84	56	43	27	11	8	7	30.5	36.5	11:10:36
D	14200	3	4067	136	96	72	47	20	14	11	30.5	36.5	11:10:44
D	14200	4	7511	242	176	135	90	39	28	23	30.5	36.5	11:11:00
D	14300	2	2584	117	79	61	41	17	13	10	30.8	37.8	11:12:32
D	14300	3	4047	191	137	108	71	30	22	16	30.8	37.8	11:12:41

Table A-2 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 sem	D20 sem	D30 sem	D45 sem	D90 sem	D120 sem	D150 sem	Air °C	Pave °C	Time hh:mm:ss
D	14300	4	7512	357	266	213	146	62	43	32	30.8	37.8	11:12:52
D	14400	2	2580	195	137	99	55	14	12	10	30.5	37.2	11:14:27
D	14400	3	4053	306	222	165	98	25	19	16	30.5	37.2	11:14:35
D	14400	4	7487	533	394	298	183	52	40	33	30.5	37.2	11:14:46
D	14501	2	2561	185	113	76	48	24	17	14	31.6	37.8	11:16:37
D	14501	3	4028	297	192	134	87	44	31	23	31.6	37.8	11:16:45
D	14501	4	7456	534	373	269	183	92	66	48	31.6	37.8	11:16:56
D	14550	2	2580	127	85	66	44	18	14	12	31.4	37.7	11:21:21
D	14550	3	4047	207	145	111	75	34	23	19	31.4	37.7	11:21:29
D	14550	4	7483	393	283	221	153	67	48	37	31.4	37.7	11:21:40
C Testing Comment: Inner Lane and Patch Work													
D	14600	2	2552	261	174	131	84	32	24	18	31.3	37.5	11:24:16
D	14600	3	4008	418	296	227	149	59	39	28	31.3	37.5	11:24:24
D	14600	4	7404	762	563	445	307	125	82	58	31.3	37.5	11:24:35
D	14700	2	2561	213	159	128	86	29	20	15	31.6	37.3	11:26:08
D	14700	3	4026	349	270	218	150	54	33	23	31.6	37.3	11:26:16
D	14700	4	7421	622	494	406	288	108	67	46	31.6	37.3	11:26:31
D	14800	2	2551	234	157	115	68	19	12	9	31.6	37.2	11:28:11
D	14800	3	4008	368	259	193	116	33	20	14	31.6	37.2	11:28:19
D	14800	4	7450	626	456	344	216	64	39	28	31.6	37.2	11:28:29
D	14900	2	2577	156	104	77	45	13	9	7	31.7	37.9	11:30:44
D	14900	3	4043	251	177	132	78	25	16	11	31.7	37.9	11:30:52
D	14900	4	7525	445	326	249	156	52	33	24	31.7	37.9	11:31:06
D	15000	2	2572	139	87	65	43	18	13	11	30.8	39.5	11:32:52
D	15000	3	4036	226	153	112	75	32	21	15	30.8	39.5	11:33:00
D	15000	4	7506	413	291	220	151	63	42	32	30.8	39.5	11:33:11
D	15051	2	2590	126	86	66	43	19	15	12	31.1	39.8	11:34:49
D	15051	3	4034	194	138	108	70	31	25	20	31.1	39.8	11:34:58
D	15051	4	7535	343	253	199	134	60	47	39	31.1	39.8	11:35:12
C Testing Comment: INNER LANE													
D	15100	2	2563	134	102	81	51	13	8	6	31.7	39.5	11:36:36
D	15100	3	4030	222	169	133	86	24	14	9	31.7	39.5	11:36:44
D	15100	4	7533	398	308	245	161	46	27	20	31.7	39.5	11:36:55
D	15200	2	2565	172	113	78	42	10	8	6	31.2	39.5	11:38:40
D	15200	3	4044	270	187	128	70	18	12	10	31.2	39.5	11:38:56
D	15200	4	7516	470	331	233	134	34	23	19	31.2	39.5	11:39:08
D	15300	2	2573	230	146	99	48	12	7	7	31.2	39.5	11:41:25
D	15300	3	4021	343	228	158	82	20	13	9	31.2	39.5	11:41:33
D	15300	4	7434	558	388	276	156	40	25	17	31.2	39.5	11:41:44
D	15400	2	2570	178	120	86	49	13	9	7	31.9	39.2	11:43:42
D	15400	3	4015	277	192	136	82	21	13	9	31.9	39.2	11:43:55
D	15400	4	7502	480	346	255	159	48	29	21	31.9	39.2	11:44:08
D	15501	2	2560	172	103	62	32	10	6	5	30.7	38.6	11:45:42
D	15501	3	4015	266	168	105	54	17	12	9	30.7	38.6	11:45:50
D	15501	4	7504	460	298	195	106	34	23	18	30.7	38.6	11:46:01
D	15550	2	2555	108	77	61	43	18	11	7	31.1	39.1	11:47:38

Table A-2 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 sem	D20 sem	D30 sem	D45 sem	D90 sem	D120 sem	D150 sem	Air °C	Pave °C	Time hh:mm:ss
D	15550	3	4040	174	128	102	73	32	19	11	31.1	39.1	11:47:50
D	15550	4	7552	320	245	198	147	67	40	22	31.1	39.1	11:48:00
C Testing Comment: INNER LANE													
D	15600	2	2573	95	57	40	24	12	10	7	30.8	38.6	11:49:56
D	15600	3	4057	152	96	68	41	21	15	12	30.8	38.6	11:50:04
D	15600	4	7558	275	182	130	82	40	31	24	30.8	38.6	11:50:15
D	15700	2	2562	140	91	59	33	11	9	6	31.7	39.1	11:52:03
D	15700	3	4025	225	152	102	56	19	12	10	31.7	39.1	11:52:11
D	15700	4	7544	399	276	190	110	38	25	19	31.7	39.1	11:52:22
D	15800	2	2542	260	171	118	62	15	10	7	30.3	39.6	11:53:52
D	15800	3	4008	411	281	197	107	25	16	11	30.3	39.6	11:54:00
D	15800	4	7447	700	496	358	206	50	31	22	30.3	39.6	11:54:11
D	15900	2	2562	184	121	87	47	12	9	6	30.5	38.9	11:56:29
D	15900	3	4036	288	199	144	82	22	13	9	30.5	38.9	11:56:37
D	15900	4	7502	492	352	263	156	46	27	19	30.5	38.9	11:56:48
D	16000	2	2563	174	112	74	37	11	9	7	32.8	40.1	11:58:23
D	16000	3	4028	264	176	121	65	19	13	10	32.8	40.1	11:58:31
D	16000	4	7519	447	309	219	126	39	27	21	32.8	40.1	11:58:42
D	16050	2	2552	149	101	72	40	15	13	10	33	39.5	12:00:35
D	16050	3	4028	229	157	114	67	24	19	15	33	39.5	12:00:43
D	16050	4	7540	402	285	209	128	52	38	32	33	39.5	12:00:53
C Testing Comment: INNER LANE													
D	16100	2	2563	230	136	87	43	14	10	8	32.1	39.8	12:02:24
D	16100	3	4015	351	216	142	71	23	16	13	32.1	39.8	12:02:32
D	16100	4	7533	590	376	254	135	46	32	25	32.1	39.8	12:02:46
D	16200	2	2585	187	114	79	44	16	13	9	32.5	39.4	12:04:33
D	16200	3	4011	291	186	131	74	27	18	13	32.5	39.4	12:04:41
D	16200	4	7484	505	337	245	147	53	36	28	32.5	39.4	12:04:51
D	16300	2	2565	187	118	79	45	15	13	10	32.1	40.6	12:06:27
D	16300	3	4019	287	188	132	74	27	19	16	32.1	40.6	12:06:35
D	16300	4	7529	495	335	237	145	53	38	30	32.1	40.6	12:06:49
D	16401	2	2555	217	140	96	50	10	6	4	31.7	41.1	12:08:25
D	16401	3	3996	323	220	153	82	16	9	7	31.7	41.1	12:08:33
D	16401	4	7519	543	381	274	153	34	19	14	31.7	41.1	12:08:44
D	16500	2	2576	91	54	38	23	10	6	6	32.7	41.5	12:10:20
D	16500	3	4053	145	92	68	42	18	11	7	32.7	41.5	12:10:28
D	16500	4	7568	269	179	135	88	37	24	16	32.7	41.5	12:10:42
D	16550	2	2558	85	49	33	19	8	6	4	32.9	40.8	12:12:25
D	16550	3	4010	133	81	56	34	14	9	6	32.9	40.8	12:12:33
D	16550	4	7604	245	157	110	68	29	19	13	32.9	40.8	12:12:43
C Testing Comment: INNER LANE													
D	16600	2	2563	130	83	57	31	9	5	4	31.9	41.1	12:14:26
D	16600	3	4037	207	138	97	55	14	9	5	31.9	41.1	12:14:37
D	16600	4	7557	372	262	189	114	32	17	9	31.9	41.1	12:14:48
D	16700	2	2558	134	77	48	25	9	6	5	32.3	40.8	12:16:24
D	16700	3	4044	207	128	84	46	16	11	6	32.3	40.8	12:16:32

Table A-2 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 sem	D20 sem	D30 sem	D45 sem	D90 sem	D120 sem	D150 sem	Air °C	Pave °C	Time hh:mm:ss
D	16700	4	7568	363	239	165	99	34	21	13	32.3	40.8	12:16:43
D	16800	2	2573	163	101	66	32	10	7	6	32.1	40.6	12:19:18
D	16800	3	4052	251	163	111	57	18	12	9	32.1	40.6	12:19:29
D	16800	4	7560	435	296	207	114	37	24	17	32.1	40.6	12:19:40
D	16901	2	2565	136	88	61	35	11	9	7	31.7	41.4	12:21:38
D	16901	3	4054	211	145	103	59	19	14	10	31.7	41.4	12:21:46
D	16901	4	7539	373	266	195	117	40	27	19	31.7	41.4	12:21:57
D	17000	2	2561	98	63	46	29	10	7	6	33	42.2	12:23:42
D	17000	3	4039	158	106	79	50	18	12	9	33	42.2	12:23:53
D	17000	4	7587	291	202	151	98	37	24	17	33	42.2	12:24:04
D	17050	2	2578	111	74	56	35	11	9	6	33.3	42	12:25:47
D	17050	3	4024	179	125	94	59	22	15	10	33.3	42	12:25:54
D	17050	4	7568	333	239	181	120	45	29	21	33.3	42	12:26:05
C Testing Comment: INNER LANE													
D	17100	2	2565	175	114	78	43	12	8	6	33.3	41.8	12:27:39
D	17100	3	4011	275	188	131	75	22	14	10	33.3	41.8	12:27:47
D	17100	4	7500	486	341	246	146	45	26	17	33.3	41.8	12:28:03
D	17201	2	2569	132	78	52	29	10	7	6	32.8	41.6	12:29:50
D	17201	3	4046	204	128	87	49	19	12	9	32.8	41.6	12:29:58
D	17201	4	7540	366	237	167	101	37	24	18	32.8	41.6	12:30:09
C Testing Comment: NEAR KM 129													
D	17300	2	2559	210	111	67	31	11	10	7	32.8	41.9	12:31:51
D	17300	3	4034	328	183	113	53	19	14	11	32.8	41.9	12:31:59
D	17300	4	7506	573	335	213	106	41	29	22	32.8	41.9	12:32:10
D	17400	2	2559	127	81	60	38	14	11	7	32.7	41.8	12:33:43
D	17400	3	4055	207	138	103	64	25	17	12	32.7	41.8	12:33:51
D	17400	4	7570	377	259	197	128	52	35	26	32.7	41.8	12:34:05
D	17500	2	2554	194	122	85	48	15	10	9	32.7	42.4	12:35:56
D	17500	3	4013	298	197	142	85	26	18	14	32.7	42.4	12:36:04
D	17500	4	7494	518	354	261	164	57	38	29	32.7	42.4	12:36:14
D	17550	2	2569	95	60	42	26	10	7	5	33	41.8	12:37:47
D	17550	3	4039	150	97	70	43	17	12	9	33	41.8	12:37:55
D	17550	4	7609	281	186	134	88	35	23	17	33	41.8	12:38:09
C Testing Comment: INNER LANE													
D	17600	2	2563	134	88	64	38	14	10	8	32.8	42.5	12:39:47
D	17600	3	4017	214	145	107	66	25	17	13	32.8	42.5	12:39:55
D	17600	4	7554	390	272	203	131	53	36	27	32.8	42.5	12:40:05
D	17700	2	2562	190	115	77	40	12	9	7	32.3	42.9	12:41:53
D	17700	3	4033	286	186	126	70	23	14	11	32.3	42.9	12:42:04
D	17700	4	7570	498	334	237	143	49	32	23	32.3	42.9	12:42:15
D	17800	2	2544	200	134	89	49	17	12	9	32.1	42.1	12:44:16
D	17800	3	4003	314	220	152	88	31	22	16	32.1	42.1	12:44:24
D	17800	4	7482	559	401	289	177	63	42	31	32.1	42.1	12:44:35
D	17900	2	2552	256	161	109	61	21	14	11	33.7	43.9	12:46:18
D	17900	3	4000	392	261	182	105	38	25	18	33.7	43.9	12:46:29
D	17900	4	7493	706	490	354	215	81	54	39	33.7	43.9	12:46:40

Table A-2 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 sem	D20 sem	D30 sem	D45 sem	D90 sem	D120 sem	D150 sem	Air °C	Pave °C	Time hh:mm:ss
D	18000	2	2552	162	112	80	47	17	11	9	32.8	42.9	12:48:26
D	18000	3	4012	260	185	136	82	30	20	14	32.8	42.9	12:48:34
D	18000	4	7508	480	351	261	167	63	42	31	32.8	42.9	12:48:45
D	18051	2	2544	198	132	90	47	16	12	9	32.7	42.4	12:50:14
D	18051	3	3984	300	207	144	79	26	19	15	32.7	42.4	12:50:26
D	18051	4	7502	537	378	268	157	55	40	30	32.7	42.4	12:50:36
C Testing Comment: INNER LANE													
D	18100	2	2576	133	84	59	32	11	7	6	32.5	42.3	12:52:41
D	18100	3	4025	210	142	99	57	19	12	10	32.5	42.3	12:52:49
D	18100	4	7593	380	263	187	112	39	25	19	32.5	42.3	12:53:00
D	18200	2	2557	216	147	104	63	20	13	10	32.3	41.2	12:55:14
D	18200	3	4023	333	238	176	109	37	24	15	32.3	41.2	12:55:22
D	18200	4	7492	580	437	336	225	83	51	35	32.3	41.2	12:55:33
D	18300	2	2563	175	113	75	43	18	13	9	32.5	42	12:57:02
D	18300	3	4012	268	182	128	75	31	21	16	32.5	42	12:57:10
D	18300	4	7592	459	327	240	153	64	44	33	32.5	42	12:57:21
C Testing Comment: NEAR KM 128													
D	18400	2	2558	174	112	77	42	12	8	6	32.5	42.3	12:59:05
D	18400	3	4003	264	176	125	71	21	13	10	32.5	42.3	12:59:13
D	18400	4	7521	461	321	233	140	45	28	20	32.5	42.3	12:59:24
D	18500	2	2566	184	120	85	48	15	12	8	31.9	42.1	13:02:10
D	18500	3	4017	281	193	138	82	27	18	11	31.9	42.1	13:02:18
D	18500	4	7546	490	348	257	159	54	35	25	31.9	42.1	13:02:29
D	18600	2	2561	156	103	69	38	11	10	7	31.7	43.4	13:04:31
D	18600	3	4022	237	160	114	62	19	14	10	31.7	43.4	13:04:39
D	18600	4	7580	412	285	204	120	40	29	23	31.7	43.4	13:04:50
D	18701	2	2561	185	126	88	46	9	8	5	32.5	43.8	13:06:27
D	18701	3	3998	279	194	140	76	15	10	7	32.5	43.8	13:06:35
D	18701	4	7527	470	331	244	139	30	18	14	32.5	43.8	13:06:46
D	18800	2	2570	155	106	80	51	16	11	6	33	44	13:08:13
D	18800	3	4015	249	180	136	90	31	19	11	33	44	13:08:21
D	18800	4	7523	464	344	268	184	66	40	25	33	44	13:08:32
D	18900	2	2545	222	141	93	49	12	9	5	33.7	43.9	13:10:07
D	18900	3	3996	334	225	154	86	23	13	8	33.7	43.9	13:10:15
D	18900	4	7494	566	401	284	172	49	28	18	33.7	43.9	13:10:26
D	19000	2	2559	178	118	87	51	15	11	7	33.7	42.7	13:12:14
D	19000	3	4012	273	193	144	88	29	17	12	33.7	42.7	13:12:22
D	19000	4	7527	479	354	272	178	64	39	26	33.7	42.7	13:12:33
D	19050	2	2572	146	101	73	43	13	10	6	32.5	43.4	13:14:15
D	19050	3	4017	223	158	118	72	21	14	10	32.5	43.4	13:14:23
D	19050	4	7543	398	291	219	139	45	28	20	32.5	43.4	13:14:33
C Testing Comment: INNER LANE													
D	19100	2	2545	229	155	109	58	14	9	8	33.6	43.5	13:16:01
D	19100	3	4020	341	242	176	98	26	16	12	33.6	43.5	13:16:09
D	19100	4	7510	571	418	312	188	55	34	24	33.6	43.5	13:16:30
D	19200	2	2543	188	134	96	55	15	10	6	32.3	43.8	13:18:23

Table A-2 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 sem	D20 sem	D30 sem	D45 sem	D90 sem	D120 sem	D150 sem	Air °C	Pave °C	Time hh:mm:ss
D	19200	3	4006	292	211	157	95	25	14	11	32.3	43.8	13:18:31
D	19200	4	7533	500	377	286	183	54	32	21	32.3	43.8	13:18:42
D	19300	2	2552	181	123	86	53	16	11	7	33.3	44.3	13:20:13
D	19300	3	4011	280	199	145	90	28	16	11	33.3	44.3	13:20:22
D	19300	4	7549	499	362	271	177	59	35	23	33.3	44.3	13:20:36
C Testing Comment: NEAR KM 127													
D	19400	2	2565	137	85	55	30	11	7	6	33	44.3	13:22:22
D	19400	3	4030	217	138	93	53	19	13	11	33	44.3	13:22:30
D	19400	4	7566	383	253	177	105	42	29	22	33	44.3	13:22:41
D	19501	2	2547	166	104	69	38	11	9	6	32.1	42.7	13:24:36
D	19501	3	3993	258	169	118	68	21	12	10	32.1	42.7	13:24:48
D	19501	4	7570	451	309	223	137	44	29	19	32.1	42.7	13:24:58
D	19600	2	2559	124	83	54	30	11	9	7	33.3	44.1	13:26:33
D	19600	3	4008	188	130	89	51	19	12	10	33.3	44.1	13:26:41
D	19600	4	7581	328	232	167	103	39	27	21	33.3	44.1	13:26:52
D	19700	2	2544	142	89	59	31	9	7	5	33.7	44	13:28:25
D	19700	3	4008	217	140	98	54	16	13	9	33.7	44	13:28:37
D	19700	4	7587	370	251	177	104	32	21	15	33.7	44	13:28:48
D	19801	2	2558	132	75	49	26	7	6	4	33.9	43.9	13:30:20
D	19801	3	4030	201	121	82	44	13	10	7	33.9	43.9	13:30:28
D	19801	4	7609	347	219	152	85	26	17	12	33.9	43.9	13:30:39
D	19901	2	2561	123	78	54	30	8	7	5	33.3	45.1	13:32:10
D	19901	3	4019	198	132	92	53	15	9	7	33.3	45.1	13:32:22
D	19901	4	7566	363	245	173	101	30	18	14	33.3	45.1	13:32:32
D	20000	2	2548	63	39	30	23	11	7	5	33.7	44.6	13:34:07
D	20000	3	4036	110	70	54	39	18	12	9	33.7	44.6	13:34:15
D	20000	4	7645	213	140	110	79	37	25	18	33.7	44.6	13:34:26
D	20050	2	2562	72	41	31	21	10	9	6	33.6	45.1	13:36:14
D	20050	3	4033	114	70	51	35	17	13	10	33.6	45.1	13:36:26
D	20050	4	7632	213	135	102	70	34	26	20	33.6	45.1	13:36:36
C Testing Comment: INNER LANE													
D	20100	2	2558	152	104	75	45	12	9	7	33.2	44	13:38:05
D	20100	3	4003	233	168	123	75	23	15	10	33.2	44	13:38:13
D	20100	4	7607	416	308	231	146	46	31	22	33.2	44	13:38:24
D	20200	2	2538	218	149	108	61	13	9	7	33.9	43.7	13:40:07
D	20200	3	3993	324	229	168	100	21	12	8	33.9	43.7	13:40:21
D	20200	4	7502	541	390	292	178	42	24	17	33.9	43.7	13:40:32
D	20300	2	2540	252	165	116	64	15	11	9	32.7	44.2	13:42:02
D	20300	3	4006	381	262	187	106	25	16	13	32.7	44.2	13:42:10
D	20300	4	7508	645	449	329	195	50	32	25	32.7	44.2	13:42:21
C Testing Comment: NEAR KM 126													
D	20402	2	2544	226	154	106	54	15	9	8	33.2	43.3	13:44:05
D	20402	3	3992	337	237	169	92	25	16	12	33.2	43.3	13:44:13
D	20402	4	7529	555	405	295	170	48	31	23	33.2	43.3	13:44:24
D	20500	2	2539	194	126	86	45	12	8	6	33.3	43.3	13:46:04
D	20500	3	4022	299	203	141	76	21	13	9	33.3	43.3	13:46:12

Table A-2 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 sem	D20 sem	D30 sem	D45 sem	D90 sem	D120 sem	D150 sem	Air °C	Pave °C	Time hh:mm:ss
D	20500	4	7593	513	357	258	148	42	26	19	33.3	43.3	13:46:22
D	20600	2	2545	209	130	86	44	11	8	6	33.7	44	13:48:24
D	20600	3	3986	308	202	138	76	20	14	11	33.7	44	13:48:32
D	20600	4	7581	506	347	245	143	43	29	22	33.7	44	13:48:43
D	20701	2	2546	188	128	91	52	15	11	8	33.9	43.7	13:50:39
D	20701	3	3978	291	206	151	90	26	17	13	33.9	43.7	13:50:47
D	20701	4	7527	505	367	276	176	57	37	27	33.9	43.7	13:50:58
D	20800	2	2544	163	103	69	36	11	11	7	33.9	43.7	13:52:40
D	20800	3	4004	240	160	112	62	19	14	11	33.9	43.7	13:52:47
D	20800	4	7599	408	282	206	122	42	29	22	33.9	43.7	13:52:58
D	20900	2	2546	175	121	82	43	10	8	7	34.1	43.4	13:54:35
D	20900	3	4001	267	186	130	72	19	11	9	34.1	43.4	13:54:43
D	20900	4	7580	447	322	234	138	40	25	18	34.1	43.4	13:54:53
D	21000	2	2546	149	93	62	34	14	12	9	33.3	43.6	13:56:48
D	21000	3	4015	236	154	107	62	24	17	12	33.3	43.6	13:56:55
D	21000	4	7585	418	288	208	130	51	36	28	33.3	43.6	13:57:06
D	21050	2	2551	204	142	102	58	14	10	7	33.3	43.6	13:58:54
D	21050	3	3987	316	224	164	97	25	16	12	33.3	43.6	13:59:02
D	21050	4	7508	564	405	303	185	52	32	23	33.3	43.6	13:59:13
C Testing Comment: INNER LANE													
D	21100	2	2552	194	122	82	47	16	13	10	34.4	44.4	14:00:49
D	21100	3	4026	298	196	138	80	28	21	17	34.4	44.4	14:00:58
D	21100	4	7568	509	348	250	152	57	41	33	34.4	44.4	14:01:09
D	21201	2	2538	265	177	123	66	18	12	10	33.2	44.8	14:02:39
D	21201	3	3992	400	279	200	112	29	19	15	33.2	44.8	14:02:47
D	21201	4	7525	664	474	352	208	59	39	30	33.2	44.8	14:03:03
D	21300	2	2557	243	164	116	67	22	17	15	33.7	42.9	14:04:55
D	21300	3	4023	367	259	188	115	39	27	23	33.7	42.9	14:05:03
D	21300	4	7521	629	464	347	224	81	54	44	33.7	42.9	14:05:14
C Testing Comment: NEAR KM 125													
C Testing Comment: AT KM 125													
D	21400	2	2552	223	154	108	62	20	17	14	34.1	42.1	14:08:05
D	21400	3	3998	334	240	175	105	36	27	22	34.1	42.1	14:08:13
D	21400	4	7549	570	424	316	201	73	54	43	34.1	42.1	14:08:24
D	21500	2	2559	227	143	92	42	11	10	7	33.7	43.6	14:10:05
D	21500	3	4006	329	215	143	72	19	14	12	33.7	43.6	14:10:13
D	21500	4	7585	543	367	252	138	39	27	23	33.7	43.6	14:10:24
D	21601	2	2560	204	136	96	55	17	16	13	34.1	44.2	14:12:07
D	21601	3	4014	301	216	157	95	31	22	19	34.1	44.2	14:12:15
D	21601	4	7585	505	371	277	178	62	44	35	34.1	44.2	14:12:26
D	21700	2	2570	288	187	126	64	16	14	11	34.3	43.2	14:14:03
D	21700	3	3979	418	285	197	106	28	19	15	34.3	43.2	14:14:11
D	21700	4	7527	706	491	349	198	55	37	31	34.3	43.2	14:14:22
D	21800	2	2550	252	168	115	62	19	13	11	34.3	41.2	14:17:23
D	21800	3	3955	382	266	187	105	31	21	18	34.3	41.2	14:17:32
D	21800	4	7533	659	467	337	201	60	41	33	34.3	41.2	14:17:43

Table A-2 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 sem	D20 sem	D30 sem	D45 sem	D90 sem	D120 sem	D150 sem	Air sC	Pave sC	Time hh:mm:ss
D	21900	2	2539	229	158	118	68	17	12	10	34.3	43.9	14:19:38
D	21900	3	4008	351	253	192	115	31	21	15	34.3	43.9	14:19:46
D	21900	4	7562	587	430	335	210	60	39	30	34.3	43.9	14:19:58
D	21999	2	2552	267	178	122	70	18	13	11	33.9	43.3	14:21:34
D	21999	3	4009	409	284	199	118	30	21	17	33.9	43.3	14:21:41
D	21999	4	7524	681	492	357	221	62	41	33	33.9	43.3	14:21:52
D	22100	2	2579	104	64	46	31	15	13	11	34.1	43.8	14:23:49
D	22100	3	4028	171	111	79	53	25	20	16	34.1	43.8	14:23:57
D	22100	4	7646	321	215	157	105	50	38	31	34.1	43.8	14:24:08
D	22201	2	2542	252	160	109	58	18	13	11	33.7	43.6	14:25:58
D	22201	3	3987	384	257	177	99	31	21	17	33.7	43.6	14:26:06
D	22201	4	7491	652	451	321	189	61	42	33	33.7	43.6	14:26:19
D	22301	2	2544	216	130	86	45	14	11	10	33.3	42.3	14:28:08
D	22301	3	3989	335	211	144	78	25	18	15	33.3	42.3	14:28:16
D	22301	4	7564	570	373	263	151	50	36	29	33.3	42.3	14:28:27
C Testing Comment: AT KM 124													
D	22400	2	2532	223	157	111	63	17	11	9	33.9	41.7	14:32:12
D	22400	3	4000	353	256	187	110	29	18	13	33.9	41.7	14:32:25
D	22400	4	7521	635	469	352	215	58	34	25	33.9	41.7	14:32:36
D	22500	2	2541	242	163	114	67	22	16	13	34.6	41.1	14:35:58
D	22500	3	4010	376	262	191	117	40	26	20	34.6	41.1	14:36:06
D	22500	4	7525	652	469	351	226	80	52	40	34.6	41.1	14:36:21
D	22600	2	2532	283	191	128	70	19	14	10	33.3	41.7	14:38:12
D	22600	3	3977	454	317	223	126	34	21	16	33.3	41.7	14:38:20
D	22600	4	7446	801	586	427	256	71	42	31	33.3	41.7	14:38:30
D	22701	2	2536	246	166	115	61	14	9	6	33.9	41.6	14:41:07
D	22701	3	4006	370	262	187	105	24	12	10	33.9	41.6	14:41:15
D	22701	4	7569	622	455	333	198	48	27	19	33.9	41.6	14:41:30
C Testing Comment: NEAR PIPE CULVERT													
D	22800	2	2528	233	150	102	55	15	11	9	32.7	42.9	14:43:32
D	22800	3	3976	351	238	167	93	25	18	14	32.7	42.9	14:43:40
D	22800	4	7574	596	412	300	179	52	36	29	32.7	42.9	14:43:51
D	22900	2	2552	205	140	101	59	19	13	10	32.7	43.4	14:45:48
D	22900	3	4008	313	226	167	100	32	21	17	32.7	43.4	14:46:01
D	22900	4	7556	543	400	308	192	62	42	33	32.7	43.4	14:46:12
D	23000	2	2558	210	144	99	58	17	12	12	34.3	44	14:47:59
D	23000	3	3993	316	227	161	96	31	21	16	34.3	44	14:48:07
D	23000	4	7577	533	395	290	184	60	40	33	34.3	44	14:48:17
C Testing Comment: NEAR PIPE CULVERT													
D	23100	2	2543	223	144	100	54	20	15	12	33.3	43.4	14:50:05
D	23100	3	4002	331	228	162	93	33	25	20	33.3	43.4	14:50:14
D	23100	4	7519	560	395	290	180	68	49	40	33.3	43.4	14:50:25
D	23200	2	2546	213	138	93	46	14	11	9	33.9	43.5	14:52:16
D	23200	3	4001	316	216	149	78	25	19	15	33.9	43.5	14:52:24
D	23200	4	7540	528	373	267	149	52	38	31	33.9	43.5	14:52:35
D	23300	2	2551	261	165	106	57	21	16	13	34.1	43.5	14:54:17

Table A-2 (cont'd).[illegible]

Table A-2 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 sem	D20 sem	D30 sem	D45 sem	D90 sem	D120 sem	D150 sem	Air °C	Pave °C	Time hh:mm:ss
D	24700	2	2538	295	208	154	99	44	33	25	33.6	39.6	15:26:54
D	24700	3	3983	466	346	264	174	77	54	39	33.6	39.6	15:27:08
D	24700	4	7488	875	671	528	365	162	110	80	33.6	39.6	15:27:19
C Testing Comment: ON PATCHING													
D	24800	2	2538	275	168	110	57	20	14	12	34.1	39.1	15:28:59
D	24800	3	3981	422	272	183	102	36	24	19	34.1	39.1	15:29:07
D	24800	4	7557	740	506	356	210	75	51	37	34.1	39.1	15:29:18
C Testing Comment: TIME 3 30													
D	24900	2	2539	243	160	106	55	19	13	11	34.3	34.9	15:31:59
D	24900	3	4009	376	256	178	98	32	23	17	34.3	34.9	15:32:08
D	24900	4	7549	665	469	339	202	67	44	33	34.3	34.9	15:32:19
D	25000	2	2525	233	146	100	56	21	14	11	33.9	40.2	15:34:04
D	25000	3	3980	366	244	172	101	36	26	19	33.9	40.2	15:34:12
D	25000	4	7551	655	461	338	210	76	51	38	33.9	40.2	15:34:28
D	25100	2	2558	219	151	110	67	22	16	13	34.4	39.4	15:36:08
D	25100	3	3998	347	251	188	118	42	27	20	34.4	39.4	15:36:16
D	25100	4	7566	644	477	370	240	86	56	40	34.4	39.4	15:36:27
C Testing Comment: ON PATCHING													
D	25200	2	2554	207	143	100	57	19	16	12	33.9	38.9	15:38:16
D	25200	3	4034	327	235	172	102	33	22	17	33.9	38.9	15:38:29
D	25200	4	7581	602	448	340	214	72	49	36	33.9	38.9	15:38:40
D	25300	2	2550	288	185	129	73	26	19	14	33.3	39.3	15:40:13
D	25300	3	4006	457	308	221	130	45	31	24	33.3	39.3	15:40:21
D	25300	4	7549	817	577	431	267	96	64	47	33.3	39.3	15:40:32
D	25400	2	2538	248	177	129	75	25	17	13	33.6	38.9	15:42:20
D	25400	3	4013	382	286	214	131	43	27	21	33.6	38.9	15:42:33
D	25400	4	7580	671	521	402	262	90	58	42	33.6	38.9	15:42:44
D	25500	2	2524	346	231	165	102	42	32	24	33	39.5	15:44:33
D	25500	3	3979	544	385	284	183	76	54	40	33	39.5	15:44:42
D	25500	4	7425	996	738	567	387	165	113	80	33	39.5	15:44:53
C Testing Comment: ON PATCHING													
D	25600	2	2558	190	136	103	66	24	17	13	33	40	15:46:41
D	25600	3	4021	308	227	176	118	42	29	20	33	40	15:46:49
D	25600	4	7564	574	441	353	245	90	58	43	33	40	15:47:00
C Testing Comment: NEAR KM 121													
D	25700	2	2551	174	115	82	48	19	14	13	34.1	39.7	15:48:43
D	25700	3	3993	278	193	140	85	31	24	19	34.1	39.7	15:48:56
D	25700	4	7557	499	364	274	176	67	48	39	34.1	39.7	15:49:12
D	25800	2	2562	100	63	46	30	13	11	8	32.1	37.9	15:51:25
D	25800	3	4027	163	108	80	52	24	17	13	32.1	37.9	15:51:33
D	25800	4	7638	313	216	163	110	51	36	28	32.1	37.9	15:51:44
D	25901	2	2557	194	126	85	47	17	13	11	33.9	38.8	15:53:42
D	25901	3	4019	313	211	149	85	32	23	17	33.9	38.8	15:53:50
D	25901	4	7564	564	399	290	176	64	46	37	33.9	38.8	15:54:06
D	26000	2	2538	174	110	74	40	16	13	11	33.7	37.9	15:56:06
D	26000	3	4030	274	184	125	70	28	21	17	33.7	37.9	15:56:14

Table A-2 (cont'd).[illegible]

Table A-3 : Measured FWD deflection data for stations 27000-42800.

IFWD DATA FILE : A:\N5S2D1A.FWD

HProject : N5
 HSection : 2
 HLocation : start from hyd tol plaza
 HRoad clas. : Flex
 HNo of lanes : 2
 HMeasured lane : outer
 H :
 HSurface type : asphalt
 HLane width : 12
 HDirection(NSWE) : s
 HShoulder type : ST
 HOffset side dist. : 3 ft
 HWeather : Sunny
 H :
 HOperator : almani

 IDate Created : 02-28-1995

 HMachine Type : KUAB FWD Model 150
 HSoftware Version : 4.23

 ILoad Mode : 1 (6+6 large buffers, 3 stack weights)
 IPlate Radius : 15.0 (cm)
 HPlate Cal Factor : 11050.00
 HPlate Cal Add : 150
 HPlate Gain Factor: 1.00000
 HPlate Cal Date : 11-27-1994
 HPlate Cal Time : 12:23:02

 HAir Cal Factor : 0.073093
 HAir Cal Add : -273
 HAir Cal Date : 02-27-1995
 HAir Cal Time : 10:07:27
 HDMI Cal Factor : 0.696384
 HDMI Last Cal Date: 02-26-1995
 HDMI Last Cal Time: 09:57:59
 IDrop Sequence : 2123
 IRecord Drop? : NYYY
 IChannel : 0 1 2 3 4 5 6
 ISensor ID : 0- 1- 2- 3- 4- 5- 6-
 IDistance : 0.0 20.0 30.0 45.0 90.0 120.0 150.0 (cm)
 IPosition : CENTER BEHIND BEHIND BEHIND BEHIND BEHIND BEHIND
 HStatic Cal Factor: 0.5642 0.2884 0.2816 0.2865 0.1399 0.1376 0.1396
 HDyn Cal Factor : 1.050 1.050 1.050 1.050 1.050 1.050 1.050
 HGain Factor : 1.000 1.000 1.000 1.000 1.000 1.000 1.000
 HChannel Cal Date : 02-24-95 02-24-95 02-24-95 02-24-95 02-24-95 02-24-95 02-24-95
 HChannel Cal Time : 14:22:24 14:22:24 14:22:24 14:22:24 14:22:24 14:22:24 14:22:24
 H

Table A-3 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 mm	D20 mm	D30 mm	D45 mm	D90 mm	D120 mm	D150 mm	Air °C	Pave °C	Time hh:mm:ss
D	27000	2	2625	120	85	64	43	15	10	7	27.3	31.1	10:10:02
D	27000	3	4116	202	152	116	74	24	15	12	27.3	31.1	10:10:11
D	27000	4	7353	393	304	236	158	53	32	22	27.3	31.1	10:10:24
C Testing Comment: start of work on day 3, at same location 27000													
D	27100	2	2613	111	73	53	32	13	10	7	27.1	30.8	10:12:46
D	27100	3	4115	187	129	93	58	23	16	12	27.1	30.8	10:12:55
D	27100	4	7383	351	257	190	123	47	33	23	27.1	30.8	10:13:13
C Testing Comment: on patch work													
D	27200	2	2604	191	127	96	58	19	12	10	27	30.6	10:14:50
D	27200	3	4090	308	220	167	102	31	21	15	27	30.6	10:14:59
D	27200	4	7357	557	415	321	208	67	42	30	27	30.6	10:15:11
D	27300	2	2622	110	81	64	44	19	15	11	27.6	31.2	10:16:46
D	27300	3	4099	184	140	111	78	34	23	17	27.6	31.2	10:17:01
D	27300	4	7388	368	293	235	164	71	46	33	27.6	31.2	10:17:13
D	27401	2	2603	179	126	96	60	25	17	12	27.5	30.9	10:18:44
D	27401	3	4080	299	225	171	111	43	28	19	27.5	30.9	10:18:53
D	27401	4	7333	571	452	355	242	93	58	40	27.5	30.9	10:19:06
D	27500	2	2606	139	94	74	45	17	12	9	28.2	31.5	10:20:42
D	27500	3	4080	232	165	128	80	26	19	14	28.2	31.5	10:20:57
D	27500	4	7361	428	322	253	165	56	37	28	28.2	31.5	10:21:09
D	27600	2	2600	137	94	73	45	16	12	9	29.2	31.7	10:22:45
D	27600	3	4102	229	164	124	80	29	19	15	29.2	31.7	10:22:54
D	27600	4	7402	418	311	240	162	58	39	28	29.2	31.7	10:23:06
C Testing Comment: near km post 119													
D	27700	2	2613	184	134	100	60	20	13	9	28.6	31.3	10:24:48
D	27700	3	4087	302	229	176	111	34	21	15	28.6	31.3	10:24:57
D	27700	4	7355	562	441	347	228	73	43	30	28.6	31.3	10:25:09
D	27800	2	2599	189	127	95	57	19	13	10	29.3	31.9	10:26:43
D	27800	3	4074	312	225	167	103	32	21	16	29.3	31.9	10:26:52
D	27800	4	7371	584	436	335	218	70	43	31	29.3	31.9	10:27:05
D	27901	2	2599	221	152	111	65	20	14	9	28.9	32	10:28:53
D	27901	3	4080	359	257	191	118	37	22	16	28.9	32	10:29:02
D	27901	4	7394	655	491	381	248	81	48	32	28.9	32	10:29:15
D	28000	2	2599	202	140	104	64	24	15	12	28.7	32.3	10:31:02
D	28000	3	4077	333	240	183	114	39	25	19	28.7	32.3	10:31:11
D	28000	4	7387	601	452	354	235	83	54	40	28.7	32.3	10:31:31
D	28100	2	2599	213	143	106	62	22	16	12	28.9	32.9	10:33:09
D	28100	3	4073	349	247	185	113	39	27	20	28.9	32.9	10:33:19
D	28100	4	7424	633	471	364	238	84	56	41	28.9	32.9	10:33:31
D	28200	2	2585	205	144	106	67	24	17	14	30.1	33.5	10:35:15
D	28200	3	4061	336	247	185	117	41	28	21	30.1	33.5	10:35:24
D	28200	4	7426	614	470	362	243	87	58	44	30.1	33.5	10:35:36
D	28300	2	2590	136	97	76	49	19	13	10	27.9	33.5	10:37:24
D	28300	3	4082	233	171	134	89	33	22	18	27.9	33.5	10:37:33
D	28300	4	7456	448	347	276	191	71	46	34	27.9	33.5	10:37:45
D	28400	2	2552	379	239	163	82	34	24	17	28.9	33.6	10:39:20

Table A-3 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 æm	D20 æm	D30 æm	D45 æm	D90 æm	D120 æm	D150 æm	Air °C	Pave °C	Time hh:mm:ss
D	28400	3	4017	626	423	295	156	62	41	29	28.9	33.6	10:39:29
D	28400	4	7251	1108	796	590	343	135	89	62	28.9	33.6	10:39:41
D	28500	2	2599	116	81	64	45	21	18	14	28.4	33	10:41:24
D	28500	3	4082	192	142	111	79	38	29	23	28.4	33	10:41:33
D	28500	4	7506	373	282	223	163	79	58	46	28.4	33	10:41:45
D	28600	2	2575	226	137	92	48	14	10	9	28.9	33.9	10:43:12
D	28600	3	4037	362	232	158	84	24	16	12	28.9	33.9	10:43:24
D	28600	4	7437	642	431	302	170	47	32	25	28.9	33.9	10:43:35
C Testing Comment: near km post 118													
D	28700	2	2584	178	116	84	51	19	13	10	28.9	33.7	10:45:22
D	28700	3	4077	298	205	151	92	33	22	16	28.9	33.7	10:45:31
D	28700	4	7415	562	405	306	199	71	47	32	28.9	33.7	10:45:43
C Testing Comment: near culvert													
D	28800	2	2613	110	71	51	32	10	9	8	29.5	34.1	10:47:26
D	28800	3	4099	172	118	87	54	19	13	11	29.5	34.1	10:47:41
D	28800	4	7518	312	220	167	106	37	25	21	29.5	34.1	10:47:52
D	28901	2	2570	219	134	87	42	11	8	7	29.5	34	10:49:25
D	28901	3	4071	349	228	153	77	19	13	12	29.5	34	10:49:34
D	28901	4	7394	624	427	297	159	39	26	21	29.5	34	10:49:46
D	29000	2	2581	226	150	106	62	20	16	12	29.1	34.1	10:51:22
D	29000	3	4050	356	249	183	109	36	25	20	29.1	34.1	10:51:37
D	29000	4	7409	636	466	352	222	73	50	39	29.1	34.1	10:51:49
D	29100	2	2575	290	208	157	98	38	28	22	29.5	34.4	10:53:23
D	29100	3	4047	480	359	276	177	67	45	34	29.5	34.4	10:53:32
D	29100	4	7366	879	692	548	369	136	90	67	29.5	34.4	10:53:44
D	29200	2	2576	177	123	92	59	20	14	12	29.5	33.9	10:55:19
D	29200	3	4088	281	203	155	101	36	24	19	29.5	33.9	10:55:41
D	29200	4	7484	510	386	301	206	75	50	37	29.5	33.9	10:55:51
D	29300	2	2580	191	131	96	57	17	12	9	28.9	34.3	10:57:24
D	29300	3	4063	315	227	170	103	31	19	13	28.9	34.3	10:57:33
D	29300	4	7440	586	441	338	217	66	40	28	28.9	34.3	10:57:45
D	29400	2	2589	177	131	102	68	23	15	12	30	32.6	11:00:17
D	29400	3	4063	291	226	178	121	43	27	19	30	32.6	11:00:31
D	29400	4	7461	557	447	359	253	93	58	40	30	32.6	11:00:43
D	29500	2	2570	250	172	129	79	22	12	9	29.7	34.4	11:02:10
D	29500	3	4022	403	290	223	145	42	21	14	29.7	34.4	11:02:19
D	29500	4	7410	732	549	435	294	90	47	30	29.7	34.4	11:02:31
D	29600	2	2572	190	130	97	60	18	11	7	28.9	35.3	11:04:02
D	29600	3	4061	308	228	172	108	32	18	11	28.9	35.3	11:04:17
D	29600	4	7451	581	449	352	233	71	37	22	28.9	35.3	11:04:29
C Testing Comment: near km post 117													
D	29700	2	2572	319	214	152	88	25	15	11	27.3	34.8	11:06:11
D	29700	3	4017	524	369	271	163	46	26	18	27.3	34.8	11:06:20
D	29700	4	7310	962	712	541	342	97	54	37	27.3	34.8	11:06:32
D	29800	2	2585	211	145	107	64	21	15	11	28.4	33.2	11:08:17
D	29800	3	4066	341	248	183	116	37	25	19	28.4	33.2	11:08:26

Table A-3 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 sem	D20 sem	D30 sem	D45 sem	D90 sem	D120 sem	D150 sem	Air °C	Pave °C	Time hh:mm:ss
D	29800	4	7437	619	467	360	236	77	50	37	28.4	33.2	11:08:39
D	29901	2	2587	227	147	100	51	13	9	7	28.4	33.7	11:10:09
D	29901	3	4060	357	243	170	93	23	15	11	28.4	33.7	11:10:18
D	29901	4	7451	623	441	318	186	45	28	21	28.4	33.7	11:10:30
D	30000	2	2599	245	171	124	74	15	8	4	28.9	34.4	11:12:07
D	30000	3	4054	386	285	209	130	28	13	8	28.9	34.4	11:12:16
D	30000	4	7451	688	527	399	260	61	27	15	28.9	34.4	11:12:28
D	30100	2	2615	242	159	112	61	16	10	5	28.2	34.8	11:14:01
D	30100	3	4044	373	259	187	108	26	14	9	28.2	34.8	11:14:10
D	30100	4	7447	663	485	360	222	57	30	19	28.2	34.8	11:14:43
D	30201	2	2592	195	134	100	57	12	6	6	28.9	34.9	11:16:35
D	30201	3	4020	293	215	158	96	22	12	9	28.9	34.9	11:16:44
D	30201	4	7434	521	387	297	187	47	24	17	28.9	34.9	11:16:56
D	30300	2	2592	271	173	106	55	14	11	7	28.5	35.2	11:18:34
D	30300	3	4061	411	279	180	97	27	16	11	28.5	35.2	11:18:43
D	30300	4	7465	704	508	349	202	56	34	24	28.5	35.2	11:18:55
D	30400	2	2572	240	161	117	67	20	13	8	27.5	36.1	11:20:34
D	30400	3	4048	379	270	202	121	37	22	15	27.5	36.1	11:20:51
D	30400	4	7429	680	508	393	253	80	48	33	27.5	36.1	11:21:02
D	30500	2	2621	149	103	74	38	10	6	5	29.8	36.2	11:22:55
D	30500	3	4089	222	156	111	63	15	9	7	29.8	36.2	11:23:04
D	30500	4	7560	357	261	190	111	26	16	12	29.8	36.2	11:23:16
D	30600	2	2605	110	69	51	31	11	8	6	30	36.3	11:25:00
D	30600	3	4089	171	117	87	54	20	14	11	30	36.3	11:25:09
D	30600	4	7519	313	222	165	109	41	28	20	30	36.3	11:25:21
C Testing Comment: near km post 116													
D	30700	2	2599	241	165	123	77	19	11	7	29.7	36.6	11:27:07
D	30700	3	4053	376	269	207	131	33	18	12	29.7	36.6	11:27:16
D	30700	4	7437	662	488	384	252	70	37	24	29.7	36.6	11:27:35
D	30800	2	2597	153	99	71	40	13	8	6	29.6	36.1	11:29:14
D	30800	3	4056	239	163	119	71	23	15	10	29.6	36.1	11:29:24
D	30800	4	7544	427	304	228	144	49	30	21	29.6	36.1	11:29:35
D	30900	2	2579	116	84	66	45	17	12	8	30	35.1	11:31:10
D	30900	3	4071	197	147	116	81	30	20	14	30	35.1	11:31:19
D	30900	4	7546	373	288	230	166	66	42	30	30	35.1	11:31:37
D	31000	2	2600	116	86	70	48	16	11	7	30.1	35.4	11:33:16
D	31000	3	4080	191	148	121	84	29	18	12	30.1	35.4	11:33:25
D	31000	4	7518	360	287	236	171	63	37	25	30.1	35.4	11:33:37
D	31101	2	2573	205	143	101	57	14	9	7	30	36.2	11:35:11
D	31101	3	4058	323	227	165	97	22	14	11	30	36.2	11:35:20
D	31101	4	7503	544	400	301	189	52	31	23	30	36.2	11:35:38
D	31200	2	2551	249	160	113	62	18	12	9	29.2	35.6	11:37:16
D	31200	3	4056	377	261	186	110	35	20	15	29.2	35.6	11:37:25
D	31200	4	7443	643	471	350	222	73	46	31	29.2	35.6	11:37:37
D	31300	2	2584	241	171	129	77	22	13	8	29.1	35.5	11:39:15
D	31300	3	4045	380	280	217	134	40	23	15	29.1	35.5	11:39:25

Table A-3 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 sem	D20 sem	D30 sem	D45 sem	D90 sem	D120 sem	D150 sem	Air °C	Pave °C	Time hh:mm:ss
D	31300	4	7443	667	507	406	264	87	50	31	29.1	35.5	11:39:43
D	31401	2	2586	124	84	62	40	14	11	8	29.8	35.2	11:41:17
D	31401	3	4060	204	144	108	70	25	16	12	29.8	35.2	11:41:26
D	31401	4	7544	382	280	216	145	54	35	25	29.8	35.2	11:41:38
D	31500	2	2586	188	121	86	50	13	9	7	29.2	35.4	11:43:12
D	31500	3	4067	291	197	144	85	21	14	11	29.2	35.4	11:43:21
D	31500	4	7523	499	349	261	163	45	29	23	29.2	35.4	11:43:39
D	31601	2	2577	172	114	80	44	13	9	8	30.8	36.2	11:45:10
D	31601	3	4077	264	181	128	73	22	15	13	30.8	36.2	11:45:26
D	31601	4	7570	447	314	230	141	47	32	25	30.8	36.2	11:45:36
C Testing Comment: km post 115 nearly													
D	31700	3	4068	195	136	97	57	14	9	7	30.6	36.8	11:47:33
D	31700	4	7566	339	245	178	109	28	18	13	30.6	36.8	11:47:52
D	31801	2	2559	210	136	94	54	11	7	5	30.7	36.4	11:49:19
D	31801	3	4061	313	214	153	88	19	11	8	30.7	36.4	11:49:28
D	31801	4	7550	516	366	269	164	38	21	15	30.7	36.4	11:49:40
D	31901	2	2567	230	156	111	61	13	7	5	30.2	35.9	11:51:14
D	31901	3	4030	339	243	177	101	23	12	7	30.2	35.9	11:51:24
D	31901	4	7487	561	411	309	187	45	22	14	30.2	35.9	11:51:42
D	32000	2	2578	139	90	63	36	7	5	4	29.8	36.2	11:53:25
D	32000	3	4061	219	148	105	59	14	8	4	29.8	36.2	11:53:34
D	32000	4	7558	373	261	187	112	26	16	11	29.8	36.2	11:53:46
D	32101	2	2563	237	143	89	39	5	2	2	29.2	35.4	11:55:37
D	32101	3	4042	370	231	147	66	9	4	2	29.2	35.4	11:55:46
D	32101	4	7459	626	404	265	123	15	7	5	29.2	35.4	11:56:04
D	32200	2	2591	149	97	70	40	9	4	4	28.2	35.6	11:57:42
D	32200	3	4061	243	168	122	72	15	8	5	28.2	35.6	11:57:51
D	32200	4	7488	437	314	232	142	31	16	9	28.2	35.6	11:58:03
D	32300	2	2594	150	109	82	50	11	5	3	30	35.5	11:59:47
D	32300	3	4041	238	180	135	84	17	7	4	30	35.5	11:59:56
D	32300	4	7524	421	322	245	159	35	13	7	30	35.5	12:00:14
D	32400	2	2621	73	52	41	26	11	6	5	28.9	35.2	12:03:33
D	32400	3	4082	127	91	72	49	18	11	7	28.9	35.2	12:03:42
D	32400	4	7556	252	191	152	105	39	23	15	28.9	35.2	12:03:54
C Testing Comment: on top of hill													
D	32501	2	2581	156	107	78	45	11	6	4	30.3	36.9	12:05:42
D	32501	3	4052	272	193	141	82	19	10	6	30.3	36.9	12:05:58
D	32501	4	7500	519	383	286	175	42	22	13	30.3	36.9	12:06:09
D	32600	2	2572	267	147	87	39	10	6	3	30.2	37.2	12:07:44
D	32600	3	4039	419	245	152	73	18	10	6	30.2	37.2	12:07:53
D	32600	4	7461	723	445	289	148	37	19	11	30.2	37.2	12:08:05
C Testing Comment: near km post 114													
D	32700	2	2579	118	73	48	25	7	4	2	30.3	37.2	12:10:08
D	32700	3	4094	187	121	82	45	12	7	4	30.3	37.2	12:10:17
D	32700	4	7558	316	218	154	89	22	12	8	30.3	37.2	12:10:29
D	32801	2	2559	233	149	103	51	6	2	2	30.3	38.6	12:12:22

Table A-3 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 sem	D20 sem	D30 sem	D45 sem	D90 sem	D120 sem	D150 sem	Air °C	Pave °C	Time hh:mm:ss
D	32801	3	4033	341	229	162	86	10	3	2	30.3	38.6	12:12:32
D	32801	4	7487	559	389	281	155	21	7	4	30.3	38.6	12:12:43
D	32901	2	2551	198	117	77	37	5	3	2	29.2	37.7	12:14:27
D	32901	3	4056	294	186	127	62	10	5	3	29.2	37.7	12:14:36
D	32901	4	7514	476	318	219	116	20	10	6	29.2	37.7	12:14:47
D	33101	2	2566	178	122	88	49	7	2	2	30	38.1	12:17:23
D	33101	3	4042	272	194	141	83	12	5	2	30	38.1	12:17:32
D	33101	4	7515	457	335	248	151	25	8	4	30	38.1	12:17:44
D	33200	2	2589	105	65	45	21	5	3	2	30.1	38.3	12:19:38
D	33200	3	4054	168	109	75	36	6	4	3	30.1	38.3	12:19:47
D	33200	4	7533	285	196	138	72	14	7	5	30.1	38.3	12:19:59
D	33300	2	2577	163	114	82	44	5	2	1	29.8	38.1	12:21:40
D	33300	3	4039	243	180	129	70	9	4	2	29.8	38.1	12:21:49
D	33300	4	7516	406	301	217	124	16	6	5	29.8	38.1	12:22:01
D	33400	2	2572	161	95	64	31	5	4	2	27.9	38.2	12:23:47
D	33400	3	4050	264	168	111	57	8	4	3	27.9	38.2	12:23:56
D	33400	4	7502	488	321	222	116	18	8	5	27.9	38.2	12:24:08
D	33500	2	2583	153	94	61	26	4	1	5	28	37.2	12:26:00
D	33500	3	4048	252	160	105	47	6	2	1	28	37.2	12:26:10
D	33500	4	7496	451	298	199	94	9	3	3	28	37.2	12:26:21
D	33601	2	2591	216	104	58	27	7	5	4	26.4	37.8	12:28:04
D	33601	3	4035	334	174	100	49	12	7	6	26.4	37.8	12:28:13
D	33601	4	7477	572	314	192	98	23	13	10	26.4	37.8	12:28:25
C Testing Comment: near km post 113													
D	33700	2	2573	137	88	64	37	14	10	7	27.6	38	12:29:59
D	33700	3	4050	229	155	111	68	22	14	11	27.6	38	12:30:08
D	33700	4	7497	428	306	226	146	49	31	21	27.6	38	12:30:27
D	33800	2	2583	150	103	77	48	12	5	4	28.6	37.7	12:32:05
D	33800	3	4030	248	177	134	83	20	11	6	28.6	37.7	12:32:14
D	33800	4	7511	482	352	274	173	43	20	11	28.6	37.7	12:32:26
D	33901	2	2549	366	196	96	32	12	12	13	30	38.3	12:34:19
D	33901	3	3987	536	296	152	51	19	20	18	30	38.3	12:34:33
D	33901	4	7437	869	494	258	94	38	38	35	30	38.3	12:34:52
D	34000	2	2572	113	79	61	39	15	10	8	28.4	38.6	12:36:41
D	34000	3	4058	184	134	104	68	24	17	12	28.4	38.6	12:36:51
D	34000	4	7547	339	256	202	137	52	33	23	28.4	38.6	12:37:03
D	34101	2	2561	270	189	142	85	27	17	13	28.9	38.8	12:38:44
D	34101	3	4020	411	299	230	143	46	29	21	28.9	38.8	12:38:53
D	34101	4	7454	697	532	422	276	96	59	42	28.9	38.8	12:39:11
D	34200	2	2572	251	181	139	93	27	18	15	30.1	39.3	12:40:53
D	34200	3	4006	377	282	221	151	46	29	22	30.1	39.3	12:41:02
D	34200	4	7446	652	503	402	283	98	60	44	30.1	39.3	12:41:14
D	34300	2	2572	261	188	144	90	27	16	12	28.6	38.6	12:43:12
D	34300	3	4021	403	303	236	154	47	29	20	28.6	38.6	12:43:21
D	34300	4	7470	716	559	449	308	106	61	41	28.6	38.6	12:43:40
D	34401	2	2572	259	180	131	81	28	21	16	30	39.4	12:45:30

Table A-3 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 mm	D20 mm	D30 mm	D45 mm	D90 mm	D120 mm	D150 mm	Air °C	Pave °C	Time hh:mm:ss
D	34401	3	4039	388	282	211	134	47	32	26	30	39.4	12:45:40
D	34401	4	7496	648	494	377	251	90	62	48	30	39.4	12:45:52
D	34500	2	2593	127	93	72	47	16	12	10	30.1	39.4	12:47:27
D	34500	3	4058	203	152	118	79	26	19	15	30.1	39.4	12:47:36
D	34500	4	7538	363	280	219	152	55	36	29	30.1	39.4	12:47:55
D	34601	2	2572	206	152	118	79	28	18	15	28.7	40	12:49:37
D	34601	3	4037	321	245	194	131	46	30	22	28.7	40	12:49:47
D	34601	4	7502	574	450	360	256	95	60	45	28.7	40	12:50:00
C Testing Comment: near km post 112 & police post no. 11													
D	34700	2	2579	226	134	92	53	24	19	16	30	39.1	12:51:38
D	34700	3	4037	351	220	153	90	41	31	25	30	39.1	12:51:54
D	34700	4	7503	632	416	304	189	87	64	50	30	39.1	12:52:06
D	34800	2	2588	134	88	64	38	15	11	9	27.1	39.3	12:53:51
D	34800	3	4044	205	144	105	65	24	17	13	27.1	39.3	12:54:01
D	34800	4	7571	362	261	199	128	50	34	25	27.1	39.3	12:54:12
D	34901	2	2580	155	102	74	48	19	14	15	28.7	39.9	12:56:04
D	34901	3	4048	249	169	124	77	32	26	23	28.7	39.9	12:56:21
D	34901	4	7542	457	321	239	152	61	47	41	28.7	39.9	12:56:33
D	35000	2	2581	137	90	63	35	13	11	9	30.3	41	12:58:15
D	35000	3	4059	226	154	110	60	22	18	14	30.3	41	12:58:24
D	35000	4	7562	411	292	212	122	44	31	26	30.3	41	12:58:35
D	35101	2	2561	203	147	108	70	24	16	13	29.6	40.1	13:00:21
D	35101	3	4028	336	253	190	120	41	26	20	29.6	40.1	13:00:37
D	35101	4	7520	623	480	368	240	84	53	39	29.6	40.1	13:00:49
C Testing Comment: 60 metres before abutment													
C Testing Comment: 35200 at bridge location													
D	35300	2	2560	252	175	127	74	24	21	17	30	40.5	13:04:06
D	35300	3	4028	392	282	209	123	39	32	26	30	40.5	13:04:21
D	35300	4	7475	683	507	382	236	81	62	50	30	40.5	13:04:40
D	35401	2	2551	240	140	87	40	14	11	10	30.8	41.6	13:06:26
D	35401	3	4008	380	231	150	72	24	18	14	30.8	41.6	13:06:36
D	35401	4	7444	675	424	289	148	47	35	28	30.8	41.6	13:06:47
D	35502	2	2573	163	108	75	43	12	10	9	29.8	40.7	13:08:55
D	35502	3	4030	261	178	126	73	21	15	13	29.8	40.7	13:09:04
D	35502	4	7544	448	319	232	141	41	29	24	29.8	40.7	13:09:23
D	35601	2	2562	243	166	114	61	16	11	10	30.8	41.2	13:11:02
D	35601	3	4008	360	259	179	101	26	19	16	30.8	41.2	13:11:12
D	35601	4	7508	602	437	316	189	52	36	31	30.8	41.2	13:11:24
C Testing Comment: near km post 111													
D	35700	2	2567	149	101	67	38	15	13	11	31.2	41.3	13:13:03
D	35700	3	4049	239	166	116	64	24	21	18	31.2	41.3	13:13:19
D	35700	4	7566	427	309	221	131	47	38	33	31.2	41.3	13:13:32
D	35800	2	2566	209	143	105	62	16	12	10	31.9	41.7	13:15:14
D	35800	3	4028	315	226	171	103	27	18	14	31.9	41.7	13:15:23
D	35800	4	7539	534	393	302	192	54	34	27	31.9	41.7	13:15:35
D	35900	2	2565	165	106	72	35	13	12	11	31.6	42.1	13:17:14

Table A-3 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 sem	D20 sem	D30 sem	D45 sem	D90 sem	D120 sem	D150 sem	Air °C	Pave °C	Time hh:mm:ss
D	35900	3	4052	249	166	116	61	20	18	18	31.6	42.1	13:17:31
D	35900	4	7520	415	286	204	114	40	35	32	31.6	42.1	13:17:43
D	36000	2	2528	264	177	127	72	21	13	11	29.6	40.8	13:19:24
D	36000	3	4006	428	299	223	129	35	22	16	29.6	40.8	13:19:33
D	36000	4	7408	784	571	436	270	73	43	32	29.6	40.8	13:19:45
D	36101	2	2579	139	95	69	43	16	11	9	28.4	39.4	13:21:29
D	36101	3	4037	229	161	120	75	26	18	14	28.4	39.4	13:21:46
D	36101	4	7549	427	314	240	155	52	36	27	28.4	39.4	13:21:58
D	36200	2	2585	84	58	47	35	18	13	11	29.6	39.6	13:23:28
D	36200	3	4056	139	100	81	61	30	21	16	29.6	39.6	13:23:37
D	36200	4	7591	273	201	166	126	60	41	31	29.6	39.6	13:23:49
D	36300	2	2544	265	175	116	63	24	17	15	29.8	39.1	13:25:25
D	36300	3	4001	425	296	206	116	38	29	23	29.8	39.1	13:25:42
D	36300	4	7415	787	573	417	251	81	57	44	29.8	39.1	13:25:54
D	36400	2	2576	187	121	87	51	18	12	9	28.5	38.3	13:27:42
D	36400	3	4025	304	209	152	93	29	19	16	28.5	38.3	13:27:51
D	36400	4	7484	570	406	305	194	59	38	28	28.5	38.3	13:28:03
D	36500	2	2552	238	162	109	60	19	12	10	30.6	39.7	13:29:49
D	36500	3	4014	398	279	194	109	31	19	15	30.6	39.7	13:30:12
D	36500	4	7430	742	543	396	235	64	39	29	30.6	39.7	13:30:23
C Testing Comment: on patchwork													
D	36600	2	2566	214	146	104	59	19	16	13	30.5	39.3	13:32:03
D	36600	3	4039	318	230	164	97	30	24	20	30.5	39.3	13:32:12
D	36600	4	7544	538	401	296	186	65	48	40	30.5	39.3	13:32:24
C Testing Comment: near km post 110													
D	36700	2	2566	289	200	145	81	23	16	14	29.6	39.1	13:34:22
D	36700	3	4011	451	326	241	143	39	27	23	29.6	39.1	13:34:32
D	36700	4	7470	810	606	460	289	83	55	45	29.6	39.1	13:34:43
D	36800	2	2581	159	107	75	43	16	13	11	29.6	38.6	13:36:29
D	36800	3	4028	239	168	123	72	27	21	18	29.6	38.6	13:36:39
D	36800	4	7566	411	301	225	142	56	43	35	29.6	38.6	13:36:59
D	36901	2	2542	220	149	110	68	21	15	13	29.6	38.6	13:38:40
D	36901	3	4030	338	239	181	114	36	25	20	29.6	38.6	13:38:48
D	36901	4	7508	581	427	335	220	74	50	39	29.6	38.6	13:39:00
D	37001	2	2554	279	195	146	88	27	20	17	28.5	38.1	13:40:44
D	37001	3	4015	422	307	234	146	43	32	26	28.5	38.1	13:40:54
D	37001	4	7475	709	533	417	275	91	63	50	28.5	38.1	13:41:13
D	37100	2	2560	245	177	130	79	24	15	13	30.5	38.8	13:42:54
D	37100	3	4033	373	279	211	132	40	26	20	30.5	38.8	13:43:03
D	37100	4	7496	644	496	384	255	83	54	40	30.5	38.8	13:43:15
D	37200	2	2552	230	162	115	70	24	17	13	28.9	37.6	13:44:55
D	37200	3	4027	354	258	190	120	40	28	21	28.9	37.6	13:45:05
D	37200	4	7497	621	472	358	240	88	58	42	28.9	37.6	13:45:24
D	37300	2	2560	162	108	79	49	20	17	12	29.1	37.7	13:47:05
D	37300	3	4047	252	177	131	84	37	26	19	29.1	37.7	13:47:14
D	37300	4	7537	448	323	246	163	73	53	37	29.1	37.7	13:47:26

Table A-3 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 sem	D20 sem	D30 sem	D45 sem	D90 sem	D120 sem	D150 sem	Air °C	Pave °C	Time hh:mm:ss
D	37401	2	2559	217	158	115	68	19	15	14	30.7	37.6	13:49:19
D	37401	3	4030	336	253	191	119	38	26	20	30.7	37.6	13:49:28
D	37401	4	7525	585	455	353	234	81	52	38	30.7	37.6	13:49:48
D	37500	2	2560	226	165	127	80	23	15	11	30.3	37	13:51:27
D	37500	3	4028	354	269	212	136	39	24	19	30.3	37	13:51:36
D	37500	4	7488	640	498	399	268	86	50	38	30.3	37	13:51:47
D	37600	2	2572	249	163	113	64	17	12	10	30.2	36.3	13:53:29
D	37600	3	4048	364	252	182	104	27	19	17	30.2	36.3	13:53:38
D	37600	4	7552	600	428	319	193	56	39	32	30.2	36.3	13:53:57
D	37700	2	2560	232	154	109	62	16	12	10	30.7	37.1	13:55:50
D	37700	3	4037	356	251	183	106	27	18	15	30.7	37.1	13:55:59
D	37700	4	7514	614	444	330	201	52	33	28	30.7	37.1	13:56:11
D	37800	2	2558	168	110	79	45	14	11	10	30.3	37.1	13:57:46
D	37800	3	4048	249	172	125	75	22	17	16	30.3	37.1	13:57:55
D	37800	4	7568	411	291	217	135	43	33	30	30.3	37.1	13:58:15
C Testing Comment: 65 metres before km post 109													
D	37900	2	2566	214	141	103	57	16	13	11	30.5	36.4	13:59:57
D	37900	3	4044	313	219	160	92	25	17	14	30.5	36.4	14:00:06
D	37900	4	7570	521	375	282	171	50	32	24	30.5	36.4	14:00:18
D	38000	2	2544	243	165	121	73	18	11	11	29.5	36.8	14:02:20
D	38000	3	4022	359	256	190	117	28	19	17	29.5	36.8	14:02:37
D	38000	4	7535	599	437	336	216	59	37	30	29.5	36.8	14:02:48
D	38100	2	2566	190	139	107	67	16	10	7	29.6	36.5	14:04:26
D	38100	3	4058	289	218	170	109	29	16	13	29.6	36.5	14:04:35
D	38100	4	7540	492	377	300	202	60	34	24	29.6	36.5	14:04:47
D	38200	2	2560	211	141	103	58	17	13	10	29.8	36.3	14:06:26
D	38200	3	4020	310	216	159	95	29	20	16	29.8	36.3	14:06:43
D	38200	4	7535	525	380	289	182	60	41	32	29.8	36.3	14:06:55
D	38300	2	2570	158	109	81	48	14	11	10	29.6	35.7	14:08:33
D	38300	3	4039	238	169	128	78	23	17	15	29.6	35.7	14:08:42
D	38300	4	7607	403	296	228	144	47	34	28	29.6	35.7	14:08:54
D	38400	2	2562	206	147	110	65	19	14	11	29.6	35.5	14:10:41
D	38400	3	4038	307	225	172	108	32	23	18	29.6	35.5	14:10:57
D	38400	4	7523	524	396	309	200	66	45	36	29.6	35.5	14:11:09
D	38500	2	2570	159	112	82	48	14	11	10	27.3	35.3	14:12:49
D	38500	3	4044	242	173	130	77	23	19	16	27.3	35.3	14:12:59
D	38500	4	7568	412	304	230	145	45	37	31	27.3	35.3	14:13:11
D	38600	2	2546	294	211	160	93	16	10	9	28.5	34.8	14:14:48
D	38600	3	4003	441	326	253	151	29	15	15	28.5	34.8	14:15:05
D	38600	4	7509	730	553	435	269	57	31	27	28.5	34.8	14:15:16
D	38700	2	2554	226	151	113	68	19	13	11	29.6	35.5	14:17:10
D	38700	3	4040	344	242	183	115	31	20	17	29.6	35.5	14:17:20
D	38700	4	7514	590	427	331	215	65	40	33	29.6	35.5	14:17:32
C Testing Comment: near km post 108													
D	38800	2	2580	146	81	51	28	14	12	10	29.2	35.1	14:19:11
D	38800	3	4047	232	132	85	45	22	19	16	29.2	35.1	14:19:21

Table A-3 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 cm	D20 cm	D30 cm	D45 cm	D90 cm	D120 cm	D150 cm	Air °C	Pave °C	Time hh:mm:ss
D	38800	4	7601	412	247	163	92	43	36	31	29.2	35.1	14:19:39
D	38901	2	2544	300	174	110	52	22	17	15	28.4	35.2	14:21:18
D	38901	3	3996	457	283	185	90	35	24	20	28.4	35.2	14:21:28
D	38901	4	7514	790	520	357	191	77	57	46	28.4	35.2	14:21:40
C Testing Comment: on patch work													
D	39000	2	2549	370	272	207	128	38	24	16	27.9	35	14:23:34
D	39000	3	4009	592	452	352	231	72	41	28	27.9	35	14:23:43
D	39000	4	7420	1050	826	661	457	153	89	59	27.9	35	14:23:56
D	39101	2	2565	251	191	157	112	43	28	20	30.1	34.9	14:30:27
D	39101	3	4030	409	321	268	194	77	48	35	30.1	34.9	14:30:36
D	39101	4	7482	752	605	510	389	165	102	72	30.1	34.9	14:30:56
D	39201	2	2558	320	234	183	115	36	23	17	29.2	34.9	14:32:43
D	39201	3	4017	498	378	298	197	65	39	29	29.2	34.9	14:32:53
D	39201	4	7471	873	686	556	386	138	83	62	29.2	34.9	14:33:06
D	39300	2	2565	152	106	84	54	22	15	12	29.6	34.7	14:34:41
D	39300	3	4058	240	177	141	95	35	25	21	29.6	34.7	14:34:51
D	39300	4	7603	431	330	268	189	77	53	41	29.6	34.7	14:35:11
D	39401	2	2559	258	148	87	39	17	14	12	28.7	34.4	14:36:48
D	39401	3	4052	396	238	145	70	29	23	20	28.7	34.4	14:36:57
D	39401	4	7582	667	417	264	134	55	45	37	28.7	34.4	14:37:09
D	39501	2	2561	210	126	82	41	14	9	7	28.4	34.4	14:38:44
D	39501	3	4056	331	206	137	73	23	14	11	28.4	34.4	14:38:53
D	39501	4	7558	583	375	258	144	46	29	21	28.4	34.4	14:39:12
D	39601	2	2558	219	148	110	62	12	8	8	28.1	34.4	14:40:46
D	39601	3	4050	324	230	170	102	23	13	11	28.1	34.4	14:40:56
D	39601	4	7625	531	389	296	186	47	27	22	28.1	34.4	14:41:08
D	39700	2	2558	220	151	108	62	12	8	6	29.1	34.2	14:42:44
D	39700	3	4045	323	230	167	100	20	12	10	29.1	34.2	14:42:54
D	39700	4	7594	534	389	290	180	41	23	18	29.1	34.2	14:43:13
D	39800	2	2552	274	196	143	82	19	9	8	29.2	33.8	14:44:52
D	39800	3	4028	424	315	239	146	32	16	12	29.2	33.8	14:45:03
D	39800	4	7575	732	562	435	279	66	32	20	29.2	33.8	14:45:15
C Testing Comment: at km 101													
D	39900	2	2563	249	175	127	72	16	8	7	28.6	34	14:47:13
D	39900	3	4040	379	272	203	121	25	13	10	28.6	34	14:47:30
D	39900	4	7585	644	474	360	224	52	25	19	28.6	34	14:47:41
D	40001	2	2567	206	142	103	61	12	8	7	28.9	33.5	14:49:47
D	40001	3	4061	307	220	163	99	21	13	10	28.9	33.5	14:50:03
D	40001	4	7581	508	374	283	178	42	25	21	28.9	33.5	14:50:14
D	40101	2	2547	236	168	116	62	12	7	5	28.7	33.5	14:51:44
D	40101	3	4025	349	254	182	102	19	12	9	28.7	33.5	14:52:01
D	40101	4	7591	583	436	318	188	40	22	18	28.7	33.5	14:52:12
D	40200	2	2570	236	155	110	62	14	8	7	29.5	33.8	14:53:48
D	40200	3	4069	345	238	173	102	22	14	11	29.5	33.8	14:53:58
D	40200	4	7585	569	404	301	187	47	29	23	29.5	33.8	14:54:09
D	40300	2	2570	258	179	136	82	21	14	13	30.1	34.7	14:55:44

Table A-3 (cont'd).

J	Station	Imp	Load	D0	D20	D30	D45	D90	D120	D150	Air	Pave	Time
J	m	Num	kgf	cm	cm	cm	cm	cm	cm	cm	°C	°C	hh:mm:ss
D	40300	3	4044	385	279	215	136	38	24	19	30.1	34.7	14:56:01
D	40300	4	7571	657	489	385	255	80	50	38	30.1	34.7	14:56:13
D	40401	2	2557	253	177	126	77	23	17	14	28.5	34.3	14:57:58
D	40401	3	4044	379	277	204	128	40	26	21	28.5	34.3	14:58:07
D	40401	4	7549	636	479	363	239	79	53	43	28.5	34.3	14:58:20
D	40500	2	2565	251	175	126	72	16	11	9	30.5	36	14:59:57
D	40500	3	4053	370	268	199	119	26	16	13	30.5	36	15:00:15
D	40500	4	7585	614	460	347	219	53	32	26	30.5	36	15:00:27
D	40601	2	2559	243	163	120	65	12	7	7	30.8	35.2	15:02:25
D	40601	3	4048	359	251	185	109	20	13	12	30.8	35.2	15:02:34
D	40601	4	7581	590	425	320	193	40	24	22	30.8	35.2	15:02:46
D	40700	2	2565	255	165	112	57	11	7	6	30	34.8	15:04:32
D	40700	3	4058	373	255	176	98	19	11	8	30	34.8	15:04:50
D	40700	4	7587	615	431	308	180	36	21	18	30	34.8	15:05:01
C Testing Comment: karachi 106 km													
D	40800	2	2567	213	143	105	59	12	8	8	30.6	34.8	15:07:06
D	40800	3	4057	313	219	164	96	19	14	12	30.6	34.8	15:07:15
D	40800	4	7649	514	366	279	169	39	25	24	30.6	34.8	15:07:27
D	40900	2	2572	255	172	123	70	17	11	10	28.7	34.8	15:09:12
D	40900	3	4046	382	272	198	117	26	18	16	28.7	34.8	15:09:22
D	40900	4	7552	632	463	345	214	53	34	28	28.7	34.8	15:09:34
D	41000	2	2572	232	154	110	59	13	9	9	28.5	34.5	15:11:25
D	41000	3	4058	347	241	176	101	24	17	15	28.5	34.5	15:11:34
D	41000	4	7581	580	418	314	189	51	34	29	28.5	34.5	15:11:47
D	41101	2	2558	222	152	111	62	13	8	6	29.1	33.8	15:15:13
D	41101	3	4032	340	244	180	106	22	12	10	29.1	33.8	15:15:24
D	41101	4	7580	576	428	323	197	43	23	19	29.1	33.8	15:15:36
D	41200	2	2577	247	168	121	72	17	11	10	28.9	33.6	15:17:09
D	41200	3	4041	372	260	190	117	31	20	15	28.9	33.6	15:17:24
D	41200	4	7571	622	451	341	222	63	39	29	28.9	33.6	15:17:35
D	41300	2	2558	287	194	146	82	16	10	8	29.2	32.9	15:19:27
D	41300	3	4017	448	315	241	139	29	16	13	29.2	32.9	15:19:36
D	41300	4	7523	775	564	436	266	60	33	24	29.2	32.9	15:19:48
D	41400	2	2566	226	154	112	66	14	9	9	29.5	33.2	15:21:35
D	41400	3	4048	339	243	180	109	25	15	13	29.5	33.2	15:21:44
D	41400	4	7580	564	413	314	197	50	29	23	29.5	33.2	15:21:56
D	41499	2	2551	208	142	104	60	13	8	6	28.7	33.3	15:24:01
D	41499	3	4030	313	223	165	100	22	12	10	28.7	33.3	15:24:10
D	41499	4	7585	531	389	296	190	47	26	19	28.7	33.3	15:24:22
D	41601	2	2572	198	133	97	54	6	5	2	28.9	33.1	15:25:58
D	41601	3	4044	303	211	156	89	12	5	6	28.9	33.1	15:26:16
D	41601	4	7614	499	358	268	163	26	12	7	28.9	33.1	15:26:29
D	41700	2	2592	174	120	90	55	19	14	11	28.9	32.7	15:28:19
D	41700	3	4073	262	192	146	93	31	23	18	28.9	32.7	15:28:28
D	41700	4	7632	445	343	268	181	66	45	35	28.9	32.7	15:28:40
ment: karachi 105 km													

Table A-3 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 æm	D20 æm	D30 æm	D45 æm	D90 æm	D120 æm	D150 æm	Air sC	Pave sC	Time hh:mm:ss
D	41800	2	2558	253	180	136	83	20	12	8	29.1	32.7	15:30:20
D	41800	3	4012	400	297	226	144	37	20	13	29.1	32.7	15:30:29
D	41800	4	7521	719	554	432	288	78	40	25	29.1	32.7	15:30:50
D	41900	2	2554	232	158	120	71	14	7	5	28.7	31.9	15:32:40
D	41900	3	4023	360	260	198	123	25	13	8	28.7	31.9	15:32:49
D	41900	4	7539	636	469	365	236	54	24	16	28.7	31.9	15:33:01
D	42000	2	2561	240	166	125	75	22	14	11	28.4	32.1	15:34:44
D	42000	3	4023	364	265	203	129	38	23	18	28.4	32.1	15:34:53
D	42000	4	7535	629	482	379	254	82	49	35	28.4	32.1	15:35:13
D	42100	2	2569	265	189	141	91	26	18	11	28.4	32.1	15:36:53
D	42100	3	4018	419	309	239	154	47	25	17	28.4	32.1	15:37:03
D	42100	4	7494	746	570	448	306	99	54	36	28.4	32.1	15:37:15
D	42200	2	2572	254	160	113	60	16	9	7	28.7	31.7	15:38:45
D	42200	3	4037	405	268	193	108	27	15	11	28.7	31.7	15:38:54
D	42200	4	7525	717	494	366	214	53	30	21	28.7	31.7	15:39:15
D	42300	2	2585	133	89	65	41	13	9	9	29.1	32.1	15:40:55
D	42300	3	4071	219	151	111	69	22	15	14	29.1	32.1	15:41:04
D	42300	4	7593	395	281	208	135	44	29	25	29.1	32.1	15:41:16
D	42400	2	2587	219	147	103	53	15	12	9	29.2	32	15:43:03
D	42400	3	4044	332	233	168	91	23	18	14	29.2	32	15:43:19
D	42400	4	7566	563	410	304	174	48	35	29	29.2	32	15:43:39
D	42502	2	2579	116	76	56	34	13	10	10	28.2	32	15:45:40
D	42502	3	4074	179	127	95	57	21	17	15	28.2	32	15:45:49
D	42502	4	7622	318	234	180	113	42	33	28	28.2	32	15:46:01
D	42601	2	2569	295	185	123	66	18	13	10	29.6	32	15:47:36
D	42601	3	4048	476	311	216	118	28	18	13	29.6	32	15:47:45
D	42601	4	7542	848	580	416	242	59	35	27	29.6	32	15:48:05
C Testing Comment: karachi 104 (bridge found)													
D	42800	2	2585	87	64	51	38	15	10	8	28.9	32.5	15:50:11
D	42800	3	4075	146	109	89	66	27	18	13	28.9	32.5	15:50:20
D	42800	4	7642	294	227	189	142	59	36	26	28.9	32.5	15:50:32
D	42901	2	2587	174	126	96	63	17	11	8	28.2	32	15:52:10
D	42800	2	2575	159	116	89	59	16	9	7	28.7	31	15:58:20

Table A-4 : Measured FWD deflection data for stations 42900-52400.**IFWD DATA FILE : A:\N5S2D1A.FWD**

HProject : N5
 HSection : 2
 HLocation : start from hyd tol plaza
 HRoad clas. : Flex
 HNo of lanes : 2
 HMeasured lane : outer
 H :
 HSurface type : asphalt
 HLane width : 12
 HDirection(NSWE) : s
 HShoulder type : ST
 HOffset side dist.: 3 ft
 HWeather : Sunny
 H :
 HOperator : M.ALI

 IDate Created : 03-08-1995

 HMachine Type : KUAB FWD Model 150
 HSoftware Version : 4.23

 ILoad Mode : 1 (6+6 large buffers, 3 stack weights)
 IPlate Radius : 15.0 (cm)
 HPlate Cal Factor : 11050.00
 HPlate Cal Add : 150
 HPlate Gain Factor: 1.00000
 HPlate Cal Date : 11-27-1994
 HPlate Cal Time : 12:23:02

 HAir Cal Factor : 0.073093
 HAir Cal Add : -273
 HAir Cal Date : 02-27-1995
 HAir Cal Time : 10:07:27
 HDMI Cal Factor : 0.696384
 HDMI Last Cal Date: 02-26-1995
 HDMI Last Cal Time: 09:57:59
 IDrop Sequence : 2123
 IRecord Drop? : NYYY
 IChannel : 0 1 2 3 4 5 6
 ISensor ID : 0- 1- 2- 3- 4- 5- 6-
 IDistance : 0.0 20.0 30.0 45.0 90.0 120.0 150.0 (cm)
 IPosition : CENTER BEHIND BEHIND BEHIND BEHIND BEHIND BEHIND
 HStatic Cal Factor: 0.5642 0.2884 0.2816 0.2865 0.1399 0.1376 0.1396
 HDyn Cal Factor : 1.050 1.050 1.050 1.050 1.050 1.050 1.050
 HGain Factor : 1.000 1.000 1.000 1.000 1.000 1.000 1.000
 HChannel Cal Date : 02-24-95 02-24-95 02-24-95 02-24-95 02-24-95 02-24-95 02-24-95
 HChannel Cal Time : 14:22:24 14:22:24 14:22:24 14:22:24 14:22:24 14:22:24 14:22:24
 H

Table A-4 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 sem	D20 sem	D30 sem	D45 sem	D90 sem	D120 sem	D150 sem	Air °C	Pave °C	Time hh:mm:ss
D	42900	2	2648	136	116	98	76	24	11	6	36.6	30.2	10:56:43
D	42900	3	4097	211	183	155	120	40	17	9	36.6	30.2	10:56:53
D	42900	4	7492	392	341	289	223	79	36	15	36.6	30.2	10:57:05
C Testing Comment: start work on 8.1.95													
D	42900	2	2569	169	124	96	62	17	11	7	34.4	37.2	13:37:21
D	42900	3	4040	270	202	159	103	29	17	12	34.4	37.2	13:37:31
D	42900	4	7504	483	370	298	202	64	34	23	34.4	37.2	13:37:43
C Testing Comment: 1 st test of the day													
D	43000	2	2542	275	196	151	89	19	10	7	34.8	43.5	13:40:03
D	43000	3	3998	440	323	251	155	33	14	9	34.8	43.5	13:40:12
D	43000	4	7418	756	579	459	296	70	30	18	34.8	43.5	13:40:33
D	43100	2	2594	182	114	76	38	7	5	4	35.2	44	13:42:34
D	43100	3	4068	273	180	125	63	11	7	5	35.2	44	13:42:43
D	43100	4	7577	463	315	224	123	23	14	11	35.2	44	13:42:55
D	43200	2	2561	177	112	78	40	7	5	4	35.7	44.6	13:44:37
D	43200	3	4058	271	177	128	69	14	8	6	35.7	44.6	13:44:46
D	43200	4	7582	467	317	232	131	27	16	12	35.7	44.6	13:45:07
D	43300	2	2577	188	126	85	47	12	9	7	34.9	44.1	13:47:10
D	43300	3	4044	284	199	139	79	21	13	11	34.9	44.1	13:47:19
D	43300	4	7529	483	349	254	155	43	28	22	34.9	44.1	13:47:31
D	43400	2	2557	250	180	136	82	17	9	7	34.9	43.4	13:49:21
D	43400	3	3989	393	291	224	141	31	14	10	34.9	43.4	13:49:30
D	43400	4	7481	690	524	410	269	63	29	19	34.9	43.4	13:49:51
D	43500	2	2567	103	64	44	24	8	5	5	35.3	43.8	13:51:40
D	43500	3	4039	155	101	72	42	11	8	6	35.3	43.8	13:51:49
D	43500	4	7655	266	180	131	80	24	16	13	35.3	43.8	13:52:01
D	43600	2	2572	200	132	93	51	9	8	6	34.8	43.6	13:53:53
D	43600	3	4027	300	208	149	84	16	10	8	34.8	43.6	13:54:02
D	43600	4	7570	511	359	266	160	34	20	16	34.8	43.6	13:54:23
D	43700	2	2602	111	71	48	28	9	7	6	34.9	43.6	13:56:05
D	43700	3	4039	175	117	79	45	15	11	9	34.9	43.6	13:56:14
D	43700	4	7621	304	205	146	90	30	21	17	34.9	43.6	13:56:26
C Testing Comment: near km post 103.													
D	43800	2	2573	226	151	105	56	12	8	7	35.7	44.1	13:58:26
D	43800	3	4035	334	230	166	93	22	14	11	35.7	44.1	13:58:44
D	43800	4	7589	557	395	289	173	46	31	24	35.7	44.1	13:58:56
D	43900	2	2569	200	126	84	45	10	8	6	35.2	43.6	14:01:00
D	43900	3	4038	308	203	139	76	15	11	8	35.2	43.6	14:01:09
D	43900	4	7579	540	367	261	148	30	19	15	35.2	43.6	14:01:21
D	44000	2	2559	171	111	80	43	10	7	6	35.3	44.7	14:03:17
D	44000	3	4028	265	180	131	75	15	11	9	35.3	44.7	14:03:35
D	44000	4	7523	474	334	247	146	32	20	17	35.3	44.7	14:03:47
D	44101	2	2555	217	138	94	45	7	6	5	35.5	43.8	14:05:39
D	44101	3	4021	320	214	148	74	14	8	7	35.5	43.8	14:05:48
D	44101	4	7586	527	363	259	141	27	17	15	35.5	43.8	14:06:00
D	44200	2	2558	208	137	94	49	11	7	6	35.7	45	14:07:45

Table A-4 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 sem	D20 sem	D30 sem	D45 sem	D90 sem	D120 sem	D150 sem	Air °C	Pave °C	Time hh:mm:ss
D	44200	3	4035	313	216	150	82	17	12	10	35.7	45	14:08:02
D	44200	4	7595	538	375	266	153	33	24	20	35.7	45	14:08:14
D	44300	2	2554	214	135	94	48	13	8	9	35.3	44.9	14:09:58
D	44300	3	4040	322	216	153	81	19	16	13	35.3	44.9	14:10:07
D	44300	4	7594	554	383	276	154	39	28	24	35.3	44.9	14:10:19
D	44400	2	2565	242	157	108	56	16	11	9	35.4	44.7	14:11:58
D	44400	3	4016	369	248	176	97	27	18	14	35.4	44.7	14:12:16
D	44400	4	7558	655	461	338	199	58	38	28	35.4	44.7	14:12:28
D	44500	2	2505	362	238	167	95	29	18	11	35.7	45.2	14:14:17
D	44500	3	3978	564	392	283	167	48	28	20	35.7	45.2	14:14:26
D	44500	4	7443	1006	727	546	341	103	58	39	35.7	45.2	14:14:39
D	44600	2	2550	241	163	116	64	14	11	8	36.2	44.8	14:16:20
D	44600	3	3992	357	251	183	106	25	15	12	36.2	44.8	14:16:38
D	44600	4	7548	602	435	323	198	50	31	23	36.2	44.8	14:16:49
C Testing Comment: near km post 103, and police check post.													
D	44700	2	2525	262	154	97	42	9	6	4	35.5	44	14:19:02
D	44700	3	3978	406	248	158	71	15	9	8	35.5	44	14:19:11
D	44700	4	7556	696	441	291	140	30	19	15	35.5	44	14:19:22
D	44800	2	2528	240	154	103	56	17	9	7	35.3	44.3	14:21:13
D	44800	3	4016	395	267	185	102	28	16	10	35.3	44.3	14:21:21
D	44800	4	7537	716	511	366	220	58	31	20	35.3	44.3	14:21:32
D	44900	2	2519	295	183	116	52	10	4	4	36.2	44.5	14:23:27
D	44900	3	3975	450	292	192	90	15	8	6	36.2	44.5	14:23:36
D	44900	4	7470	758	510	348	172	28	15	11	36.2	44.5	14:23:47
D	45000	2	2533	223	144	102	56	10	5	4	34.9	44.8	14:26:20
D	45000	3	4015	335	227	165	95	18	8	6	34.9	44.8	14:26:29
D	45000	4	7632	564	398	296	181	37	18	12	34.9	44.8	14:26:40
D	45101	2	2547	177	129	97	57	10	5	2	35.5	44.1	14:28:33
D	45101	3	3992	278	209	159	98	18	6	4	35.5	44.1	14:28:42
D	45101	4	7575	495	377	297	192	38	14	9	35.5	44.1	14:28:53
D	45200	2	2543	258	176	124	70	17	10	7	35.9	43.1	14:30:54
D	45200	3	3978	386	274	200	118	28	17	13	35.9	43.1	14:31:02
D	45200	4	7553	658	483	363	228	61	35	26	35.9	43.1	14:31:13
D	45300	2	2529	230	149	103	54	11	8	5	35.5	43.3	14:32:57
D	45300	3	4001	353	244	170	93	19	11	7	35.5	43.3	14:33:06
D	45300	4	7580	625	449	326	191	41	23	16	35.5	43.3	14:33:17
D	45400	2	2523	223	152	113	64	13	7	4	34.9	44.3	14:35:08
D	45400	3	3978	353	251	190	112	24	12	7	34.9	44.3	14:35:16
D	45400	4	7623	644	474	370	230	54	25	15	34.9	44.3	14:35:27
D	45500	2	2533	256	170	121	68	11	5	2	35.2	43.8	14:37:02
D	45500	3	4002	386	272	198	115	20	10	6	35.2	43.8	14:37:11
D	45500	4	7523	668	485	364	223	43	18	11	35.2	43.8	14:37:22
D	45600	2	2510	251	169	119	63	12	8	4	35.9	44.3	14:39:15
D	45600	3	3978	400	282	204	116	25	11	7	35.9	44.3	14:39:24
D	45600	4	7514	720	524	389	237	51	24	14	35.9	44.3	14:39:35
C Testing Comment: near km post 101													

Table A-4 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 sem	D20 sem	D30 sem	D45 sem	D90 sem	D120 sem	D150 sem	Air °C	Pave °C	Time hh:mm:ss
D	45700	2	2546	284	167	106	46	6	4	1	35.3	44	14:41:21
D	45700	3	3953	429	264	170	79	9	4	3	35.3	44	14:41:30
D	45700	4	7470	717	451	300	145	17	8	6	35.3	44	14:41:50
D	45800	2	2564	148	78	48	24	7	6	5	35.5	44.7	14:43:42
D	45800	3	4033	231	132	79	39	13	9	7	35.5	44.7	14:43:50
D	45800	4	7690	408	241	151	80	25	18	13	35.5	44.7	14:44:02
D	45900	2	2542	103	57	37	20	8	5	3	35.3	45.1	14:45:41
D	45900	3	4040	171	99	64	38	14	8	6	35.3	45.1	14:45:49
D	45900	4	7635	311	192	131	80	28	16	10	35.3	45.1	14:46:10
D	46000	2	2527	353	170	79	21	2	2	2	35.5	44.5	14:48:15
D	46000	3	3984	509	265	135	38	1	1	2	35.5	44.5	14:48:28
D	46000	4	7566	838	458	243	75	2	3	3	35.5	44.5	14:48:43
D	46100	2	2532	171	94	60	28	7	5	4	35.5	43.5	14:50:42
D	46100	3	4013	267	158	100	48	11	9	6	35.5	43.5	14:50:50
D	46100	4	7651	463	289	192	98	24	16	11	35.5	43.5	14:51:11
D	46200	2	2565	87	51	35	19	6	3	3	35.2	40.8	14:56:48
D	46200	3	4032	132	84	59	32	9	7	5	35.2	40.8	14:56:58
D	46200	4	7670	238	155	111	65	18	12	9	35.2	40.8	14:57:09
D	46300	2	2527	238	160	114	62	10	5	3	35.5	43.8	14:58:51
D	46300	3	3980	373	260	190	108	18	8	4	35.5	43.8	14:58:59
D	46300	4	7558	671	487	365	220	40	17	10	35.5	43.8	14:59:11
D	46400	2	2550	239	157	106	54	9	5	2	36.2	42.3	15:01:28
D	46400	3	4026	357	249	172	93	16	8	5	36.2	42.3	15:01:37
D	46400	4	7597	606	439	314	181	37	17	11	36.2	42.3	15:01:49
C Testing Comment: near km post 100													
D	46500	2	2531	204	129	87	44	7	4	3	34.6	42.9	15:03:35
D	46500	3	4020	305	203	141	74	12	7	5	34.6	42.9	15:03:43
D	46500	4	7652	505	347	248	141	25	14	10	34.6	42.9	15:04:04
D	46600	2	2545	223	140	92	43	6	3	3	35.5	42.4	15:06:04
D	46600	3	4018	328	215	147	75	9	5	3	35.5	42.4	15:06:13
D	46600	4	7662	547	366	259	142	18	8	6	35.5	42.4	15:06:24
D	46700	2	2543	214	140	98	50	10	6	3	34.9	42.3	15:08:09
D	46700	3	4010	324	222	159	87	15	9	6	34.9	42.3	15:08:18
D	46700	4	7609	534	381	284	167	32	17	10	34.9	42.3	15:08:39
D	46800	2	2557	259	176	123	68	16	8	4	34.6	42.1	15:10:32
D	46800	3	4017	405	293	212	123	29	14	9	34.6	42.1	15:10:40
D	46800	4	7566	735	556	420	260	66	31	17	34.6	42.1	15:10:52
D	46900	2	2523	236	158	114	65	17	9	6	34.9	42.3	15:13:13
D	46900	3	4033	367	259	193	115	27	15	11	34.9	42.3	15:13:22
D	46900	4	7645	651	477	362	228	59	32	22	34.9	42.3	15:13:43
D	47000	2	2530	265	180	131	76	15	8	4	34.8	42.6	15:15:35
D	47000	3	3999	429	304	226	136	26	12	8	34.8	42.6	15:15:44
D	47000	4	7487	801	588	450	283	56	24	15	34.8	42.6	15:15:55
D	47000	2	2528	256	174	128	74	14	8	5	37.5	40.9	15:17:22
D	47000	3	3981	421	296	221	133	26	13	7	37.5	40.9	15:17:30
D	47000	4	7522	771	570	438	277	57	25	15	37.5	40.9	15:17:51

Table A-4 (cont'd).

J	Station	Imp	Load	D0	D20	D30	D45	D90	D120	D150	Air	Pave	Time
J	m	Num	kgf	sem	sem	sem	sem	sem	sem	sem	°C	°C	hh:mm:ss
C Testing Comment: test repeated on instructions of Dir.highways.													
D	47100	2	2533	232	152	107	57	11	7	4	34.1	42.5	15:21:15
D	47100	3	3998	364	251	180	100	19	10	6	34.1	42.5	15:21:24
D	47100	4	7552	654	468	347	203	39	20	13	34.1	42.5	15:21:35
D	47201	2	2514	233	154	110	57	11	5	5	35.3	42.5	15:23:35
D	47201	3	4016	371	254	184	99	18	10	7	35.3	42.5	15:23:53
D	47201	4	7589	666	476	357	208	39	21	15	35.3	42.5	15:24:04
D	47300	2	2534	285	186	128	63	11	6	5	35.5	42.3	15:25:46
D	47300	3	4006	463	316	225	115	19	11	8	35.5	42.3	15:25:55
D	47300	4	7539	861	615	456	247	40	22	17	35.5	42.3	15:26:06
C Testing Comment: near km post 99													
D	47400	2	2525	203	133	90	48	9	6	4	35	42.6	15:28:38
D	47400	3	4014	305	211	146	82	15	9	7	35	42.6	15:28:47
D	47400	4	7591	525	373	268	157	33	19	13	35	42.6	15:28:58
D	47500	2	2544	238	154	109	57	11	7	5	35.5	42	15:31:06
D	47500	3	3997	364	247	178	100	20	11	7	35.5	42	15:31:15
D	47500	4	7618	634	450	332	194	42	23	16	35.5	42	15:31:27
D	47601	2	2551	242	161	112	63	16	9	7	34.8	42.1	15:33:09
D	47601	3	4029	369	254	184	106	27	16	11	34.8	42.1	15:33:19
D	47601	4	7635	645	460	342	211	56	33	22	34.8	42.1	15:33:30
D	47700	2	2532	235	155	113	69	25	18	17	34.6	41.6	15:35:06
D	47700	3	3998	363	253	185	116	44	31	26	34.6	41.6	15:35:15
D	47700	4	7517	652	475	362	236	89	63	48	34.6	41.6	15:35:27
D	47801	2	2539	162	106	76	46	22	17	13	34.3	39.9	15:38:40
D	47801	3	4004	253	173	128	79	33	24	22	34.3	39.9	15:38:50
D	47801	4	7630	485	348	262	169	65	49	41	34.3	39.9	15:39:02
D	47901	2	2520	197	132	96	55	19	13	13	34.8	41.7	15:40:51
D	47901	3	4006	304	216	158	98	32	23	19	34.8	41.7	15:41:00
D	47901	4	7568	541	398	302	192	63	44	38	34.8	41.7	15:41:13
D	48000	2	2535	237	156	110	60	15	10	9	34.9	41.4	15:43:03
D	48000	3	4038	364	251	180	103	24	17	14	34.9	41.4	15:43:12
D	48000	4	7580	632	454	333	202	50	32	27	34.9	41.4	15:43:24
D	48100	2	2539	265	186	137	86	32	26	22	34.4	41.9	15:44:58
D	48100	3	4001	408	301	227	148	56	41	32	34.4	41.9	15:45:08
D	48100	4	7637	749	573	446	304	119	83	63	34.4	41.9	15:45:20
D	48200	2	2528	230	151	105	56	14	8	5	34.3	41.3	15:47:08
D	48200	3	3986	349	240	172	94	22	14	10	34.3	41.3	15:47:17
D	48200	4	7624	609	435	323	188	47	27	19	34.3	41.3	15:47:28
D	48300	2	2531	153	105	77	47	14	10	7	34.1	41.6	15:49:06
D	48300	3	4027	240	172	130	82	23	15	11	34.1	41.6	15:49:15
D	48300	4	7643	428	319	248	166	49	30	22	34.1	41.6	15:49:27
C Testing Comment: near km post 98													
D	48400	2	2530	207	140	101	60	15	10	7	34.8	41.3	15:51:29
D	48400	3	4019	327	232	171	105	26	14	10	34.8	41.3	15:51:37
D	48400	4	7614	603	445	336	217	57	31	22	34.8	41.3	15:51:49
D	48500	2	2533	287	194	135	73	18	10	7	34.3	40.4	15:53:25

Table A-4 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 æm	D20 æm	D30 æm	D45 æm	D90 æm	D120 æm	D150 æm	Air °C	Pave °C	Time hh:mm:ss
D	48500	3	4006	453	322	230	131	31	17	11	34.3	40.4	15:53:34
D	48500	4	7560	833	619	461	280	66	33	22	34.3	40.4	15:53:55
D	48601	2	2503	307	189	118	63	19	12	9	34.3	41	15:55:36
D	48601	3	3966	476	309	200	113	32	20	14	34.3	41	15:55:44
D	48601	4	7473	836	577	393	236	68	40	28	34.3	41	15:55:56
D	48700	2	2526	274	171	109	56	10	5	4	34.4	41.6	15:57:29
D	48700	3	4003	413	271	180	97	18	9	5	34.4	41.6	15:57:38
D	48700	4	7550	691	469	323	185	36	16	9	34.4	41.6	15:57:59
D	48800	2	2509	324	209	142	81	20	11	7	34.6	41.4	15:59:34
D	48800	3	3978	501	343	240	140	34	17	11	34.6	41.4	15:59:43
D	48800	4	7519	859	618	446	275	71	36	22	34.6	41.4	15:59:55
D	48900	2	2544	275	174	121	62	15	10	7	34.3	40.3	16:01:32
D	48900	3	3994	431	290	206	112	26	15	10	34.3	40.3	16:01:41
D	48900	4	7589	772	551	407	236	57	32	22	34.3	40.3	16:02:02
D	49000	2	2525	227	140	92	43	10	7	7	34.4	39.4	16:03:46
D	49000	3	3982	349	227	153	75	17	12	11	34.4	39.4	16:03:55
D	49000	4	7649	596	404	279	146	34	24	20	34.4	39.4	16:04:06
D	49100	2	2526	181	114	78	43	10	8	6	34.9	40	16:06:38
D	49100	3	4011	284	187	133	75	19	11	8	34.9	40	16:06:47
D	49100	4	7633	498	343	253	152	39	25	19	34.9	40	16:07:09
D	49200	2	2533	214	137	94	48	12	7	5	32.7	39.4	16:08:59
D	49200	3	3989	327	218	156	85	20	11	7	32.7	39.4	16:09:08
D	49200	4	7637	572	404	299	176	43	24	16	32.7	39.4	16:09:20
D	49300	2	2527	105	69	49	29	10	6	5	34.8	39.9	16:11:18
D	49300	3	4044	174	116	85	51	16	14	8	34.8	39.9	16:11:26
D	49300	4	7678	314	222	167	106	36	24	17	34.8	39.9	16:11:48
C Testing Comment: near km post 97													
D	49401	2	2535	129	77	54	30	8	5	4	34.4	39.9	16:13:31
D	49401	3	4055	200	131	92	54	13	9	6	34.4	39.9	16:13:41
D	49401	4	7671	351	242	176	108	28	17	12	34.4	39.9	16:13:52
D	49500	2	2548	195	123	81	43	9	5	5	34.6	40.1	16:15:45
D	49500	3	4011	294	194	134	73	14	9	7	34.6	40.1	16:16:04
D	49500	4	7637	511	348	247	140	29	19	14	34.6	40.1	16:16:23
D	49601	2	2546	184	118	84	49	11	7	5	34.6	39.6	16:18:07
D	49601	3	4014	285	194	140	82	19	12	9	34.6	39.6	16:18:16
D	49601	4	7637	511	358	268	168	45	26	18	34.6	39.6	16:18:28
D	49700	2	2551	81	51	35	21	6	5	4	34.6	39.5	16:20:08
D	49700	3	4042	124	81	57	34	11	8	5	34.6	39.5	16:20:27
D	49700	4	7719	227	153	113	70	24	16	11	34.6	39.5	16:20:38
D	49800	2	2527	81	57	43	29	10	7	4	34.8	39.7	16:22:13
D	49800	3	4014	127	90	71	50	17	11	6	34.8	39.7	16:22:22
D	49800	4	7698	236	173	140	103	39	22	14	34.8	39.7	16:22:34
D	49900	2	2538	171	112	76	39	8	5	3	34.9	39.4	16:24:10
D	49900	3	4015	258	175	123	67	13	7	4	34.9	39.4	16:24:29
D	49900	4	7663	445	314	225	131	27	15	10	34.9	39.4	16:24:40
D	50000	2	2531	197	117	76	35	3	1	2	32.3	39.1	16:26:35

Table A-4 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 sem	D20 sem	D30 sem	D45 sem	D90 sem	D120 sem	D150 sem	Air °C	Pave °C	Time hh:mm:ss
D	50000	3	4030	298	188	125	62	4	1	2	32.3	39.1	16:26:48
D	50000	4	7653	512	333	229	117	10	3	3	32.3	39.1	16:27:00
D	50100	2	2539	163	100	65	29	2	1	2	33.9	39.3	16:28:42
D	50100	3	4015	245	157	106	48	2	1	1	33.9	39.3	16:29:03
D	50100	4	7673	429	282	195	98	6	1	2	33.9	39.3	16:29:20
D	50200	2	2473	185	122	85	45	8	4	3	33.6	38.6	16:30:56
D	50200	3	3950	287	196	139	78	13	8	5	33.6	38.6	16:31:05
D	50200	4	7594	499	353	259	153	30	14	7	33.6	38.6	16:31:16
D	50300	2	2531	211	144	105	62	16	12	9	32.5	38.4	16:32:51
D	50300	3	4030	321	226	168	104	28	17	15	32.5	38.4	16:33:10
D	50300	4	7645	560	406	308	198	56	35	29	32.5	38.4	16:33:22
C Testing Comment: near km post 96													
D	50400	2	2529	207	140	103	63	16	10	10	33.7	37.9	16:35:04
D	50400	3	4006	328	230	172	108	28	19	16	33.7	37.9	16:35:12
D	50400	4	7610	569	418	318	209	56	34	26	33.7	37.9	16:35:24
D	50500	2	2557	181	127	92	54	12	7	7	33.6	37.9	16:37:11
D	50500	3	4013	282	202	151	92	21	13	10	33.6	37.9	16:37:20
D	50500	4	7632	493	363	277	176	44	26	20	33.6	37.9	16:37:32
D	50601	2	2536	223	160	118	71	17	12	9	33.7	37.1	16:39:11
D	50601	3	4015	347	260	196	122	32	18	14	33.7	37.1	16:39:20
D	50601	4	7578	612	470	360	236	67	38	27	33.7	37.1	16:39:32
D	50702	2	2542	134	90	67	43	13	9	9	33.7	38	16:41:15
D	50702	3	4040	213	148	113	73	23	15	13	33.7	38	16:41:24
D	50702	4	7663	375	271	211	145	48	32	25	33.7	38	16:41:43
D	50801	2	2528	211	140	101	57	9	5	3	33.6	37.4	16:43:27
D	50801	3	3994	327	228	167	97	17	9	6	33.6	37.4	16:43:36
D	50801	4	7616	572	413	312	192	39	19	13	33.6	37.4	16:43:48
D	50900	2	2527	163	111	77	43	7	3	2	33.7	37.2	16:45:40
D	50900	3	4028	253	179	128	73	14	7	4	33.7	37.2	16:45:49
D	50900	4	7665	444	323	242	150	31	14	8	33.7	37.2	16:46:01
D	51000	2	2543	269	184	132	75	11	5	4	33.6	37.2	16:47:48
D	51000	3	4004	402	283	208	126	22	10	6	33.6	37.2	16:47:57
D	51000	4	7574	678	492	372	232	47	20	12	33.6	37.2	16:48:08
D	51100	2	2501	242	169	131	79	20	11	6	33.6	37.1	16:49:53
D	51100	3	3971	383	285	220	144	40	21	12	33.6	37.1	16:50:02
D	51100	4	7564	706	545	435	303	95	48	28	33.6	37.1	16:50:14
D	51200	2	2514	236	161	116	62	9	4	3	33.6	36.8	16:52:09
D	51200	3	4040	370	262	194	112	17	7	4	33.6	36.8	16:52:17
D	51200	4	7622	636	466	352	211	39	15	10	33.6	36.8	16:52:29
D	51301	2	2558	94	57	39	20	4	3	1	32.5	36.3	16:54:15
D	51301	3	4049	146	91	63	34	7	5	4	32.5	36.3	16:54:24
D	51301	4	7711	253	163	117	65	15	10	6	32.5	36.3	16:54:36
C Testing Comment: near km 95													
D	51400	2	2548	182	117	84	46	9	5	4	33	36.4	16:56:33
D	51400	3	4039	279	189	138	78	17	8	6	33	36.4	16:56:42
D	51400	4	7684	485	340	255	155	35	18	12	33	36.4	16:57:05

Table A-4 (cont'd).

J J	Station m	Imp Num	Load kgf	D0 æm	D20 æm	D30 æm	D45 æm	D90 æm	D120 æm	D150 æm	Air °C	Pave °C	Time hh:mm:ss
D	51501	2	2521	197	126	89	49	10	7	6	33	35.7	16:59:06
D	51501	3	4026	300	202	145	84	18	11	9	33	35.7	16:59:15
D	51501	4	7667	515	358	266	162	38	22	18	33	35.7	16:59:26
D	51601	2	2519	194	127	87	44	6	4	3	33.3	35.7	17:01:01
D	51601	3	4020	295	202	142	77	11	6	4	33.3	35.7	17:01:10
D	51601	4	7649	509	357	261	151	25	11	7	33.3	35.7	17:01:32
D	51700	2	2558	88	55	38	22	7	6	3	33	35.3	17:03:06
D	51700	3	4077	142	91	64	39	13	9	6	33	35.3	17:03:14
D	51700	4	7752	256	171	123	79	27	17	12	33	35.3	17:03:26
D	51801	2	2524	188	119	82	45	9	4	3	33.2	35	17:05:04
D	51801	3	4030	308	203	141	78	16	9	5	33.2	35	17:05:13
D	51801	4	7643	592	392	277	156	33	16	10	33.2	35	17:05:35
D	51901	2	2548	54	29	20	12	5	3	2	33.3	35.2	17:07:29
D	51901	3	4066	84	49	34	23	10	6	4	33.3	35.2	17:07:38
D	51901	4	7779	163	94	68	44	18	11	9	33.3	35.2	17:07:56
D	52000	2	2555	74	41	30	20	8	6	4	32.8	35.2	17:09:32
D	52000	3	4071	118	69	51	35	15	10	6	32.8	35.2	17:09:41
D	52000	4	7734	227	144	106	73	31	19	12	32.8	35.2	17:10:03
D	52100	2	2540	92	53	38	24	10	7	5	33.2	34.2	17:11:42
D	52100	3	4040	158	94	66	42	18	11	8	33.2	34.2	17:11:51
D	52100	4	7659	317	200	141	92	39	24	16	33.2	34.2	17:12:02
D	52200	2	2548	155	106	79	49	13	7	4	33.2	35.6	17:13:32
D	52200	3	4023	259	186	138	86	25	13	7	33.2	35.6	17:13:41
D	52200	4	7630	504	373	284	187	56	29	17	33.2	35.6	17:14:03
D	52301	2	2541	195	129	90	49	6	2	2	33.2	35.1	17:15:38
D	52301	3	4025	317	220	157	87	11	3	1	33.2	35.1	17:15:46
D	52301	4	7621	567	402	293	174	23	6	2	33.2	35.1	17:15:58
D	52400	2	2559	126	72	45	24	4	2	1	33	35.5	17:17:31
D	52400	3	4033	214	127	84	43	7	3	2	33	35.5	17:17:40
D	52400	4	7635	398	248	167	89	14	6	3	33	35.5	17:18:02

APPENDIX B

Table B-1 (cont'd).

HChannel Cal Date : 02-24-95 02-24-95 02-24-95 02-24-95 02-24-95 02-24-95 02-24-95									
HChannel Cal Time : 14:22:24 14:22:24 14:22:24 14:22:24 14:22:24 14:22:24 14:22:24									
H									
J Station	Imp	Load	D0	D20	D30	D45	D60	D120	D180
J m Num	kgf	æm	æm	æm	æm	æm	æm	æm	æm
J		øC	øC	hh:mm:ss					
J-----									
Insert at least 20 equal " = " signs in this row.									
E 1 9000									
SL	Temp(°F)	Load(lbf)	D0	D20	D30	D45	D60	D120	D180
100	97.7	8933	5.23622	3.70079	2.95276	1.9685	1.41732	0.55118	0.31496
201	98.24	8953	6.88976	5	3.93701	2.51969	1.65354	0.43307	0.15748
301	97.52	8973	5.3937	3.97638	2.99213	1.92913	1.22047	0.27559	0.11811
400	99.32	8935	9.68504	7.32283	5.74803	3.8189	2.51969	0.59055	0.27559
501	100.58	8893	8.62205	6.49606	4.96063	3.11024	1.9685	0.27559	0.11811
601	101.84	8904	10.4724	7.75591	6.02362	4.05512	2.75591	0.90551	0.3937
701	100.94	8909	8.4252	6.25984	4.88189	3.30709	2.20472	0.62992	0.27559
800	102.38	8942	8.4252	6.22047	5.07874	3.58268	2.51969	0.7874	0.27559
901	102.38	8889	8.93701	6.29921	4.84252	3.0315	2.00787	0.47244	0.19685
1001	102.02	8904	8.26772	6.22047	4.80315	3.22835	2.12598	0.47244	0.15748
1101	103.46	8904	9.80315	7.55906	6.10236	4.17323	2.79528	0.74803	0.31496

Table B-2 :Formatted data file for MICHBACK for stations 1101-2900.**IFWD DATA FILE : A:\N5S2D1A.FWD**

HProject : N5
 HSection : 2
 HLocation : start from hyd tol plaza
 HRoad clas. : Flex
 HNo of lanes : 2
 HMeasured lane : outer
 H :
 HSurface type : asphalt
 HLane width : 12
 HDirection(NSWE) : s
 HShoulder type : ST
 HOffset side dist.: 3 ft
 HWeather : Sunny
 H :
 HOperator : almani

 IDate Created : 02-26-1995

 HMachine Type : KUAB FWD Model 150
 HSoftware Version : 4.23

 "ILoad Mode : 1 (6+6 large buffers, 3 stack weights)"
 IPlate Radius : 15.0 (cm)
 HPlate Cal Factor : 11050.00
 HPlate Cal Add : 150
 HPlate Gain Factor: 1.00000
 HPlate Cal Date : 11-27-1994
 HPlate Cal Time : 12:23:02

 HAir Cal Factor : 0.073666
 HAir Cal Add : -273
 HAir Cal Date : 11-26-1994
 HAir Cal Time : 15:03:10

 HDMI Cal Factor : 0.696384
 HDMI Last Cal Date: 02-26-1995
 HDMI Last Cal Time: 09:57:59

 IDrop Sequence : 2123
 IRecord Drop? : NYYY

IChannel	:	0	1	2	3	4	5	6
ISensor ID	:	0-	1-	2-	3-	4-	5-	6-
IDistance	:	0.0	20.0	30.0	45.0	90.0	120.0	150.0 (cm)
IPosition	:	CENTER	BEHIND	BEHIND	BEHIND	BEHIND	BEHIND	BEHIND

 HStatic Cal Factor: 0.5642 0.2884 0.2816 0.2865 0.1399 0.1376 0.1396
 HDyn Cal Factor : 1.050 1.050 1.050 1.050 1.050 1.050 1.050
 HGain Factor : 1.000 1.000 1.000 1.000 1.000 1.000 1.000

Table B-2 (cont'd).

HChannel Cal Date : 02-24-95 02-24-95 02-24-95 02-24-95 02-24-95 02-24-95 02-24-95									
HChannel Cal Time : 14:22:24 14:22:24 14:22:24 14:22:24 14:22:24 14:22:24 14:22:24									
H									
J Station	Imp	Load	D0	D20	D30	D45	D90	D120	D150
J m Num	kgf	æm	æm	æm	æm	æm	æm	æm	æm
J									
Insert at least 20 equal " = " signs in this row.									
E									
1									
9000									
SL	Temp(°F)	Load(lbf)	D0	D20	D30	D45	D90	D120	D150
1201	104.18	8869	10.0787	7.04724	5.27559	3.30709	0.82677	0.3937	0.19685
1300	104.9	8900	10.9449	8.07087	6.10236	3.70079	0.82677	0.31496	0.15748
1400	106.16	8814	17.2441	12.4016	9.25197	5.55118	1.61417	0.94488	0.59055
1501	105.98	8810	14.1339	9.6063	6.81102	3.97638	1.41732	0.90551	0.55118
1600	105.98	8909	8.38583	6.10236	4.72441	3.22835	0.98425	0.55118	0.31496
1701	105.26	8880	13.3858	8.93701	5.98425	2.87402	0.55118	0.35433	0.23622
1800	104.9	8911	7.67717	4.40945	2.75591	1.33858	0.35433	0.23622	0.19685
1900	106.52	8867	10.315	7.59843	5.90551	4.17323	2.04724	1.49606	1.14173
2001	105.62	8898	8.66142	6.1811	4.76378	3.14961	1.10236	0.70866	0.35433
2100	95.18	8911	7.6378	5.35433	4.05512	2.75591	1.1811	0.74803	0.59055
2201	105.44	8887	8.85827	6.22047	4.88189	3.26772	1.1811	0.66929	0.47244
2301	109.22	8803	21.2598	15.0787	11.1417	6.73228	1.73228	0.98425	0.66929
2400	107.78	8801	16.5748	12.7559	9.96063	6.49606	1.92913	1.02362	0.66929
2500	108.14	8891	7.40157	6.29921	5.82677	5	2.6378	1.61417	0.94488
2600	107.96	8816	20.2362	14.1339	10.3937	6.02362	1.81102	1.14173	0.82677
2701	107.24	8889	8.85827	6.53543	5.11811	3.38583	1.41732	0.98425	0.74803
2800	106.52	8942	5.07874	3.58268	2.95276	2.24409	1.14173	0.86614	0.66929
2900	106.88	8904	7.91339	6.02362	4.96063	3.46457	1.29921	0.82677	0.62992

APPENDIX C

APPENDIX C

Table C-1 :Backcalculated layer moduli using the MICHBACK computer program.

SL	TEMP (°F)	LOAD (Lb)	DEFLECTION IN MILS							LAYER MODULI IN PSI			Stiff**
			D0	D20	D30	D45	D90°	D120	D150°	AC	Base	Road bed	Layer
100	97.70	8933	5.236	3.701	2.953	1.969	1.417	0.551	0.315	1194759	70662	72152	278
201	98.24	8953	6.890	5.000	3.937	2.520	1.654	0.433	0.157	1025400	42832	53712	113
301	97.52	8973	5.394	3.976	2.992	1.929	1.220	0.276	0.118	1467244	43315	88053	125
400	99.32	8935	9.685	7.323	5.748	3.819	2.520	0.591	0.276	998901	20841	47828	162
501	100.58	8893	8.622	6.496	4.961	3.110	1.969	0.276	0.118	1118665	18893	73504	124
601	101.84	8904	10.472	7.756	6.024	4.055	2.756	0.906	0.394	639288	32434	32239	148
701	100.94	8909	8.425	6.260	4.882	3.307	2.205	0.630	0.276	958638	32421	44446	144
800	102.38	8942	8.425	6.220	5.079	3.583	2.520	0.787	0.276	929517	44582	31013	113
901	102.38	8889	8.937	6.299	4.843	3.031	2.008	0.472	0.197	814471	29041	51012	129
1001	102.02	8904	8.268	6.220	4.803	3.228	2.126	0.472	0.157	1065047	29045	45019	109
1101	103.46	8904	9.803	7.559	6.102	4.173	2.795	0.748	0.315	1010517	23180	37054	143
1201	104.18	8869	10.079	7.047	5.276	3.307	0.827	0.394	0.197	623436	28235	40415	89
1300	104.90	8900	10.945	8.071	6.102	3.701	0.827	0.315	0.157	751723	18730	44903	91
1400	106.16	8814	17.244	12.402	9.252	5.551	1.614	0.945	0.591	334660	16519	26525	119
1501	105.98	8810	14.134	9.606	6.811	3.976	1.417	0.906	0.551	258561	28434	30759	118
1600	105.98	8909	8.386	6.102	4.724	3.228	0.984	0.551	0.315	832532	39376	37086	113
1701	105.26	8880	13.386	8.937	5.984	2.874	0.551	0.354	0.236	385730	16269	83659	179
1800	104.90	8911	7.677	4.409	2.756	1.339	0.354	0.236	0.197	363095	51877	100000	199
1900	106.52	8867	10.315	7.598	5.906	4.173	2.047	1.496	1.142	516386	45445	31732	341
2001	105.62	8898	8.661	6.181	4.764	3.150	1.102	0.709	0.354	572416	52405	30884	180
2100	95.18	8911	7.638	5.354	4.055	2.756	1.181	0.748	0.591	698821	52300	50947	304
2201	105.44	8887	8.858	6.220	4.882	3.268	1.181	0.669	0.472	779130	36427	42643	162
2301	109.22	8803	21.260	15.079	11.142	6.732	1.732	0.984	0.669	298353	11522	26320	154
2400	107.78	8801	16.575	12.756	9.961	6.496	1.929	1.024	0.669	552621	12403	26500	158
2500	108.14	8891	7.402	6.299	5.827	5.000	2.638	1.614	0.945	3000000	37230	14396	91
2600	107.96	8816	20.236	14.134	10.394	6.024	1.811	1.142	0.827	262322	13968	27617	185
2701	107.24	8889	8.858	6.535	5.118	3.386	1.417	0.984	0.748	734892	38313	44526	463
2800	106.52	8942	5.079	3.583	2.953	2.244	1.142	0.866	0.669	986804	119236	56151	720
2900	106.88	8904	7.913	6.024	4.961	3.465	1.299	0.827	0.630	1347674	28080	52464	505
3000	106.88	8856	11.063	8.031	6.181	3.740	0.945	0.551	0.472	721298	16918	69231	720
3100	107.06	8816	13.386	8.858	6.299	3.504	1.063	0.630	0.512	346111	22111	49742	239
3200	107.78	8836	7.874	5.512	4.252	2.835	0.945	0.551	0.394	892039	36745	54436	176
3300	104.90	8867	10.039	6.535	4.685	2.913	0.945	0.669	0.472	439645	34452	55630	250
3400	106.34	8825	11.260	8.268	6.260	3.937	0.984	0.512	0.276	616068	22195	37797	103
3500	107.78	8757	17.008	11.299	7.953	4.370	0.827	0.315	0.118	273251	16766	28148	87
3600	107.42	8836	11.850	8.740	6.575	3.858	0.945	0.512	0.315	552471	19799	43816	124
3701	107.78	8856	12.047	8.425	5.866	3.228	0.669	0.433	0.197	340448	25059	44237	92
3801	109.22	8847	12.638	9.055	6.811	4.173	1.102	0.630	0.433	541216	18795	43418	164
3900	107.42	8759	16.890	12.087	8.976	5.157	0.945	0.315	0.118	424439	11511	37581	93
4000	108.68	8884	9.331	6.654	5.000	3.189	0.866	0.512	0.276	649299	31053	41598	195
4101	109.58	8891	10.039	6.535	4.764	2.835	0.787	0.394	0.236	478455	33215	47523	103
4200	109.22	8911	8.031	4.803	3.346	1.929	0.551	0.315	0.197	372889	54076	62006	97
4301	107.78	8810	20.000	14.094	10.157	5.669	0.984	0.394	0.197	295711	10556	33634	95

Table C-1 (cont'd).

SL	TEMP (°F)	LOAD (Lb/ft)	DEFLECTION IN MILS							LAYER MODULI IN PSI			Stiff Layer
			D0	D20	D30	D45	D90°	D120	D150°	AC	Base	Road bed	
4400	107.06	8792	19.528	13.701	10.079	6.220	1.417	0.630	0.315	327708	13208	23248	92
4501	105.62	8785	13.740	8.976	6.299	3.504	0.945	0.551	0.354	300185	23261	42640	123
4600	107.78	8876	10.551	6.378	4.173	2.402	0.906	0.630	0.512	268496	38535	68214	553
4700	107.24	8915	8.386	6.063	4.803	3.228	0.984	0.512	0.276	925687	35266	38953	98
4800	107.96	8911	5.984	3.504	2.165	1.024	0.157	0.118	0.079	519493	51781	100000	66
4901	109.76	8867	8.937	6.181	4.528	2.598	0.433	0.157	0.039	700224	26370	58348	71
5000	109.76	8843	11.850	7.677	5.315	2.756	0.591	0.236	0.118	353085	26189	47634	80
5100	108.50	8856	7.362	4.803	3.465	2.087	0.591	0.315	0.157	548805	52580	54779	87
5200	108.68	8860	9.921	6.220	4.252	2.244	0.472	0.236	0.118	406257	30754	68942	95
5300	109.40	8957	5.709	3.780	2.835	1.732	0.354	0.197	0.157	1220778	38403	100000	110
5400	109.04	8832	10.472	6.969	4.724	2.638	0.669	0.354	0.197	373728	31899	50734	97
5500	109.22	8860	7.874	5.197	3.740	2.244	0.748	0.433	0.315	565812	44224	64829	164
5600	109.94	8827	11.772	8.228	6.063	3.425	0.709	0.394	0.157	409605	25017	37519	95
5701	109.58	8843	9.173	6.457	4.724	2.835	0.748	0.433	0.276	623797	29725	56546	129
5800	107.78	8862	6.102	4.134	3.150	1.969	0.591	0.354	0.236	959442	49315	77857	145
5901	108.68	8821	10.709	7.402	5.315	2.913	0.669	0.433	0.315	483956	23011	69809	189
6000	107.78	8880	7.638	5.276	3.819	2.283	0.630	0.433	0.236	591323	43745	61040	107
6100	109.22	8898	6.339	4.291	3.228	1.890	0.591	0.394	0.276	803896	48552	86161	201
6201	109.94	8873	10.276	7.874	6.260	4.291	1.457	0.827	0.551	936753	22971	36243	166
6300	108.68	8838	14.685	9.252	6.102	3.031	0.591	0.276	0.157	247132	21079	49481	89
6401	107.78	8821	9.213	6.457	4.803	2.717	0.512	0.197	0.118	735975	22199	74940	97
6501	109.22	8843	7.244	4.803	3.504	2.087	0.472	0.236	0.118	699405	41885	65195	83
6600	107.78	8838	10.591	7.165	4.921	2.480	0.433	0.197	0.079	618191	13768	100000	35
6701	109.22	8825	15.315	10.394	6.929	3.346	0.354	0.118	0.079	618191	13768	100000	150
6800	108.32	8765	17.480	11.102	6.969	2.874	0.236	0.118	0.118	262211	13346	94856	107
6900	109.22	8849	11.929	7.441	5.118	2.795	0.748	0.433	0.276	306262	28936	52236	120
7001	110.48	8783	19.882	13.110	8.504	3.819	0.433	0.197	0.157	356861	10000	73248	148
7101	109.58	8891	6.969	4.134	2.874	1.732	0.669	0.433	0.276	348954	74356	69343	144
7200	109.22	8869	8.150	5.512	3.937	2.283	0.591	0.354	0.236	614462	35192	72959	132
7300	110.84	8801	8.386	5.394	3.740	2.323	0.866	0.472	0.354	421330	49488	56147	151
7400	110.84	8898	8.307	4.882	3.425	2.008	0.709	0.433	0.276	323143	57026	61650	130
7500	110.48	8851	5.748	3.819	2.874	1.929	0.906	0.591	0.472	656054	85505	68485	348
7600	111.56	8843	8.543	5.118	3.307	1.929	0.630	0.394	0.276	324281	48774	73911	158
7702	110.84	8851	7.283	4.291	2.795	1.654	0.630	0.394	0.276	315973	66783	78358	165
7800	111.74	8832	8.386	5.591	4.055	2.638	0.984	0.669	0.472	508088	47273	53604	222
7900	110.12	8911	8.268	5.276	3.661	2.165	0.787	0.551	0.354	381116	52075	62022	177
8000	109.40	8832	7.756	4.961	3.465	1.969	0.748	0.551	0.433	448378	47520	84889	581
8100	109.40	8832	7.008	4.606	3.189	1.969	0.787	0.512	0.394	499124	58813	72553	270
8200	107.78	8821	9.016	5.669	3.661	2.008	0.591	0.394	0.354	412436	34440	100000	628
8300	108.14	8801	12.402	8.504	6.102	3.583	1.142	0.709	0.551	403833	23844	47252	249
8402	106.88	8783	14.370	9.764	6.969	3.898	0.945	0.591	0.394	337354	18919	44994	152
8500	104.72	8792	14.173	10.236	7.480	4.291	1.024	0.630	0.433	412611	16597	44671	169
8600	107.06	8869	5.197	3.425	2.598	1.732	0.669	0.472	0.315	820808	84626	76023	189
8700	109.94	8889	5.709	3.268	2.402	1.654	0.866	0.669	0.512	313865	126834	81259	720
8800	108.14	8807	15.157	10.591	7.717	4.803	1.811	1.299	0.945	308213	23123	31888	371
8900	109.22	8814	11.102	7.559	5.512	3.780	1.969	1.496	1.181	252899	56836	31976	720

Table C-1 (cont'd).

SL	TEMP (°F)	LOAD (LB)	DEFLECTION IN MILS							LAYER MODULI IN PSI			Stiff Layer
			D0	D20	D30	D45	D90°	D120	D150°	AC	Base	Roadbed	
9000	98.24	8849	8.189	5.748	4.646	3.346	1.614	1.260	1.063	531405	71311	37288	720
9100	107.06	8772	17.598	12.559	8.898	4.961	1.969	1.496	1.220	239284	17954	35874	720
9201	104.90	8790	12.598	8.740	6.575	4.016	1.417	0.984	0.866	476371	21141	50832	720
9301	104.36	8821	8.661	5.709	3.937	2.323	1.063	0.748	0.630	332429	53024	59479	720
9400	106.34	8794	9.370	6.063	4.213	2.677	1.339	0.984	0.787	260140	60461	47354	720
9501	103.28	8616	27.441	19.449	14.646	8.976	3.189	2.047	1.496	196705	11188	16601	241
9600	104.18	8770	16.457	10.748	7.126	3.780	1.299	0.945	0.787	195522	20815	45271	720
9701	103.28	8741	21.181	15.276	10.945	6.496	2.205	1.496	1.142	241345	13716	26037	356
9800	104.90	8825	12.520	9.094	6.693	4.173	1.614	1.142	0.906	437991	24799	40636	720
9901	104.72	8847	8.425	5.906	4.528	3.031	1.299	0.906	0.709	635031	45483	49137	604
9999	103.28	8829	10.512	7.480	5.472	3.386	1.024	0.669	0.472	549773	26547	50123	214
10099	103.82	8779	10.197	6.969	5.079	3.150	1.299	0.866	0.630	390635	40068	42658	249
10201	104.36	8719	21.220	14.882	10.748	6.181	2.008	1.299	0.984	231062	13741	26814	271
10301	104.00	8761	16.890	12.480	9.488	6.063	2.047	1.260	0.906	405519	16030	26081	203
10400	103.28	8823	7.283	5.000	3.976	2.835	1.614	1.339	1.102	363750	122521	37204	720
10501	103.64	8832	9.173	6.260	4.724	3.346	1.890	1.457	1.181	278817	85548	33336	720
10600	102.92	8726	16.732	11.614	8.504	5.157	1.969	1.575	1.378	305538	17091	40342	717
10700	104.36	8827	16.811	12.008	8.740	5.394	1.575	0.906	0.630	361603	16107	30234	161
10800	102.20	8783	17.835	11.969	8.701	5.000	1.614	1.102	0.787	248922	17932	32106	241
10900	102.74	8814	14.646	9.606	6.654	3.661	1.063	0.630	0.433	269490	22374	41348	147
11000	102.56	8814	8.780	5.669	4.213	2.717	1.102	0.787	0.591	446894	47931	53798	369
11100	102.20	8851	6.260	3.976	2.835	1.732	0.669	0.472	0.276	455514	79860	66983	142
11210	101.48	8851	6.220	4.213	3.228	2.244	0.984	0.669	0.472	672226	80472	54631	206
11300	102.92	8858	8.780	5.276	3.622	2.087	0.866	0.669	0.472	290039	52703	69654	359
11401	102.02	8889	7.480	5.512	4.291	2.677	0.906	0.591	0.433	935859	35405	63516	254
11500	102.92	8858	7.638	5.079	3.740	2.402	0.945	0.630	0.472	563321	52168	59921	226
12034	97.88	8807	10.118	7.087	5.079	3.110	1.220	0.906	0.669	428930	35460	49936	353
12100	98.42	8779	19.291	12.992	8.937	4.921	0.945	0.551	0.394	260735	12627	42254	145
12201	98.78	8803	10.118	6.417	4.331	2.402	0.906	0.591	0.433	370869	32357	77828	720
12300	99.50	8854	6.772	4.213	2.874	1.772	0.709	0.472	0.354	430807	66777	79223	241
12400	89.78	8995	7.913	6.142	4.921	3.504	1.220	0.709	0.433	1264312	33672	39364	131
12501	90.50	9004	5.827	4.213	3.228	1.969	0.669	0.433	0.354	1183708	44054	98298	461
12601	91.22	8975	9.724	6.969	5.197	3.110	0.709	0.394	0.276	757633	20987	74877	154
12700	91.40	8942	9.843	6.614	4.764	2.717	0.669	0.433	0.276	548140	26840	70704	203
12800	89.78	9001	5.000	3.583	2.795	1.890	0.827	0.551	0.394	1088380	87189	67780	209
12900	90.50	8962	10.118	7.598	5.787	3.622	0.906	0.433	0.354	891862	16964	72520	195
13000	87.80	8931	11.102	7.795	5.787	3.425	1.024	0.709	0.551	577072	21213	67506	720
13100	84.20	8926	10.039	7.087	5.276	3.189	1.024	0.669	0.512	631765	25418	62581	541
13200	93.74	8962	7.874	5.748	4.291	2.598	0.827	0.551	0.433	822410	32291	74821	373
13300	95.00	8977	5.472	3.661	2.717	1.772	0.827	0.551	0.512	826411	73317	94189	572
13400	94.64	8884	9.843	6.850	4.961	2.913	1.063	0.748	0.551	458801	34261	54357	319
13500	95.72	8900	10.984	7.559	5.472	3.150	0.827	0.472	0.315	483185	25469	52192	134
13600	96.08	8946	10.906	7.874	6.102	3.937	1.260	0.709	0.512	714132	23302	42615	168
13700	98.78	8893	11.378	9.055	7.402	5.118	2.126	1.417	1.102	944945	21049	32379	720
13800	99.50	8851	16.811	10.906	7.126	3.740	1.260	0.906	0.669	237249	17825	51735	686
13900	98.24	8911	10.906	8.110	6.102	3.740	1.181	0.787	0.630	644161	21501	54835	491

Table C-1 (cont'd).

SL	TEMP (°F)	LOAD (Lbf)	DEFLECTION IN MILS							LAYER MODULI IN PSI			Stiff
			D0	D20	D30	D45	D90	D120	D150	AC	Base	Roadbed	Layer
14000	98.96	8946	8.543	5.079	3.622	2.205	0.866	0.551	0.472	320922	57055	61813	232
14100	100.22	8900	14.252	9.449	6.654	3.543	1.102	0.787	0.630	292307	21132	53885	393
14200	97.70	8966	5.354	3.780	2.835	1.850	0.787	0.551	0.433	957632	71052	82651	313
14300	100.04	8922	7.520	5.394	4.252	2.795	1.181	0.866	0.630	765783	50322	51998	365
14400	98.96	8935	12.047	8.740	6.496	3.858	0.984	0.748	0.630	552217	17186	72478	686
14501	100.04	8880	11.693	7.559	5.276	3.425	1.732	1.220	0.906	261693	43140	39773	720
14550	99.86	8922	8.150	5.709	4.370	2.953	1.339	0.906	0.748	646517	49405	50606	375
14600	99.50	8836	16.457	11.654	8.937	5.866	2.323	1.535	1.102	335038	22426	23576	215
14700	99.14	8876	13.740	10.630	8.583	5.906	2.126	1.299	0.906	715550	17381	27031	211
14800	98.96	8836	14.488	10.197	7.598	4.567	1.299	0.787	0.551	457821	15385	50000	686
14900	100.22	8913	9.882	6.969	5.197	3.071	0.984	0.630	0.433	632118	25596	43342	160
15000	103.10	8898	8.898	6.024	4.409	2.953	1.260	0.827	0.591	462033	50631	44783	240
15051	103.64	8893	7.638	5.433	4.252	2.756	1.220	0.984	0.787	588646	60295	48787	720
15100	103.10	8884	8.740	6.654	5.236	3.386	0.945	0.551	0.354	974424	24492	52838	160
15200	103.10	8915	10.630	7.362	5.039	2.756	0.709	0.472	0.394	543225	19489	100000	706
15300	103.10	8865	13.504	8.976	6.220	3.228	0.787	0.512	0.354	378137	17419	79878	630
15400	102.56	8851	10.906	7.559	5.354	3.228	0.827	0.512	0.354	540679	22280	100000	683
15501	101.48	8851	10.472	6.614	4.134	2.126	0.669	0.472	0.354	427770	49335	63785	168
15550	102.38	8907	6.850	5.039	4.016	2.874	1.260	0.748	0.433	786467	81632	30574	100
15600	101.48	8944	5.984	3.780	2.677	1.614	0.827	0.591	0.472	436752	86380	87757	720
15700	102.38	8873	8.858	5.984	4.016	2.205	0.748	0.472	0.394	439109	36564	77617	337
15800	103.28	8836	16.181	11.063	7.756	4.213	0.984	0.630	0.433	290187	16505	44115	161
15900	102.02	8898	11.339	7.835	5.669	3.228	0.866	0.512	0.354	518852	20697	48330	138
16000	104.18	8880	10.394	6.929	4.764	2.559	0.748	0.512	0.394	532551	17163	100000	91
16050	103.10	8880	9.016	6.181	4.488	2.638	0.945	0.748	0.591	2132111	10000	100000	26
16100	103.64	8851	13.819	8.504	5.591	2.795	0.906	0.630	0.512	257412	22611	70680	720
16200	102.92	8843	11.457	7.323	5.157	2.913	1.063	0.709	0.512	296139	33821	49837	229
16300	105.08	8860	11.299	7.402	5.197	2.913	1.063	0.748	0.630	348633	29465	61950	720
16401	105.98	8810	12.717	8.661	6.024	3.228	0.630	0.354	0.276	419792	18267	68313	167
16500	106.70	8935	5.709	3.622	2.677	1.654	0.709	0.433	0.276	580484	85155	73262	160
16550	105.44	8840	5.236	3.189	2.205	1.339	0.551	0.354	0.236	468267	99207	89363	150
16600	105.98	8900	8.150	5.433	3.819	2.165	0.551	0.354	0.197	507025	40218	67061	112
16700	105.44	8915	8.150	5.039	3.307	1.811	0.630	0.433	0.236	294330	57454	65520	123
16800	105.08	8933	9.882	6.417	4.370	2.244	0.709	0.472	0.354	352718	34050	73941	230
16901	106.52	8937	8.307	5.709	4.055	2.323	0.748	0.551	0.394	536514	38003	74361	321
17000	107.96	8904	6.220	4.173	3.110	1.969	0.709	0.472	0.354	803693	55992	79452	263
17050	107.60	8871	7.047	4.921	3.701	2.323	0.866	0.591	0.394	686601	53197	58579	189
17100	107.24	8843	10.827	7.402	5.157	2.953	0.866	0.551	0.394	418541	28030	55993	185
17201	106.88	8920	8.031	5.039	3.425	1.929	0.748	0.472	0.354	366215	52661	72792	204
17300	107.42	8893	12.913	7.205	4.449	2.087	0.748	0.551	0.433	162241	31774	80986	487
17400	107.24	8940	8.150	5.433	4.055	2.520	0.984	0.669	0.472	516936	49959	55182	228
17500	108.32	8847	11.732	7.756	5.591	3.346	1.024	0.709	0.551	421778	25233	55846	401
17550	107.24	8904	5.906	3.819	2.756	1.693	0.669	0.472	0.354	630667	69033	88513	305
17600	108.50	8856	8.425	5.709	4.213	2.598	0.984	0.669	0.512	551506	42069	59758	348
17700	109.22	8891	11.260	7.323	4.961	2.756	0.906	0.551	0.433	330259	30590	58048	215
17800	107.78	8825	12.362	8.661	5.984	3.465	1.220	0.866	0.630	333456	27030	45883	290

Table C-1 (cont'd).

SL	TEMP (°F)	LOAD (Lbf)	DEFLECTION IN MILS							LAYER MODULI IN PSI			Stiff Layer
			D0	D20	D30	D45	D90°	D120	D150°	AC	Base	Roadbed	
17900	111.02	8818	15.433	10.276	7.165	4.134	1.496	0.984	0.709	237532	24146	34822	163
18000	109.22	8845	10.236	7.283	5.354	3.228	1.181	0.787	0.551	470298	33622	44391	162
18051	108.32	8783	11.811	8.150	5.669	3.110	1.024	0.748	0.591	358717	25147	59705	712
18100	108.14	8873	8.268	5.591	3.898	2.244	0.748	0.472	0.394	549324	37385	78628	314
18200	106.16	8869	13.110	9.370	6.929	4.291	1.457	0.945	0.591	387477	26442	31343	151
18300	107.60	8845	10.551	7.165	5.039	2.953	1.220	0.827	0.630	343674	37317	48946	311
18400	108.14	8825	10.394	6.929	4.921	2.795	0.827	0.512	0.394	450949	28500	62074	214
18500	107.78	8856	11.063	7.598	5.433	3.228	1.063	0.709	0.433	375549	33032	41650	146
18600	110.12	8867	9.331	6.299	4.488	2.441	0.748	0.551	0.394	451025	32903	71878	271
18701	110.84	8814	10.984	7.638	5.512	2.992	0.591	0.394	0.276	471876	21137	73377	168
18800	111.20	8851	9.803	7.087	5.354	3.543	1.220	0.748	0.433	637738	33790	37198	142
18900	111.02	8810	13.150	8.858	6.063	3.386	0.906	0.512	0.315	311630	24382	42480	117
19000	108.86	8845	10.748	7.598	5.669	3.465	1.142	0.669	0.472	532237	28183	43181	167
19050	110.12	8856	8.780	6.220	4.646	2.835	0.827	0.551	0.394	688385	30082	63796	222
19100	110.30	8862	13.425	9.528	6.929	3.858	1.024	0.630	0.472	414645	18646	49367	206
19200	110.84	8832	11.496	8.307	6.181	3.740	0.984	0.551	0.433	636492	17057	36942	134
19300	111.74	8843	11.024	7.835	5.709	3.543	1.102	0.630	0.433	550346	24854	46777	191
19400	111.74	8884	8.543	5.433	3.661	2.087	0.748	0.512	0.433	415894	41409	84781	574
19501	108.86	8803	10.157	6.654	4.646	2.677	0.827	0.472	0.394	453642	29953	64247	231
19600	111.38	8836	7.402	5.118	3.504	2.008	0.748	0.472	0.394	552630	45163	80922	337
19700	111.20	8836	8.543	5.512	3.858	2.126	0.630	0.512	0.354	452218	37174	86564	401
19801	111.02	8884	7.913	4.764	3.228	1.732	0.512	0.394	0.276	408896	44564	100000	253
19901	113.18	8860	7.795	5.197	3.622	2.087	0.591	0.354	0.276	616648	37303	85388	200
20000	112.28	8898	4.331	2.756	2.126	1.535	0.709	0.472	0.354	744022	139353	79230	207
20050	113.18	8891	4.488	2.756	2.008	1.378	0.669	0.512	0.394	518408	141881	94920	720
20100	111.20	8825	9.173	6.614	4.843	2.953	0.906	0.591	0.394	604068	31739	53199	175
20200	110.66	8803	12.756	9.016	6.614	3.937	0.827	0.472	0.315	492985	17469	51555	143
20300	111.56	8832	15.000	10.315	7.362	4.173	0.984	0.630	0.512	395225	14681	61518	720
20402	109.94	8801	13.268	9.331	6.654	3.622	0.984	0.630	0.472	522441	10000	100000	98
20500	109.94	8867	11.772	7.992	5.551	2.992	0.827	0.512	0.354	359964	25702	54431	150
20600	111.20	8787	12.126	7.953	5.433	2.992	0.787	0.551	0.433	356658	23199	67363	267
20701	110.66	8770	11.457	8.110	5.945	3.543	1.024	0.669	0.512	512354	22075	53857	252
20800	110.66	8827	9.449	6.299	4.409	2.441	0.748	0.551	0.433	454176	31310	79166	375
20900	110.12	8821	10.512	7.323	5.118	2.835	0.748	0.433	0.354	507181	24025	69168	215
21000	110.48	8851	9.291	6.063	4.213	2.441	0.945	0.669	0.472	353299	43788	58377	210
21050	110.48	8790	12.441	8.819	6.457	3.819	0.984	0.630	0.472	489220	18960	53304	270
21100	111.92	8876	11.732	7.717	5.433	3.150	1.102	0.827	0.669	356160	27676	59732	720
21201	112.64	8801	15.748	10.984	7.874	4.409	1.142	0.748	0.591	342930	15606	47193	268
21300	109.22	8869	14.449	10.197	7.402	4.528	1.535	1.063	0.906	399790	18731	44609	720
21400	107.78	8814	13.150	9.449	6.890	4.134	1.417	1.063	0.866	419452	20585	48517	720
21500	110.48	8832	12.953	8.465	5.630	2.835	0.748	0.551	0.472	299370	21567	78756	455
21601	111.56	8849	11.850	8.504	6.181	3.740	1.220	0.866	0.748	511187	21030	58434	720
21700	109.76	8772	16.457	11.220	7.756	4.173	1.102	0.748	0.591	275872	16254	47838	249
21800	106.16	8719	15.039	10.472	7.362	4.134	1.220	0.827	0.709	337714	17023	50360	358
21900	111.02	8836	13.819	9.961	7.559	4.528	1.220	0.827	0.591	460819	17198	43538	233
21999	109.94	8838	16.102	11.181	7.835	4.646	1.181	0.827	0.669	347568	15040	49250	303

Table C-1 (cont'd).

SL	TEMP (°F)	LOAD (Lbf)	DEFLECTION IN MILS							LAYER MODULI IN PSI			Stiff Layer
			D0	D20	D30	D45	D90	D120	D150	AC	Base	Road bed	
22100	110.84	8880	6.732	4.370	3.110	2.087	0.984	0.787	0.630	361882	89973	61616	720
22201	110.48	8790	15.118	10.118	6.969	3.898	1.220	0.827	0.669	281066	19908	47153	443
22301	108.14	8794	13.189	8.307	5.669	3.071	0.984	0.709	0.591	278978	24315	62440	589
22400	107.06	8818	13.898	10.079	7.362	4.331	1.142	0.709	0.512	437600	17279	43951	207
22500	105.98	8840	14.803	10.315	7.520	4.606	1.575	1.024	0.787	358034	20663	36030	237
22600	107.06	8768	17.874	12.480	8.780	4.961	1.339	0.827	0.630	287040	14659	37427	214
22701	106.88	8832	14.567	10.315	7.362	4.134	0.945	0.472	0.394	460699	14417	54501	198
22800	109.22	8765	13.819	9.370	6.575	3.661	0.984	0.709	0.551	340375	19333	55742	254
22900	110.12	8836	12.323	8.898	6.575	3.937	1.260	0.827	0.669	499976	20635	49148	491
23000	111.20	8803	12.441	8.937	6.339	3.780	1.220	0.827	0.630	417653	22876	46420	249
23100	110.12	8823	13.031	8.976	6.378	3.661	1.299	0.984	0.787	341795	23542	51157	720
23200	110.30	8821	12.441	8.504	5.866	3.071	0.984	0.748	0.591	318759	23822	62657	460
23300	110.30	8832	16.220	10.945	7.283	3.976	1.417	0.984	0.748	211754	21531	40212	251
23400	110.12	8858	16.378	11.063	7.913	5.000	2.047	1.496	1.102	238181	24884	29510	419
23501	108.14	8856	14.331	10.472	7.559	4.488	1.378	0.984	0.787	408698	17455	46175	404
23600	109.94	8752	15.827	11.024	7.913	4.724	2.047	1.496	1.299	270897	21637	36780	720
23700	107.24	8893	10.039	7.126	5.276	3.583	2.126	1.811	1.535	266808	87574	28024	720
23800	106.34	8843	10.315	6.693	4.843	3.150	1.496	1.142	0.945	324454	44560	49914	720
23900	106.70	8873	8.937	6.181	4.528	2.953	1.496	1.102	0.827	384122	57665	44663	529
24000	104.90	8876	6.890	4.488	3.228	2.323	1.220	0.945	0.827	315706	113704	50335	720
24100	103.82	8871	11.378	8.228	6.142	3.780	1.299	0.866	0.669	530973	24660	46231	395
24201	103.82	8761	18.976	13.937	10.512	6.732	2.520	1.772	1.378	328939	15238	25354	720
24300	103.10	8781	17.874	11.890	7.717	4.055	1.299	0.906	0.669	183044	18733	40565	257
24401	102.38	8845	17.126	11.378	7.795	4.291	1.339	0.945	0.748	236876	17969	43220	429
24500	89.60	8893	13.346	9.882	7.598	4.882	1.693	1.181	0.906	535208	19452	37941	694
24600	100.94	8851	13.819	9.843	7.165	4.291	1.220	0.787	0.630	448651	17516	48040	388
24700	103.28	8781	18.346	13.622	10.394	6.850	3.031	2.126	1.535	292112	21621	19304	335
24800	102.38	8776	16.614	10.709	7.205	4.016	1.417	0.945	0.748	203875	21440	40139	351
24900	94.82	8838	14.803	10.079	7.008	3.858	1.260	0.906	0.669	272398	21454	44253	337
25000	104.36	8774	14.409	9.606	6.772	3.976	1.417	1.024	0.748	272526	24368	39794	338
25100	102.92	8814	13.661	9.882	7.402	4.646	1.654	1.063	0.787	434449	22091	33647	228
25200	102.02	8893	12.874	9.252	6.772	4.016	1.299	0.866	0.669	440279	21378	45086	361
25300	102.74	8832	17.992	12.126	8.701	5.118	1.772	1.220	0.945	249517	18011	32975	379
25400	102.02	8847	15.039	11.260	8.425	5.157	1.693	1.063	0.827	453659	16461	35254	342
25500	103.10	8772	21.417	15.157	11.181	7.205	2.992	2.126	1.575	217204	17966	19808	244
25600	104.00	8865	12.126	8.937	6.929	4.646	1.654	1.142	0.787	571922	24938	33099	230
25700	103.46	8803	10.945	7.598	5.512	3.346	1.220	0.945	0.748	443987	28185	55519	720
25800	100.22	8878	6.417	4.252	3.150	2.047	0.945	0.669	0.512	556889	74670	67018	421
25901	101.84	8860	12.323	8.307	5.866	3.346	1.260	0.906	0.669	308442	29353	46520	309
26000	100.22	8884	10.787	7.244	4.921	2.756	1.102	0.827	0.669	324413	33235	62842	720
26100	102.92	8862	9.055	6.181	4.646	2.913	1.535	1.181	0.906	306389	65878	41249	720
26200	99.32	8776	13.583	9.094	6.457	3.898	1.535	1.102	0.748	258792	30457	34756	247
26300	99.50	8805	11.890	8.425	6.457	4.252	1.929	1.378	1.102	430199	32911	35063	483
26401	99.32	8821	13.740	9.449	6.890	4.094	1.220	0.827	0.630	392017	20030	45569	282
26500	102.02	8873	8.268	5.118	3.465	2.047	0.827	0.669	0.512	358814	49837	82551	720
26600	99.32	8884	11.850	7.441	4.882	2.520	0.866	0.591	0.433	242169	31793	61420	228

Table C-1 (cont'd).

SL	TEMP (°F)	LOAD (Lbf)	DEFLECTION IN MILS							LAYER MODULI IN PSI			Stiff Layer
			D0	D20	D30	D45	D90°	D120	D150°	AC	Base	Roadbed	
26700	99.32	8838	12.205	8.583	6.260	3.701	1.142	0.669	0.472	440424	24050	42085	165
26800	100.04	8911	9.606	6.417	4.567	2.795	0.945	0.669	0.433	425152	39093	51663	175
26900	98.96	8851	15.551	10.984	7.874	4.567	1.299	0.827	0.551	324029	18584	35423	172
27000	100.76	8847	11.496	7.756	5.472	3.110	0.984	0.591	0.433	381023	28002	49868	176
27100	87.44	9072	7.362	5.079	3.661	2.283	0.906	0.630	0.472	601763	52473	66765	249
27200	87.08	9017	12.126	8.661	6.575	4.016	1.220	0.827	0.591	520353	22280	45197	257
27300	88.16	9037	7.244	5.512	4.370	3.071	1.339	0.906	0.669	1052989	50218	45459	229
27401	87.62	8995	11.772	8.858	6.732	4.370	1.693	1.102	0.748	527538	29618	31107	190
27500	88.70	8995	9.134	6.496	5.039	3.150	1.024	0.748	0.551	714653	29895	59656	318
27600	89.06	9043	9.016	6.457	4.882	3.150	1.142	0.748	0.591	728949	32908	55150	276
27700	88.34	9010	11.890	9.016	6.929	4.370	1.339	0.827	0.591	658992	19680	42087	227
27800	89.42	8981	12.283	8.858	6.575	4.055	1.260	0.827	0.630	522602	21359	46353	248
27901	89.60	8995	14.134	10.118	7.520	4.646	1.457	0.866	0.630	450556	19661	36095	190
28000	90.14	8988	13.110	9.449	7.205	4.488	1.535	0.984	0.748	500941	21437	38294	245
28100	91.22	8979	13.740	9.724	7.283	4.449	1.535	1.063	0.787	408506	22279	37947	251
28200	92.30	8953	13.228	9.724	7.283	4.606	1.614	1.102	0.827	479099	21750	37148	268
28300	92.30	8999	9.173	6.732	5.276	3.504	1.299	0.866	0.709	883213	28080	54389	489
28400	92.48	8856	24.646	16.654	11.614	6.142	2.441	1.614	1.142	128039	15979	21996	254
28500	91.40	8999	7.559	5.591	4.370	3.110	1.496	1.142	0.906	659759	68024	42213	720
28600	93.02	8900	14.252	9.134	6.220	3.307	0.945	0.630	0.472	264008	22431	53258	219
28700	92.66	8988	11.732	8.071	5.945	3.622	1.299	0.866	0.630	414620	29553	42474	216
28800	93.38	9037	6.772	4.646	3.425	2.126	0.748	0.512	0.433	849965	43680	91460	503
28901	93.20	8975	13.740	8.976	6.024	3.031	0.748	0.512	0.472	315942	19463	79433	369
29000	93.38	8929	14.016	9.803	7.205	4.291	1.417	0.984	0.787	394516	20138	44317	499
29100	93.92	8922	18.898	14.134	10.866	6.969	2.638	1.772	1.339	359814	15555	23174	265
29200	93.02	9012	11.063	7.992	6.102	3.976	1.417	0.945	0.748	634429	25252	45541	300
29300	93.74	8957	12.402	8.937	6.693	4.055	1.220	0.748	0.512	495526	22365	40241	152
29400	90.68	8957	11.457	8.898	7.008	4.764	1.693	1.063	0.748	788775	21825	34113	221
29500	93.92	8867	15.866	11.417	8.780	5.709	1.654	0.827	0.551	524586	14591	29285	140
29600	95.54	8953	12.126	8.976	6.772	4.252	1.260	0.709	0.433	559637	22747	34580	128
29700	94.64	8856	20.630	14.528	10.669	6.417	1.811	1.024	0.709	290179	13034	25741	157
29800	91.76	8964	13.425	9.764	7.205	4.567	1.457	0.984	0.748	484326	19780	40990	267
29901	92.66	8951	14.055	9.567	6.693	3.661	0.906	0.591	0.433	342121	19274	53215	200
30000	93.92	8937	15.197	11.220	8.228	5.118	1.102	0.512	0.315	509153	13404	38608	119
30100	94.64	8915	14.685	10.197	7.362	4.252	1.024	0.551	0.354	383204	17973	39673	127
30201	94.82	8862	11.535	8.465	6.220	3.780	0.866	0.472	0.354	647497	17128	60679	207
30300	95.36	8953	16.181	10.984	7.087	3.819	1.063	0.630	0.433	230601	20086	41074	166
30400	96.98	8924	14.921	10.630	7.953	4.764	1.457	0.866	0.591	394765	19201	32943	162
30500	97.16	9015	8.740	6.142	4.370	2.480	0.591	0.354	0.276	676436	27361	86738	201
30600	97.34	9015	6.732	4.606	3.425	2.126	0.787	0.551	0.433	771664	49448	80680	445
30700	97.88	8935	14.803	10.591	8.150	5.157	1.299	0.709	0.472	526914	14901	37094	157
30800	96.98	8942	9.409	6.417	4.685	2.795	0.906	0.591	0.394	501935	35908	53265	168
30900	95.18	8975	7.756	5.787	4.567	3.189	1.181	0.787	0.551	1038785	38802	47833	221
31000	95.72	8995	7.520	5.827	4.764	3.307	1.142	0.709	0.472	1370967	31059	49216	203
31101	97.16	8946	12.717	8.937	6.496	3.819	0.866	0.551	0.433	501879	17320	62829	274
31200	96.08	8942	14.843	10.276	7.323	4.331	1.378	0.787	0.591	348921	20588	36833	181

Table C-1 (cont'd).

SL	TEMP (°F)	LOAD (Lb)	DEFLECTION IN MILS							LAYER MODULI IN PSI			Stiff Layer
			D0	D20	D30	D45	D90°	D120	D150°	AC	Base	Roadbed	
31300	95.90	8918	14.961	11.024	8.543	5.276	1.575	0.906	0.591	478824	17103	30136	152
31401	95.36	8951	8.031	5.669	4.252	2.756	0.984	0.630	0.472	752392	39458	57695	220
31500	95.72	8966	11.457	7.756	5.669	3.346	0.827	0.551	0.433	520447	21278	67226	266
31601	97.16	8988	10.394	7.126	5.039	2.874	0.866	0.591	0.512	506569	25826	75158	487
31700	98.24	8968	7.677	5.354	3.819	2.244	0.551	0.354	0.276	771887	31429	97584	234
31801	97.52	8953	12.323	8.425	6.024	3.465	0.748	0.433	0.315	474072	19473	60623	164
31901	96.62	8884	13.346	9.567	6.969	3.976	0.906	0.472	0.276	429716	19028	40788	108
32000	97.16	8953	8.622	5.827	4.134	2.323	0.551	0.315	0.157	501452	37611	58374	90
32101	95.72	8911	14.567	9.094	5.787	2.598	0.354	0.157	0.079	154299	26765	32584	19
32200	96.08	8953	9.567	6.614	4.803	2.835	0.591	0.315	0.197	645795	25176	66089	113
32300	95.90	8909	9.370	7.087	5.315	3.307	0.669	0.276	0.157	913067	19136	63372	109
32400	95.36	8999	5.000	3.583	2.835	1.929	0.709	0.433	0.276	1339038	73090	65641	134
32501	98.42	8933	10.709	7.598	5.551	3.228	0.748	0.394	0.236	552424	23862	51289	111
32600	98.96	8904	16.496	9.646	5.984	2.874	0.709	0.394	0.236	150774	23245	48605	118
32700	98.96	9026	7.362	4.764	3.228	1.772	0.472	0.276	0.157	487957	49080	77512	100
32801	101.48	8891	13.425	9.016	6.378	3.386	0.394	0.118	0.079	338900	17212	49912	70
32901	99.86	8942	11.575	7.323	5.000	2.441	0.394	0.197	0.118	394896	21534	93757	119
33101	100.58	8911	10.709	7.638	5.551	3.268	0.472	0.197	0.079	522377	21934	51090	72
33200	100.94	8937	6.614	4.291	2.953	1.417	0.236	0.137	0.118	600540	40356	100000	88
33300	100.58	8904	9.567	7.087	5.079	2.756	0.354	0.157	0.079	539524	22731	70137	75
33400	100.76	8929	10.394	6.614	4.370	2.244	0.315	0.157	0.118	459640	23976	99833	113
33500	98.96	8924	9.921	6.299	4.134	1.850	0.236	0.079	0.039	388815	28672	81220	68
33601	100.04	8896	13.150	6.850	3.937	1.929	0.472	0.276	0.236	171405	29875	93108	181
33700	100.40	8929	9.016	6.102	4.370	2.677	0.866	0.551	0.433	573089	34010	65168	281
33800	99.86	8884	9.764	6.969	5.276	3.268	0.787	0.433	0.236	656909	26724	46955	105
33901	100.94	8790	21.102	11.654	5.984	2.008	0.748	0.787	0.709	55114	22127	63336	720
34000	101.48	8946	7.244	5.276	4.094	2.677	0.945	0.669	0.472	927331	41290	60888	306
34101	101.84	8862	16.181	11.772	9.055	5.630	1.811	1.142	0.827	420944	16223	30173	238
34200	102.74	8832	14.843	11.102	8.701	5.945	1.811	1.142	0.866	632511	13340	36162	469
34300	101.48	8865	15.866	11.929	9.291	6.063	1.850	1.142	0.787	512487	14601	29137	212
34401	102.92	8904	15.276	11.102	8.307	5.276	1.850	1.260	1.024	432462	17513	36052	685
34500	102.92	8946	7.992	5.984	4.646	3.110	1.024	0.748	0.591	1029387	28208	70368	720
34601	104.00	8900	12.638	9.646	7.638	5.157	1.811	1.181	0.866	698435	19108	33959	332
34700	102.38	8900	13.819	8.661	6.024	3.543	1.614	1.220	0.984	182562	36589	38322	720
34800	102.74	8915	8.071	5.669	4.134	2.559	0.945	0.669	0.512	627299	40661	65082	458
34901	103.82	8924	9.803	6.654	4.882	3.031	1.260	1.024	0.906	493610	33120	67474	720
35000	105.80	8948	8.898	6.063	4.331	2.362	0.866	0.709	0.551	409794	40902	67120	720
35101	104.18	8880	13.228	9.961	7.480	4.724	1.614	1.024	0.787	535025	19332	37340	344
35300	104.90	8880	15.433	11.102	8.228	4.843	1.535	1.260	1.024	320125	19437	36339	720
35401	106.88	8836	14.961	9.094	5.906	2.835	0.945	0.709	0.551	180953	23831	62427	482
35502	105.26	8884	10.276	7.008	4.961	2.874	0.827	0.591	0.512	522389	24851	80392	720
35601	106.16	8836	14.173	10.197	7.047	3.976	1.024	0.748	0.630	346364	17550	55329	720
35700	106.34	8926	9.409	6.535	4.567	2.520	0.945	0.827	0.709	451242	31327	88623	720
35800	107.06	8880	12.402	8.898	6.732	4.055	1.063	0.709	0.551	550788	17684	55616	279
35900	107.78	8933	9.803	6.535	4.567	2.402	0.787	0.709	0.709	341799	38016	64004	691
36000	105.44	8832	16.850	11.772	8.780	5.079	1.378	0.866	0.630	344898	15088	36580	216

Table C-1 (cont'd).

SL	TEMP (°F)	LOAD (Lbf)	DEFLECTION IN MILS							LAYER MODULI IN PSI			Stiff Layer
			D0	D20	D30	D45	D90°	D120	D150°	AC	Base	Road bed	
36101	102.92	8900	9.016	6.339	4.724	2.953	1.024	0.709	0.551	642209	32786	59875	274
36200	103.28	8942	5.472	3.937	3.189	2.402	1.181	0.827	0.630	1056703	97151	51783	328
36300	102.38	8821	16.732	11.654	8.110	4.567	1.496	1.142	0.906	266637	17331	42944	720
36400	100.94	8873	11.969	8.228	5.984	3.661	1.142	0.748	0.630	495142	22085	55442	520
36500	103.46	8849	15.669	10.984	7.638	4.291	1.220	0.748	0.591	321217	17262	43137	224
36600	102.74	8904	12.520	9.055	6.457	3.819	1.181	*	0.787	439589	21758	48090	250
36700	102.38	8843	17.756	12.835	9.488	5.630	1.535	1.063	0.906	373583	12080	44136	720
36800	101.48	8880	9.409	6.614	4.843	2.835	1.063	0.827	0.709	447397	38323	54644	720
36901	101.48	8884	13.307	9.409	7.126	4.488	1.417	0.984	0.787	503695	18832	45803	615
37001	100.58	8851	16.614	12.087	9.213	5.748	1.693	1.260	1.024	425034	13201	41628	720
37100	101.84	8891	14.685	10.984	8.307	5.197	1.575	1.024	0.787	503405	15458	38714	268
37200	99.68	8878	13.937	10.157	7.480	4.724	1.575	1.102	0.827	436824	20054	37639	254
37300	99.86	8922	9.921	6.969	5.157	3.307	1.457	1.024	0.748	431028	43679	40922	230
37401	99.68	8884	13.228	9.961	7.520	4.685	1.496	1.024	0.787	537818	17866	42362	414
37500	98.60	8880	13.937	10.591	8.346	5.354	1.535	0.945	0.748	665863	12860	45744	605
37600	97.34	8924	14.331	9.921	7.165	4.094	1.063	0.748	0.669	421252	15768	64485	720
37700	98.78	8900	14.016	9.882	7.205	4.173	1.063	0.709	0.591	444267	16047	57544	510
37800	98.78	8924	9.803	6.772	4.921	2.953	0.866	0.669	0.630	506112	30047	63898	720
37900	97.52	8915	12.323	8.622	6.299	3.622	0.984	0.669	0.551	478469	19512	61951	336
38000	98.24	8867	14.134	10.079	7.480	4.606	1.102	0.748	0.669	533674	13249	67470	720
38100	97.70	8946	11.378	8.583	6.693	4.291	1.142	0.630	0.512	850853	14699	62479	720
38200	97.34	8862	12.205	8.504	6.260	3.740	1.142	0.787	0.630	473943	21469	53715	517
38300	96.26	8904	9.370	6.654	5.039	3.071	0.906	0.669	0.591	748404	23013	85724	709
38400	95.90	8902	12.087	8.858	6.772	4.252	1.260	0.906	0.709	598067	18581	52449	488
38500	95.54	8915	9.528	6.811	5.118	3.031	0.906	0.748	0.630	647438	24107	85204	712
38600	94.64	8825	17.362	12.835	9.961	5.945	1.142	0.591	0.591	424325	10000	55287	720
38700	95.90	8907	13.543	9.528	7.205	4.528	1.220	0.787	0.669	568894	15223	56330	558
38800	95.18	8922	9.134	5.197	3.346	1.772	0.866	0.748	0.630	172946	68216	66975	720
38901	95.36	8810	17.992	11.142	7.283	3.543	1.378	0.945	0.787	144265	20993	45818	339
39000	95.00	8838	23.307	17.795	13.858	9.094	2.835	1.614	1.102	376387	10000	18773	188
39101	94.82	8884	16.102	12.638	10.551	7.638	3.031	1.890	1.378	763564	13668	21567	342
39201	94.82	8856	19.606	14.882	11.732	7.756	2.559	1.535	1.142	464820	11039	23886	302
39300	94.46	8946	9.449	6.969	5.551	3.740	1.378	0.984	0.827	754541	31749	45163	720
39401	93.92	8933	15.591	9.370	5.709	2.756	1.142	0.906	0.787	123234	29621	50930	720
39501	93.92	8942	13.031	8.110	5.394	2.874	0.906	0.551	0.433	254199	27364	56488	201
39601	93.92	8929	12.756	9.055	6.693	4.016	0.906	0.512	0.433	600006	15016	67747	420
39700	93.56	8918	12.717	9.055	6.575	3.937	0.787	0.472	0.394	559752	15042	73495	386
39800	92.84	8880	16.693	12.402	9.409	5.748	1.260	0.630	0.472	513635	10288	45201	227
39900	93.20	8907	14.921	10.709	7.992	4.764	0.984	0.512	0.394	514322	12573	53748	213
40001	92.30	8953	12.087	8.661	6.417	3.898	0.827	0.512	0.394	587012	16561	66377	276
40101	92.30	8873	13.740	10.000	7.165	4.016	0.748	0.472	0.354	431815	14983	62858	201
40200	92.84	8970	13.583	9.370	6.811	4.016	0.866	0.551	0.433	467624	16250	61635	285
40300	94.46	8915	15.157	10.984	8.465	5.354	1.496	0.945	0.748	527814	13701	42781	493
40401	93.74	8915	14.921	10.906	8.031	5.039	1.575	1.024	0.827	461602	16214	40366	607
40500	96.80	8935	14.567	10.551	7.835	4.685	1.024	0.630	0.512	500679	13193	58393	446
40601	95.36	8924	14.134	9.882	7.283	4.291	0.787	0.512	0.472	435384	14060	71506	720

Table C-1 (cont'd).

SL	TEMP (°F)	LOAD (Lbf)	DEFLECTION IN MILS							LAYER MODULI IN PSI			Stiff Layer
			D0	D20	D30	D45	D90°	D120	D150°	AC	Base	Roadbed	
40700	94.64	8946	14.685	10.039	6.929	3.858	0.748	0.433	0.315	367559	16378	55951	153
40800	94.64	8944	12.323	8.622	6.457	3.780	0.748	0.551	0.472	481699	17160	73142	720
40900	94.64	8920	15.039	10.709	7.795	4.606	1.024	0.709	0.630	399061	14464	55723	720
41000	94.10	8946	13.661	9.488	6.929	3.976	0.945	0.669	0.591	460698	15675	71240	720
41101	92.84	8889	13.386	9.606	7.087	4.173	0.866	0.472	0.394	564423	13782	66976	343
41200	92.48	8909	14.646	10.236	7.480	4.606	1.220	0.787	0.591	429478	16796	44229	256
41300	91.22	8856	17.638	12.402	9.488	5.472	1.142	0.630	0.512	421510	10646	48958	298
41400	91.76	8924	13.346	9.567	7.087	4.291	0.984	0.591	0.512	579455	14002	67658	720
41499	91.94	8884	12.323	8.780	6.496	3.937	0.866	0.472	0.394	638564	15043	69571	382
41601	91.58	8915	11.929	8.307	6.142	3.504	0.472	0.197	0.236	683046	12903	100000	179
41700	90.86	8979	10.315	7.559	5.748	3.661	1.220	0.906	0.709	612205	27219	50207	720
41800	90.86	8845	15.748	11.693	8.898	5.669	1.457	0.787	0.512	503339	13587	32520	150
41900	89.42	8869	14.173	10.236	7.795	4.843	0.984	0.512	0.315	522126	14343	42599	126
42000	89.78	8869	14.331	10.433	7.992	5.079	1.496	0.906	0.709	554479	15113	40980	357
42100	89.78	8858	16.496	12.165	9.409	6.063	1.850	0.984	0.669	499658	14206	27223	158
42200	89.06	8900	15.945	10.551	7.598	4.252	1.063	0.591	0.433	329020	17039	42446	157
42300	89.78	8975	8.622	5.945	4.370	2.717	0.866	0.591	0.551	634016	33950	70159	720
42400	89.60	8915	13.071	9.173	6.614	3.583	0.906	0.709	0.551	390770	18593	66196	720
42502	89.60	8981	7.047	5.000	3.740	2.244	0.827	0.669	0.591	642118	52225	68908	720
42601	89.60	8924	18.740	12.244	8.504	4.646	1.102	0.709	0.512	241446	15049	41260	198
42800	90.50	8984	5.748	4.291	3.504	2.598	1.063	0.709	0.512	1614521	56656	55732	271
42900	98.96	8907	10.630	7.953	6.260	4.055	1.142	0.669	0.472	829963	19079	49618	223
43000	110.30	8814	17.323	12.717	9.882	6.102	1.299	0.551	0.354	526696	10000	38117	149
43100	111.20	8968	10.748	7.087	4.921	2.480	0.433	0.276	0.197	420209	23543	89038	137
43200	112.28	8946	10.669	6.969	5.039	2.717	0.551	0.315	0.236	503710	23190	78351	156
43300	111.38	8915	11.181	7.835	5.472	3.110	0.827	0.512	0.433	503011	22003	69414	373
43400	110.12	8794	15.472	11.457	8.819	5.551	1.220	0.551	0.394	613794	10185	47867	203
43500	110.84	8904	6.102	3.976	2.835	1.654	0.433	0.315	0.236	762096	45987	100000	142
43600	110.48	8878	11.811	8.189	5.866	3.307	0.630	0.394	0.315	507444	17945	78974	263
43700	110.48	8904	6.890	4.606	3.110	1.772	0.591	0.433	0.354	588135	46091	100000	351
43800	111.38	8896	13.150	9.055	6.535	3.661	0.866	0.551	0.433	430191	18137	60098	264
43900	110.48	8902	12.126	7.992	5.472	2.992	0.591	0.433	0.315	380729	21010	77676	218
44000	112.46	8880	10.433	7.087	5.157	2.953	0.591	0.433	0.354	563567	20511	97596	720
44101	110.84	8865	12.598	8.425	5.827	2.913	0.551	0.315	0.276	406090	18486	82765	226
44200	113.00	8896	12.323	8.504	5.906	3.228	0.669	0.472	0.394	431317	18436	81938	421
44300	112.82	8907	12.677	8.504	6.024	3.189	0.748	0.630	0.512	341067	20975	69997	720
44400	112.46	8854	14.528	9.764	6.929	3.819	1.063	0.709	0.551	324991	19181	50237	288
44500	113.36	8770	22.205	15.433	11.142	6.575	1.890	1.102	0.787	242962	12531	25023	171
44600	112.64	8801	14.055	9.882	7.205	4.173	0.984	0.591	0.472	453349	15509	54430	279
44700	111.20	8770	15.984	9.764	6.220	2.795	0.591	0.354	0.315	205387	18388	73196	210
44800	111.74	8854	15.551	10.512	7.283	4.016	1.102	0.630	0.394	266284	20655	36031	118
44900	112.10	8763	17.717	11.496	7.559	3.543	0.591	0.315	0.236	226505	14750	56247	125
45000	112.64	8851	13.189	8.937	6.496	3.740	0.709	0.315	0.236	540399	15404	62215	147
45101	111.38	8801	10.945	8.228	6.260	3.858	0.709	0.236	0.157	918758	12390	86531	167
45200	109.58	8770	15.197	10.787	7.874	4.646	1.102	0.669	0.512	418498	14486	46827	243
45300	109.94	8821	13.898	9.606	6.693	3.661	0.748	0.433	0.276	351018	18406	49830	122

Table C-1 (cont'd).

SL	TEMP (°F)	LOAD (Lbf)	DEFLECTION IN MILS							LAYER MODULI IN PSI			Stiff Layer
			D0	D20	D30	D45	D90	D120	D150	AC	Base	Roadbed	
45400	111.74	8770	13.898	9.882	7.480	4.409	0.945	0.472	0.276	472029	16270	39629	108
45500	110.84	8823	15.197	10.709	7.795	4.528	0.787	0.394	0.236	399969	14359	44498	107
45600	111.74	8770	15.748	11.102	8.031	4.567	0.984	0.433	0.276	409473	14315	38948	112
45700	111.20	8715	16.890	10.394	6.693	3.110	0.354	0.157	0.118	247020	15118	67521	104
45800	112.46	8891	9.094	5.197	3.110	1.535	0.512	0.354	0.276	238647	44765	100000	227
45900	113.18	8907	6.732	3.898	2.520	1.496	0.551	0.315	0.236	351216	70861	89131	153
46000	112.10	8783	20.039	10.433	5.315	1.496	0.039	0.039	0.079	351216	70861	89131	150
46100	110.30	8847	10.512	6.220	3.937	1.890	0.433	0.354	0.236	282845	30811	100000	262
46200	105.44	8889	5.197	3.307	2.323	1.260	0.354	0.276	0.197	750814	63674	100000	155
46300	110.84	8774	14.685	10.236	7.480	4.252	0.709	0.315	0.157	388700	15733	40916	87
46400	108.14	8876	14.055	9.803	6.772	3.661	0.630	0.315	0.197	370707	16923	52870	105
46500	109.22	8862	12.008	7.992	5.551	2.913	0.472	0.276	0.197	408411	19793	77255	131
46600	108.32	8858	12.913	8.465	5.787	2.953	0.354	0.197	0.118	408411	19793	77255	150
46700	108.14	8840	12.756	8.740	6.260	3.425	0.591	0.354	0.236	409957	18085	63491	128
46800	107.78	8856	15.945	11.535	8.346	4.843	1.142	0.551	0.354	402675	14713	35748	120
46900	108.14	8891	14.449	10.197	7.598	4.528	1.063	0.591	0.433	474348	15254	46326	183
47000	108.68	8816	16.890	11.969	8.898	5.354	1.024	0.472	0.315	439754	11483	41847	130
47100	108.50	8814	14.331	9.882	7.087	3.937	0.748	0.394	0.236	371493	17028	46108	108
47201	108.50	8854	14.606	10.000	7.244	3.898	0.709	0.394	0.276	377977	15565	55348	137
47300	108.14	8832	18.228	12.441	8.858	4.528	0.748	0.433	0.315	277897	12437	50490	141
47400	108.68	8849	12.008	8.307	5.748	3.228	0.591	0.354	0.276	469704	18338	76056	184
47500	107.60	8812	14.331	9.724	7.008	3.937	0.787	0.433	0.276	375440	17207	47370	120
47601	107.78	8882	14.528	10.000	7.244	4.173	1.063	0.630	0.433	373723	18387	42212	154
47700	106.88	8814	14.291	9.961	7.283	4.567	1.732	1.220	1.024	369947	21676	39602	720
47801	103.82	8827	9.961	6.811	5.039	3.110	1.299	0.945	0.866	506053	31973	61767	720
47901	107.06	8832	11.969	8.504	6.220	3.858	1.260	0.906	0.748	503786	21663	53809	720
48000	106.52	8902	14.331	9.882	7.087	4.055	0.945	0.669	0.551	402792	15927	62739	611
48100	107.42	8821	16.063	11.850	8.937	5.827	2.205	1.614	1.260	364965	19735	27931	720
48200	106.34	8787	13.740	9.449	6.772	3.701	0.866	0.551	0.394	366732	18406	52383	179
48300	106.88	8878	9.449	6.772	5.118	3.228	0.906	0.591	0.433	736223	25145	61381	272
48400	106.34	8860	12.874	9.134	6.732	4.134	1.024	0.551	0.394	546184	17510	47278	165
48500	104.72	8832	17.835	12.677	9.055	5.157	1.220	0.669	0.433	310742	14226	33263	129
48601	105.80	8743	18.740	12.165	7.874	4.449	1.260	0.787	0.551	188651	17830	35404	165
48700	106.88	8825	16.260	10.669	7.087	3.819	0.709	0.354	0.197	318437	11533	100000	322
48800	106.52	8770	19.724	13.504	9.449	5.512	1.339	0.669	0.433	372170	10000	44856	154
48900	104.54	8805	16.969	11.417	8.110	4.409	1.024	0.591	0.394	281579	16003	39258	135
49000	102.92	8779	13.740	8.937	6.024	2.953	0.669	0.472	0.433	296724	18923	80671	720
49100	104.00	8843	11.181	7.362	5.236	2.953	0.748	0.433	0.315	441909	25013	60114	158
49200	102.92	8794	12.874	8.583	6.142	3.346	0.787	0.433	0.276	366134	21841	48231	118
49300	103.82	8915	6.850	4.567	3.346	2.008	0.630	0.551	0.315	605936	52434	76723	221
49401	103.82	8940	7.874	5.157	3.622	2.126	0.512	0.354	0.236	602602	36662	88074	169
49500	104.18	8843	11.575	7.638	5.276	2.874	0.551	0.354	0.276	432980	20896	81536	200
49601	103.28	8849	11.220	7.638	5.512	3.228	0.748	0.472	0.354	515131	21451	66029	216
49700	103.10	8911	4.882	3.189	2.244	1.339	0.433	0.315	0.197	715834	83265	100000	150
49800	103.46	8849	5.000	3.543	2.795	1.969	0.669	0.433	0.236	1237740	78958	57710	107
49900	102.92	8851	10.157	6.890	4.843	2.638	0.512	0.276	0.157	467676	26284	63600	98

Table C-1 (cont'd).

SL	TEMP (°F)	LOAD (Lbf)	DEFLECTION IN MILS							LAYER MODULI IN PSI			Stiff Layer
			D0	D20	D30	D45	D90*	D120	D150*	AC	Base	Roadbed	
50000	102.38	8884	11.732	7.402	4.921	2.441	0.157	0.039	0.079	239986	23873	50000	55
50100	102.74	8851	9.646	6.181	4.173	1.890	0.079	0.039	0.039	539512	18830	100000	68
50200	101.48	8708	11.299	7.717	5.472	3.071	0.512	0.315	0.197	442709	20604	67877	116
50300	101.12	8884	12.638	8.898	6.614	4.094	1.102	0.669	0.591	608007	16111	62610	720
50400	100.22	8832	12.913	9.055	6.772	4.252	1.102	0.748	0.630	558335	16117	60988	720
50500	100.22	8847	11.102	7.953	5.945	3.622	0.827	0.512	0.394	641913	18211	67201	291
50601	98.78	8851	13.661	10.236	7.717	4.803	1.260	0.709	0.551	608817	13843	48119	316
50702	100.40	8907	8.386	5.827	4.449	2.874	0.906	0.591	0.512	904712	27555	78854	720
50801	99.32	8805	12.874	8.976	6.575	3.819	0.669	0.354	0.236	710813	12310	99001	675
50900	98.96	8880	9.961	7.047	5.039	2.874	0.551	0.276	0.157	574744	24040	61422	108
51000	98.96	8827	15.827	11.142	8.189	4.961	0.866	0.394	0.236	434575	12949	42218	102
51100	98.78	8754	15.079	11.220	8.661	5.669	1.575	0.827	0.472	522939	15964	26120	119
51200	98.24	8907	14.567	10.315	7.638	4.409	0.669	0.276	0.157	587034	10000	58736	147
51301	97.34	8926	5.748	3.583	2.480	1.339	0.276	0.197	0.157	677507	52810	100000	85
51400	97.52	8904	10.984	7.441	5.433	3.071	0.669	0.315	0.236	597701	20592	66554	129
51501	96.26	8876	11.811	7.953	5.709	3.307	0.709	0.433	0.354	516826	19001	73863	243
51601	96.26	8862	11.614	7.953	5.591	3.031	0.433	0.236	0.157	447745	19183	75998	106
51700	95.54	8988	5.591	3.583	2.520	1.535	0.512	0.354	0.236	676427	69859	96115	159
51801	95.00	8884	12.126	7.992	5.551	3.071	0.630	0.354	0.197	362587	24042	52025	100
51901	95.36	8964	3.307	1.929	1.339	0.906	0.394	0.236	0.157	578163	207486	100000	88
52000	95.36	8975	4.646	2.717	2.008	1.378	0.591	0.394	0.236	427937	157102	75500	125
52100	93.56	8907	6.220	3.701	2.598	1.654	0.709	0.433	0.315	385164	89254	73845	177
52200	96.08	8869	10.197	7.323	5.433	3.386	0.984	0.512	0.276	575752	30737	36947	97
52301	95.18	8873	12.480	8.661	6.181	3.425	0.433	0.118	0.039	472394	17733	50510	69
52400	95.90	8891	8.425	5.000	3.307	1.693	0.276	0.118	0.079	289492	59348	3000	19

* The first eleven stations have sensor 5 and 7 at 60cm and 180 cm but rest of the stations have sensor 5 and 7 at 90 cm and 150 cm respectively.

** The depth to stiff layer calculated by MICHBACK is given here in inches.

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