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COMPARATIVE STUDY OF NONDESTRUCTIVE PAVEMENT TESTING MACDILL AIR FORCE BASE, FLORIDA

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by

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This project is the most comprehensive single undertaking to date which is directed toward an evaluation of the validity of concepts of nondestructive evaluation of the load-carrying capacity of airfield pavements. Seven nondestructive test devices tested five sections of airfield pavements at MacDill Air Force Base (AFB) which consisted of two rigid, two flexible, and one composite pavements, ranging from 20-in. portland cement concrete (PCC) to 5.5-in. asphaltic concrete. Analytical treatments of the test data included empirical correlation analyses, and layered-elastic and finite element computer analyses. Six private firms each with a different nondestructive testing (NDT) evaluation method provided evaluation results in terms of allowable aircraft loads and overlay thicknesses. The Air Force produced one set of results using its new nondestructive pavement testing method, and Waterways Experiment Station provided three sets of results.

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19. ABSTRACT (Continued).

The NDT evaluation methods characterize the pavement structural layers based on the response measured with the NDT devices. Most procedures produce moduli values for the pavement layers and subgrade. Most of the evaluation methods used a back-calculating technique whereby moduli are determined through an iterative process of matching calculated deflection basins to measured basins. The Air Force method determines the velocity of waves propagated through the pavement layers and converts these to moduli.

However, as carefully as the project was planned and conducted, the results are not conclusive. There is a lack of agreement between the allowable load ratings and overlay thickness predictions of the NDT evaluation methods to the standard test pit rating, and a lack of agreement among results from the NDT evaluation methods themselves.

None of the NDT evaluation methods agree perfectly with the standard test-pit method in terms of allowable loads or overlay thicknesses. However, the standard test-pit results make assumptions as to factors such as the quality of base and subbase material, load transfer at joints, condition of the existing pavement, and traffic distribution that might be different from the manner that the NDT evaluation methods treated the same variables. Conventional tests such as California Bearing Ratio and plate-bearing tests are performed on partially disturbed materials because the pavement must be excavated to perform the tests. In contrast, the NDT is a truly in situ test that evaluates the pavement without any disturbance or modification. The allowable aircraft loads from the NDT evaluation methods appear to agree better with the test-pit method than do the predicted overlay thicknesses. The reason for this is not readily apparent since the same basic approaches are used by most evaluation methods for both sets of results.

This study has shown that NDT technology exists for evaluation of airfield pavements. For the pavements at MacDill AFB, some NDT evaluation methods agreed better with the standard test-pit method than others. However, the pavements at MacDill AFB are rather nontypical, and those NDT evaluation methods that did not give good results at MacDill may give more agreeable results on different pavements. The lack of agreement between results of the NDT evaluation methods does justify concern and may point to the need for a standard evaluation method.

EXECUTIVE SUMMARY

This project, which is directed toward an evaluation of the validity of concepts of nondestructive evaluation of the load-carrying capacity of airfield pavements, has been the most comprehensive single undertaking to date. Seven nondestructive test devices were used to test five sections of airfield pavement at MacDill Air Force Base (AFB), consisting of two rigid, two flexible, and one composite pavements and ranging from 20-in. portland cement concrete (PCC) to 5.5-in. asphaltic concrete (AC). Analytical treatments of the test data included empirical correlation analyses, and layered-elastic and finite-element computer analyses. Six private firms each with a different nondestructive testing (NDT) evaluation method provided evaluation results in terms of allowable aircraft loads and overlay thicknesses. The Air Force produced one set of results using its new nondestructive pavement testing (NDPT) method, and the US Army Engineer Waterways Experiment Station (WES) provided three sets of results with the Dynamic Stiffness Modulus method and layered-elastic analysis using data from the WES 16-kip vibrator and a Dynatest Model 8000 Falling Weight Deflectometer (FWD) using layered-elastic analysis. The participants in the project and the NDT equipment used by each were:

Participant	NDT Equipment
ARE, Inc.	Dynaflect
Louis Berger International	Pavement Profiler Model 2000
Dynatest Consulting	Dynatest Model 8000 FWD
ERES Consultants, Inc.	Dynatest Model 8000 FWD*
Reinard W. Brandley	Dynatest Model 8000 FWD*
	Brandley Centilever Beam
Pavement Consultancy Services	Shell FWD
WES	WES 16-kip vibrator
	Dynatest Model 8000 FWD
Air Force Engineering and Services Center (AFESC)	NDPT wave velocity van

* Tests were conducted by Dynatest Consulting for these participants.

The tests were conducted on pavement sections where test pits for density and California Bearing Ratio (CBR) had been placed 2 years earlier by the AFESC.

However, as carefully as the project was planned and conducted, the results are not conclusive. There is a lack of agreement between the allowable load ratings and overlay thickness predictions of the NDT evaluation methods to the standard test-pit rating, and a lack of agreement between results from the NDT evaluation methods themselves.

The pavement materials such as limerock base and the sand subgrade at MacDill AFB are not typical of most other airfield pavements. The standard test-pit data were collected 2 years prior to the NDT, although conditions and material strengths probably had changed little. The test-pit measurements reported by AFESC were suspected in the area of flexural strength (R) of PCC and plate-bearing measurements. Standard test-pit measurements in terms of CBR and subgrade modulus k in a cohesionless material such as the sand subgrade are difficult to obtain accurately. For the standard rating based on test-pit measurements, test data collected in the 1940's were used to supplement the AFESC test-pit data. The pavement properties used for the standard evaluation were:

Test Area	Pavement Properties
1	20-in. PCC, R = 750 psi 6-in. stabilized subbase, k = 300 pci Subgrade (SP-SM)
2	11-in. AC 8-in. limerock base, CBR = 80 7-in. stabilized subbase, CBR = 30 Subgrade (SP) CBR = 25
3	5.5-in. AC 8.0-in. limerock base, CBR = 80 7.0-in. stabilized subbase, CBR = 30 Subgrade (SP), CBR = 25
4	7.5-in. AC 6.0-in. PCC, R = 650 psi Subgrade (SP), k = 250 pci
	<u>Alternate as flexible pavement</u>
5	7.5-in. AC 6.0-in. base, CBR = 80 Subgrade (SP), CBR = 25
	10.5-in. PCC, R = 650 psi Subgrade (SP), k = 250 pci

The NDT evaluation methods characterize the pavement structural layers based on the response measured with the NDT devices. Most procedures produce moduli values for the pavement layers and subgrade. Most of the evaluation methods used a back-calculating technique whereby moduli are determined through as iterative process of matching calculated deflection basins to measured basins. The Air Force method determines the velocity of stress waves propagated through the pavement layers and converts these to moduli.

A critical part of each pavement evaluation method is the relationship v to performance. The link to performance in this study has been of a measured or calculated parameter in the form of limiting stress or strain in the pavement components, limiting deflection of the subgrade, and as correlations to established pavement parameters such as CBR and k . All of these factors are someway related to the number of load repetitions to cause failure of the pavement system. The performance criteria must be based on real-world performance of airfield pavements. The evaluation methods involved in this study included such features as considerations of existing pavement conditions, seasonal effects, load transfer at joints, and other important items. Some evaluation methods make predictions of rut depth and cracking as a function of applied traffic. However, the performance predictions can only be as good as the limiting criteria on which the predictions are based. This performance criteria must be compatible with the evaluation method in which it is used; i.e., it must be a closed system in that the computed moduli, limiting criteria, and predicted performance have been derived and validated against true performance standards. Different performance criteria may account for the major differences in the evaluations of the test areas at MacDill AFB.

None of the NDT evaluation methods agreed perfectly with the standard test-pit method in terms of allowable loads or overlay thicknesses. However, the standard test-pit results make assumptions as to factors such as the quality of base and subbase material, load transfer at joints, condition of the existing pavement, and traffic distribution that might be different from the manner which the NDT evaluation methods treated the same variables. Conventional tests such as CBR and plate-bearing tests are performed on partially disturbed materials, because the pavement must be excavated to perform the tests. In contrast, the NDT is a truly in situ test that evaluates the pavement without any disturbance or modification. The allowable aircraft loads from the NDT evaluation methods appear to agree better with the test-pit method than do the predicted overlay thicknesses. The reason for this is not readily apparent since the same basic approaches are used by most evaluation methods for both sets of results.

This study has shown that NDT technology exists for evaluation of airfield pavements. For the pavements at MacDill AFB, some NDT evaluation methods agreed better with the standard test-pit method than others. However, the pavements at MacDill AFB are rather nontypical, and those NDT evaluation methods that did not give good results at MacDill may give more agreeable results on different pavements. The lack of agreement between results of the NDT evaluation methods does justify concern and may point to the need for a standard evaluation method.

This study has also indicated that further comparisons of the NDT evaluation methods should be made on an airfield with pavements more representative of typical conditions such as on a clay subgrade. The clay subgrade would allow more exact CBR and k measurements with higher confidence. Test-pit measurements should be made concurrently with the NDT. The airfield should be of a medium-load design so that the allowable loads would not be at the maximum-design loads, and the required overlay thicknesses would be produced for comparison. This would provide for a better comparison to the NDT results, and a more definite assessment of the validity of NDT.

PREFACE

This report was prepared by the Pavement Systems Division (PSD), Geotechnical Laboratory (GL), of the US Army Engineer Waterways Experiment Station (WES) under Air Force Project Order No. F-82-74. The work was sponsored by the Air Force Engineering and Services Center, Tyndall Air Force Base, Fla. The Project Monitor was LTC Bill Tolson.

The work reported herein was performed during the period August 1982-September 1983. WES engineers actively engaged in the project were Messrs. Jim W. Hall, Jr., and Don R. Alexander. This report was prepared by Mr. Hall. The work was performed under the direction of Dr. T. D. White, Chief, PSD, and Dr. W. F. Marcuson III, Chief. GL.

COL Allen F. Grum, USA, was the previous Director of WES. COL Dwayne G. Lee, CE, is the present Commander and Director. Dr. Robert W. Whalin is Technical Director.

CONTENTS

CONVERSION FACTORS, NON-SI TO SI (METRIC) UNITS OF MEASUREMENT

Non-SI units of measurement used in this report can be converted to SI (metric) units as follows:

Multiply	By	To Obtain
degrees (angle)	0.01745329	radians
Fahrenheit degrees	5/9	Celsius degrees or Kelvins*
feet	0.3048	metres
inches	2.54	centimetres
kips (force)	4.448222	kilonewtons
kips (force) per square inch	6.894757	megapascals
miles (US statue)	1.609347	kilometres
mils	0.0254	millimetres
pounds (force)	4.448222	newtons
pounds (force) per square inch	6.894757	kilopascals
pounds (mass)	0.4535924	kilograms
pounds (mass) per cubic foot	16.01846	kilograms per cubic metre
pounds (mass) per cubic inch	27.6799	grams per cubic centimetre
square feet	0.09290304	square metres
square inches	6.4516	square centimetres

* To obtain Celsius (C) temperature readings from Fahrenheit (F) readings, use the following formula: C = (5/9)(F - 32). To obtain Kelvin (K) readings, use K = (5/9) (F - 32) + 273.15.

COMPARATIVE STUDY OF NONDESTRUCTIVE PAVEMENT TESTING, MACDILL AIR FORCE BASE, FLORIDA

PART I: INTRODUCTION

Background

1. The Air Force Engineering Services Center (AFESC), Tyndall Air Force Base, (AFB) Fla., requested that the US Army Engineer Waterways Experiment Station (WES) conduct a study of various pavement evaluation techniques based on nondestructive testing (NDT). In the 1982 statement of work for the project the following background was given:

> During recent years several nondestructive (NDT) pavement evaluation systems have been developed by government agencies and civilian firms to analyze the load-carrying capability of airfield pavements. The use of NDT devices is seen as a great advance over costly and time-consuming destructive evaluation techniques. Although the NDT devices do not allow the same analysis as destructive testing, the benefits of minimal operational impact and reduced effort to produce a final report are particularly attractive. The use of NDT by the Air Force for airfield evaluation is now feasible and desirable; however, the newness of the systems and the disparities in data reporting format (between NDT systems and destructive testing) make a prudent selection of any type of NDT system difficult. To insure the Air Force receives the kind of information it needs in a given situation, familiarity with the NDT systems and the data they produce is needed. A side-by-side field comparison of available NDT systems which could be contracted by the Air Force would allow USAF personnel to make intelligent decisions about which system to use in any given situation. This side-by-side comparison will be conducted at an airfield designated by AFESC that has been evaluated by destructive techniques which will provide comparison of NDT results with the traditional system results.

2. The NDT of pavements was begun as early as 1933 by the German Research Society for Soil Mechanics and was further developed by the Royal Dutch Shell Laboratory in The Netherlands and the Road Research Laboratory in the United Kingdom. This early work used vibratory devices generally consisting of counter-rotating eccentric masses arranged to produce vertical

loadings. Within the past 10 years or so, more advanced equipment such as the electrohydraulic and electromagnetic vibrators and falling weight impulse devices have been introduced.

3. WES has kept current in the advancement of NDT technology, particularly as related to airfield pavements. WES followed the early work of the Shell researchers and participated in joint efforts during the 1950's (Heukelom and Foster 1960; Maxwell 1960a, 1960b). As part of this early WES work, wave propagation measurements were conducted at the American Association of State Highway Officials (AASHO) Road Test (WES 1963) at Foss Field (WES 1964), and on military airfields (Maxwell and Joseph 1967) and roadways. The Air Force sponsored early work (Hall 1970, 1972, 1973) at WES that led to the development of the present WES NDT procedures. Additional work funded by the Army, the Air Force, and the Federal Aviation Administration (FAA) produced the present WES equipment and WES NDT evaluation method called the Dynamic Stiffness Modulus (DSM) method (Ahlvin 1971, Green and Hall 1975). The DSM method has been adopted by the FAA (1976) and the Department of the Army (Hall 1978). WES also conducted studies based on layered-elastic theory and developed procedures for NDT (Green 1978, Weiss 1980, Bush 1980a). In a study conducted by WES for the FAA, several NDT devices were evaluated for use on light airport pavements, and comparisons were made of the measurements made by each (Bush 1980b). However, no attempt was made in that study to compare analytical methodologies.

4. During the past 10 to 15 years, much effort has been applied by various research organizations to the area of NDT, and as a result, numerous methods have been developed using a range of equipment. The Transportation Research Board (TRB) made a review of nondestructive evaluation of pavements in 1978, and TRB formed a Task Force (A2T56) in January 1981 to make a state-of-the-art review of NDT of airfield pavements (Moore, Hansen, and Hall 1978). Some 15 different procedures have been brought before the Task Force of which the author is a member. Table 1 gives a list of the evaluation methods presented to the Task Force. The information and procedures being reviewed by the Task Force provided some of the background for selection of the participants in this project. The evaluation methods selected for the study and reported herein were those complete evaluation procedures that had been demonstrated on airfield evaluation projects. Also selected were those methods providing the full range of available NDT equipment and analysis techniques.

Purpose and Scope

5. The primary purpose of this study was to provide the AFESC with an assessment of the nondestructive approach to pavement evaluation so that the Air Force can make sound decisions as to the possible uses and benefits of NDT pavement evaluation methods. It was not the purpose of this investigation to identify any "best method" but rather to assess the state of the art, demonstrate differences in test and analysis methods, and study the impact of these differences on results at one airfield. Because it is possible to obtain the best answer for the wrong reason (accidentally compensating mistakes), a comparative evaluation at a single airfield (that is, a single type of subgrade and base course) could never be used as a basis for defining one method as best (Hadala 1975). Comparative evaluation of different methods will give the decision maker a reasonably good exposure to the differences in the methods, their individual strengths and weaknesses, their areas of commonality, and a feel for the effect of the differences on practical engineering decisions.

6. The scope of the project involved comparisons of selected NDT equipment and procedures on representative airfield pavements and a comparison of the NDT results with those obtained from the standard Air Force evaluation procedures based on test-pit measurements. WES selected six leading firms with demonstrated NDT capabilities. These firms are believed to represent the state of the art or terms of commercial NDT equipment and available analytical evaluation methods. In addition, WES demonstrated three NDT procedures that it had developed and the AFESC demonstrated its new NDT evaluation method. The field demonstrations were conducted on five selected test areas at MacDill AFB, Tampa, Fla., during October and November 1982. The test areas at MacDill AFB had each been evaluated in March 1980 by test-pit measurements in each of the five test areas. Each participant made an evaluation of the test areas and independently submitted a report to WES. Allowable gross aircraft loadings were computed for each test area for the 13 aircraft groups and 4 pass intensity levels as given in Air Force Regulation AFR 93-5 (Headquarters, Department of the Air Force 1981). Also, overlay thickness requirements were determined for the KC10A (DC-10-30) aircraft at a total of 1,000 passes and for the E4 (B-747) aircraft at 10,000 passes. This report contains results presented by each of the participants and makes comparisons with the standard Air Force evaluation procedure based on test-pit measurements.

Site Selection

7. The AFESC selected MacDill AFB as the demonstration site. A visit was made to MacDill AFB on 30 August 1982 by LTC Bill Tolson and CPT Paul Foxworthy of AFESC and Mr. Jim W. Hall, Jr., of WES. Five test areas were selected to provide a range of pavement types and strengths. Figure 1 shows a layout of the airfield at MacDill AFB indicating the five test areas. A test pit had been placed in each of the test areas during a pavement evaluation conducted by AFESC in March 1980. The information obtained from each test pit as reported in the pavement evaluation report is shown in Figure 2 (AFESC 1980). Note that the subgrade material was classified as an SP sand* in Test Areas 2-5 and as an SP-SM sand in Test Area 1; therefore, the subgrade was nearly the same for all test areas. A construction history for each of the test areas is shown in Table 2.

Description of Test Areas

8. Each of the test areas contained approximately 50,000 sq ft** of pavement. This size was selected to be large enough to provide a representative amount of pavement and yet permit all five test areas to be studied in 1 day by each participant. The test areas were selected so as to provide the least interference with MacDill AFB's daily aircraft operations. Each test area was outlined and marked so that location of all tests could be identified.

Test Area 1

9. The pavement in Test Area 1 consisted of a 20-in. portland cement concrete (PCC) pavement. The 25- by 20-ft slabs constructed in 1959 were in excellent condition. The test area, located on Taxiway 33 at MacDill AFB, was 3 slabs wide (75 ft) by 28 slabs long (700 ft). A layout of the area is shown in Figure 3; the marking system was used to locate all NDT measurements. Test Area 1 contained no observable surface distress. An overall view of Test Area 1 is shown in Figure 4.

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* Classified according to the Unified Soil Classification System (USCS).
** A table of factors for converting non-SI units of measurement to SI (metric) units is presented on page 7.

Test Area 2

10. Test Area 2 was located on the Parallel Taxiway (Taxiway 3B) to the Main Runway and was constructed in 1943. An asphalt concrete (AC) overlay was placed in the center 18 ft of the taxiway in 1956, and additional overlays were placed in 1963 and 1971. The pavement was in good condition, but contained longitudinal and transverse cracking. This test area, shown in Figure 5, was 75 ft wide and 700 ft long. Station numbers, beginning with 0+00 at the south end of the test area, were marked every 100 ft along the center line. Figure 6 is an overall view of this test area.

Test Area 3

11. Test Area 3 was along the same parallel taxiway as Test Area 2 but farther north. This pavement was also constructed in 1943 and was originally identical to Test Area 2. The original asphalt surface had been overlayed with AC in 1956 and again in 1969. This area was considered in fair condition, although exhibiting considerable distress in the form of block cracking. This test area shown in Figure 7 was 40 ft wide by 1,000 ft long. This area was confined to the 40-ft width because the pavement outside this width was apparently not the same thickness. Station numbers were marked at 100-ft intervals beginning with 0+00 at the south end. Figure 8 gives an overall view of Test Area 3.

Test Area 4

12. Test Area 4 was a composite section located in Apron 1-A-1. The original 6-in. PCC pavement was constructed in 1941 with a slab size of 25 by 25 ft. An AC overlay was placed on this pavement in 1952 followed by a slurry seal in 1966. Considerable reflective cracking of the joints and cracks in the underlying slabs had occurred. The overall condition was considered good. The layout in Figure 9 shows the identification scheme used. Letters A-E were marked every 50 ft along one side and station numbers were marked every 50 ft along the other direction. The area was 200 by 250 ft. Test Area 4 is shown in Figure 10.

Test Area 5

13. Test Area 5 was a 10.5-in. PCC pavement with 15- by 12.5-ft slabs. The pavement, constructed in 1975, consists of the slabs placed directly on the sand subgrade. This apron area, designated Apron 1-A, is actively used for F-16 aircraft parking. The pavement was in excellent condition with only minor distress in the form of corner spalls and joint spalls. Figure 11 gives

a layout of this test area and shows the identification scheme used. The rectangular area consisted of a total of 270 slabs with 18 slabs along the 12.5-ft slab dimension and 15 slabs along the 15-ft-slab dimension. Letters A-O were used to identify the slabs along the 15-ft slab dimension and numbers 1-18 were used to label the side with the 12.5-ft-slab dimension. Figure 12 is an overall view of Test Area 5.

Physical Properties of Test Pavements

14. The pavement properties (California Bearing Ratio (CBR), subgrade modulus k , flexural strength) used by AFESC for evaluation differed from those reported in earlier pavement evaluation reports (US Engineer Office, Jacksonville, Fla. 1944; Office, District Engineer, Savannah, Ga. 1947; US Army Engineer District, Jacksonville, Fla. 1960) and condition survey reports (US Army Engineer, Ohio River Division Laboratories 1954; the Rigid Pavement Laboratory, Ohio River Division Laboratories 1960; Construction Engineering Laboratory, Ohio River Division Laboratories 1964). Table 3 compares these pavement properties for the pavements located in each of the five test areas. Two primary differences are the flexural strength R of the PCC and the subgrade modulus k .

15. For Test Areas 1, 4, and 5, AFESC reports flexural strengths of 480, 580, and 470 psi, respectively (Table 3 (AFESC 1980)). Earlier reports showed flexural strengths of 750 psi for Area 4 (Table 3, US Engineer Office, Jacksonville, Fla. 1944; US Army Engineer District, Jacksonville, Fla. 1960; US Army Engineer, Ohio River Division Laboratories 1954). The AFESC used results from tensile-split tests on 4-in.-diam cores and obtained the flexural strength from correlations of tensile-split test results to flexural strengths. Generally, fairly good correlation results by using 6-in.-diam cores, but the correlation with 4-in.-diam cores is poor (Hammitt 1974). Flexural strength generally does not decrease with time; therefore, the values given in the earlier reports are probably more representative of actual flexural strengths.

16. Some subgrade strengths in terms of subgrade modulus k are not consistent with values reported in the earlier evaluations. Subgrade modulus k of 85 and 80 pci for Test Areas 4 and 5 are in disagreement with values ranging between 250 and 400 pci measured in the earlier evaluations. CBR

values of 35 and 30 were measured by AFESC on the sand subgrade in Test Areas 2 and 3, respectively. The sand subgrade, classified as a poorly graded sand (SP), appears to be fairly uniform throughout the airfield. According to the correlation between CBR and k , a CBR of 30 corresponds to a k value of 300 pci or greater, and a CBR of 25 corresponds to a k of approximately 250 pci (Hall and Elsea 1974). Therefore, the k values of 80 and 85 pci seem unreasonably low for these conditions.

17. Also, some discrepancy exists as to the thickness of pavement layers. Thicknesses reported by AFESC for evaluation (Table 3, (AFESC 1980)) are not the same as indicated by AFESC test-pit data (Figure 2). Thicknesses given by earlier pavement studies are also somewhat different (US Engineer Office, Jacksonville, Fla. 1944; Office, District Engineer, Savannah, Ga. 1947; US Army Engineer District, Jacksonville, Fla. 1960; US Army Engineer, Ohio River Division Laboratories 1954; the Rigid Pavement Laboratory, Ohio River Division Laboratories 1960; Construction Engineering Laboratory, Ohio River Division Laboratories 1964). The AFESC report gives additional thickness measurements made from core borings (AFESC 1980). All of the available thickness information was used to select a set of values for each of the five test areas for use in the study reported herein.

18. Based on the above considerations and a review of all available information on the test area pavements, the following properties have been selected for the standard test-pit analysis for this study:

Test Area	Pavement Properties
1	20-in. PCC, R = 750 psi where R denotes flexural strength 6-in.-stabilized subbase, k = 300 pci Subgrade (SP-SM)
2	11-in. AC 8-in. limerock base, CBR = 80 7-in. stabilized subbase, CBR = 30 Subgrade (SP), CBR = 25
3	5.5-in. AC 8.0-in. limerock base, CBR = 80 7.0-in. stabilized subbase, CBR = 30 Subgrade (SP), CBR = 25

(Continued)

Test Area	Pavement Properties
4	7.5-in. AC 6.0-in. PCC, R = 650 psi Subgrade (SP), k = 250 pci
	Alternate as Flexible Pavement
5	7.5-in. AC 6.0-in. base, CBR = 80 Subgrade (SP), CBR = 25
	10.5-in. PCC, R = 650 psi Subgrade (SP), k = 250 pci

Project Requirements

19. The specific requirements of the project were to (a) select several of the better NDT procedures and equipment for demonstration, (b) have each procedure demonstrated through field tests on each of the five test areas at MacDill AFB, (c) obtain pavement evaluation reports from each procedure giving allowable loadings and overlay requirements for each test area, and (d) compare the results from each method with the standard Air Force evaluation based on test-pit measurements. The original plan was to use the test-pit data collected in 1981 by AFESC; however, some changes were made to these data as previously discussed.

20. Each participant in this demonstration project was given a full day at MacDill AFB to test all five test areas. With the exception of the AFESC, who performed tests for several days, only one participant was on the field for any given day of the demonstration. At the completion of the field tests, each participant provided WES a copy of the field test data.

21. Each participant prepared an evaluation report of the five test areas. This evaluation required the assessment of the allowable gross aircraft loads (AGAL's) for all 13 military aircraft groups at four specified pass intensity levels as given in AFR 93-5 (Headquarters, Department of the Air Force 1981). A pass intensity level is a specified number of aircraft passes (operational movements) for which the AGAL is to be determined. Therefore, the AGAL for pass intensity I would be less than the AGAL for pass intensity II, etc., since pass intensity I requires more passes than pass intensity II. The 13 aircraft groups and the various aircraft in each group are

shown in Table 4. Table 5 shows the controlling aircraft (primary aircraft to be considered) in each group and gives the number of passes for each group for each of four pass intensity levels. Note that the number of passes for a given pass intensity level is not the same for all 13 aircraft groups. The characteristics of the controlling aircraft in each of the 13 aircraft groups to be used for pavement evaluations are shown in Table 6. The evaluation by each participant also included overlay thickness requirements for each of the five test areas for two design loads: (a) 1,000 passes of the DC-10-30 aircraft (KC 10A), and (b) 10,000 passes of the B-747 aircraft (E-4).

PART II: NONDESTRUCTIVE TESTING EVALUATION METHODS

Selection of NDT Evaluation Methods

22. In the selection of the NDT evaluation methods to be demonstrated, both equipment and analytical procedures were considered. The participants selected were those with a unique and demonstrated capability (experience in evaluating airfield pavements). Because several types of NDT equipment were available for nondestructive pavement testing (NDPT), attempts were made to include evaluation methods that would demonstrate all equipment types. Evaluation methods in use included a range of analytical treatments, and again, effort was made to include a cross section of various analysis schemes. Six private firms, WES, and AFESC were selected to participate, and sole-source contracts were negotiated with each private firm. WES also contracted with the New Mexico Engineering Research Institute (NMERI) to have its representative assist in the demonstration of the AFESC methodology. The NMERI was the developer of the AFESC procedure. The following is a list of the participants and the equipment used by each:

Participant	NDT Equipment
ARE, Inc.	Dynaflect
Louis Berger International (Berger)	Pavement Profiler Model 2000
Dynatest Consulting (Dynatest)	Falling weight deflectometer (FWD)
	Dynatest Model 8000
ERES Consultants, Inc.	Dynatest Model 8000 FWD*
Reinard W. Brandley (Brandley)	Dynatest Model 8000 FWD*
	Brandley Centilever Beam
Pavement Consultancy Services (PCS)	Shell FWD
WES	WES 16-kip vibrator
	Dynatest Model 8000 FWD
AFESC	NDPT wave velocity van

* Tests were conducted by Dynatest Consulting for these participants.

23. Each participant demonstrated its analytical procedure using test data from the NDT device used. Ten different analysis schemes were considered in the study. These consisted of six evaluation methods from the six private firms, the AFESC evaluation method, and three evaluation methods from WES.

Field Demonstrations

24. The field tests were conducted during the period 26 October to 3 November 1982. The date on which the areas were tested by each participant were:

Participant	Date
PCS	27 October 1982
ARE	28 October 1982
Dynatest	29 October 1982
ERES	30 October 1982
Berger	31 October 1982
Brandley	1 November 1982
WES	2 November 1982
AFESC	27 October- 3 November 1982

25. The field tests were coordinated with MacDill AFB operations. All test areas were fairly free of aircraft movement during the 6-day test period except Test Area 5. In this area, which is the parking apron for F-16 aircraft, some delays in the testing were experienced because of frequent aircraft movements. Test Area 4 was used as a parking apron for F-111 aircraft on 2 November, making some of this area unavailable to WES.

Description of NDT Equipment

26. Seven NDT devices were used in the project and characteristics of each are presented in Table 7. Three devices--the WES 16-kip vibrator, the Berger Pavement Profiler, and the ARE Dynaflect--operate with a vibratory loading. All of the other devices use an impulse (drop-weight) loading. All devices except the Air Force NDPT device measure the deflection response of the pavement surface to the applied load. The Air Force NDPT device operates on the principle of wave propagation. A brief description of each NDT equipment used in the project is given.

ARE Dynaflect

27. The Dynaflect is an electromechanical system for measuring the dynamic deflection of a pavement caused by an oscillatory load. It is manufactured by SIE, Inc., Fort Worth, Tex. This trailer-mounted device (Figure 13) applies a 1,000-lb peak-to-peak sinusoidal load to the pavement. The load is generated by two counterrotating masses that rotate at a constant

frequency of 8 Hz. The force is transmitted to the pavement through two 4-in.-wide, 16-in.-outside-diam polyurethane-coated steel wheels spaced 20 in. apart. The Dynaflect applies a 2,000-lb static weight to the pavement.

28. The pavement response to the dynamically applied load is measured with 210-Ω, 4.5-Hz geophones that are shunted to a damping factor of approximately 0.7. One geophone is located directly between the two steel wheels. The other four geophones are spaced at 1-ft intervals toward the front of the trailer.

Berger Pavement Profiler Model 2000

29. This device is a Road-Rater Model 2000 manufactured by Foundation Mechanics, Inc., El Segundo, Calif. The Model 2000 applies a peak-to-peak cyclic load of 4.5 kip at a frequency of 25 Hz. The trailer-mounted device (Figure 14) is an electrohydraulic system. The Model 2000 has a self-contained power supply. The gasoline engine supports the hydraulic and electrical systems of the device. The reaction mass of the Model 2000 is 2,000 lb.

30. Three load cells mounted on the load plate monitor the force. The three load cells are summed for total-force output. Deflection is monitored by four velocity sensors. The first is located in the center of the 18-in.-diam load plate, and the other three are at 12, 24, and 36 in. or 12, 24, and 60 in. from the center of the load plate.

Dynatest FWD

31. The Dynatest 8000 FWD is an impact load device that applies a single-pulse transient load of approximately 25-30 msec duration. This trailer-mounted device (Figure 15) measures both applied load and seven deflection points on the pavement with the maximum distance of the deflection point being 7 ft from the center of the load plate. The load is adjustable to a maximum of 24,000 lb and is applied through a 300-mm (approximately 12-in.) diam load plate. The system is controlled with a Hewlett-Packard HP-85 computer that also records the output data. This equipment is shown in Figure 16.

Brandley deflection beam

32. The Brandley deflection beam (Figure 17) is used for testing joints in PCC pavement sections to determine the effectiveness of the load transfer at the joints. The test procedure consists of placing a cantilever deflection beam on the slab with two linear potentiometers located at the free end of the

beam. The beam is set on the slab such that one of the potentiometers is located on one side of the joint and the other potentiometer is located on the other side of the joint. A rubber-tired wheel, which imposes approximately the same total load as the aircraft using the pavements, is then pulled or driven across the joint perpendicular to the joint and passes immediately adjacent to the location of the potentiometers. In this manner, the total relative deflection of the slab at the joint and the relative movement of one slab with respect to the other slab (slab rocking) as the wheel moves over the joint can be measured and recorded. A test vehicle with 50,000 lb per single wheel would normally be used, but the only equipment available at MacDill AFB was a truck-mounted crane with three axles. The rear axles had dual wheels, and each of dual wheels was loaded to 7,000-8,000 lb. Because this was the only equipment available, the tests were conducted using these loads.

PCS FWD

33. The PCS FWD applies a pulse load to the pavement surface by dropping a mass on a baseplate that is connected to the load plate by a set of springs. The maximum force is 22.4 kips, and the force is varied by adjusting the drop height. Both force and deflection are electronically recorded. Velocity transducers, which are electronically integrated to measure deflection, are located at the center of the load plate and at three radial distances of 60, 100, and 200 cm. This trailer-mounted device is shown in Figure 18, and the data recording equipment is shown in Figure 19.

WES 16-kip vibrator

34. The WES 16-kip vibrator shown in Figures 20 and 21 is an electrohydraulic vibratory loading system. The unit is contained in a 36-ft semitrailer along with supporting power supplies and automatic data recording equipment. A 16,000-lb preload is applied to the pavement with a superimposed dynamic load ranging up to 30,000 lb peak-to-peak. The dynamic load can be applied over a frequency range of 5 to 100 Hz but the standard test frequency is 15 Hz. The dynamic load is measured with a set of three load cells mounted on an 18-in.-diam load plate. Velocity transducers located on the load plate and at points away from the plate are calibrated to measure deflection. Test results are recorded on X-Y plotters and a digital printer.

35. Data collected with the WES 16-kip vibrator are the DSM and deflection basins. DSM is the slope (load/deflection) of the dynamic load versus deflection curve obtained by sweeping the force from zero to maximum at a

constant frequency of 15 Hz. This slope is taken at the maximum force levels. The deflection basin is obtained by measuring deflections at distances of 0, 18, 36, and 60 in. from the center of the load plate. The deflection ratio $\Delta 60/\Delta 18$ (obtained by taking the deflection at 60 in. and dividing by the deflection at 18 in.) is used to determine the radius of relative stiffness ℓ for rigid pavements using the developed correlations.

<u>WES FWD</u>

36. The FWD used by WES is a Model 8000 manufactured by Dynatest (Figure 22). A dynamic force is applied to the pavement surface by dropping a 440-lb weight onto a set of rubber cushions, resulting in an impulse loading. The applied force and pavement deflections are measured with load cells and velocity transducers, respectively. The drop height can be varied from 0 to 15.7 in. to produce a force from 0 to 15,000 lb. The load is transmitted to the pavement through an 11.8-in.-diam plate. The signal-conditioning equipment displays the resulting average pressure in kilopascals and the maximum peak displacement in micrometers. As many as three displacement sensors may be recorded at one time.

37. FWD data collected were deflection basin measurements. Displacements were measured on the load plate and at distances of 12, 24, 36, and 48 in. from the center of the load plate. Because this particular model has only two transducers for deflection basin measurements, the four deflection points were obtained by dropping the weight twice and shifting the transducers to the additional spacings.

<u>Air Force NDPT device</u>

38. The AFESC NDPT device is an impact hammer used to excite the pavement system to measure wave velocity response. The hydraulically operated hammer can be dropped from 6 to 36 in. and the drop weight varied from 220 to 500 lb. The assembly is equipped with grippers that lift the hammer, release it, and then catch the hammer after the first impact to prevent the hammer from striking the pavement more than once. A 12-in.-diam loading plate is used with a rubber mat on PCC pavement and without the mat on AC surfaces. Accelerometers are generally placed on the pavement surface at 1, 2, 4, 8, and 16 ft from the edge of the load plate. Signals from the accelerometers are collected through a Hewlett-Packard HP-6942 multiprogrammer and transferred to an HP-9845B computer for analysis and stored on an HP-9895 floppy disk.

39. The computer is primarily used to compute fast Fourier transforms

(FFT) for phase angle versus frequency and wave velocity versus wavelength (dispersion) plots immediately after the data are acquired. When sufficient data are collected for interpretation of the dispersion curve (based on operator experience), the data are stored on the floppy disk and a hard copy is made.

40. It is from this hard copy that the operator selects the velocity values that will ultimately be used in the computer analysis for load-carrying capability of the pavement. The van containing the NDPT device is shown in Figure 23. A close-up of the impact hammer and load plate is shown in Figure 24.

Summary of NDT Evaluation Methods

41. A brief description of the analytical procedures used by each evaluation method is given here. Table 8 gives a summary of some important characteristics of the methods. A more detailed description is given in Appendix A.

ARE, Inc. (1983)

42. Deflection basin data from the Dynaflect are used with the BASFIT program, which is a deflection-basin fitting program that prodicts moduli of the pavement layers and subgrade. A layered-elastic program AIRPOD is used in a fatigue analysis to predict remaining pavement life and allowable loadings. Another layered-elastic program ELSYM-5 is used to compute overlay thickness requirements.

Louis Berger International Inc. (1983)

43. The evaluation method used by Berger is a combination of layered-elastic theory and a modified version of the WES DSM method (Hall 1978). Test data were collected with the Model 2000 pavement profiler. Deflection basin data were used to back-calculate elastic moduli of the pavement layers and subgrade. These moduli were used for an apparent quality assessment of the pavement materials. A correlation was used to convert the DSM's measured with the pavement profiler to the DSM that would be obtained with the WES 16-kip vibrator. Then the DSM procedure with some modifications was used to evaluate the load capacity. For flexible pavements, a subgrade CBR was determined from both the DSM procedure and from the calculated subgrade moduli. The CBR values were then used with the CBR design curve to determine allowable load

and overlay requirements. The DSM was used to determine allowable loadings for rigid pavements using a modified relationship of DSM to allowable gross load. Load transfers at joints in rigid pavements were evaluated with the pavement profiler.

Dynatest Consulting (1983)

44. Dynatest uses the Dynatest 8000 FWD to measure deflection basins, and these measurements are the input for a computer program called ELMOD developed for an HP-85 microcomputer. The ELMOD program includes the method of equivalent thicknesses (MET) to calculate the elastic modulus of up to four pavement layers (Ullidtz 1973, 1977). Nonlinearity of the subgrade is considered in these calculations. Evaluations of joints and corners of rigid-pavement slabs are made with the FWD tests and Westergaard equations (Westergaard 1948). The ELMOD program allows consideration of seasonal temperature effects in the load evaluation. The performance criteria used by Dynatest are permissible normal stress in unbound materials and subgrade, horizontal strain at the bottom of AC, and a fatigue relationship based on flexural strength for PCC (Herholdt et al. 1979).

ERES Consultants, Inc. (1982)

45. The ERES procedure for NDT evaluation uses the Dynatest Model 8000 FWD test results; three load magnitudes are used including the maximum of 24 kips. Pavement layer stiffness values are back-calculated from the measured deflection basins using a layered-elastic program for flexible pavement and a finite element program (ILLISLAB) for rigid pavement. The method for flexible pavements is to model the pavement as a two-layered system to determine the subgrade modulus, and then to calculate other layer moduli that match the theoretical deflection basin to the measured basin (Hoffman and Thompson 1981). Failure criteria for flexible pavement includes radial strain in the asphalt and vertical strain in the subgrade; both rutting (Chou 1976) and fatigue (Bonnaure, Gravois, and Udron 1980) are considered. Fatigue life of the limerock base course was also part of the flexible pavement analysis (Larson and Nussbaum 1967). For rigid pavements, an E modulus of the concrete and a subgrade k modulus are calculated by matching the area of the center slab delfection basin and the maximum deflection. Failure criteria are a relationship of aircraft coverages to concrete modulus of rupture stress ratio. The modulus of rupture is estimated from the E of the slab. Measured load transfer at joints is accounted for in the evaluation.

Reinard W. Brandley (1983)

46. Brandley used test results from the Dynatest 8000 FWD, the WES 16-kip vibrator, and the cantilever deflection beam. Two loads were applied with the FWD, 830 and 1,500 kPa. Test data from both the FWD and the 16-kip vibrator were used with the Dynatest programs of the ELMOD and ISSEM4. These programs, along with the Chevron layered elastic model program, were used to calculate moduli of the pavement layers and subgrade from the FWD deflection data. These moduli were used to compute subgrade deflection under different aircraft loadings; these were compared to the Brandley limiting subgrade deflection criteria to obtain the evaluation results (Brandley 1975). Joint conditions in rigid pavements were evaluated using the cantilever beam. It is the opinion of Brandley that neither the FWD nor the 16-kip vibrator can adequately load joints to measure load transfer.

PCS (1983)

47. The general approach of PCS demonstrated in this project is the collection of deflection data with the PCS FWD, input of these measured deflection basins into the BISAR layered-elastic computer program, and back-calculated elastic moduli (E) for the pavement layers. These moduli are then translated to CBR and/or subgrade k modulus from correlations such as

$$E = 1{,}500 \text{ CBR}$$

$$E = 10^x \text{ where } x = 1.415 + 1.284 \log k$$

E in units of psi and k in units of pci

The values of CBR were used for flexible pavements, while k values were obtained on the rigid pavements, and these values were used with the conventional Air Force load evaluation procedures to determine the allowable aircraft loadings and overlay thickness requirements (Headquarters, Department of the Air Force 1981). The method used by PCS for load evaluation used the flexible pavement design equation developed by WES and the equivalent single-wheel analysis (Yoder and Witczak 1975). For rigid pavements the evaluations were based on the Westergaard free-edge stress.

WES DSM method
(Hall and Alexander 1983)

48. The DSM procedure is based on correlations between DSM (load/deflection) measurements with the WES 16-kip vibrator and the allowable single-wheel load (ASWL) as determined from test-pit measurements. DSM is a

ratio of dynamic load:deflection. The correlations were developed from tests on a large number of inservice airfield pavements. The procedure for NDT evaluation provides for correction of deflection measurements on AC for temperature effects, calculation of the effective subgrade CBR for flexible pavement, and determination of the raduis of relative stiffness for rigid pavement (Asphalt Institute 1969). Existing analytical relationships from the standard US Army Corps of Engineers design procedures convert the ASWL to AGAL and compute overlay thicknesses (Headquarters, Departments of the Navy, Army, and Air Force 1978; Headquarters, Departments of the Army and Air Force 1979). A load reduction factor based on joint load transfer measurements is included in the procedure.

WES layered-elastic
method (Hall and Alexander 1983)

49. This evaluation method (Bush 1980a, Alexander 1982) uses deflection basin measurements from the WES 16-kip vibrator or FWD as input to layered-elastic computer programs (Bush 1980a, Alexander 1982). The program used is BISDEF, which is a modification of the BISAR program (Bush 1980a, Peutz 1968). Elastic moduli of the pavement layers and subgrade are back-calculated, and these moduli are then used in the AIRPAV layered-elastic program to determine allowable loads and overlay thicknesses (Alexander 1982). Failure criteria consists of limiting tensile stress in the bottom of PCC slabs, and limiting horizontal tensile strain in AC and vertical subgrade strain in flexible pavement subgrade. A load reduction factor based on joint load-transfer measurements is included in the procedure.

AFESC (1983)

50. Data from the Air Force NDPT impulse load device are interpreted to give shear wave velocity values for each pavement layer and subgrade. These velocity values are converted to elastic moduli, which are used with the PREDICT computer program to determine allowable aircraft loads. Performance criteria are based on tensile stress or strain in the pavement surface layer and subgrade compressive strain. Overlay thicknesses are not presently determined by the method. Load transfer at joints is not measured.

PART III: COMPARISON OF RESULTS

Test Data Comparisons

51. The scope of this project does not provide for an indepth study of NDT equipment capabilities and comparison but, instead, concentrates on the complete evaluation method. However, some comparisons of results from different equipment that are readily available are offered here. Test data collected with each NDT device are presented in Appendix B. Some study of pavement response in terms of measured parameters, such as deflections, deflection basin, applied load, loading frequency, and wave velocity, may aid understanding of NDT equipment requirements.

52. Most of the NDT evaluation methods make use of the deflection basin (shape of deflected pavement surface) for calculation of layer moduli. A comparison of the deflection basins measured with each of the test devices near the 1980 test-pit locations is presented in Figures 25 through 29. The Air Force NDPT device does not measure deflection, and is, therefore, not included. These figures show the relative magnitude of displacements corresponding to the maximum dynamic/impulse force for each particular test device. These deflection data were then normalized in terms of a unit force of 1,000 lb by dividing measured deflection by applied force; the resulting value is termed unit deflection. The static load (preload) applied by some devices (WES 16-kip vibrator, Berger Pavement Profiler, and ARE Dynaflect) is not considered in these comparisons; only the applied dynamic load was used. Unit deflections in mils per 1,000 lb of applied force are presented in Figures 30 through 34. The Dynaflect, which has the smallest measured deflection at all test areas, gives the largest unit deflection for Test Areas 1, 4, and 5. Test Areas 1 and 5 are rigid pavements and Test Area 4 is a composite pavement.

53. A quantity often used to express the pavement response to nondestructive testing is a ratio of load/deflection or stiffness. To make additional comparisons of the pavement response with the NDT devices used in the project, a comparison of stiffness measurements is presented in Table 9. Table 9 gives an average stiffness for each test area for each NDT device. The number of tests conducted on each test area and used for the average stiffness is shown. Also shown is an average stiffness for each test area

which was obtained by averaging the average stiffness for each NDT device for that test area. The standard deviation and coefficient of variation are shown for each set of data. The coefficient of variation is of interest because it gives some indication of the variability of each NDT test device on the different test areas. A graphical comparison of the stiffness measured by each NDT device is a ratio of the average stiffness from all devices (Figure 35). Differences in load plate diameter, static preload, and dynamic load may produce different stiffness values, and these factors are not considered in Figure 35. However, a study of Figure 35 shows how the measurements vary from the average as a function of pavement strength. The PCS FWD and Dynaflect FWD have very similar characteristics, yet these do not closely agree in this comparison. The two devices manufactured by Dynatest (Dynatest FWD and WES FWD) do agree well even though the dynamic load magnitude is different. The greatest variation occurred in Test Area 3, the composite pavement. No consistent trend developed as to which device had greater or lesser variation in Figure 35, and maximum variation of results from all test areas combined is a factor of approximately 2 (maximum stiffness divided by minimum stiffness).

54. Because the stiffness value can be used with the WES DSM evaluation method to determine allowable load, that method was used to indicate the significance of the range in stiffness values from the NDT devices. Allowable gross aircraft loads were computed for three aircraft using the upper and lower limits of the stiffness range. The following comparison was made for only two of the test areas and three aircraft but gives a representative set of results.

Test Area	Pavement Type	Range in Stiffness, kips/in.	Aircraft	Range in Allowable Load, kips	Increase from Lower Value, percent
3	Flexible	509-1,139	F-4	26-60	131
			C-141	110-291	165
			B-52	143-379	165
5	Rigid	1,924-3,200	F-4	52-60	15
			C-141	249-345	39
			B-52	231-385	67

55. The range of stiffness values is highly significant on the weaker flexible pavement (Test Area 3) and not as significant on the rigid pavement (Test Area 5). On pavements with high stiffness values, such as Test Areas 1,

2, and 4, the range is not important since the low side of the range evaluates the pavement at a high allowable load level.

56. The WES computer program BISDEF was used to calculate modulus values for each of the five test areas using the deflection basins in Figures 25 through 29. Because most evaluation methods use a back-calculating technique to obtain layer moduli, this comparison is of interest. The moduli obtained using BISDEF and deflection data from all six devices are provided in Table 10. The Dynaflect loading area was difficult to model in this program, and values presented for that device in Table 10 may be suspect. Table 10 does show that the back-calculated moduli can vary considerably as a function of the deflection basin.

Comparison of Predicted In Situ Moduli

57. All evaluation methods characterized the pavement sections through prediction of the moduli of the pavement layers and subgrade except the WES DSM procedure. Table 11 summarizes these predicted moduli. A graphical comparison of the subgrade moduli for each of the five test areas is presented in Figure 36. By some evaluation methods, the subgrade modulus for Test Area 1 was treated as a composite of the 6-in. subbase and the sand subgrade with a single modulus computed for the composite materials. This causes the appearance of a large variation in predicted subgrade moduli of Area 1 until this is understood; i.e., that the subgrade modulus for Test Area 1 was not computed on the same basis by all methods. Brandley, ARE, and AFESC were the participants making the separation of a subbase and subgrade, and therefore computing a modulus for each material. All others treated the material beneath the PCC slab in Test Area 1 as subgrade only and did not identify the subbase as a separate layer. The procedure of ERES gives only a subgrade modulus k for the subgrade beneath rigid pavements and, therefore, no elastic moduli for the subgrade by that method are available for Test Areas 1, 4, and 5.

58. An analysis of the elastic moduli of the subgrade predicted by all methods for all five test areas gives the following (Area 1 includes data from only Brandley, ARE, and AFESC):

	Subgrade Moduli, psi		
Area	Mean	Standard Deviation	Spread of Data
1	20,250	9,820	19,250
2	30,910	12,550	39,450
3	22,570	8,640	29,250
4	21,450	5,170	15,800
5	21,210	7,570	22,850

The mean value shows approximately the same subgrade moduli for all areas except Test Area 2, but the spread of data indicates the significant range in the individual values by each evaluation method. The spread of data is defined as the maximum value less the minimum value.

59. With the exception of Test Area 1, the highest moduli of the subgrade were determined by PCS, and in all areas the lowest values came from the AFESC method. For Test Area 1, Brandley, ARE, and AFESC gave E values for both the subgrade and subbase, whereas the other evaluation methods combined the subbase and subgrade; however, for Test Area 1 only the moduli from Brandley, ARE, and AFESC were used for the above statistics.

60. Only ARE predicted modulus values for the subbase layers of Test Areas 2 and 3; the other participants determined a combined modulus of the base and subbase. A presentation of the base course moduli is shown in Figure 37. By all evaluation methods (except by Brandley where both areas have the same value), the base course in Test Area 3 was rated with a lower modulus than the base course of Test Area 2. A significant range in the base course moduli occurs as shown.

	Base Course Moduli, psi		
Area	Mean	Standard Deviation	Spread of Data
2	74,700	47,950	148,000
3	42,280	25,620	75,000

61. Because the modulus of AC is temperature-dependent, values were selected from temperature-modulus relationships by most participants. However, a fairly wide range of values was used for the AC. The moduli for the AC surface from all test areas combined gave the following.

AC Moduli, psi		
Mean	Standard Deviation	Spread of Data
410,000	217,000	852,000

The value of 1,391,000 psi predicted by AFESC for Test Area 4 was not included in the above statistics.

62. For design and evaluation purposes, most evaluation methods provide for a variable moduli of the AC layer (as well as the subgrade) to allow for changing seasonal conditions throughout the design life. This appears to be an important feature since the layered-elastic procedures use the limiting stress/strain concept to predict number of aircraft passes, and the strain is a function of the seasonal/environmental fluctuations in the layer moduli.

63. It is of interest to note in Table 11 the values of subgrade modulus k were determined from some evaluation methods (Dynatest, ERES, Berger). The k values range from 195 to 500 pci, which tends to confirm the value of 250 pci selected earlier in this report for the standard evaluation procedure. As could be expected, the moduli determined for the PCC layers were more consistent with most values being in the range of 4×10^6 to 5×10^6 psi. The AFESC did predict a low value of 2.1×10^6 psi for Test Area 5.

64. In addition to the moduli values presented for the evaluation analysis, both Brandley and Berger offered additional comparisons. These values are of interest because some moduli are computed with deflection basin data from the same equipment using different analytical procedures; whereas, some moduli are computed with the same analytical procedure using deflection measurements from different NDT equipment. These results are shown in Table 12. Similar comparisons can be made by looking at the two columns in Table 11 where WES made computations with the same analytical procedure using deflection data from two NDT devices.

Comparisons of Performance Criteria

65. Performance criteria are the link between pavement characterization and evaluation in terms of predicted allowable loadings and remaining pavement life. The evaluation methods demonstrated in this project use several approaches to performance criteria. Some methods such as PCS, Berger, and WES DSM correlate the NDT-pavement characterization to conventional parameters of CBR and k and then apply the standard relationships in terms of design curves from existing Air Force manuals (or use computer codes using these criteria). Other methods, such as Dynatest, ERES, ARE, and AFESC, use allowable stress/strain levels in the various pavement components to predict when pavement failure will occur. Another approach is the use of limiting levels of subgrade deflection, such as Brandley. Table 13 summarizes the various

performance criteria used in the evaluation method demonstated in this study. These criteria differ considerably in format, and, therefore, a direct comparison is difficult.

66. The existing pavement evaluation procedure used by the Air Force uses test-pit measurements based on many years of performance data collected on both inservice pavements and special test sections which were trafficked to failure. This approach uses values of CBR and k to characterize the strength of subgrade and of base and subbase layers. Moisture and density are accounted for as well as other important material properties such as gradation and plasticity. Failure of pavements in this system is characterized by cracking and/or rutting. This method has been validated through the years and is considered as the standard (Headquarters, Departments of the Navy, Army, and Air Force 1978; Headquarters, Departments of the Army and Air Force 1979).

67. Those evaluation methods using the standard Air Force evaluation curves make use of this established performance criteria. However, the relationships used to predict the CBR and k values become the critical elements. PCS used a direct correlation between predicted modulus and CBR or k. The Berger and WES DSM methods also used correlations to the existing Air Force procedure, but, by making correlations to ASWL as obtained from CBR or k, the methods are more indirect.

68. Other methods, such as Dynatest, ERES, ARE, and AFESC, have limiting criteria placed on critical elements of the pavement structure such as the AC, PCC, and subgrade. PCS states that they have a similar evaluation method, but it was not demonstrated for this project. Brandley bases the link to the performance on subgrade deflection criteria. Although the subgrade deflection criteria are presented in graphical form by Brandley, the curves have been converted to an equation that approximates the curves for inclusion in Table 13.

Comparison of Allowable Load Predictions

69. The project requirements called for evaluation of the five test areas in terms of AGAL's for each of the 13 aircraft groups, each at four pass-intensity levels. Each aircraft group has a controlling aircraft (the most critical aircraft for the group), and the evaluations are actually made for these controlling aircraft. These controlling aircraft for each group and

pass-intensity level are presented in Table 5. The aircraft characteristics including maximum design loads and empty loads are shown in Table 6.

70. The AGAL's for the 13 aircraft groups were computed using the standard Air Force method based on test-pit measurements. The test-pit data used for the standard evaluation have been previously discussed. The rigid pavement AGAL's were determined using extended traffic (shattered slab) criteria as set forth in TM 5-827-1 (Headquarters, Departments of the Army and Air Force 1981) and TM 5-827-3 (Headquarters, Department of the Army 1982). The flexible pavement AGAL's were determined as set forth in TM 5-827-2 (Headquarters, Departments of the Army and Air Force 1981). The AGAL's based on the standard are shown in Table 14. Overlay thicknesses, which are discussed later, are also shown in Table 14. Pavement properties used for evaluation are also shown in this table. Test Areas 1 and 2 rate as adequate to support the maximum design loads for all 13 aircraft groups at all pass intensity levels. (Note that + indicates the allowable load is greater than maximum weight of the aircraft.) Test Areas 3 and 4 rate adequate for the maximum load at pass intensity levels III and IV. Test Area 5 has the lowest load rating of all the five areas, but it too has a fairly high load rating.

71. Allowable loads and overlays were also computed for Test Areas 1 and 5 using test-pit data reported in the 1980 AFESC Evaluation Report (AFESC 1980). These results are shown in Table 15. Test Area 4 was evaluated as an equivalent flexible pavement in Table 14, and therefore the discrepancy between 1980 AFESC test-pit data and the values selected for use in Table 14 would not change the results for Test Area 4. The allowable loads and overlays in Table 15 can be compared with those in Table 14. No significant change occurs for Test Area 1; however, a significant difference results for Test Area 5.

72. Each participant was furnished a copy of pages 5-16, 21-22, and 24-51 of the 1980 AFESC Pavement Evaluation Report (AFESC 1980). These pages contain the data summarized in the first column of Table 3.

73. The allowable load results from each NDT evaluation method are compared to the standard rating, as shown in Table 16. The comparisons are made only for three aircraft, the F-4, C-141, and B-52, which represent light-, medium-, and heavy-load aircraft, respectively. Because the allowable loads represented by + mean that the rating exceeds the maximum design load (see Table 6 for maximum values), a comparison of these ratings could be

misleading. This is because, in this case, the amount that the predicted load rating exceeds the maximum design load is not known. Obviously, most of the test area pavements were more than adequate for all aircraft. This fact makes the comparisons difficult.

74. Figures 38 through 43 graphically display the allowable load comparisons. Figures 38, 39, and 40 are for Test Area 3; whereas, Figures 41, 42, and 43 show results for Test Area 5. The three aircraft, F-4, C-141, and B-52, are shown for pass intensity level I. Test Areas 3 and 5 were selected for these comparisons because the allowable loads from the NDT evaluation methods for these areas are not all at the maximum design loads. Similar comparisons for the other three test areas are not possible because the allowable loads are at the maximum.

75. Figures 38, 39, and 40 show that all NDT evaluation methods predicted the allowable loads for Test Area 3 to be generally lower than the standard load rating. The pattern, however, varies with the different aircraft, and this may indicate some difference in the way the evaluation methods consider multiple-wheel gear configurations. The evaluation methods agree better with the standard load rating for the rigid pavement of Test Area 5 (Figures 41, 42, and 43). The distribution is very similar for the F-4 and C-141 but somewhat different for the B-52.

76. The fatigue relationships inherent in all the evaluation methods adjust the allowable loads as a function of number of passes (load repetitions). Figures 44 and 45 show the relationship of allowable load to passes for flexible (Test Area 3) and rigid (Test Area 5) pavements, respectively.

Comparison of Overlay Thickness

77. Overlay thickness computations were made using the standard Air Force procedure and each of the NDT evaluation methods. The overlays were computed for two design load conditions--1,000 passes of KC-10A (DC-10-30) aircraft, and 10,000 passes of an E-4 (B-747) aircraft. Table 17 shows the predicted overlay thicknesses from the standard procedure (minimum overlay criteria has not been included) and from the various NDT evaluation methods. The AFESC NDT procedure does not presently produce overlay thicknesses, so it is absent from the table. Some evaluation methods presented only AC overlays; whereas, others gave both AC and PCC options.

78. By the standard procedure, overlay thickesses were only required for Test Area 5 because all other test areas evaluated as adequate to support the design aircraft. The overlay calculations (for Test Area 5 which is PCC pavement) were performed as set forth in TM 5-824-3/AFM 88-6 (Headquarters, Departments of the Army and Air Force 1979). All overlay designs are based on initial failure criteria. Thickness of nonrigid (AC) overlay on a rigid pavement, t_{ac}, is determined by

$$t_{ac} = 2.5 \quad [F(h_d) - Ch]$$

where

F = factor that projects the cracking that may be expected to occur in the base pavement

h_d = required single slab thickness, in.

C = condition factor (0.5 to 1.0)

h = existing rigid slab thickness, in.

Rigid overlays to be placed directly on the existing rigid base pavement were designed using the partial bond equation

$$h_o = 1.4 \sqrt{h_d^{1.4} - Ch^{1.4}}$$

and for the base where the rigid slab is to be placed on a flexible leveling course or bond breaker the unbonded equation was used.

$$h_o = h_d^2 - Ch^2$$

where

h_d = required single slab thickness, in.

C = condition factor (0.35 to 1.0)

h = existing rigid slab thickness, in.

For the overlay designs for Test Area 5, the condition factor C in the above equations was taken as 1.0 because of the excellent condition of the existing pavement. The F factor was also 1.0.

79. Most NDT evaluation methods showed little, if any, overlay needed for Test Areas 1 and 2. The methods indicated some overlay for Test Area 3. AC overlays predicted for Test Areas 4 and 5 ranged considerably. Statistics

from all evaluation methods indicate the following.

AC Overlays, in.

Test Area	Design Aircraft	Mean	Standard Deviation	Spread of Data	Standard Air Force Test-Pit Method, in.
1	KC10A	0	0	0	0
	E4	0.30	0.90	0-2.7	0
2	KC10A	0.20	0.60	0-1.8	0
	E4	0.41	1.23	0-3.7	0
3	KC10A	5.94	9.62	0-31.1	0
	E4	8.71	8.45	0-26.1	0
4	KC10A	2.74	3.27	0-8	0
	E4	4.05	5.98	0-17	0
5	KC10A	4.58	6.39	0-18.9	1.8
	E4	8.40	8.67	0-21.0	4.5

80. This same type of information cannot be presented for PCC overlays, because not all evaluation methods give PCC overlays; not enough information is available for the statistical computations.

PART IV: CONCLUSIONS

81. As earlier stated, the main purpose of the study reported herein was to assess several NDT evaluation methods and to provide the Air Force with information to make sound decisions for the possible uses and benefits of NDT. The results of this study led to the following conclusions:

a. The study did not set out to identify any best method for NDT, and no best method for general application at all airfields was identified as a result of the data collected and comparisons made.

b. It appears that the site selected (MacDill AFB) proved to be a poor choice for the following reasons: (1) unusual subgrade (sand) and base course (limerock) materials are nontypical; (2) the pavements were strong enough so that most evaluated as being adequate for all loading conditions using the current standard method which reduced one's ability to compare the results of evaluation techniques (Headquarters, Department of the Air Force 1981); and (3) the baseline test-pit data were not collected concurrently with the NDT results (test-pit data were 2 years old), and some test-pit data are suspected of being in error.

c. Based on use of the NDT evaluation method at MacDill, wide variation occurs in terms of allowable loads among the results and substantial disagreement of some methods with the standard test-pit method (Figures 38 through 43). Some NDT methods predicted overlay thicknesses that were in agreement with the overlay thickness predicted by the test-pit standard; others did not agree (Table 17). Some methods agreed well on some pavement test areas, but did not agree on other test areas. In general, the various NDT evaluation methods produced inconsistent results for the pavement areas evaluated. However, in almost all cases, the NDT methods gave results more conservative (i.e., smaller allowable load and thicker overlay) than those from the test-pit standard method. Overlay thicknesses from some methods generally agreed with the standard. Because of the unusual base course and subgrade conditions, the relative ranking of the various methods in terms of overlay thickness prediction should not be generalized to other airfields.

d. Significant differences were noted in measurements made by the various NDT devices, and no one device can be said to give the best results on the pavement test areas studied. Deflection basin data from the various NDT devices were compared (Figures 25 through 29). The devices with higher load magnitudes, i.e., WES 16-kip vibrator, PCS FWD, and Dynatest FWD, produced larger deflections and steeper deflection basins than did the smaller ARE Dynaflect and Berger Pavement Profiler devices. Input of deflection basin data from each device into a common layered-elastic theory analysis gave inconsistent and variable elastic moduli using the back-calculating technique (Table 10).

_e_. Stiffness values (maximum load divided by maximum deflection) from each device on each test area were compared. The overall range of stiffness values was a factor of approximately two with no consistent trends of high or low mean value from any device common to all or nearly all of the five test areas. The Berger Pavement Profiler consistently gave the highest coefficient of variation in terms of stiffness value.

_f_. All evaluation methods, except the WES DSM method, determine elastic moduli for the pavement layers and subgrade. Considerable variation in these moduli occurred from one technique to another (Figures 36 and 37).

_g_. The performance criteria, which translates the NDT measurements to evaluated load-carrying capacity and overlay requirements, were quite different for the various NDT evaluation methods (Table 13). The performance criteria were given in terms of limiting stress or strain for pavement components, limiting subgrade deflection, and correlations to existing Air Force criteria and are functions of pass intensity level. No direct comparisons could be made of the performance criteria from different methods because of fundamental differences in the nature of the criteria. A comparison of predicted allowable loads at different pass intensities indicated that the rate of change in allowable load with pass intensity was significantly different by some methods (Figures 44 and 45). Because the performance criteria are the only parts of the methods which are functions of pass intensity, a conclusion is drawn that the performance criteria used in some of the methods are more sensitive to the number of passes than others for the conditions at MacDill AFB.

_h_. Most of the NDT procedures provide for testing of the load transfer capacity at joints in PCC pavement. This was typically done by applying a load on one slab near the joint, and measuring the deflection of each slab at the joint. Not all methods used the load transfer measurements in the allowable load and overlay computations. The standard Air Force evaluation method for PCC pavement assumes an average load transfer of 25 percent at the joints, which may not be true for all pavement conditions. This may account for some of the variation in results, particularly for Test Area 5.

_i_. Use of the NDT procedures to evaluate the load transfer capacity of joints in PCC pavements appears to be a viable approach and is an important aspect of any structural evaluation. Further work needs to be devoted to development of this concept to validate the various methods demonstrated in this project.

PART V: RECOMMENDATIONS

82. The following recommendations are made:

- a. The study reported herein should be repeated at other sites to produce more conclusive results. These sites should cover more typical pavements over fine-grained soils (clays and silts), test-pit data should be collected concurrently with the NDT data, and the pavements should be of such design that a range of allowable loads and overlay thicknesses would be anticipated so that a better comparison of results could be made. What is needed is a set of test areas where the standard method predicts some areas are in danger of incipient failure under common aircraft loads and other areas are not. At MacDill, this was not the case.

- b. A standard NDT evaluation method is apparently needed. The standard could be a general procedure (based on an appropriate analytical theory); the performance criteria must be compatible with the system and based on known performance of airfield pavements and the method should be validated. Such a standard could be used to assess the validity of new or more simplified methods. Further study should be made of performance criteria, such as limiting stress, strain, and deflection, and criteria should be selected for use with the standard NDT evaluation method.

- c. Further work with NDT equipment is needed to determine limitations (if any) of different NDT devices. A desirable goal is a standard analysis method that would accept input from any one of several different test devices. A sensitivity study could be made using the standard NDT evaluation method with input from various NDT devices to identify limitations.

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Table 1

NDT Method Presented to Transportation Research Board

Task Force AZT56, August 11-14, 1981

O'Massey, R. C. and McReynolds, M. (McDonnell Douglas), "Dynamic Pavement Modeling - Preliminary Studies"

Ilves, G. J. and Majidzadeh, K. (Resource International), "Nondestructive Evaluation of Airfield Pavements"

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Shahin, M. Y., Sharma, J., Smith, M. E. and Stubstad, R. N. (Dynatest - ERES) "Nondestructive Testing of Airfield Pavements"

Visser, W., and Koole, R. C. (Pavement Consultancy Services/Shell), "Evaluation of Aircraft Pavements"

Harr, M. E. and Elton, D. J. (Purdue), "Non Contact - Non Destructive Evaluation Using Prototype Loads"

Hall, J. W. (WES), "Nondestructive Evaluation of Airfield Pavements - DSM Method"

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Table 2

Construction History

Area	Description	Approximate Construction Period	Remarks
1	Taxiway 33	1959	COE Project AP 86-04-16
2	Taxiway 3B	1943	Original construction by COE
		1956	18-ft-keel overlay, MacDill Project 22-57
		1963	MacDill Project 5-62, overlay
		1971	MacDill Project 62-0, overlay
3	Taxiway 3	1943	Original construction by COE
		1956	MacDill Project 22-57, 18-ft-keel overlay
		1969	MacDill Project 8-5, overlay
4	Apron 1A-1	1941	Original construction by COE
		1952	COE Project 85-04-04, overlay
		1966	Slurry seal, MacDill Project 7-5
		1968	Seal coat, MacDill Project 214-8
5	Apron 1A	1941	Original construction by COE
		1952	COE Project 06-06-02
		1975	MacDill Project 90-3, remove existing pavement and replace

Table 3

Summary of Pavement Physical Properties

Test Area	Air Force Engineering and Services Center (1980)	US Engineer Office, Jacksonville, Fla. (1944)	Office, District Engineer, Savannah, Ga. (1947)
1	20-in. PCC, R = 480 11.5-in. subbase (SP-SM), k = 230 Subgrade (SP-SM), γ_d = 98.3, ω = 23.9	---	---
2	11-in. AC 11-in. base, CBR = 80 4-in. base, CBR = 80 Subgrade, CBR = 35, γ_d = 105.4 , ω = 6.7	---	3-in. AC 8-in. limerock, CBR = 80 Subgrade (GP), CBR = 30
3	5.5-in. AC 8.5-in base, CBR = 80 5.5-inch SP-SM, CBR = 25 , γ_d = 107.3 , ω = 9.1 SP, CBR = 30, γ_d = 97.0 , ω = 10.8	---	3-in. AC 8-in. limerock, CBR = 80 Subgrade (GP), CBR = 30
4	7.5-in. AC 6.5-in. PCC, R = 580 SP, k = 85 , γ_d = 101.4 , ω = 9.0 Alternate for Area 4 as flexible pavement: 7.5-in. AC 6.5-in. base, CBR = 80 SP, CBR = 30	R = 591 Subgrade (SP), k = 440 γ_d = 110 , ω = 7.8, 0-6 in. depth γ_d = 106 , ω = 9.5, 6-18 in. depth	8-6 in. PCC* Sand (SP), k = 370
5	10.5-in. PCC, R = 470 SP, k = 80 , γ_d = 109.8 , ω = 11.7	k = 360 pci γ_d = ω = 107 , 4.3 , 0-6 in. depth γ_d = ω = 100 , 15.8 , 6-18 in. depth	8-6-8 in. PCC* Sand (SP), k = 370 psi

(Continued)

Note: γ_d = dry density, pcf; ω = moisture content, percent; SP-SM = poorly graded silty sand; SP = poorly graded sand; and GP = poorly graded gravel.

* Working stress of PCC = 345 psi.

Table 3 (Concluded)

Test Area	US Army Engineer District, Jacksonsville, Fla. (1960)	US Army Engineer, Ohio River Laboratories (1954)	Rigid Pavement Laboratory of the Ohio River Division (1960)	Construction Engineering Laboratory, Ohio River Division Laboratories (1964)
1	20-in. PCC, R = 750 6-in. stabilized subbase, k = 300 Sand (SP)	--	--	20-in. PCC, R = 750 6-in. stabilized subgrade, k = 300 Sand (SP-SM)
2	6-in. AC 8-in. limerock, CBR = 80 7-in. stabilized subbase, CBR = 30 Sand (SP), CBR = 25	3-in. AC 8-in. limerock base, CBR = 80 7-in. limerock stabilized subbase, CBR = 30 Sand (SP), CBR = 30	--	--
3	6-in. AC 8-in. limerock, CBR = 80 7-in. stabilized subbase, CBR = 30 Sand (SP), CBR = 25	3-in. AC 8-in. limerock base, CBR = 80 7-in. limerock stabilized subbase, CBR = 30 Sand (SP), CBR = 30	--	--
4	6-in. AC 6-in. PCC, R = 650 Sand (SP), k = 250	6-in. AC 8-6-8-in. PCC, R = 700 Sand (SP), k = 370, CBR = 40	6-in. AC 8-6-8 in. PCC, ¢ = 650 Sand (SP-SM), k = 250 CBR = 25	6-in. AC 8-6-8 in. PCC, R = 650 Sand (SP-SM), k = 250
5	6-in. AC 6-in. PCC, R = 650 Sand (SP), k = 250	6-in. AC 8-6-8-in. PCC, R = 700 Sand (SP), k = 370, CBR = 40	6-in. AC 9-6-9 in. PCC, R = 650 Sand (SP-SM), k = 250, CBR = 25	6-in. AC 9-6-9-in. PCC, R = 650 Sand (SP--SM), k = 250

Table 4

Thirteen Aircraft Groups

Aircraft Group	Aircraft
1	C-123
2	A-7, A-10, A-37, F-4, F-5, F-14, F-15, F-16, F-100, F-101, F-102, F-105, F-106, T-33, T-37, T-38, T-39, OV-10
3	F-111, FB-111
4	C-130
5	C-7, C-9, DC-9, C-54, C-131, C-140, T-29
6	737, T-43, C-119, EC-121
7	727, KC-97
8	707, E-3, C-135, KC-135, VC-137
9	C-141
10	C-5A
11	KC-10A, DC-10, L-1011
12	747, E-4
13	B-52

Table 5

Pass Levels for Pavement Evaluation

Aircraft Group	Controlling Aircraft	Number of Passes for Four Pass Intensities I	II	III	IV
1	C-123	300,000	50,000	15,000	3,000
2	F-4	300,000	50,000	15,000	3,000
3	F-111	300,000	50,000	15,000	3,000
4	C-130	50,000	15,000	3,000	500
5	C-9	50,000	15,000	3,000	500
6	T-43 (B-737)	50,000	15,000	3,000	500
7	B-727	50,000	15,000	3,000	500
8	KC-135	50,000	15,000	3,000	500
9	C-141	50,000	15,000	3,000	500
10	C-5A	50,000	15,000	3,000	500
11	KC-10A	15,000	3,000	500	100
12	E-4	15,000	3,000	500	100
13	B-52	15,000	3,000	500	100

Table 6

Aircraft Characteristics for Pavement Evaluation

Aircraft Group	Controlling Aircraft	Tire Spacing in.	Tire Contact Area sq in.	Tire Pressure psi	Main Gear Load percent	Group Load Range* Minimum kips	Group Load Range* Maximum kips
1	C-123	--	270	100	84.3	35	60
2	F-4	--	100	--	87.7	5	60
3	F-111	--	241	--	95.0	50	120
4	C-130	60	400	--	95.7	60	175
5	C-9	26	165	--	93.6	20	110
6	T-43	30.5	174	--	92.8	40	150
7	B-727	34	237	--	92.4	85	175
8	KC-135/ E-3	34.5 × 56	218	--	93.5	105	335
9	C-141	32.5 × 48	208	--	94.4	135	345
10	C-5A	35 × 53 × 65	285	--	94.2	325	770
11	KC-10A (DC 10-30)	54 × 64	294	--	92.2	230	590
12	E-4 (B-747)	44 × 58	245	--	93.5	300	780
13	B-52	37 × 62	267	--	52.0	175	490

* Group Load Range is the minimum (empty) and maximum (loaded) aircraft weights used for evaluation.

Table 7

Characteristics of Nondestructive Testing Equipment

	WES 16-kip	WES FWD	Dynatest FWD	PCS FWD	Berger Pavement Profiler	ARE Dynaflect	AF NDPT Van
Type of load applied	Vibratory	Impulse	Impulse	Impulse	Vibratory	Vibratory	Impulse
Type deflection output	Peak-Peak	Peak	Peak	Peak	Peak-Peak	Peak-Peak	#
Contact area, sq in.	254	110	110	110	254	8.6	113
Maximum dynamic/impulse force (peak-to-peak), lb	30,000	15,000	24,000	22,400	4,500	1,000	520-lb weight dropped 30 in.
Static weight, lb	16,000	--	--	--	3,800	2,000	--
Test frequency, Hz	15	--	--	--	25	8	--
Loading time, msec	--	25-30	25-30	--	--	--	--
Number of displacement sensors	4	3	7	4	4	5	##
Location of displacement sensors, distance from center of loaded area, in.:							
0	+	+	+	+	+	+	
8			+				
12		+	+		+	+	
18	+						
24		+	+	+	+	+	
36	+	+	+*		+*	+	
39				+			
48		+	+			+	
60	+		+*		+**		
71					+**		
79				+			
96			+**				

Note: # = Accelerometers spaced at 1, 2, 4, 8, and 16 ft from plate to measure wave velocity.
= Measures phase difference between transducers.
* = Flexible pavements only.
** = Rigid pavements only.
\+ = Locations of sensors.

Table 8

Summary of NDT Evaluation Methods

Method	Data Analysis	Type Theory	Performance Criteria
PCS	Back-calculate modulus of pavement layers from deflection basin	Layered-elastic (BISAR)	Correlation of E to California Bearing Ratio and k , then use AF design curves
Dynatest	Back-calculate moduli of pavement layers from deflection basin	Layered-elastic (ELMOD) (MET)	Normal stress in unbound materials, horizontal strain bottom of AC, fatigue based on flexural strength of PCC
ERES	Back-calculate moduli of pavement layers from deflection basin (subgrade k modulus determined for subgrade under PCC)	Finite element (ILLISLAB) for rigid pavement; layered-elastic for flexible pavement	For rigid pavement--relationship of aircraft coverages to computed stress in concrete; for flexible pavement--radial strain in AC and vertical strain in subgrade; fatigue of base layer
Brandley	Back-calculate moduli of pavement layers from deflection basin	Layered-elastic (ELMOD) (ISSEM4) (CHEVRON)	Limiting subgrade deflection
Berger	Back-calculate moduli of pavement layers from deflection basin and correlation analysis to allowable load and overlay	Layered-elastic (CRANLAY) (GWLB-100) (COMRIGID) (COMPLAYER)	Correlation of stiffness to existing AF design criteria
ARE	Back-calculated moduli of pavement layers from deflection basin (BASFIT)	Layered-elastic (AIRPOD) (ELSYM-5)	Limiting stress in PCC; limiting strain in AC
AFESC	Elastic moduli of pavement layers from wave velocity dispersion curves	Finite element (PREDICT)	Limiting tensile strain in AC; limiting stress in PCC; limiting vertical strain in subgrade
WES DSM	DSM of composite pavement from load-deflection data; radius of relative stiffness, ℓ , from deflection basin	Correlation relationships and analysis of computer (FLEXEVAL) (RIGEVAL)	Correlation of DSM to existing Corps of Engineers/AF design criteria
WES layered-elastic	Back-calculate moduli of pavement layers from deflection basin	Layered-elastic (BISDEF) (AIRPAV)	Limiting strain in subgrade and AC for flexible pavement; limiting tensile stress in PCC for rigid pavement

Table 9

Comparison of Stiffness Measurements

Nondestructive Testing Device	Number of Test	Average Stiffness kips/in.	Standard Deviation	Coefficient of Variation
		Test Area 1		
WES 16-kip vibrator	28	6,053	617	10.2
WES FWD	28	7,689	665	8.6
Dynatest FWD	14	8,575	582	6.8
PCS FWD	28	9,367	512	5.5
Berger Pavement Profiler	8	10,249	1,260	12.3
ARE Dynaflect	14	6,366	627	9.85
Average for Test Area	--	8,050	--	--
		Test Area 2		
WES 16-kip vibrator	30	1,762	212	12.0
WES FWD	30	1,481	167	11.3
Dynatest FWD	16	1,304	225	17.2
PCS FWD	18	1,719	205	11.9
Berger Pavement Profiler	16	2,348	337	14.4
ARE Dynaflect	15	2,453	240	9.8
Average for Test Area	--	1,845	--	--
		Test Area 3		
WES 16-kip vibrator	22	865	102	11.7
WES FWD	21	509	49	9.6
Dynatest FWD	22	499	55	11.1
PCS FWD	26	676	66	9.3
Berger Pavement Profiler	22	808	126	15.6
ARE Dynaflect	22	1,189	155	13.0
Average for Test Area	--	--	--	--
		Test Area 4		
WES 16-kip vibrator	12	2,233	287	12.8
WES FWD	12	2,125	305	14.4
Dynatest FWD	12	2,230	400	18.0
PCS FWD	20	2,362	540	22.8
Berger Pavement Profiler	10	2,933	686	23.4
ARE Dynaflect	25	2,274	419	18.4
Average for Test Area	--	2,360	--	--

(Continued)

Table 9 (Concluded)

Nondestructive Testing Device	Number of Test	Average Stiffness kips/in.	Standard Deviation	Coefficient of Variation
		Test Area 5		
WES 16-kip vibrator	35	2,588	186	7.2
WES FWD	34	2,762	188	6.8
Dynatest FWD	25	2,554	297	11.6
PCS FWD	28	3,200	285	8.9
Berger Pavement Profiler	22	2,896	316	10.9
ARE Dynaflect	14	1,924	181	9.4
Average for Test Area	--	2,654	--	--
			Variation, All Areas	
WES 16-kip vibrator			10.8	
WES FWD			10.1	
Dynatest FWD			12.9	
PCS FWD			11.7	
Berger Pavement Profiler			15.3	
ARE Dynaflect			12.1	

Table 10

Moduli Predicted from Deflection Basins

from Different NDT Equipment

Elastic Modulus, psi

Test Area 1

NDT Device	20-in. PCC	Subgrade Sand
WES 16-kip vibrator	3,440,538	46,244
WES FWD	6,928,316	35,639
Dynatest FWD	9,117,088	31,499
PCS FWD	9,452,344	35,080
Berger Pavement Profiler	6,111,868	59,205
ARE Dynafleet	11,530,20	10,367

Test Area 2

NDT Device	10-in. AC	15-in. Limerock-Stabilized Base	Subgrade Sand
WES 16-kip vibrator	680,279	59,740	37,209
WES FWD	572,022	30,116	37,438
Dynatest FWD	538,205	36,649	29,799
PCS FWD	559,951	65,255	31,818
Berger Pavement Profiler	452,499	90,633	50,928
ARE Dynafleet	154,052	403,405	22,579

Test Area 3

NDT Device	5.5-in. AC	15-in. Limerock-Stabilized Base	Subgrade Sand
WES 16-kip vibrator	691,229	40,926	26,753
WES FWD	185,244	16,241	31,738
Dynatest FWD	185,952	20,682	20,375
PCS FWD	332,768	18,244	27,155
Berger Pavement Profiler	537,513	35,074	24,344
ARE Dynafleet	52,175	40,381	23,872

(Continued)

Table 10. (Concluded)

NDT Device	Elastic Modulus, psi 7-in. AC	6-in. Limerock-Stabilized Base	Subgrade Sand
	Test Area 4		
WES 16-kip vibrator	1,440,817	3,227,078	25,157
WES FWD	1,982,382	2,047,265	23,242
Dynatest FWD	1,903,426	1,841,818	22,108
PCS FWD	2,334,218	1,387,285	17,160
Berger Pavement Profiler	6,878,414	248,228	23,376
ARE Dynaflect	12,030,469	716,935	10,687
		10.5-in. AC	Subgrade Sand
	Test Area 5		
WES 16-kip vibrator		3,119,032	26,580
WES FWD		3,756,947	23,448
Dynatest FWD		4,040,810	19,496
PCS FWD		6,846,501	22,938
Berger Pavement Profiler		3,652,117	24,131
ARE Dynaflect		3,562,470	11,292

Table 11
Summary of Predicted Moduli

Test Area	Layer	Modulus of Pavement Layers, psi: Dynatest*	ERES**	PCS†	Brandley	Berger	ARE	AFESC	WES 16-kip	WES FWD
1	PCC	4,400,000	4,000,000	4,000,000	4,000,000	4,000,000	5,000,000	3,150,000	3,200,000	3,950,000
	Base	--	--	--	60,000	--	200,000	65,000	--	--
	Subgrade	63,300	k = 450 pci	63,300	18,000	70,000	31,000	11,750	39,000	47,000
		k = 345 pci				k = 500 pci				
2	AC	348,000	180.000	63,000	330,000	400,000	500,000	782,000	250,000	250,000
	Base	32,000	80.000	35,300	60,000	100,000	120,000	78,000	51,000	36,000
	Subbase	--	--	--	--	--	60,000	--	--	--
	Subgrade	26,000	23,400	51,200	16,000	37,000	34,500	11,750	39,000	39,000
3	AC	401,000	150,000	635,000	330,000	300,000	200,000	1,002,000	250,000	250,000
	Base	16,000	40,000	10,000	60,000	50,000	60,000	85,000	44,000	13,500
	Subbase	--	--	--	--	--	35,000	--	--	--
	Subgrade	20,000	19,300	41,000	13,000	24,000	27,000	11,750	24,000	24,000
4	AC	533,000	400,000	635,000	330,000	800,000	300,000	1,391,000	250,000	250,000
	PCC	4,500,000	5,800,000	900,000	4,000,000	4,000,000	6,000,000	2,796,000	500,000	500,000
	Subgrade	26,000	k = 375 pci	30,600	18,000	24,000	21,000	14,800	19,000	18,000
		k = 270 pci								
5	PCC	4,900,000	4,500,000	4,900,000	4,000,000	4,000,000	3,300,000	2,100,000	4,300,000	5,900,000
	Subgrade	15,800	k = 315 pci	34,600	18,000	30,000	17,500	11,750	22,000	20,000
		k = 195 pci				k = 250 pci				

* For evaluation, k = 310 and CBR = 27 were selected for subgrade by PCS.
** Moduli shown for Test Areas 2 and 3 are for 8 ft left of center line.
† Moduli shown for Test Area 2 are for 20 ft left of center line and 10 ft left for Test Area 3.

Table 12

Moduli Comparison from Brandley and Berger

Test Area	Pavement Layer	Burmister-Hogg* PP	Burmister-Hogg* WES 16-kip	Burmister-Hogg* WES FWD	Matching Deflection Bowls-GWLB-100* PP	Matching Deflection Bowls-GWLB-100* WES 16-kip	Matching Deflection Bowls-GWLB-100* WES FWD	ELMOD** WES FWD†	ISSEM 4** WES FWD†	Boussinesq Equivalent Thickness† WES FWD†	Boussinesq Equivalent Thickness† WES 16-kip	CHEVRON N-Layer† WES FWD	CHEVRON N-Layer† WES 16-kip
		Modulus of Pavement Layers, kips per square inch											
1	PCC	4,400	2,090	2,990	4,880	2,200	3,780	4,250		75	—	60	42
	Subgrade	67.5	46.7	53.0	53.8	45.0	46.0	62					
2	AC	400††	400††	400††	500	500	365	340					
	Base	414	150	127	180	135	68	54		27	—	13	
	Subgrade	51.5	39.2	36.2	44.0	34.0	38.0	31					
3	AC	400††	400††	400††	450	400	407	446	227				
	Base	172	163	70.6	200	270	59	7	14	64	—	5	
	Subgrade	25.7	23.5	21.5	25.0	21.3	22.3	26	25				
4	AC	800††	800††	800††	800	800	800	140					
	PCC	11,100	5,300	1,400	8,000	4,000	4,000	4,500		30	—	32	
	Subgrade	25.1	21.8	23.7	20.0	20.0	20.0	25					
5	PCC	3,810	3,480	4,150	3,000	2,900	3,640	3,863		29	—	25	
	Subgrade	28.5	26.0	25.2	24.0	25.0	24.0	27					

* Louis Burger International, Inc. 1983.
** Both the ELMOD and ISSEM 4 are programs provided by Dynatest, Inc.
† Brandley 1983.
†† Assumed value.

Table 13

Summary of Performance Criteria

Methodology	Rigid Pavement	Flexible Pavement	Subgrade
Dynatest	$FS = A \times (E/E_o)^d$ A = 1.18 MPa (170 psi) E = modulus of PCC E_o = 1,000 Mpa (1,450,000 psi) $N = 10^{\left[12 \times (1-\Sigma DS/FS)/(1-PS/\Sigma DS)\right]}$ ΣDS = static + dynamic load FS = flexural strength PS = static load	$\varepsilon_t = 0.000228 \times VB \times N^{-0.178}$ ε_t = permissible horizontal strain at bottom of AC VB = volume percentage of asphalt, approximately 12 N = load applications	$\sigma = 0.05 \times n^{-0.0667} \times (E/E_o)^d$ σ = permissible normal stress n = load applications E = modulus E_o = 160 MPa (23,000 psi) d = power equal to 1.0 where $E > E_o$, otherwise 1.16
ERES	$\mathrm{Log}_{10}\, C = 2.27 \times \left(\frac{MR}{\sigma}\right) + 0.056$ $\mathrm{Log}_{10}\, C$ = coverage to 50 percent slab cracking MR = modulus of rupture determined from modulus FWD σ = critical stress in slab using load transfer in ILLISLAB	$\varepsilon_r = \left(4.102 \times PI - 0.205 \times PI \times Vb + 1.049 \times Vb - 2.707\right) \times S_m^{-0.28} \times N_{cov}^{-0.2}$ ε_r = radical strain PI = penetration index (assumed = 0) Vb = volumetric bitumen content (15 percent) S_m = stiffness of mix (N/m**2) N_{cov} = number of coverages	$\varepsilon_v = 5.511 \times 10^{-3} \dfrac{1}{N_{cov}^{0.1532}}$ ε_v = vertical strain on subgrade N_{cov} = number of coverages of the specified aircraft producing strain

(Continued)

(Sheet 1 of 5)

Table 13. (Continued)

Methodology	Rigid Pavement	Flexible Pavement	Subgrade
ARE	$N = a\left(\frac{f}{\sigma}\right)^b$ N = number of aircraft loads until failure (fatigue life) f = concrete flixural strength, psi σ = computed stress due to aircraft load on rigid pavement, psi a, b = constants $L_R = 100 - \left(\Sigma\frac{n}{N}\right) \times 100$ L_R = fatigue life remaining in pavement. n = aircraft operations to date for an individual craft N = allowable number of aircraft loads until failure for an individual aircraft	$N = c\left(\frac{1}{\varepsilon}\right)^d$ N = number of aircraft loads until failure (fatigue life) c, d = constants ε = computed strain due to aircraft load on flexible pavement, psi $L_R = 100 - \left(\Sigma\frac{n}{N}\right) \times 100$ L_R = fatigue life remaining in pavement n = aircraft operations to date for an individual aircraft N = allowable number of aircraft loads until failure for an individual aircraft	
PCS	E-k Relationship* E = 10 X with E in psi units with X = 1.415 + 1.284 log k	E-CBR Relationship* E = 1,500 (CBR) with E in psi units	

(Continued)

* K and CBR used with standard Air Force pavement evaluation procedure.

(Sheet 2 of 5)

Table 13 (Continued)

Methology	Rigid Pavement	Flexible Pavement	Subgrade
Berger	$P_G = 0.0159 \times DSM \times F_L \times T_c$ Composite pavement $P_G = 0.0162 \times DSM \times F_L \times T_c$ DSM = measured ratio of load/deflection from pavement profiler F_L = load factor T_c = traffic factor	$CBR = \frac{\alpha^2 \times 1,000 \times ASML}{8.1 \times \left(T_t^2 + \alpha^2 A/\pi\right)}$ $ASML = 0.0437 \times DSM$ T_t = equivalent thickness from predicted layer modulus Then CBR and T_t used with standard Air Force pavement evaluation procedure DSM = measured ratio of load/deflection from pavement profiler	
Brandley			$C = 0.00036\ T^{2.88325} D^{-2.8641}$ C = coverages to failure T = total thickness of pavement above subgrade D = subgrade deflection, in.

(Continued)

(Sheet 3 of 5)

Table 13 (Continued)

Methodology	Rigid Pavement	Flexible Pavement	Subgrade
WES-DSM	$P_G = 0.0819(DSM)F_L T_C$ Compositive pavement $P_G = 0.0172(DSM)F_L T_C$ F_L = load factor T_C = traffic factor	$P_G = \frac{F_{K(DSM)}}{S(\%ESWL)} \times \frac{N_m}{N_c} \times 100$ F_K = load factor S = load on rose gear %ESWL = equivalent single-wheel load in percent N_m = number of main gear wheels N_c = number of controlling wheels	
WES Layered Elastic	$\epsilon_{All} = \frac{R}{A + B(LOG_{10}COV)}$ R = flexural strength of PCC, psi A = 0.58901 B = 0.35486 COV = number of passes divided by pass to coverage ratio	$\epsilon_{All_{(AC)}} = 10^A$ $A = \frac{N + 2.665\left(LOG_{10}\frac{E_{AC}}{14.22}\right) + 0.392}{5.0}$ N = aircraft repetitions E_{AC} = AC modulus	Allowable repetitions = $10{,}000\left(\frac{A}{S_s}\right)^B$ where $A = 0.000247 + 0.000245 \log M_R$ S_s = vertical strain at the top of the subgrade $B = 0.0658\ M_R^{0.559}$ M_R = resilient modulus in pounds per square inch of the subgrade

(Continued)

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Table 13 (Concluded)

Methodology	Rigid Pavement	Flexible Pavement	Subgrade
AFESC	Operations = CPC $\times 10^{(96-PERMR)/8.0}$ CPC = cycles per coverage PERMR = $\frac{\text{Max. Element Stress}}{\text{Mod of Rupt of PCC}} \times 100\%$	CONSTM = $1.054 - \left\{0.137 \times \left[ALOG_{10}(PROPTY)\right]\right\}$ CONSTL = -4.15490 + CONSTM $\times$ 6.60206 PROPTY = Young's modulus EXZMAX = asphaltic concrete tensile strain	Weak flexible pavement - Operations = CPC $\times$ (4.7188 E - 22) $\times \left[ABS(EY_{max})^{-8.6615}\right]$ Heavy multiple-wheel aircraft- Operations = CPC $\times$ (1.448 E - 15) $\times \left[ABS(EY_{max})^{-6.605}\right]$ Rigid pavement and strong flexible pavement - Operations = CPC $\times$ (1.07 E - 8) $\times \left[ABS(EY_{max})^{-4.4}\right]$ EY_{max} = vertical subgrade strain

(Sheet 5 of 5)

Table 14

Evaluation of Test Areas Based on Standard Air Force Test-Pit Procedures

Test Area	Pavement Properties for Evaluation		Pass Intensity Level	Allowable Aircraft Loads, kips													Overlay Thickness, in. DC-10-30, 1,000 passes			Overlay Thickness, in. B-747, 10,000 passes		
				C123	F4	F111	C130	C9	T43	B727	E4	C141	C5A	KC10	B747	B52	AC	PCC Partial (Bonded)	PCC (Unbonded)	AC	PCC Partial (Bonded)	PCC (Unbonded)
1	20-in. PCC	R = 750	I	+	+	+	+	+	+	+	+	+	+	+	+	+	0	0	0	0	0	0
	6-in. subbase	k = 300	II																			
	Sand subgrade (SP)		III																			
			IV																			
2	10-in. AC		I														0			0		
	8-in. limerock base	CBR = 80	II																			
	7-in. limerock stabilized subbase	CBR = 30	III																			
	Sand subgrade (SP)	CBR = 25	IV																			
3	5.5-in. AC		I													415	0			0		
	8-in. limerock base	CBR = 80	II													451						
	7-in. limerock stabilized subbase	CBR = 30	III													+						
	Sand subgrade (SP)	CBR = 25	IV													+						
4*	7.5-in. AC		I			106										346	0			0		
	6-in. PCC	CBR = 80	II			+										400						
	Sand subgrade (SP)	k = 250-300	III			+										+						
		CBR = 25	IV			+										+						
5	10.5-in. PCC	R = 650	I		57	67		102	108	119	268	263		480	646	198	1.8	1.9	3.9	6.4	3.9	6.4
	Sand subgrade (SP)	k = 250	II		+	80		110	116	128	286	280		510	685	216						
			III		+	85		+	125	138	304	298		547	735	233						
			IV		+	92		+	137	151	328	321		585	+	252						

Note: Plus (+) sign indicates allowable gross load was greater than maximum weight of aircraft.
* Evaluated as flexible pavement.

Table 15

Evaluation of Test Areas 1 and 5 Based on Test-Pit Data From 1980 AFESC Evaluation Report

Test Area	Pavement Properties for Evaluation		Pass Intensity Level	Allowable Aircraft Loads, kips													Overlay Thickness, in.					
																	DC-10-30, 1,000 passes			B-747, 10,000 passes		
				C123	F4	F111	C130	C9	T43	B727	E4	C141	C5A	KC10	B747	B52	AC	PCC Partial (Bonded)	PCC (Unbonded)	AC	PCC Partial (Bonded)	PCC (Unbonded)
1	20-in. PCC	R = 480	I	+	+	+	+	+	+	+	+	+	+	+	+	385	0	0	0	0	0	0
	6-in. subbase	k = 230	II	+	+	+	+	+	+	+	+	+	+	+	+	467						
	Sand subgrade (SP)		III	+	+	+	+	+	+	+	+	+	+	+	+	+						
			IV	+	+	+	+	+	+	+	+	+	+	+	+	+						
5	16.5-in. PCC	R = 470	I	43	36	0	108	62	65	0	144	141	524	259	351	0	19.2	13.4	16.6	20.0	13.9	17.1
	Sand subgrade (SP)	k = 80	II	53	45	50	120	70	73	0	159	156	582	292	398	0						
			III	60	51	57	140	82	86	92	182	178	658	340	467	0						
			IV	+	+	68	169	101	105	113	214	210	762	399	352	181						

Note: Plus (+) sign indicates allowable gross load was greater than maximum weight of aircraft.

Table 16

Comparisons of Allowable Load

Allowable Gross Aircraft Load, kips

Procedure	Pass Intensity Level I F4	Level I C141	Level I B52	Level II F4	Level II C141	Level II B52	Level III F4	Level III C141	Level III B52	Level IV F4	Level IV C141	Level IV B52
Test Area 1												
Standard evaluation from test-pit data	60+	345+	490+	+	+	+	+	+	+	+	+	+
Dynatest*	60+	345+	490+	+	+	+	+	+	+	+	+	+
ERES**	60+	345+	292	+	+	+	+	+	+	+	+	+
PCS†	60+	345+	480+	+	+	+	+	+	+	+	+	+
Brandley††	60	345	490	60	345	490	60	345	490	60	345	490
Berger	60+	345+	490+	+	+	+	+	+	+	+	+	+
ARE	62	317	488	62	317	488	62	317	488	62	317	488
AFESC	60+	345+	460	+	+	490+	+	+	+	+	+	+
WES (DSM)	60+	345+	490+	+	+	+	+	+	+	+	+	+
WES (layered-elastic, 16-kip)	60+	345+	490+	+	+	+	+	+	+	+	+	+
Wes (layered-elastic, FWD data)	60+	345+	490+	+	+	+	+	+	+	+	+	+
Test Area 2												
Standard evaluation from test-pit data	60+	345+	490+	+	+	+	+	+	+	+	+	+
Dynatest*	60+	345+	490+	+	+	+	+	+	+	+	+	+
ERES**	60+	345+	490+	+	+	+	+	+	+	+	+	+
PCS†	45	225	240	55	250	290	60+	300	380	+	345+	480+
Brandley††	60	179	353	60	272	490	60	345	490	60	345	490
Berger	60+	345+	490+	+	+	+	+	+	+	+	+	+
ARE	62	317	488	62	317	488	62	317	488	62	317	488
AFESC	60+	345+	300	+	+	377	+	+	490	+	+	+
WES (DSM)	60+	345+	490+	+	+	+	+	+	+	+	+	+
WES (layered-elastic, 16-kip	60+	345+	490+	+	+	+	+	+	+	+	+	+
WES (layered-elastic FWD data)	60+	345+	455	+	+	490+	+	+	+	+	+	+

(Continued)

Note: Plus (+) sign denotes allowable gross load greater than maximum gross weight of aircraft; A denotes allowable gross load less than minimum (basic) gross weight of aircraft.

* Eighty percent of test points.

** Fifty percent slab cracking for PCC pavement, 0.5-inch rutting for Asphalt Concrete pavement.

† Initial crack for PCC pavement.

†† Allowable load presented as percent of gross in report.

(Sheet 1 of 3)

Table 16 (Continued)

Procedure	Pass Intensity Level I F4	Level I C141	Level I B52	Level II F4	Level II C141	Level II B52	Level III F4	Level III C141	Level III B52	Level IV F4	Level IV C141	Level IV B52
Test Area 3												
Standard evaluation from test-pit data	60+	345+	415	+	+	451	+	+	490+	+	+	+
Dynatest*	25	A	217	28	A	241	30	137	272	34	154	303
ERES**	55	195	490+	60+	248	+	+	345	+	+	345+	+
PCS†	A	A	A	A	A	A	A	A	A	A	A	A
Brandley††	50	128	225	60	190	392	60	331	490	60	345	490
Berger	58	212	255	60+	230	245	+	280	305	+	345+	405
ARE	7	51	65	10	64	72	11	158	135	12	317	488
AFESC	27	200	A	48	295	200	60+	345+	261	60+	+	330
WES (DSM)	59	237	298	60+	261	347	+	321	433	+	345+	490+
WES (layered-elastic, 16-kip)	48	223	225	52	237	246	55	257	271	59	281	296
WES (layered-elastic data)	32	172	213	43	222	248	52	263	273	60+	287	298
Test Area 4												
Standard evaluation from test-pit data	60+	345+	346	+	+	400	+	+	490+	+	+	+
Dynatest*	60+	275	490+	+	295	+	+	321	+	+	345+	+
ERES**	30	165	<175	36	188	<175	42	216	210	54	318	282
PCS†	60+	345+	480+	+	+	+	+	+	+	+	+	+
Brandley††	43	100	196	60	148	343	60	262	490	60	345	490
Berger	52	241	190	60+	272	215	+	295	230	+	325	250
ARE	41	244	350	54	278	425	62	317	488	62	317	488
AFESC	60+	345+	457	+	+	490+	+	+	+	+	+	+
WES (layered-elastic, 16-kip)	60+	295	305	+	316	336	+	345+	376	+	+	415
WES (layered-elastic, FWD data)	60+	285	292	+	306	324	+	337	363	+	345+	402

(Continued)

* Eighty percent of test points.

** Fifty percent slab cracking for PCC pavement, 0.5-inch rutting for Asphalt Concrete pavement.

† Initial crack for PCC pavement.

†† Allowable load presented as percent of gross in report.

(Sheet 2 of 3)

Table 16 (Concluded)

Procedure	Pass Intensity											
	Level I			Level II			Level III			Level IV		
	F4	C141	B52	F4	C141	B52	F4	C141	B52	F4	C141	B52
					Test Area 5							
Standard evaluation from test-pit data	57	263	198	60+	280	216	+	298	233	+	321	252
Dynatest*	32	A	401	36	A	437	39	139	477	42	152	490+
ERES**	30	177	<175	37	200	<175	42	250	187	54	>345	265
PCS†	40	210	195	50	235	220	55	260	240	60	290	270
Brandley††	41	86	181	60	135	308	60	231	490	60	345	490
Berger	52	241	190	60+	273	215	+	295	230	+	325	250
ARE	51	271	385	62	317	467	62	317	488	62	317	488
AFESC	28	267	184	31	288	202	34	318	223	37	345+	241
WES (DSM)	60+	345+	315	+	+	348	+	+	386	+	+	430
WES (layered-elastic, 16 kip)	60+	245	217	+	269	248	+	309	295	+	345	357
WES (layered-elastic, FWD data)	60+	215	190	+	235	217	+	270	259	+	325	313

† Initial crack for PCC pavement.
†† Allowable load presented as percent of gross in report.

(Sheet 3 of 3)

Table 17

Comparison of Overlay Thickness, in.

Procedure	Aircraft	Test Area 1				Test Area 2				Test Area 3				Test Area 4				Test Area 5			
		AC	PCC*	PCC**	PCC†	AC	PCC*	PCC**	PCC†	AC	PCC*	PCC**	PCC†	AC	PCC*	PCC**	PCC†	AC	PCC*	PCC**	PCC†
Standard	KC10A	0	0	0		0	0	0		0		0		0		0		1.8	1.9	3.9	
	E-4	0	0	0		0		0		0		0		0		0		4.5	3.9	6.4	
Dynatest	KC10A	0				0				5.60				1.90				18.0††			
	E-4	0				0				6.40				2.93				21.0††			
ERES	KC10A	0	0			0				5.25-6.0				5.5				5.9	1.2	4.8	
	E-4	2.7	0			0				7.75-9.0				11.3				13.7	5.8	10.7	
PCS‡	KC10A	0				1.8				31.1‡‡				7.3				0			
	E-4	0				3.7				26.1‡‡				0				0			
Brandley	KC10A	0			0	0			0	0			0	8			13	6			12
	E-4				0	9			13	20			16	17			14	19			15
ARE	KC10A	0				0				3.0				0				0			
	E-4	0				0				5.7				1.0				0			
Berger	KC10A	0	0	0		0	0	0		2.9				1.5					1.5		
	E-4	0	0	0		0	0	0		3.5				2.5					2.5		
WES DSM Method	KC10A	0	0	0		0				0.6				0				0	0	0	
	E-4	0	0	0		0				2.4				0				0	0	0	
WES layered-elastic (16-kip vibrator)	KC10A	0	0	0		0	0	0		3.3				0.2				0.8	1.1	2.6	
	E-4	0	0	0		0	0	0		3.3				0.7				4.5	3.9	6.4	
WES Layered-elastic (FWD)	KC10A	0	0	0		0	0	0		2.6				0.4				5.0	4.2	6.8	
	E-4	0	0	0		0	0	0		3.2				1.0				9.0	6.5	9.4	

* PCC overlay, bonded.
** PCC overlay, unbonded.
† Recommends a 12-in. minimum PCC overlay for load transfer at joints.
†† Alternative is to break up existing PCC and overlay with 3.3 in. and 4.2 in., respectively.
‡ PCS overlay thicknesses are based upon the use of "weakest layer concept" derived from nondestructive testing studies.
‡‡ The shear of the base layer controlled the overlay and not the subgrade.

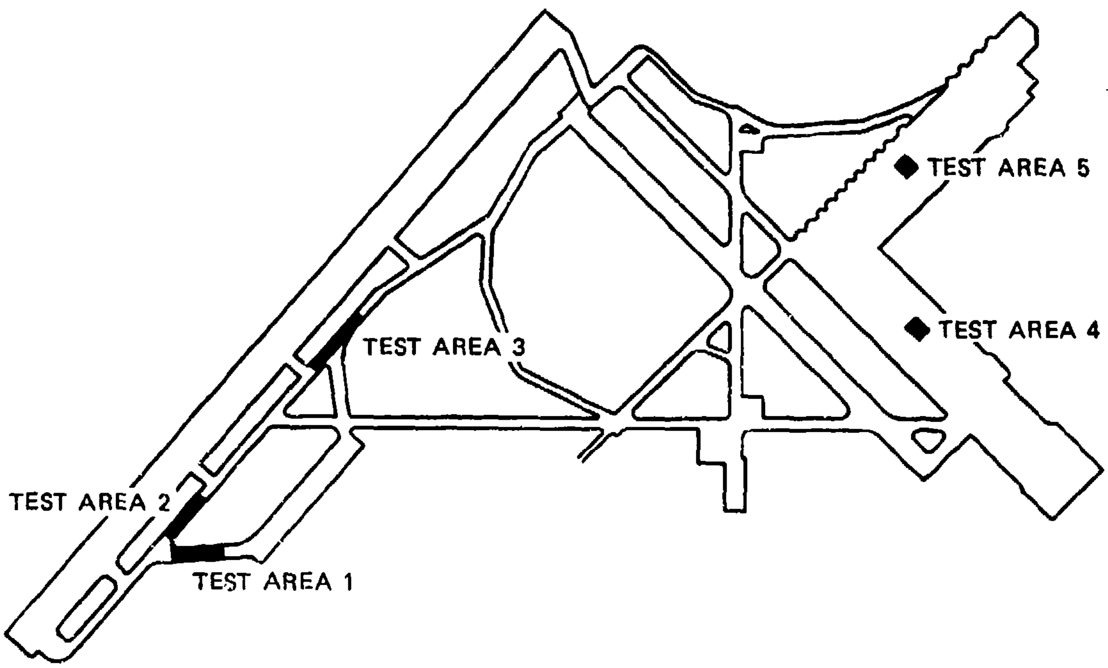

Figure 1. Airfield layout at MacDill AFB showing location of test area

TEST AREA 1								
DEPTH, IN	MATERIAL		ω, %	γ_d, PCF	CE 55		W_p/I_p, %	K, PSI/IN.
	SYMBOL	CLASSIF.			% COMP	OMC		
		PCC						
21.5		SP-SM	23.9	98.3	88.1	11.5	NP	230
33.0		SP-SM	16.7			12.1	NP	
48.0			21.8					

TEST AREA 2								
DEPTH, IN.	MATERIAL		ω, %	γ_d, PCF	CE 55		W_p/I_p, %	CBR, %
	SYMBOL	CLASSIF.			% COMP	OMC		
		AC						
10.0		LIME ROCK	11.0	106.4	90.5	11.3	NP	30
21.0		LR	8.1	103.1	87.7	11.3	NP	6
26.0		SP	6.7	105.4	100.2	12.1	NP	35
36.0			6.0					
48.0			10.5					

TEST AREA 3								
DEPTH, IN	MATERIAL		ω, %	γ_d, PCF	CE 55		W_p/I_p, %	CBR, %
	SYMBOL	CLASSIF.			% COMP	OMC		
		AC						
5.0 / 13.5		LIME POCK	10.4	114.1	97.1	11.3	NP	10
		SP-SM	9.1	107.3	96.1	11.5	NP	26
19.0		SP	10.8	97.0	92.2	12.1	NP	30
24.0			9.4					
36.0			4.7					
48.0			14.6					

TEST AREA 4								
DEPTH, IN	MATERIAL		ω, %	γ_d, PCF	CE 55		W_p/I_p, %	K, PSI/IN.
	SYMBOL	CLASSIF.			% COMP	OMC		
		AC						
7.5		PCC						
14.0		SP	9.0	101.4	98.4	12.1	NP	85
24.0			7.1					
36.0			9.4					
48.0			12.8					

TEST AREA 5								
DEPTH, IN	MATERIAL		ω, %	γ_d, PCF	CE 55		W_p/I_p, %	
	SYMBOL	CLASSIF			% COMP	OMC		
		PCC						K, PSI/IN.
10.5		SP	11.7	109.8	104.4	12.1	NP	80
24.0			9.3					
36.0			6.9					
48.0			18.9					

LEGEND

K	=	SUBGRADE MODULUS, PCI
CBR	=	CALIFORNIA BEARING RATIO, PERCENT
OMC	=	OPTIMUM MOISTURE CONTENT, PERCENT
% COMP	=	FIELD DENSITY AS PERCENT OF LABORATORY DENSITY
ω	=	IN-PLACE MOISTURE CONTENT, PERCENT
γ_d	=	IN-PLACE DENSITY, PCF

Figure 2. Test-pit data for each test area as presented by AFESC

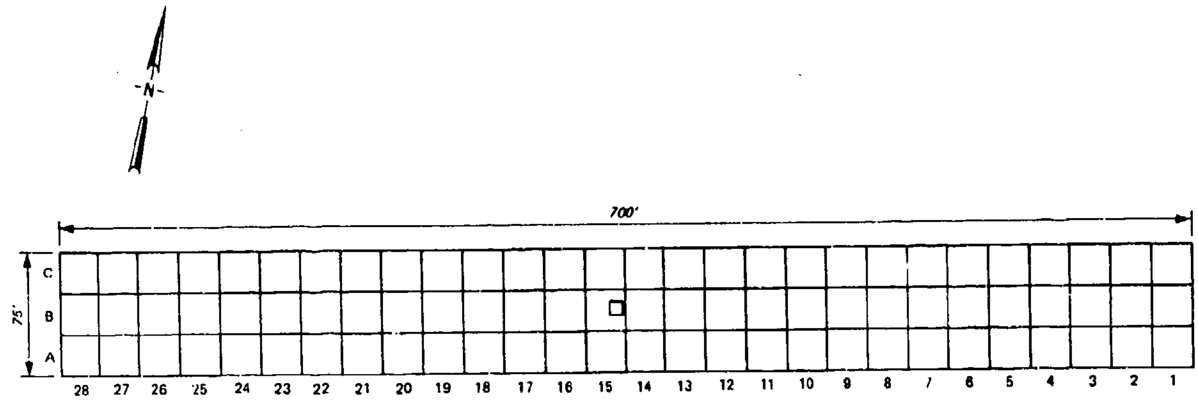

Figure 3. Layout of Test Area 1

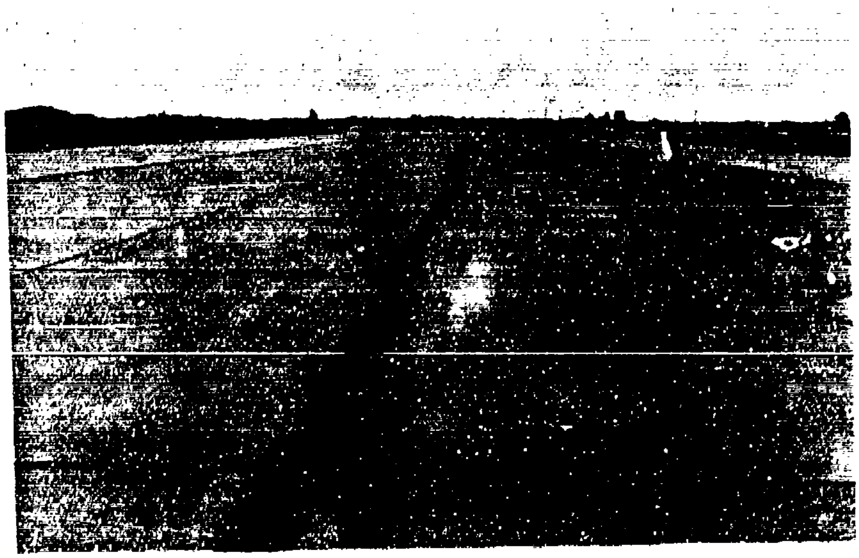

Figure 4. Test Area 1

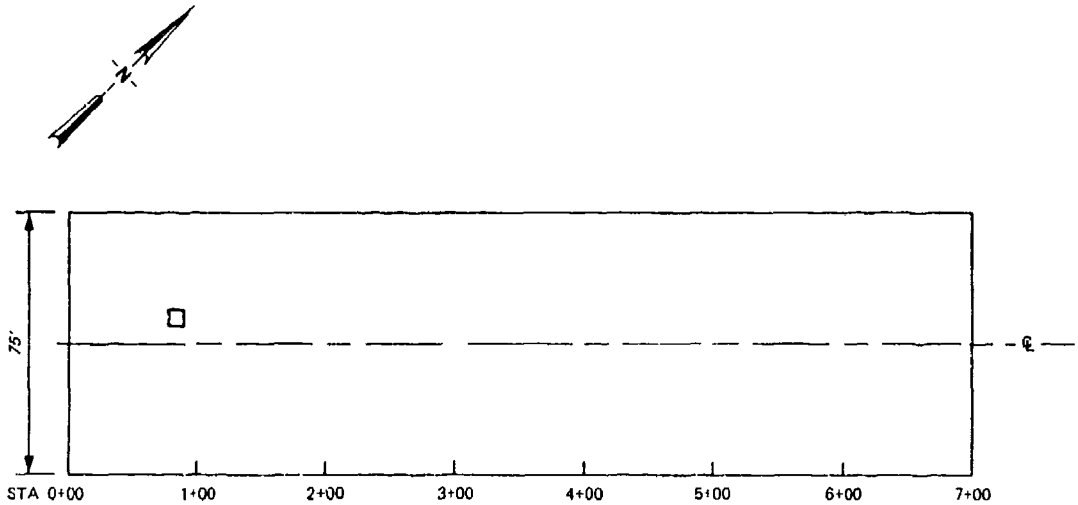

Figure 5. Layout of Test Area 2

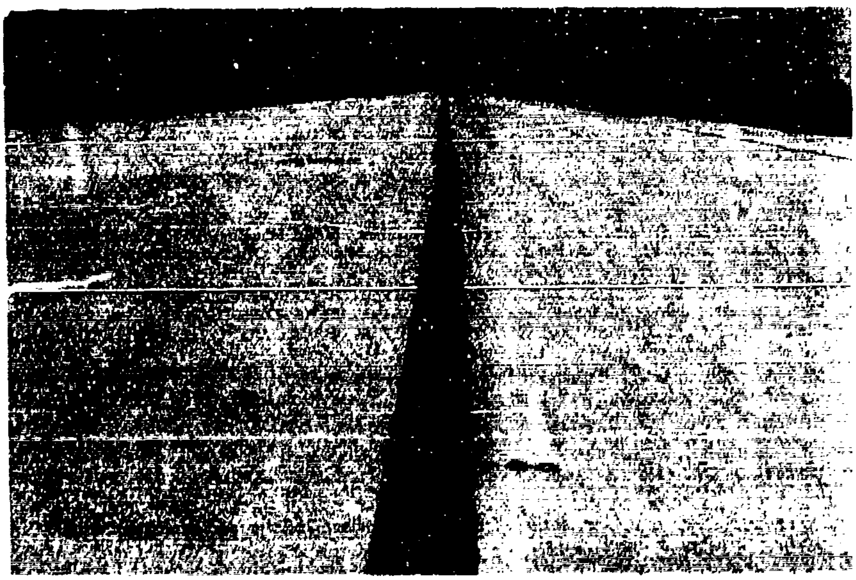

Figure 6. Test Area 2

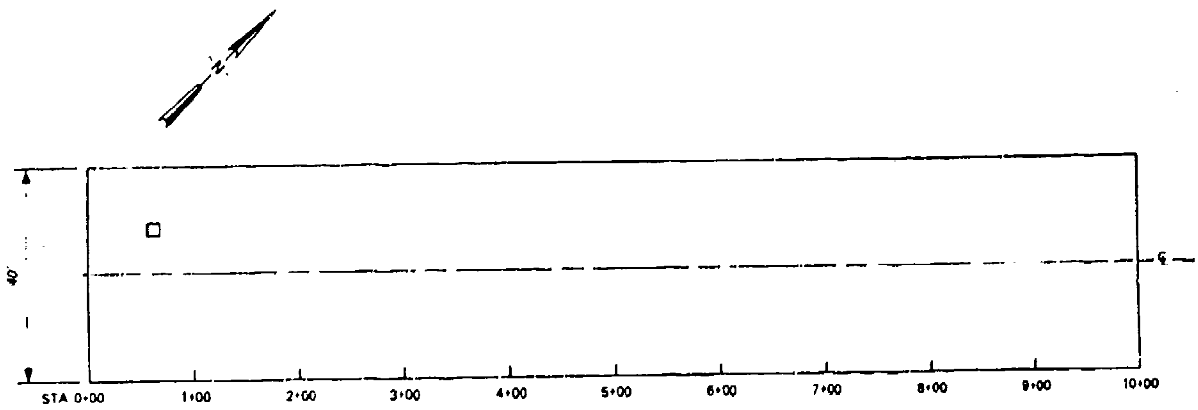

Figure 7. Layout of Test Area 3

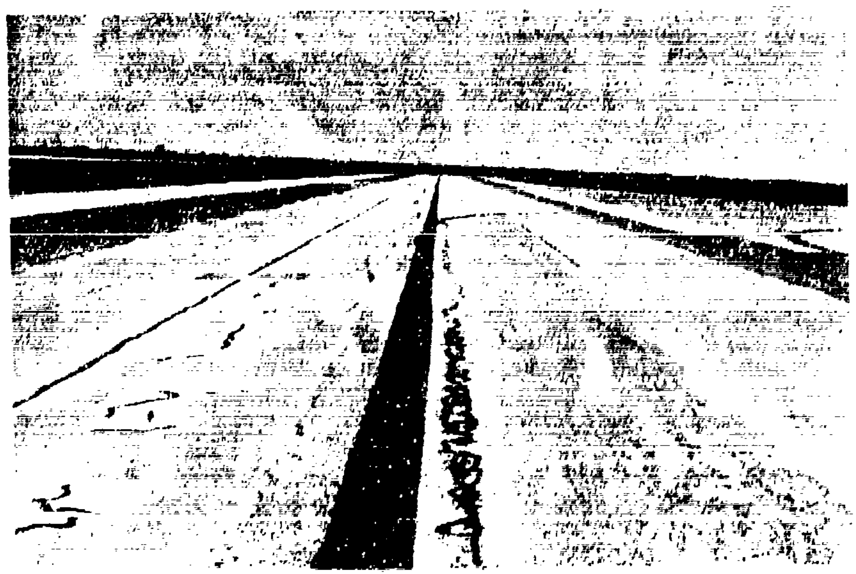

Figure 8. Test Area 3

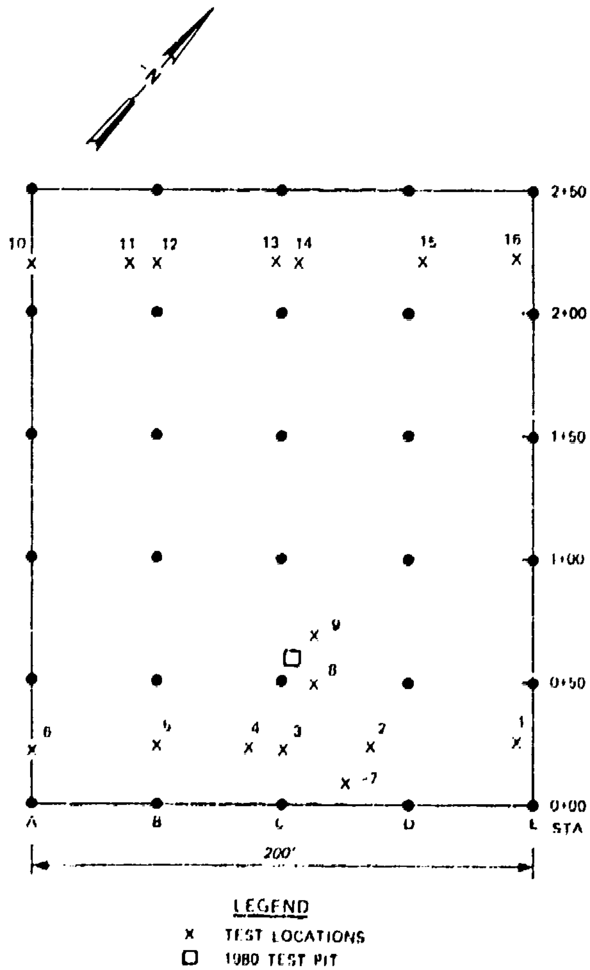

Figure 9. Layout of Test Area 4

Figure 10. Test Area 4

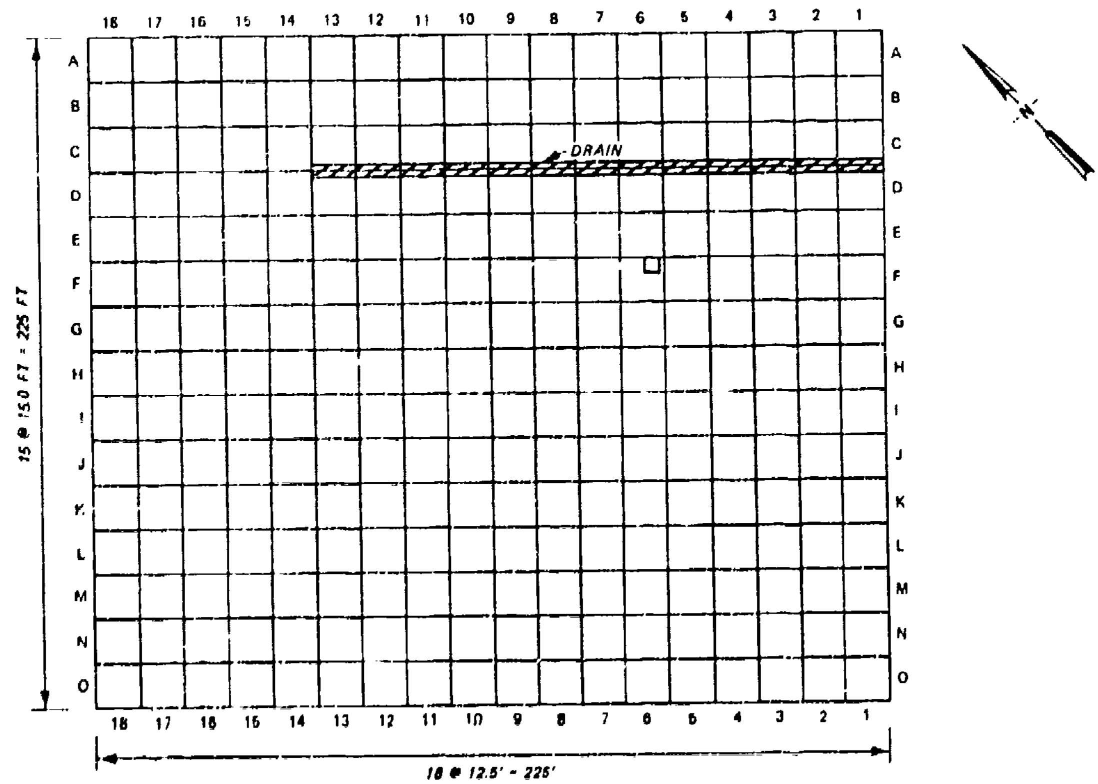

Figure 11. Layout of Test Area 5

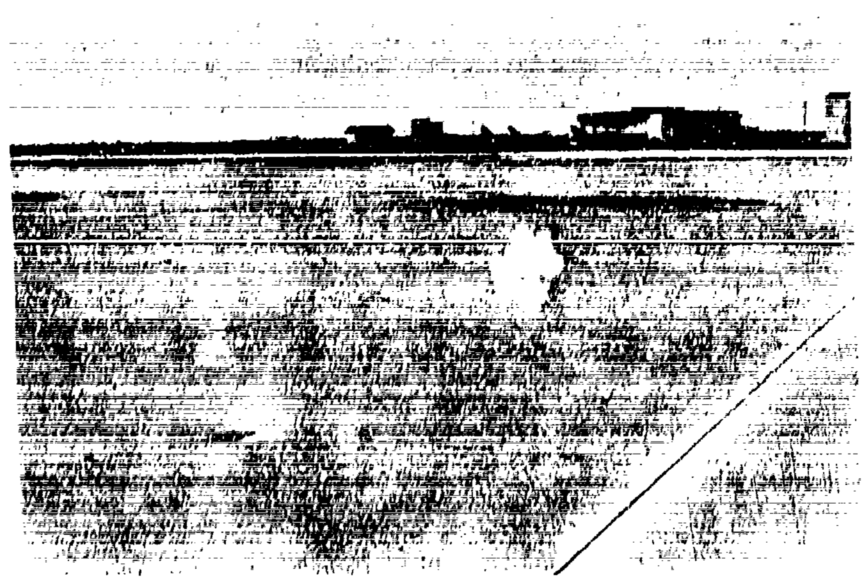

Figure 12. Test Area 5

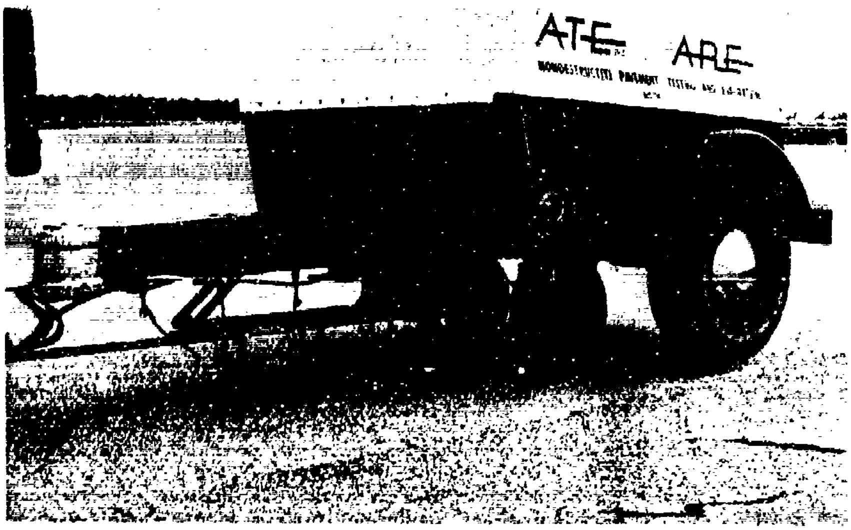

Figure 13. Dynaflect used by ARE, Inc.

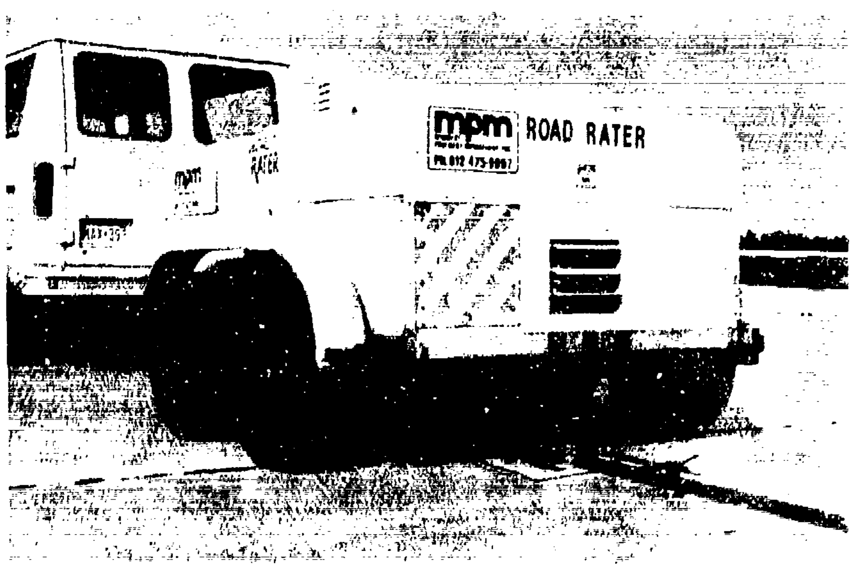

Figure 14. Road-Rater Model 2000 used by Berger

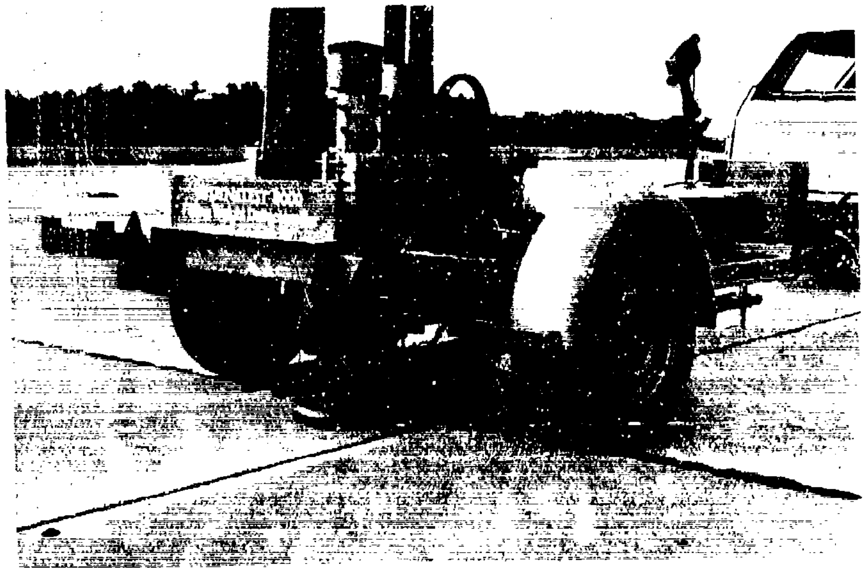

Figure 15. Dynatest Model 8000 FWD

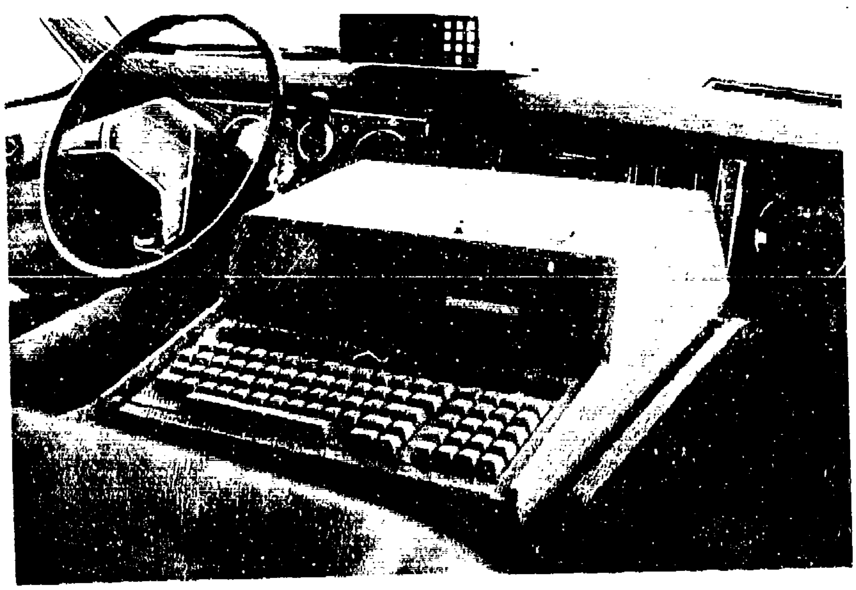

Figure 16. HP-85 computer used with Dynatest Model 8000 FWD

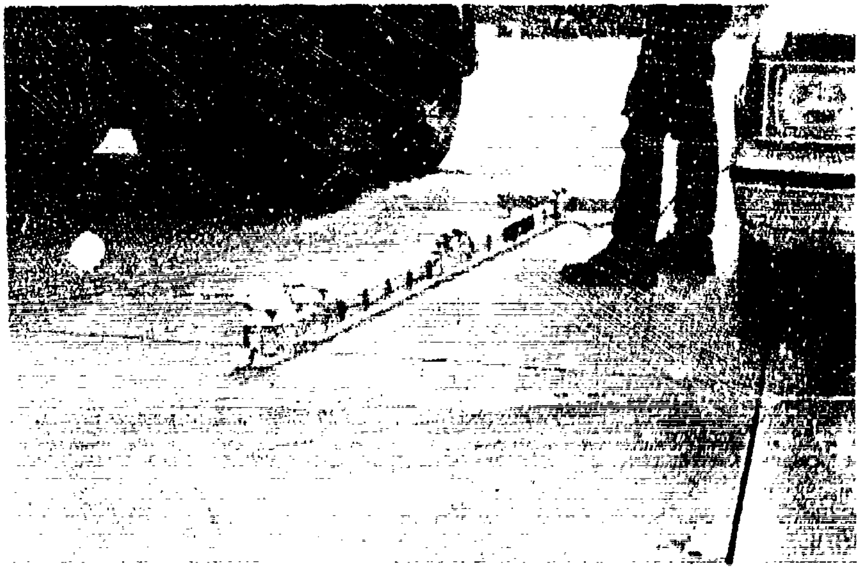

Figure 17. Brandley Cantilever Deflection Beam

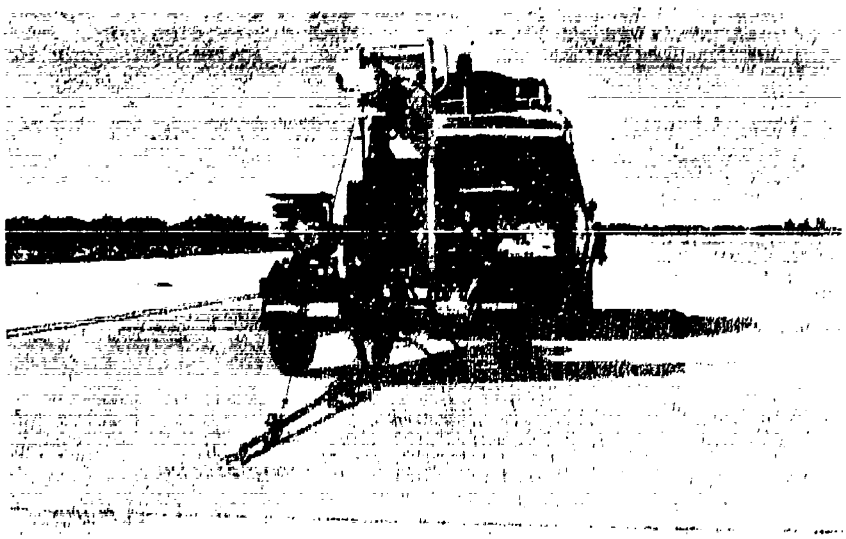

Figure 18. PCS FWD

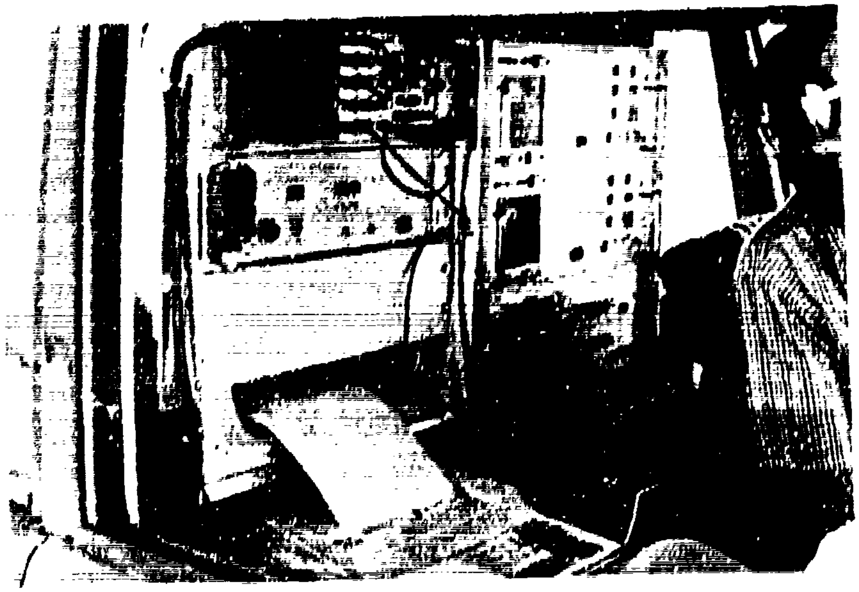

Figure 19. Data recording equipment used by PCS

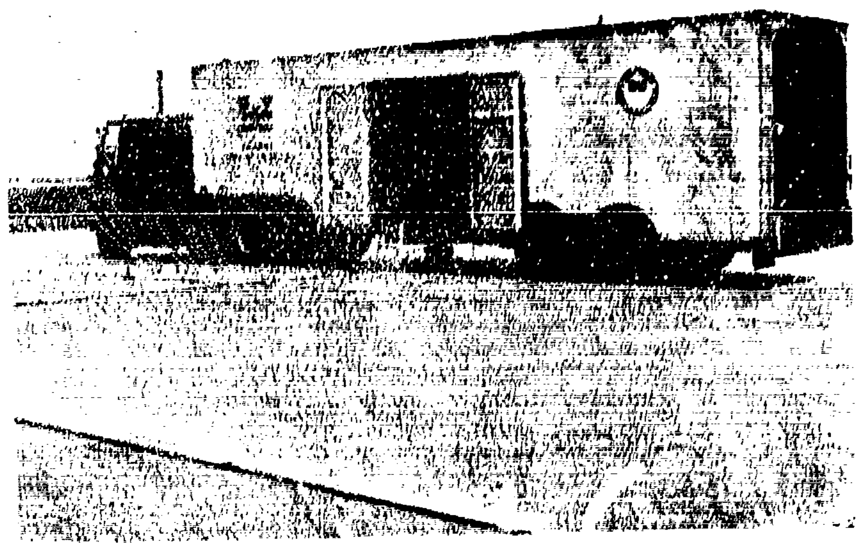

Figure 20. WES 16-kip vibrator

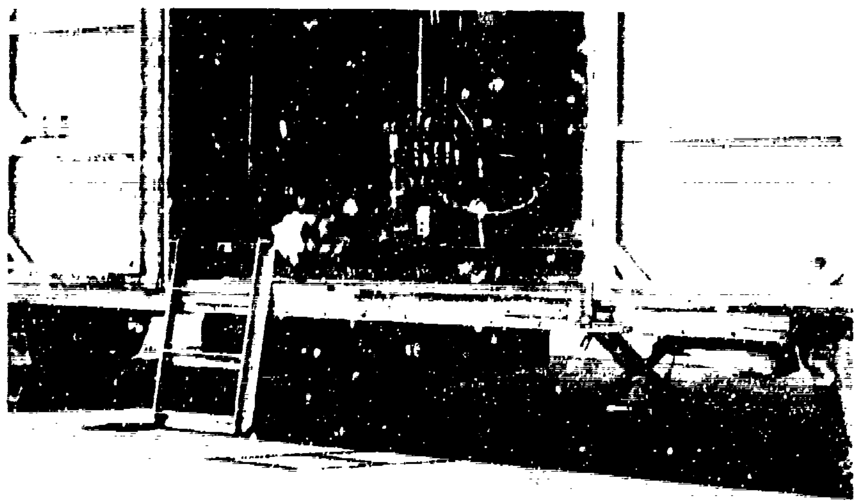

Figure 21. Load plate of WES 16-kip vibrator

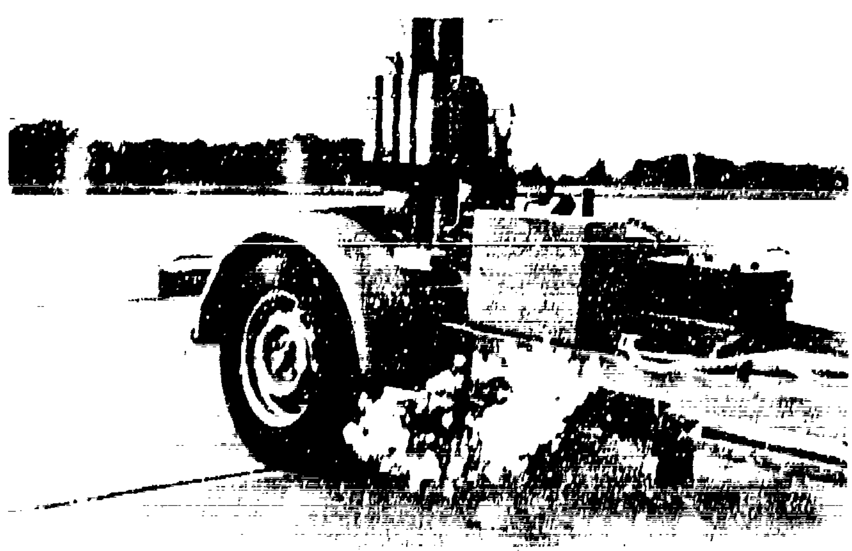

Figure 22. WES FWD (manufactured by Dynatest)

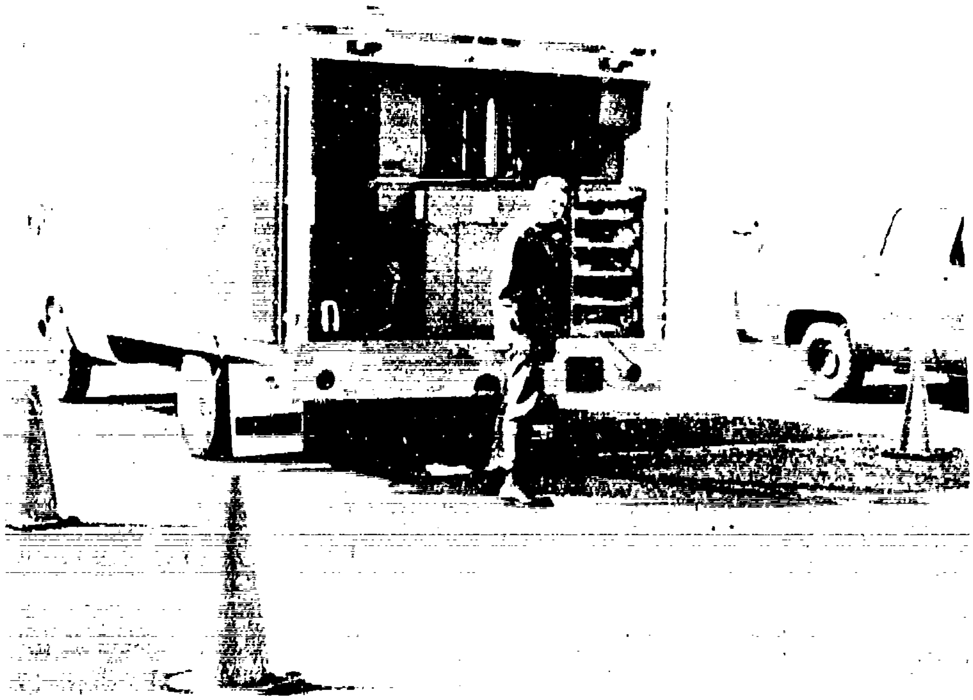

Figure 23. AFESC NDPT van

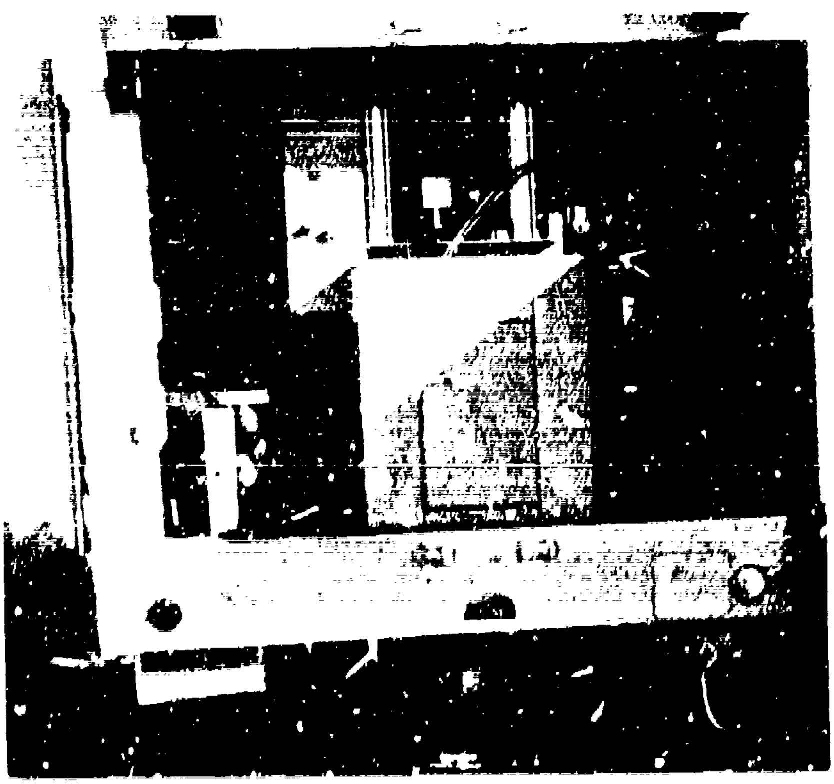

Figure 24. Load plate and impact hammer of AFESC NDPT device

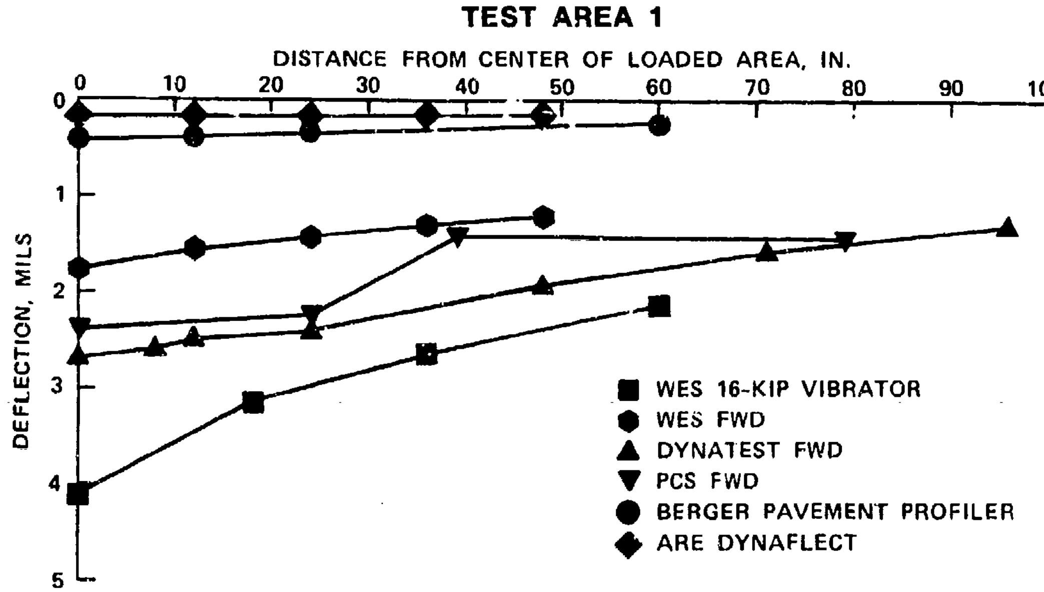

Figure 25. Comparison of measured deflector basins for Test Area 1

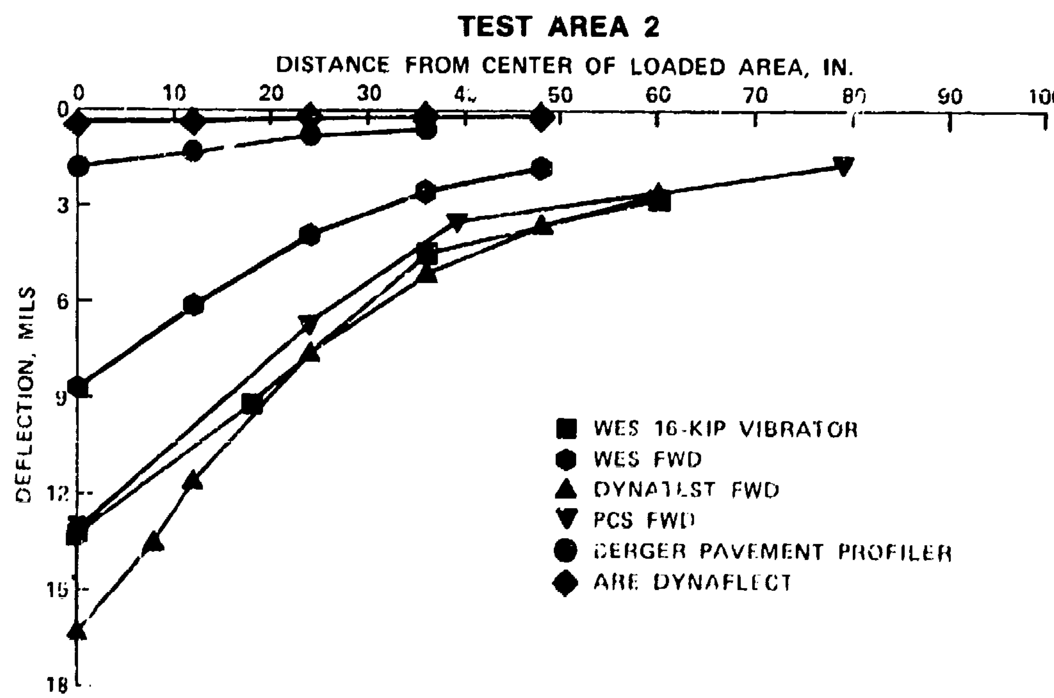

Figure 26. Comparison of measured deflector basins for Test Area 2

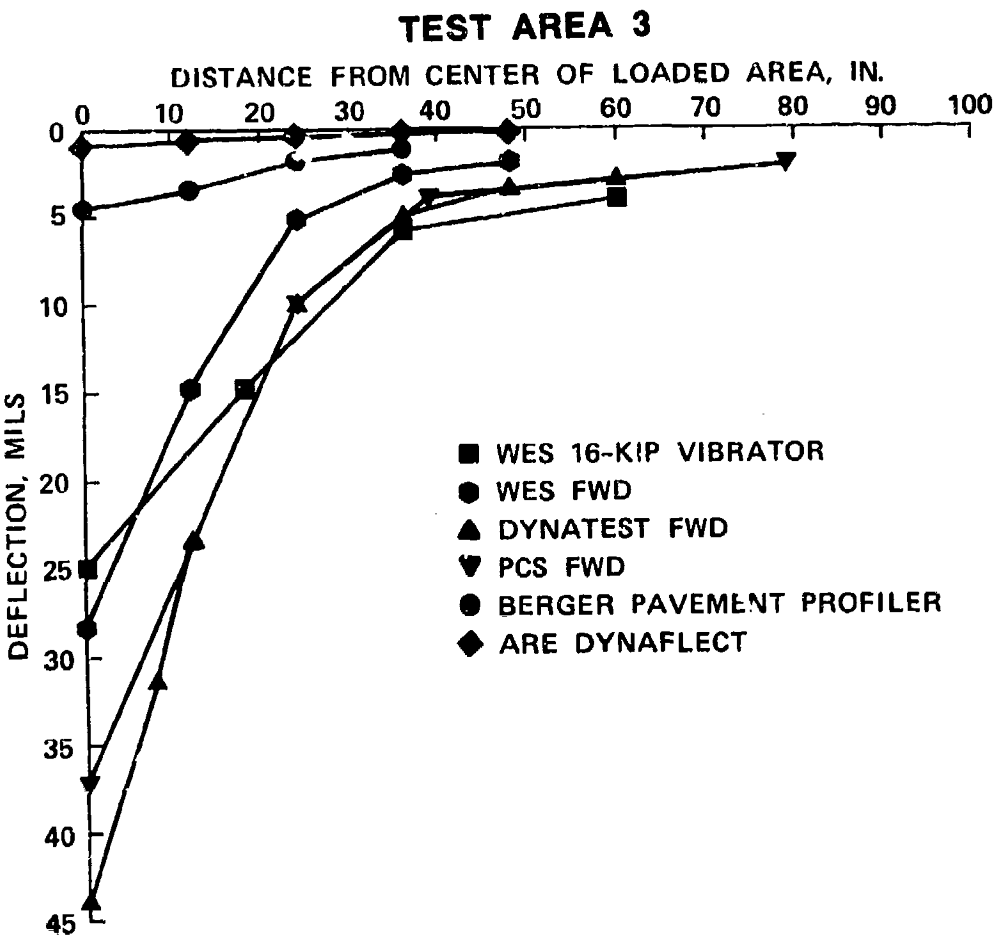

Figure 27. Comparison of measured deflector basins for Test Area 3

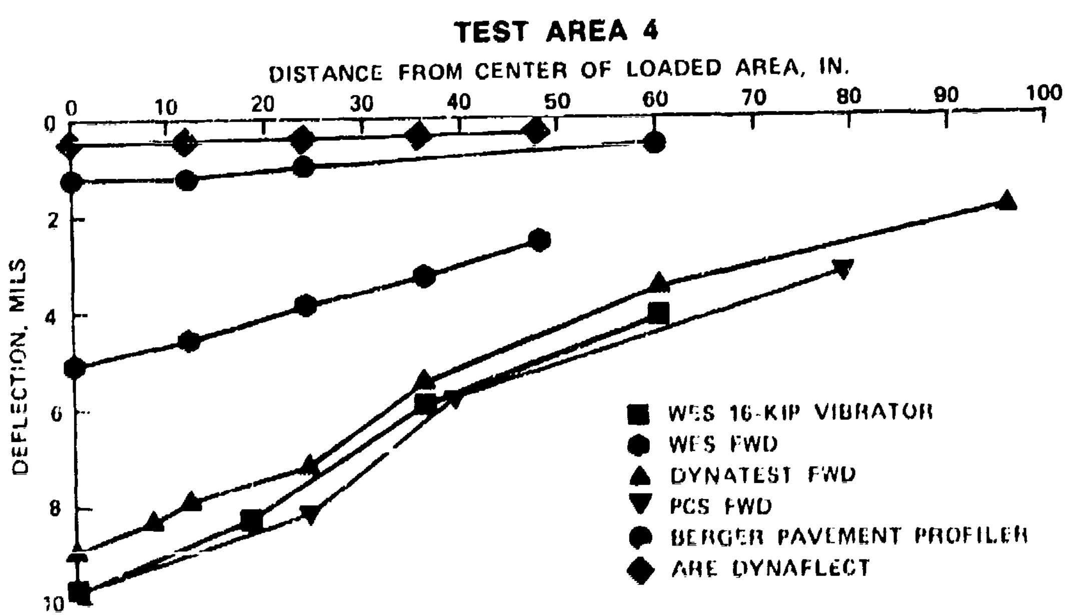

Figure 28. Comparison of measured deflector basins for Test Area 4

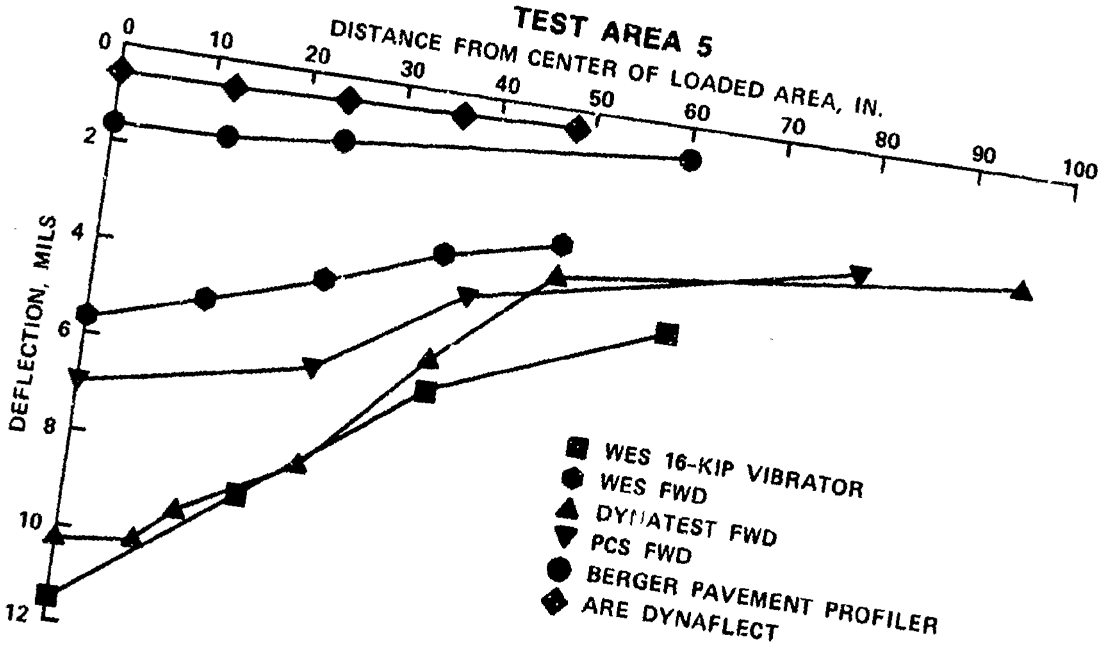

Figure 29. Comparison of measured deflector basins for Test Area 5

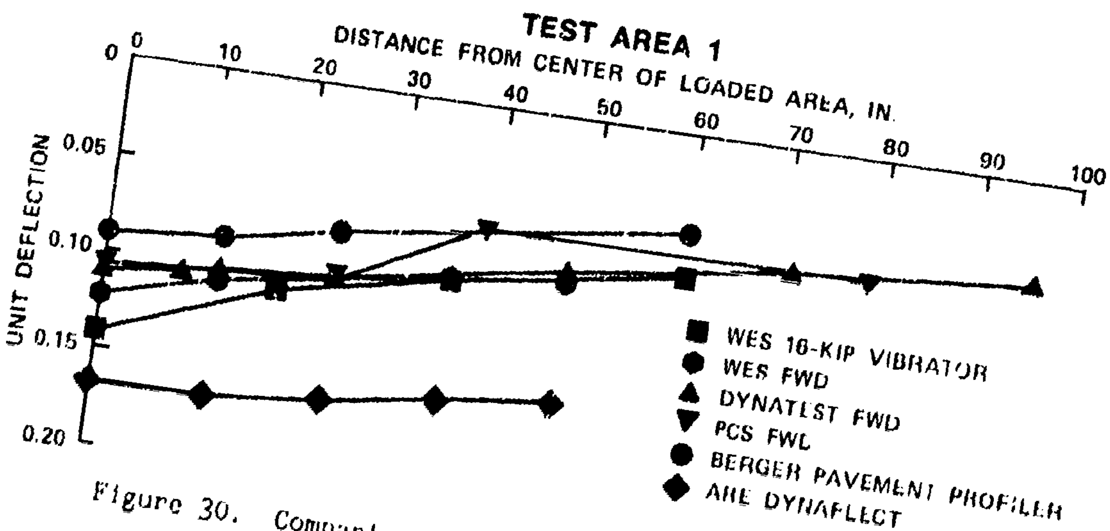

Figure 30. Comparison of normalized deflector basins for Test Area 1

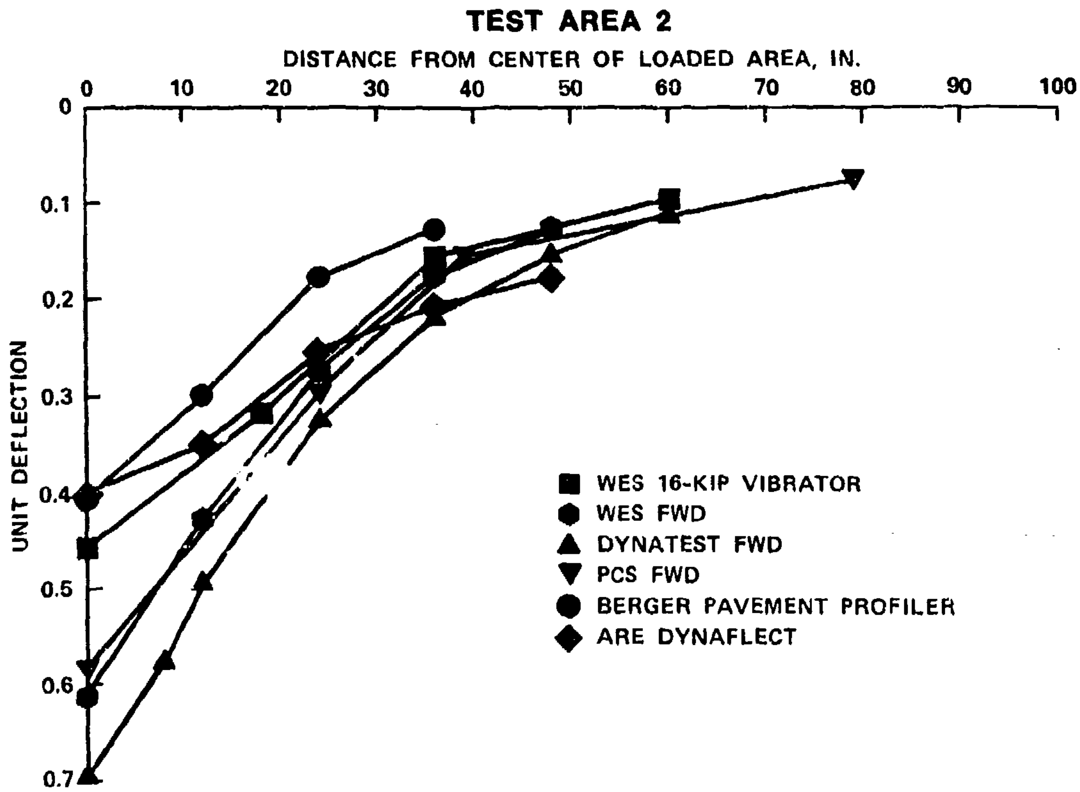

Figure 31. Comparison of normalized deflection basins for Test Area 2

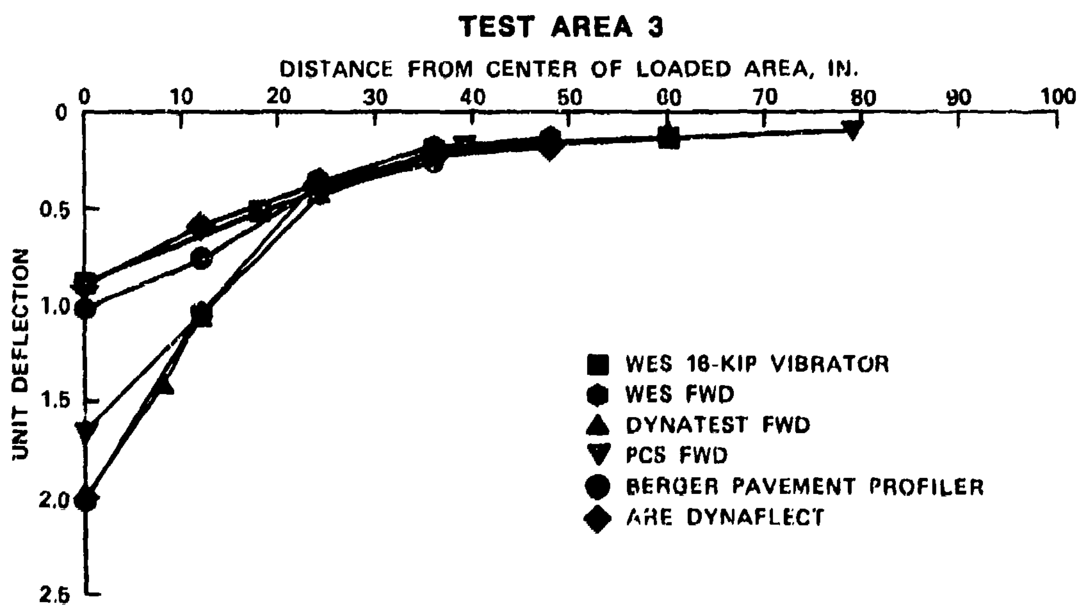

Figure 32. Comparison of normalized deflection basins for Test Area 3

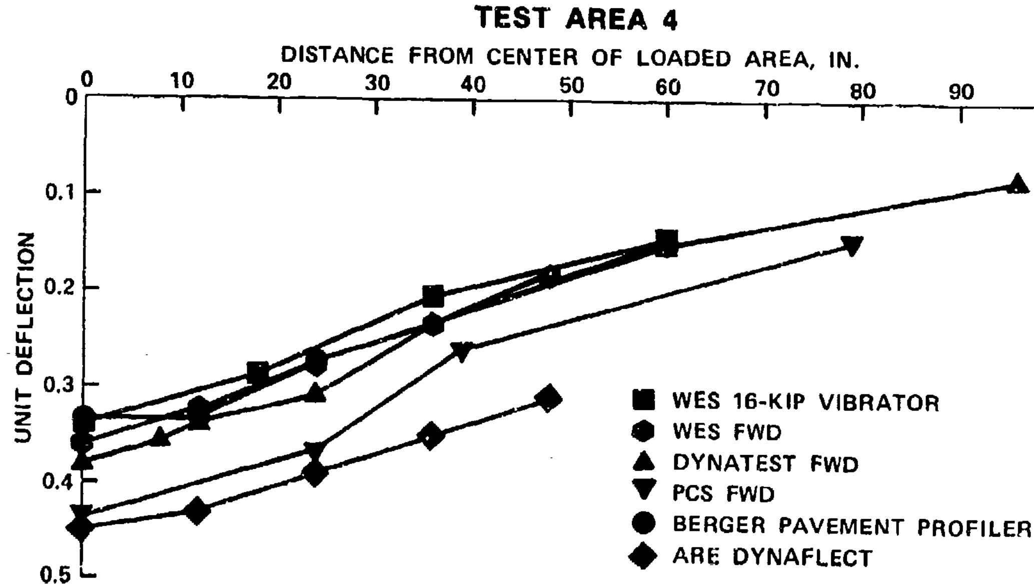

Figure 33. Comparison of normalized deflection basins for Test Area 4

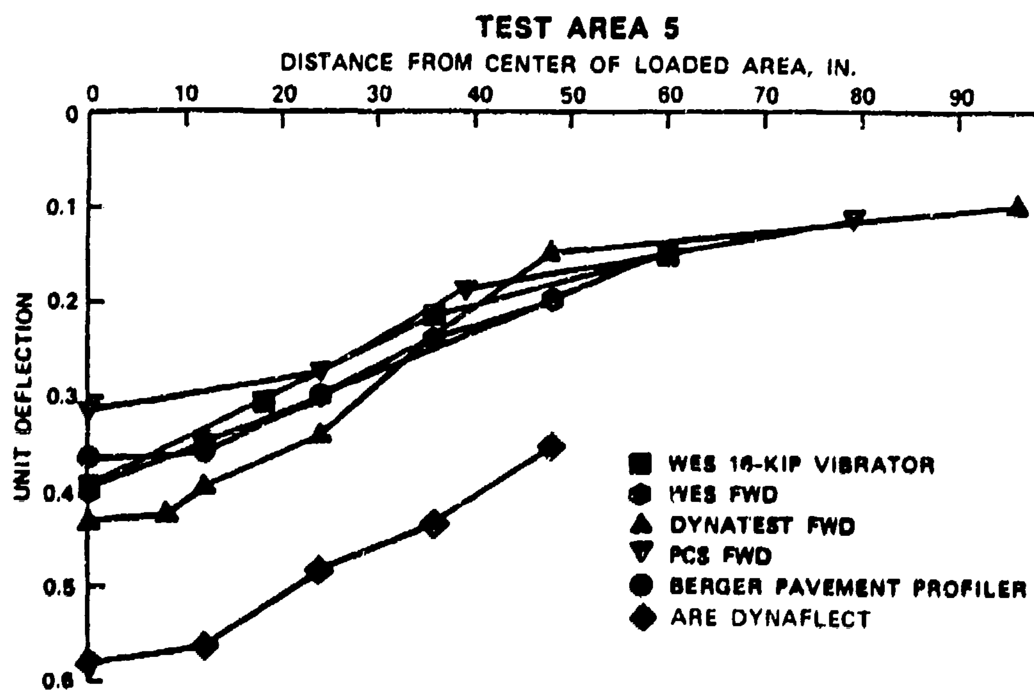

Figure 34. Comparison of normalized deflection basins for Test Area 5

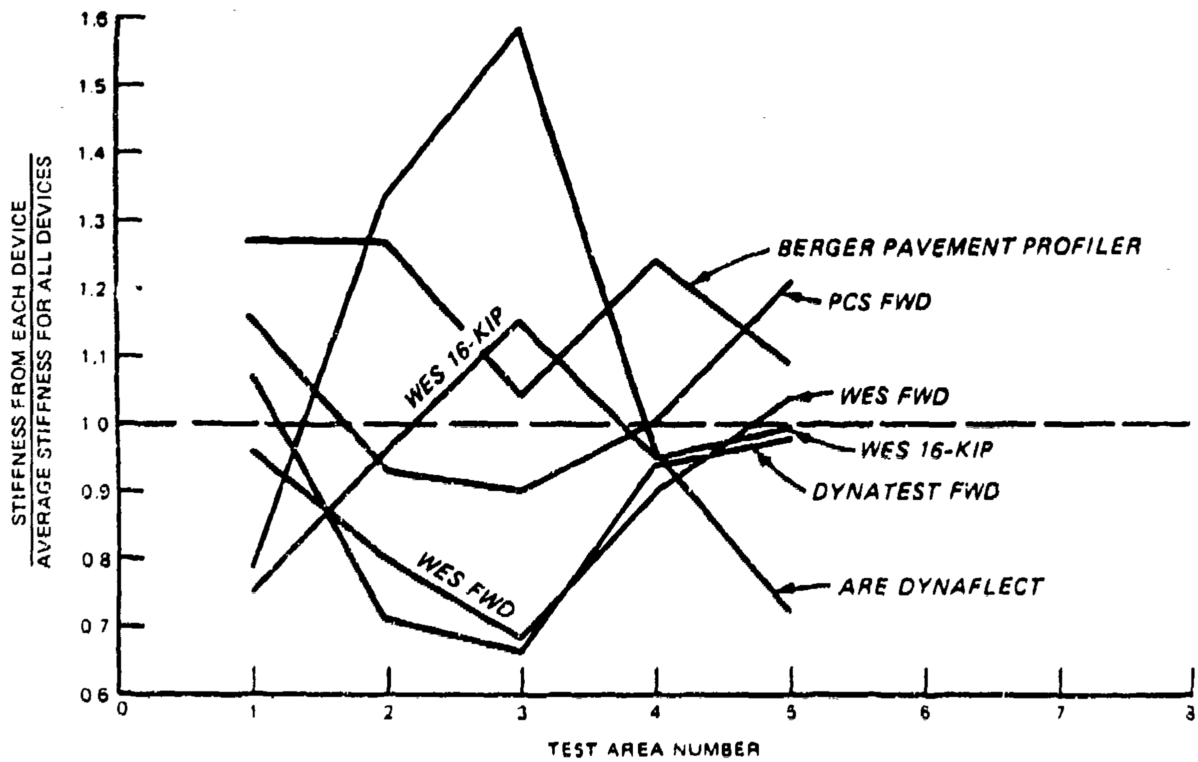

Figure 35. Comparison of stiffness measurements

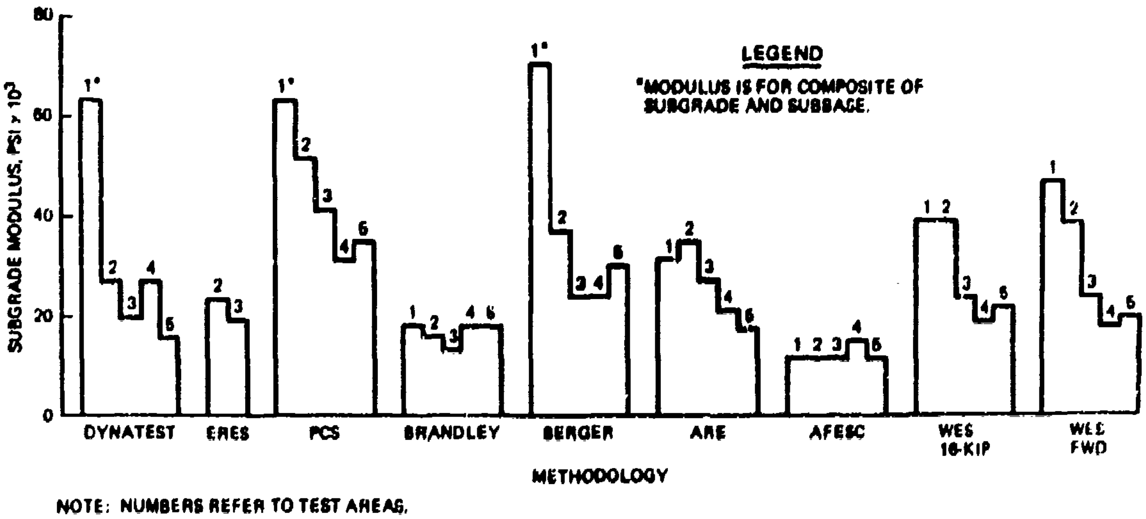

Figure 36. Presentation of predicted subgrade moduli

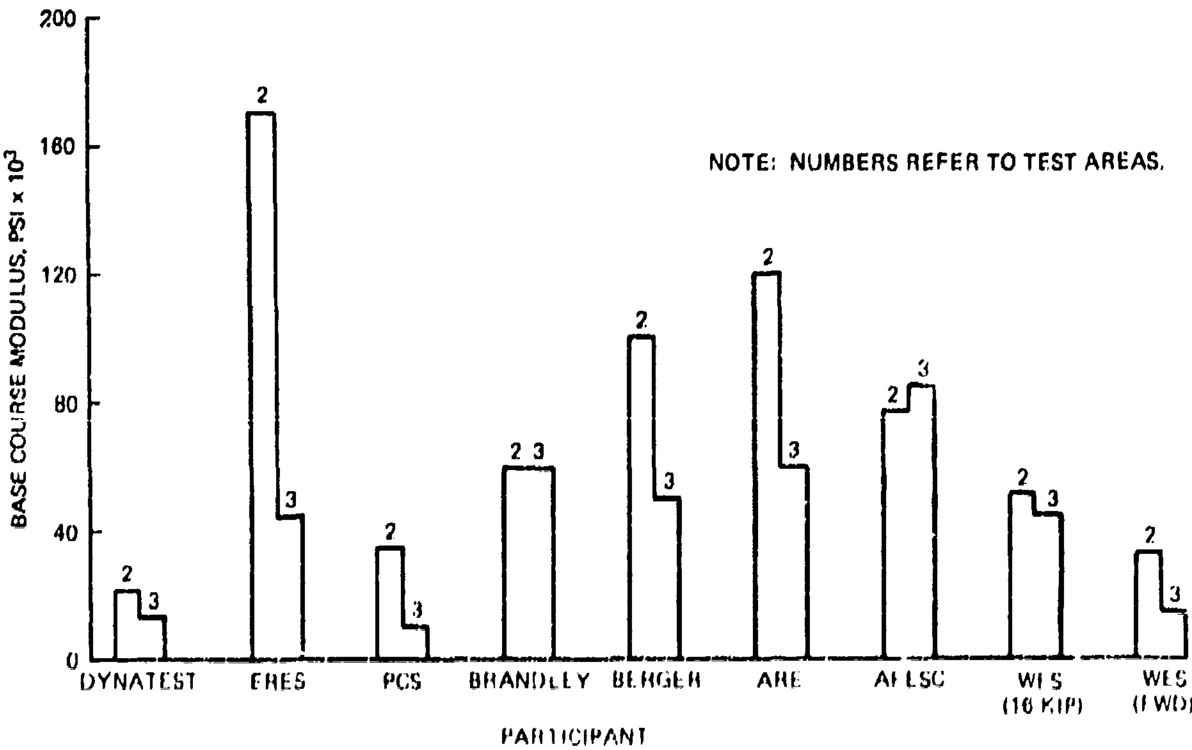

Figure 37. Presentation of predicted base course moduli

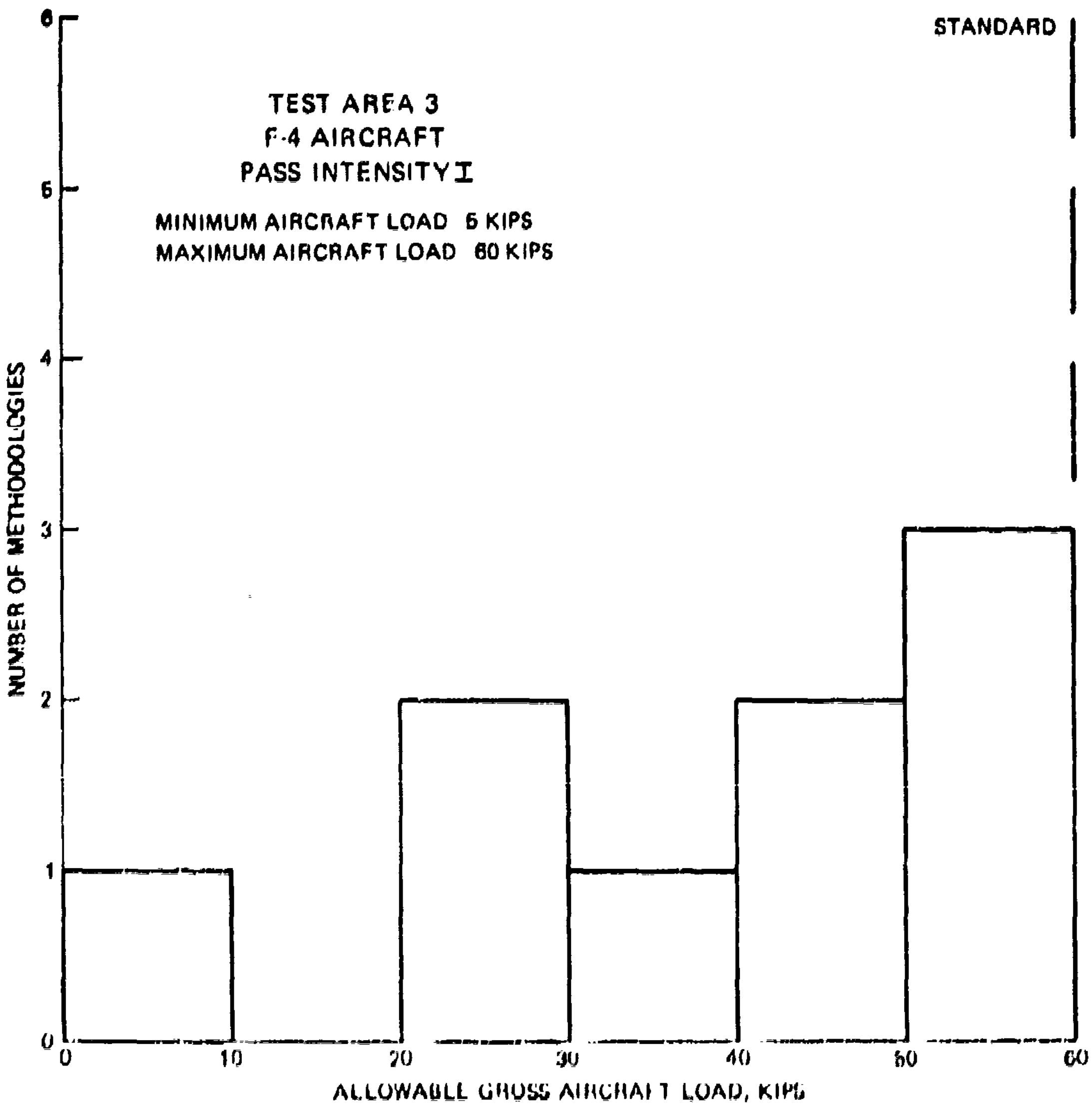

Figure 38. Comparison of predicted loads, Test Area 3, F-4 aircraft

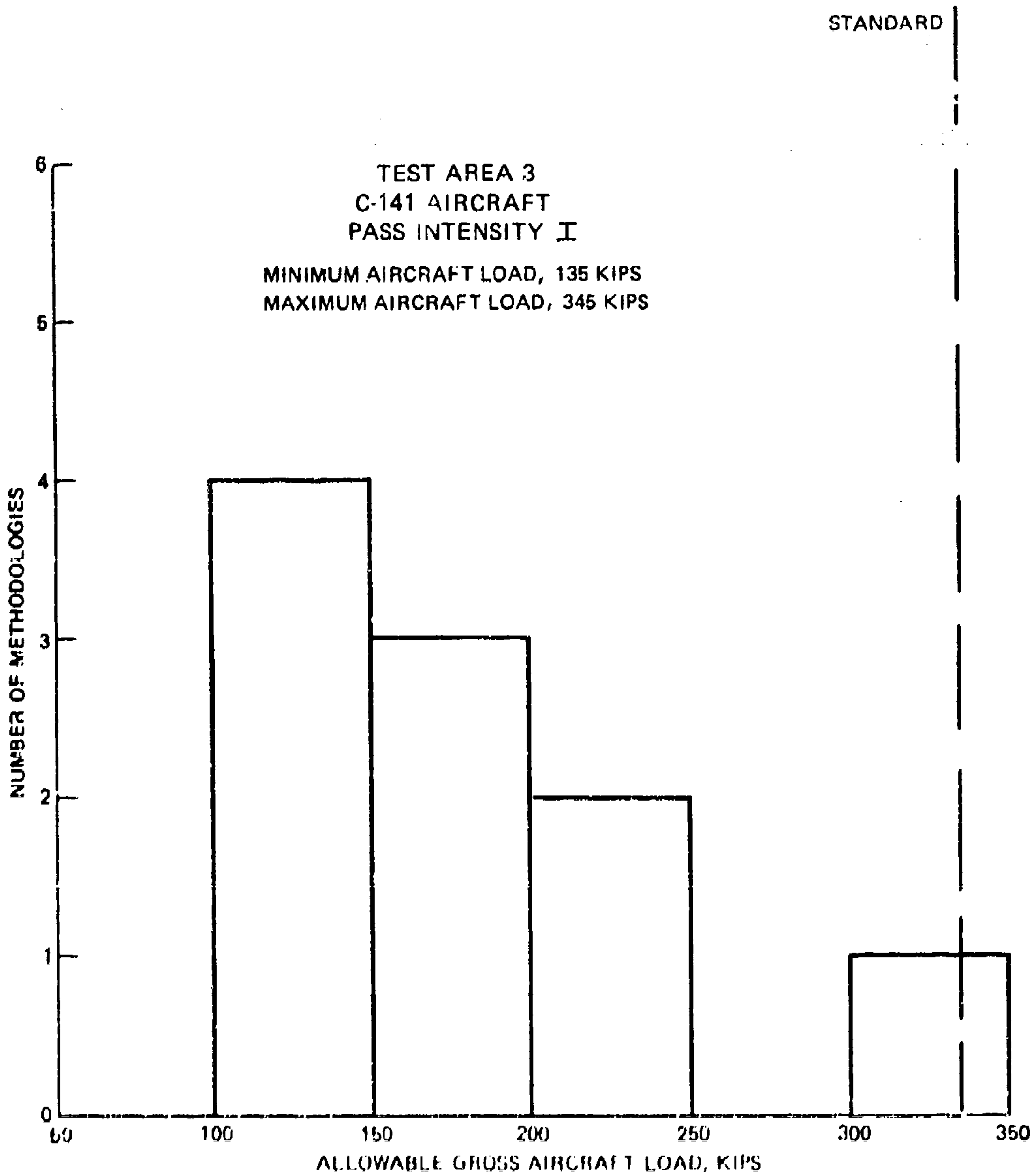

Figure 39. Comparison of predicted loads, Test Area 3, C-141 aircraft

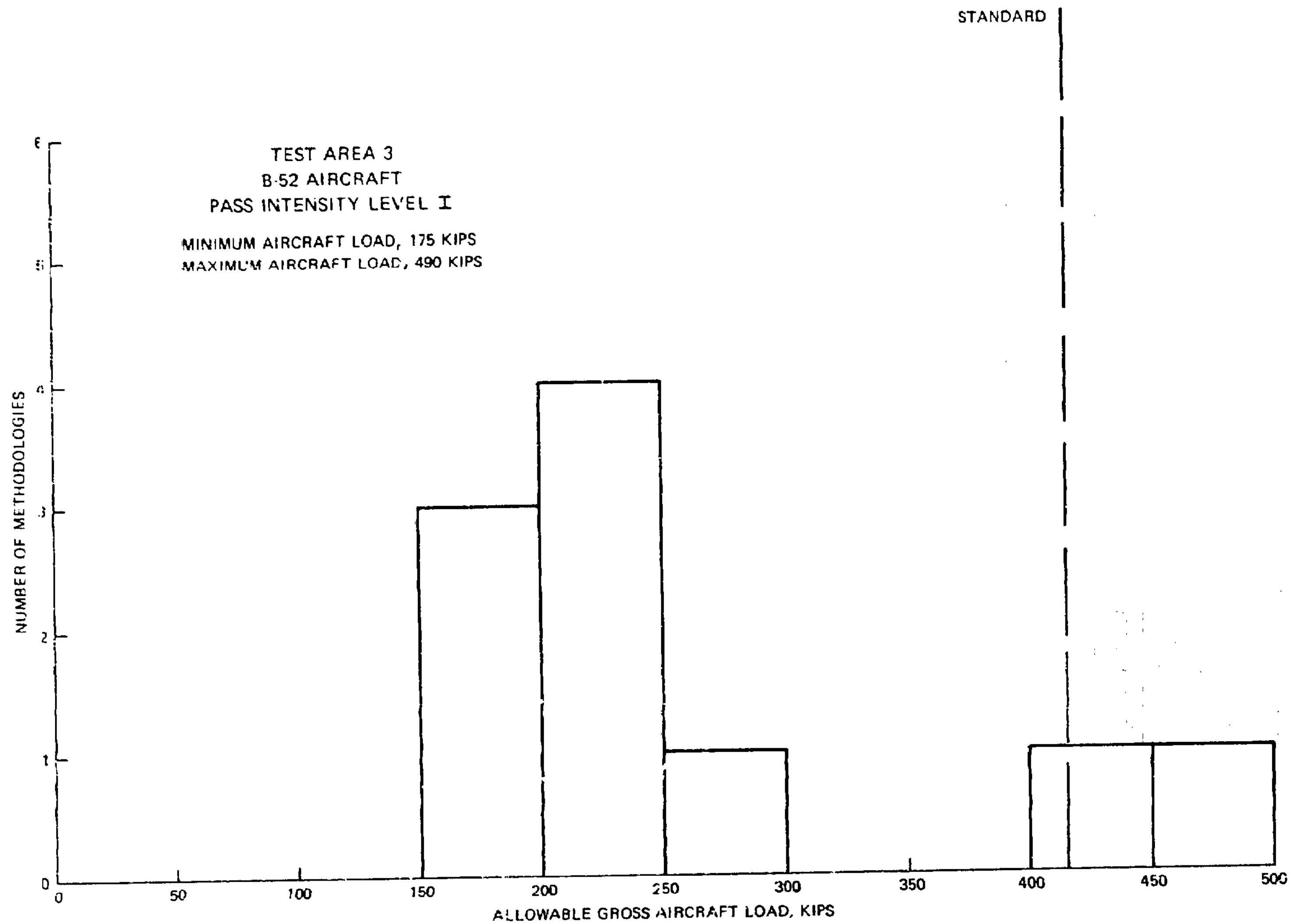

Figure 40. Comparison of predicted loads, Test Area 3, B-52 aircraft

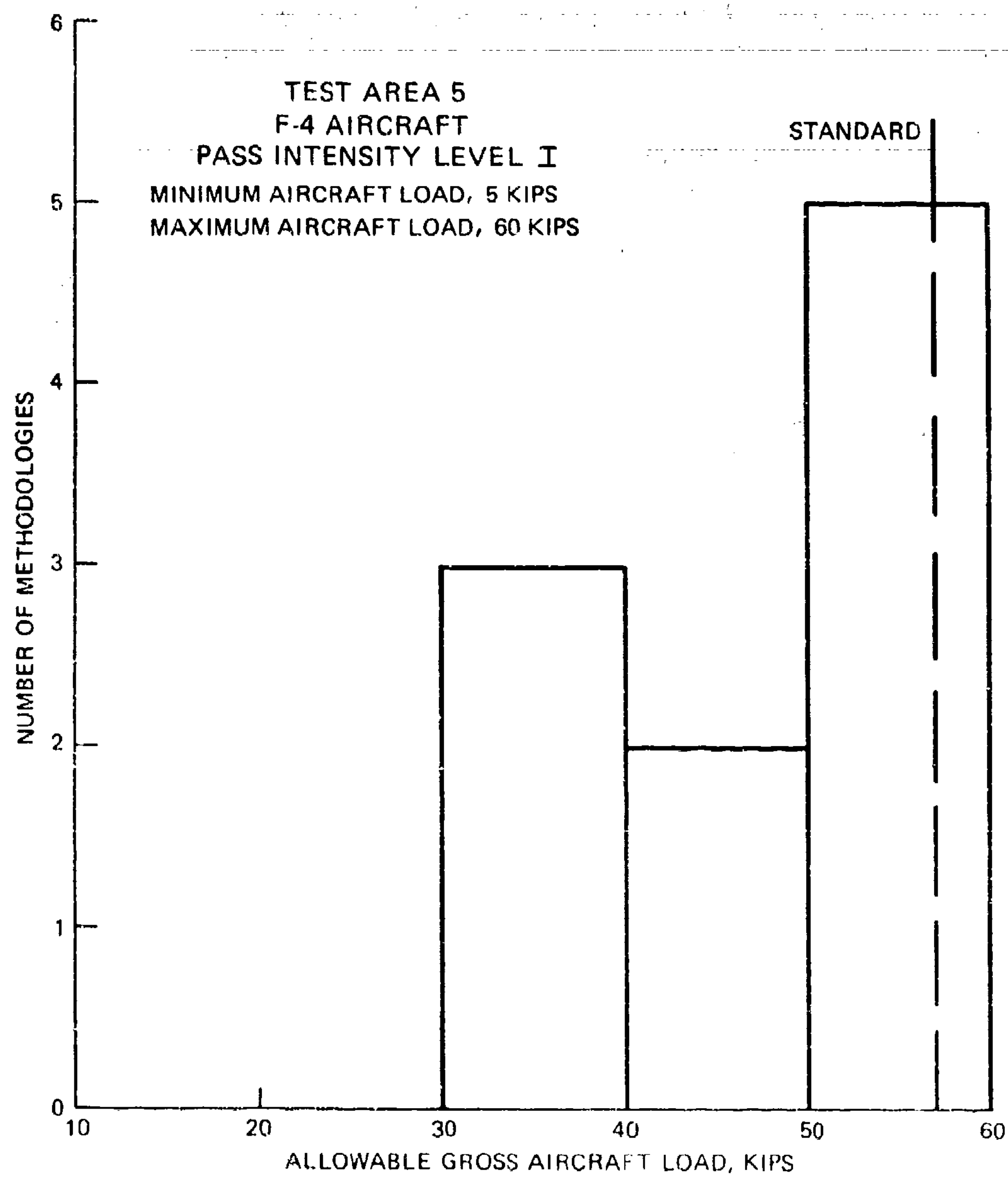

Figure 41. Comparison of predicted loads,
Test Area 5, F-4 aircraft

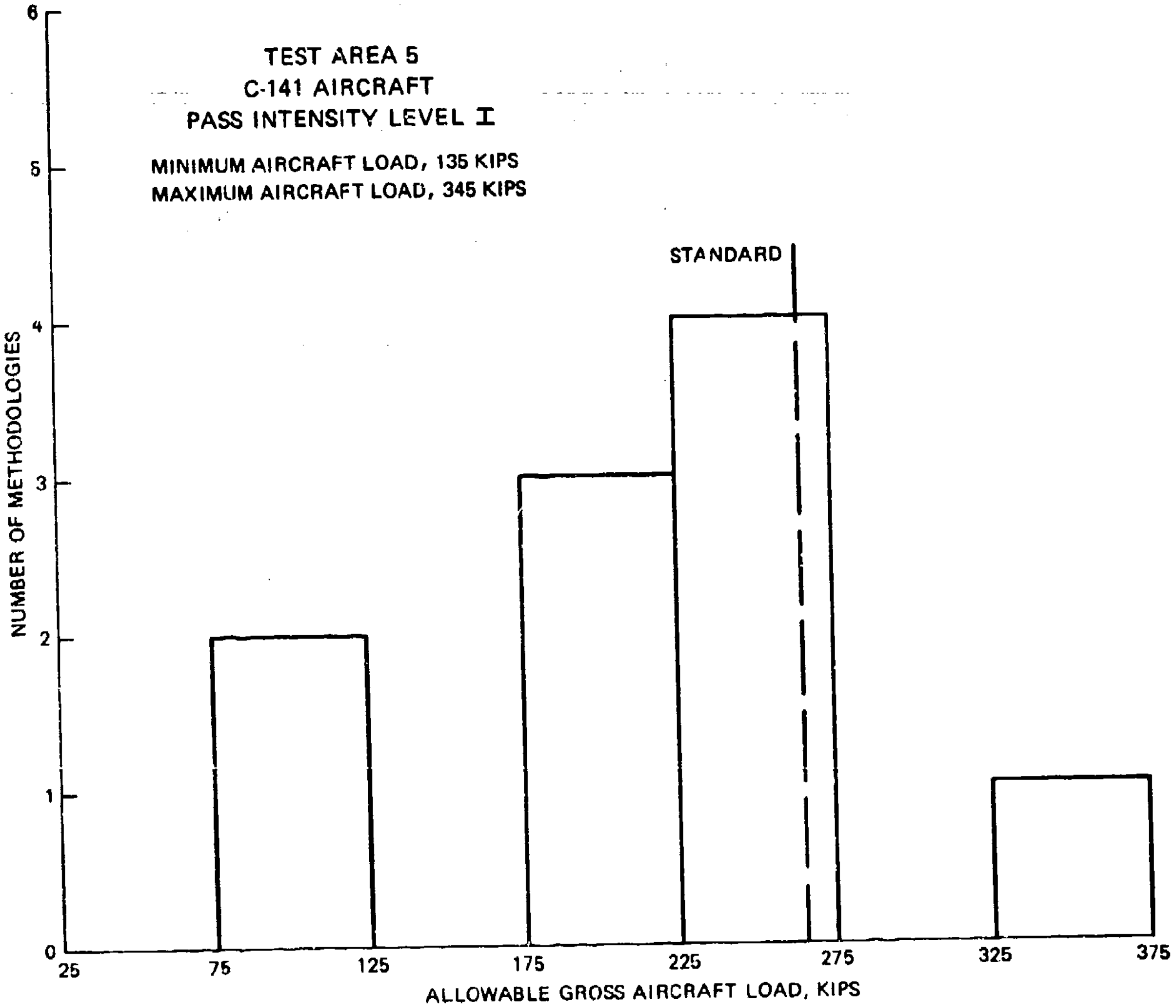

Figure 42. Comparison of predicted loads,
Test Area 5, C-141 aircraft

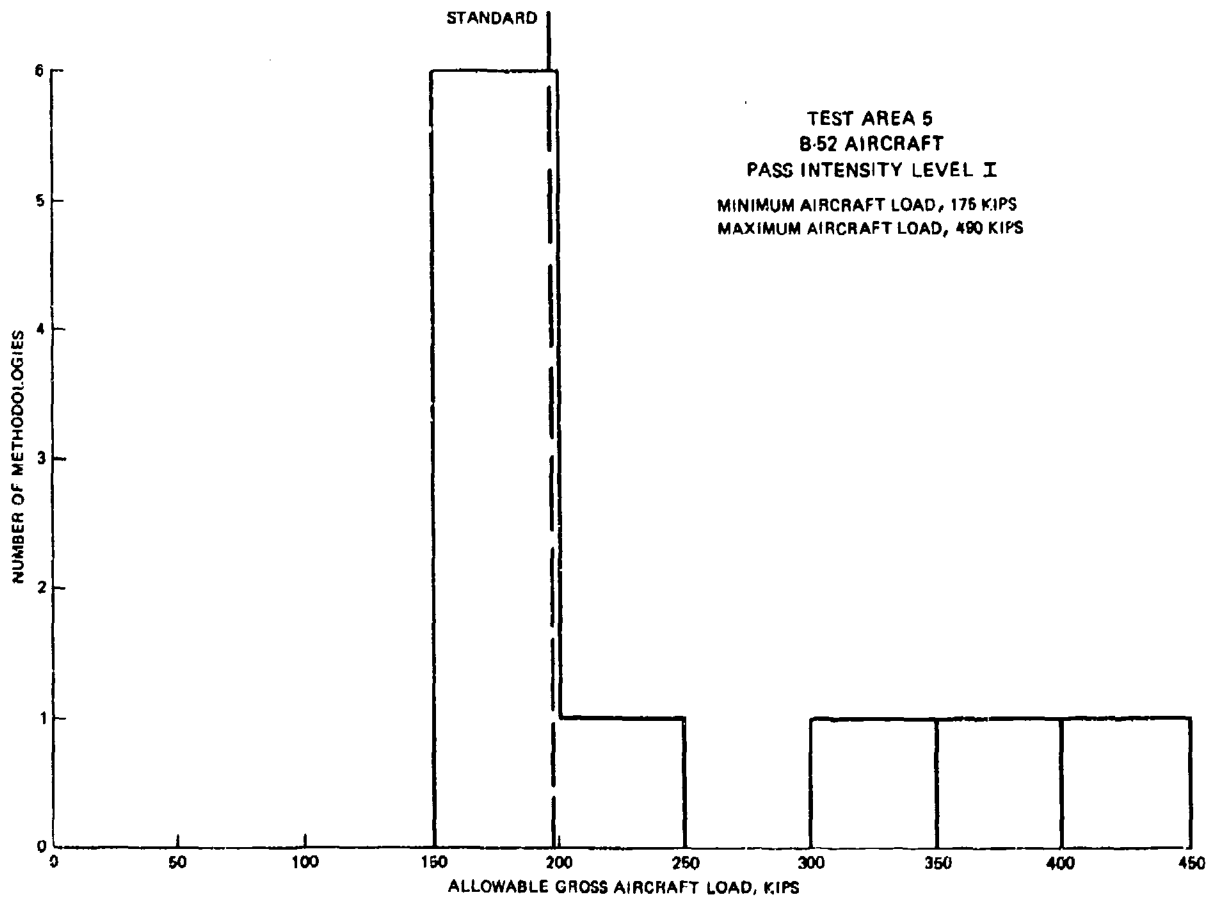

Figure 43. Comparison of predicted loads, Test Area 5, B-52 aircraft

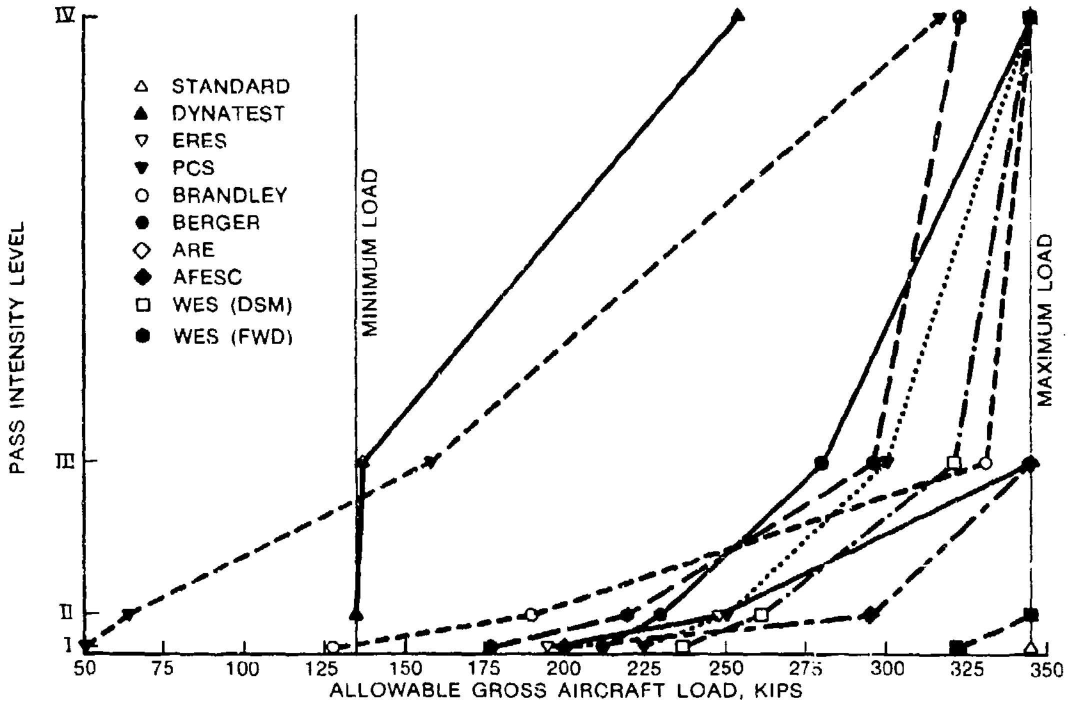

Figure 44. Relationship of allowable loads to passes for flexible pavement. (Allowable load by the standard procedure exceeded the maximum design load for all pass intensity levels)

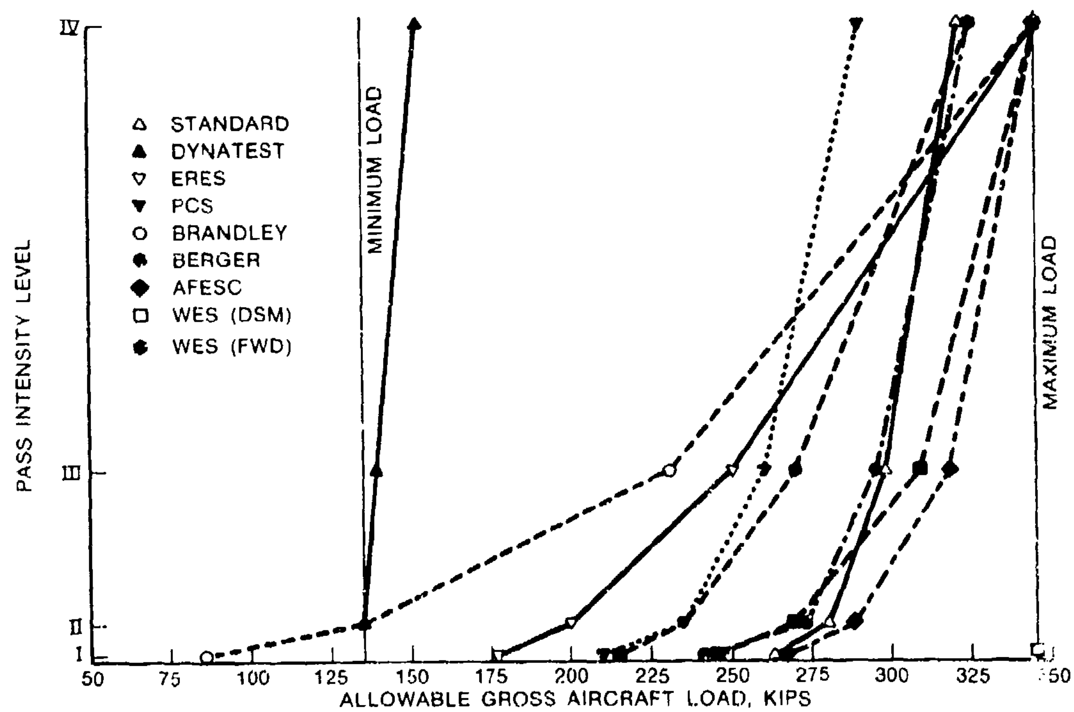

Figure 45. Relationship of allowable load to passes for rigid pavement

APPENDIX A: DESCRIPTION OF NONDESTRUCTIVE TESTING EVALUATION METHODS

1. The purpose of this appendix is to provide a general description of the evaluation method used by each participant in the project. This information is needed to understand the different approaches to nondestructive testing (NDT) pavement evaluation and to explain some of the differences in final results as presented in the main text of this report. These descriptions were extracted from information presented in the reports from each participant.

Pavement Consultancy Services, Inc. (PCS)

2. The basic approach of PCS is based upon the use of the Shell BISAR multilayered elastic program to evaluate the in situ moduli of pavement layers present. To use these results within current military design approaches, correlations relating moduli either to the modulus of subgrade reaction value (Westergaard "k") or to layer California Bearing Ratio (CBR) are necessary. The use of the current US Air Force Load Evaluation Procedure was selected by PCS to illustrate the complete system applicability of NDT testing and subsequent interpretation within current military conventional design methods (Headquarters, Department of the Air Force 1981.*)

3. PCS uses NDT measurements performed with a heavy falling weight deflectometer (FWD) at a force level of 100 kN (22.4 kips). A mass falls on a baseplate that is connected to a 12-in.-diam rigid foot plate by means of a set of springs, thus exerting a pulse load onto the pavement surface. The duration of the pulse load is comparable to the duration of the pulse load exerted by actual traffic. The force level can be changed by adjusting the drop height. The deflection of the pavement is measured by four velocity transducers (geophones): one in the center of the foot plate (δ_0) and at three other radial distances-- $r_1(\delta_1)$, $r_2(\delta_2)$, and $r_3(\delta_3)$. At MacDill Air Force Base (AFB), the radial distances were 0, 60, 100, and 200 cm. The deflection signals are obtained by a single integration of the velocity signals from the geophones, which is performed electronically, by integrated circuits. PCS uses the BISAR computer program developed by the Koninklijke Shell Laboratory in Amsterdam in their NDT evaluation program. The BISAR is a linear-elastic multilayer computer program that is used for the calculation of

* References cited in this Appendix are included in the References at the end of the main text.

stresses, strains, and displacements because of one or more uniform circular surface loads (vertical as well as surface shear loads) and allows the use of a variable degree of interface friction (smooth to rough) between any two adjacent layers within the pavement system.

4. For any given multilayer system having known thicknesses h_i and moduli E_i , the surface deflections at various radial locations (from the center of the uniformly loaded area) can be computed from the BISAR. In NDT analysis, layer thicknesses are known but layer moduli (in situ E_i and Poisson's ratio) values are unknown parameters. By assuming that the predicted deflection, at any radial distance, is equal to the measured FWD deflection at the same radial location, the BISAR can be used in a searching routine to evaluate the set of layer moduli that predict the same measured radial deflections as that determined by the FWD geophones. Thus, by measuring the surface deflection basin under a known load and known set of layer thickness, it is possible to determine the in situ response of layer material properties at the specific test location.

5. The layer moduli are developed through an existing PCS software program that sequences through several BISAR iterations until predicted deflections agree within a preselected percentage error of the FWD measured deflections. The PCS evaluation method demonstrated for this project consisted of determination of layer moduli from NDT data and conversion to conventional pavement properties through correlations between the E derived layer values and the classical CBR and k values.

6. The correlations that have been used are:

a. E-CBR relationship. E = 1,500 (CBR) with E in psi units. This is the widely known Shell Oil relationship developed by Heukelom and Foster (1960) from in situ dynamic vibratory tests.

b. E-k relationship. $E = 10^x$ with E in psi units with $x = 1.415 + 1.284 \log k$ with k in pci units. This relationship has been developed by the US Army Corps of Engineers and is based upon laboratory resilient modulus results and in situ measured plate-bearing (k) evaluations (Chou 1981).

Whereas, E-CBR relationships are valid for individual layers, the E-k correlation is only valid for subgrade.

7. The results of the NDT testing program obtained by PCS at MacDill AFB on five test sections resulted in the following general observations relative to the in situ layer properties:

a. The sand subgrade (SP) appears to be relatively uniform, but inherently variable, within all individual sections. The most significant deviation occurs on the SP-SM subgrade of section TW-33.

b. Using the $E = 1{,}500$ (CBR) correlation equation, the average CBR of the subgrade is 27 with an associated range of 16 to 44. These NDT-predicted CBR values appear to be in excellent agreement with test-pit studies.

c. The average NDT predicted k value is 310 pci with a general range of 210 to 450 pci. These values appear to be higher than values obtained from test-pit data.

d. The analysis of the results of the limerock base layer material (SM) indicate that this material exhibits very poor in situ strength/response characteristics. The range of NDT-predicted CBR was found to be between 4 and 50 (overall average near 15). These NDT-predicted CBR values appear to be in excellent agreement with test-pit studies.

e. The asphalt concrete moduli predicted from NDT results show an average E value of 635 ksi and range of approximately 300 to 900 ksi.

f. NDT-predicted values of portland cement concrete (PCC) layer moduli indicated an average moduli of 4.9×10^6 psi and a range from 3.5×10^6 to 6.2×10^6 psi.

g. NDT analysis of the only composite pavement indicated that the existing PCC layer is severely cracked. This conclusion was based on the abnormally low PCC layer moduli that was predicted from the NDT deflection test results on this pavement section ($\bar{E} = 1 \times 10^6$ psi).

8. The flexible pavement load evaluation used by PCS in this study was based upon the CBR equation developed by the WES. This equation is:

$$t = \alpha_i \left\{ A_c \left[0.0481 - 1.1562\ (x) - 0.6414\ (x)^2 - 0.473\ (x)^3 \right] \right\} \tag{A1}$$

where

t = flexible pavement thickness, in.

α_i = load repetition factor

A_c = contact area of one tire in the known gear system, sq in.

CBR = strength of layer considered

x = $\log_{10} \text{CBR}/p_e = \log_{10} (\text{CBR} \times a_c)/P_e$

p_e = equivalent tire pressure at depth z used in calculating the P_e value

P_e = equivalent single-wheel load

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p_e = equivalent tire pressure at depth z used in calculating the P_e value

P_e = equivalent single-wheel load

The alpha α_i traffic factor is a function of the number of aircraft passes (N_p) and number of tires used in the equivalent single-wheel load analysis (n_t) (Yoder and Witczak 1975).

9. For each controlling aircraft in the Aircraft Group Index (AGI), single-wheel/load depth relationships were determined from a Chevron elastic-layered computer solution (Boussinesq solution) using the well-known principles of the equivalent single-wheel procedure of the Corps of Engineers (i.e., equal interface deflection theory). Various deflection locations were used within the gear representing the controlling aircraft of the specific AGI to determine the maximum deflection location. The results of the deflection analysis were then used to establish closed-form solutions of equivalent single-wheel load-depth relationships for each AGI.

10. Rigid-pavement evaluations were based upon the Westergaard free edge stress. The theoretical free edge stress is modified by a load-transfer factor β (taken in design to be $\beta = 0.75$) to account for observed differences in joint load transfer, and hence actual stress, to that predicted by the Westergaard theory. Westergaard free edge stresses were computed for all 13 AGI (controlling aircraft) and closed-form solutions were developed for each aircraft. The model form used was:

$$\sigma_{fe} = \frac{1}{h^2}\left(b_0 + b_1 \text{ Ln } \ell + b_2 \ell^{-1}\right) \tag{A2}$$

11. The allowable load equation, using this stress equation form, and the existing Air Force (Corps of Engineers) relationship was then:

$$P_a = \frac{P_s \times h^2 \times MR}{\beta \left[g(k, C_f)\right] \times \left(b_0 + b_1 \text{ Ln } \ell + b_2 \ell^{-1}\right)} \tag{A3}$$

where

P_a = allowable load

P_s = standard load used in the H-51 Westergaard stress analysis

h = PCC slab thickness

MR = design flexural strength (modulus of rupture)

β = load transfer factor

$g(k,C_f)$ = mathematical function relating the modulus of reaction k and coverage to failure level (C_f) to the parameter called the design factor

b_0, b_1, b_2 = statistical regression coefficients that are functions of the specific AGI (aircraft type)

ℓ = radius of relative stiffness

12. The load evaluation summary presented in the PCS report is based upon the initial failure (first crack) criterion. Pass-to-coverage ratios which were necessary for each AGI to perform the load evaluation were calculated using taxiway conditions and assuming that 75 percent of the total traffic volume covered the assumed traffic lane. While not all test sections evaluated in this study were taxiways, this assumption was used for all sections simply for computational expediency.

Dynatest Consulting, Inc. (1983)

13. Below are listed some of the most important steps in the Dynatest procedure for evaluation and overlay design.

a. Layer thicknesses are measured, and the modulus of each layer, including the subgrade, is calculated from deflection tests.

b. The moduli are adjusted to correspond to the climate conditions of each season in the design procedure.

c. The permissible stresses or strains in each material are established as a function of the condition of the material (i.e., modulus) and of the number of load repetitions.

d. The reductions in residual life caused by previous loads are either calculated from the previous loads or are considered (indirectly) through their influence on the present structural condition.

e. Number, size, and position of future loads are established.

f. The needed overlay thickness of a given material to provide the desired serviceability or structural condition for the design period is calculated.

14. The Dynatest 800 FWD Test System was used for the NDT. The adjustable load was set to its maximum capacity of approximately 24,000 lb (force), and a loading plate of approximate 6-in. radius (150 mm) was used to simulate the stress level of a heavily loaded jet aircraft. The resulting stress level was somewhat in excess of 200 psi under the loading plate.

15. The FWD load is transient (as opposed to vibratory), having a time of loading of some 25-30 msec, thus corresponding to the effect of a moving aircraft wheel load. Both the load level and a series of seven simultaneous deflections are monitored for each FWD test, with the deflections measured at

the surface of the pavement from the center of the loading plate (through a small hole in the middle of it) out to a distance of more than 2 m from the center. This enables calculation of the elastic properties of each structural layer in the pavement (assuming pavement layer thicknesses are known) through the use of a reverse, iterative procedure that matches up the load and deflections measured against a unique set of material properties.

16. To obtain reasonably accurate moduli of the pavement layers, Dynatest states that it is essential to consider the nonlinearity of the subgrade. Nonlinear subgrade moduli may be considered either by using finite element methods or by using a modified version of the MET (Ullidtz 1977). If a large number of points are to be evaluated, and this is desirable because of the large variations in pavement structures and subgrades, then the use of the finite element method by Dynatest is not practical for time and cost reasons. Furthermore, MET has been found to give as good as or better agreement than the so-called exact methods (including the finite element method), when compared to actually measured stresses, strains, and deflections in road structures (Ullidtz 1973).

17. The nonlinearity of the subgrade may be determined by carrying out FWD tests at different stress levels. Another possibility is to calculate the nonlinearity from the shape of the deflection basin at one stress level. This second alternative employs the ELMOD program even though it is very easy to change stress level with the FWD, because it is preferable to include other changes in modulus with depth (e.g., layered subgrades, changes in moisture content or overburden pressure) as an "apparent" nonlinearity rather than to disregard such variations. The moduli of the pavement layers, including the subgrade, were determined with the ELMOD program, taking the nonlinearity of the subgrade into consideration.

18. MET has been incorporated into the ELMOD program (for evaluation of layer moduli and overlay design). This program has been written for the HP-85 microcomputer, the same microcomputer that controls the 8000 FWD. The ELMOD program determines the layer moduli, including the nonlinearity of the subgrade, by fitting the theoretical deflection basin to the measured deflections. When, in a later step of the calculations, the overlay thickness is to be determined, the MET is used to calculate the critical stresses and strains.

19. To consider the conditions at joints and corners of rigid

pavements, a special version of the ELMOD program is used. For the center of a slab, the same procedure as described above is used. For joints and corners, the concrete modulus is then assumed to be the same as determined at the center, and the modulus of subgrade reaction k is calculated using Westergaard's modified equations (Westergaard 1948). At joints, the degree of load transfer is calculated and considered in calculating the modulus of subgrade reaction and later when determining the required overlay thickness. Westergaard's equations are also used to calculate the modulus of subgrade reaction at the center of the slab, and, by comparing this value to the value determined at the joint, it is possible to infer the presence of voids at the joints.

20. The moduli determined from the deflection measurements obviously correspond to the climatic conditions during testing. To carry out a proper overlay design, the year should be divided into seasons of reasonably constant climatic conditions.

21. With the ELMOD program, it is possible to divide the year into up to 12 seasons. A sinusoidal relationship is used for the asphalt temperature and the asphalt modulus is determined from

$$E_T = \left[A + B \times \log_{10}\left(\frac{T}{C}\right)\right] \times E_c \qquad (A4)$$

where

E_T = modulus at T , degrees Celsius

T = measured temperature, °F

E_C = modulus at a reference temperature C, °C

C = reference temperature, °C

A and B = constants (input values)

The permissible stresses or strains will be closely related to the definition of "failure." For "bound" materials, such as PCC or asphaltic materials, "failure" may be defined as cracking of the material. In this case, the permissible stress or strain may be determined from fatigue testing in the laboratory. But a transfer function is needed between laboratory and in situ conditions.

22. Two seasons were used in the structural evaluation, each of 26 weeks. The mean temperature was assumed to be 59° F (15° C) for one season, and 94.5° F (35° C) for the other season. The subgrade modulus varies

sinusoidally with season according to the equation

$$R = \frac{1}{2} \times \left(1 + \frac{E_{min}}{E_{max}}\right) + \frac{1}{2} \left(1 - \frac{E_{min}}{E_{max}}\right) \times \sin\left[\frac{\pi}{26} (W - WM - 13)\right] \qquad (A5)$$

where

R = seasonal factor

E_{min} = minimum modulus during the wet season

E_{max} = maximum modulus during the dry season

W = week number, counted from January 1

WM = the number of the week when the modulus is at its minimum (for this evaluation $WM = 6$)

$\frac{E_{min}}{E_{max}}$ = 0.67 (estimated from previous FWD testing in Florida)

The seasonal correction of the modulus is applied to the subgrade only. For asphalt, the following modulus-temperature relationship has been used:

$$\frac{E(T)}{E(C)} = 1 - 2 \log_{10} \left(\frac{T - 32}{45}\right) \qquad (A6)$$

where

$E(T)$ = modulus at T, °F

$E(C)$ = a reference modulus corresponding to a temperature of 45 + 32 = 77° F

The nonlinear properties of the subgrade are expressed as:

$$E = C \times \left(\frac{\sigma_1}{\sigma'}\right)^n \qquad (A7)$$

where

σ_1 = major principal stress

σ' = reference stress (a value of 0.1 MPa (14.5 psi) has been used)

C and n = constants (n is negative)

23. For the nonlinear subgrade the modulus used in the structural evaluation E_m is the modulus corresponding to a plate-loading test on the top of the subgrade with a 450-mm- (17.7-in.-) diam slab at a magnitude of deflection of 1 mm (39 mils).

24. For composite pavements, a fixed modulus is used for the concrete and the asphalt modulus is calculated by the program.

25. A standard overlay material is used with a modulus of 650 ksi (4,500 MPa) in one season and 290 ksi (2,000 MPa) in the other season. A Poisson's ratio of 0.35 is used for all materials except concrete where Poisson's ratio is assumed to be 0.15.

26. For the unbound materials, including the subgrade, the following stress criteria has been used:

$$\sigma = 0.5 \times N^{-0.0667} \times \left(\frac{E}{Eo}\right)^{d} \tag{A8}$$

where

σ = permissible normal stress for N number of load applications, MPa

E = modulus of the material, MPa

Eo = reference value, here equal to 160 MPa (2,300 psi)

d = a power which is equal to 1 when E is greater than Eo, otherwise 1.16

This relationship has been derived from a combination of full-scale field testing and dynamic testing of permanent deformations. The E/Eo relationship was derived from the American Association of State Highway Officials (AASHO) Road Test.

27. For asphalt materials the following failure strain criteria was used:

$$\varepsilon_t = 0.000228 \times VB \times N^{-0.178} \tag{A9}$$

where

ε_t = permissible horizontal strain at the bottom of the asphalt layer for N number of load applications

VB = volume percentage of bitumen, here approximately 12

For PCC the flexural strength corresponding to static loading was determined from

$$ZP = A \times \left(\frac{E}{Eo}\right)^{d} \tag{A10}$$

where

ZP = flexural strength of PCC, MPa

A = a constant, here 1.18 MPa (170 psi)

E = modulus of the concrete, MPa

E_o = a reference modulus, here 10,000 MPa (1,450 ksi),

d = a power, here 1 for $E > E_o$ and 0.77 for $E < E_o$

Flexural strength, psi $= 9 \times \sqrt{\text{compressive strength, psi}}$

28. A maximum flexural strength of 610 psi was assumed, because this is the maximum value measured by the Air Force Engineering and Services Center (AFESC) at MacDill AFB.

29. The permissible number of load repetitions, when the dynamic, repeated loading is superimposed by a static load from temperature gradient is (Herholdt et al. 1979)

$$N = 10^{[12\times(1-\Sigma DS/FS)/(1-PS/\Sigma DS)]} \qquad \text{(A11)}$$

where

ΣDS = sum of dynamic and static load (in this analysis static load assumed to be insignificant)

FS = flexural strength

PS = static load

30. It is recommended by Dynatest that the allowable gross aircraft load be taken as the load that can be sustained by more than 80 percent of the test points.

31. A pass-to-coverage ratio of 1 is used throughout by Dynatest. Furthermore, for the concrete sections, the loading corresponds to early morning conditions. Corners and joints of concrete slabs were evaluated during the morning hours because this is the critical period from a structural point of view.

32. Test Area 1 was treated as a two-layer system, because it was impossible to distinguish the limerock-stabilized sand base from the subgrade. Test Areas 2 and 3 were both considered as three-layer systems. For both of these test areas, the subbase was included as part of the subgrade. An asphalt overlay has been assumed with a winter modulus of 650 ksi and a summer modulus of 290 ksi. The maximum gross load used for the B-747 was 825 kips and for the DC-10-30, 555 kips.

ERES Consultants, Inc. (1982)

33. The overall procedures used by ERES to evaluate the pavements were as follows:

a. A condition survey was first conducted to determine what distress exists and the present overall condition of the pavement using the Pavement Condition Index (PCI).

b. The pavement structural response to aircraft loads was measured with a Dynatest Model 8000 FWD; the heavy load (24,000 lb) was required to simulate the heavy aircraft wheel loads using the pavements. ERES states that the FWD closely simulates the deflection basin obtained under actual moving wheel loads. The entire deflection basin 6 ft from the load plate was measured. The load-carrying capacity of the joints was measured, and the critical load location determined.

c. The stiffness of the pavement layers were back-calculated from the deflection basin curvature using an elastic layer model for AC pavements and a finite element model for concrete and composite pavements.

d. The critical stresses and strains were calculated for various aircraft loads placed at the critical location on the pavement using the same elastic layer and finite element pavement models used to characterize the pavements. The measured load transfer at the joints was directly taken into account in the analysis.

e. The number of load coverages to a selected proportion of cracking (and rutting) was then calculated using field-verified damage models for given aircraft types and loads.

34. The FWD used by ERES was manufactured by Dynatest Engineering, Ltd., of Denmark. The unit can produce loads from 1,500 to 24,000 lb with a duration of approximately 27 msec.

35. The load is applied to the loading plate by dropping a weight package on a dampening system and is measured directly by a load cell. The resulting pavement deflection is measured by seven seismic deflection transducers spaced at predetermined intervals from the loading plate (12-in. intervals in this study). The signals from the load cell and deflection transducers are fed into the system processor which selects the peak values and transfers this information to the HP-85 computer. Three different load magnitudes were used in this evaluation ranging up to 24,000 lb.

36. According to ERES, characterization of jointed concrete pavement is best modeled with a finite element model that can accurately represent the joints. ERES uses the ILLISLAB finite element program (modified) that was developed at the University of Illinois.

37. The pavement can be accurately characterized by back-calculating the modulus of elasticity of the slab and the k-value of the foundation from the measured deflection basin. ERES has used several different methods to determine the best modulus of elasticity E and k values for given pavements. The most consistent method is to use the area of the center slab deflection basin and maximum deflection. A graphical relationship of area versus maximum deflection as functions of the modulus of the concrete slab and the foundation support modulus k is then developed over a reasonable range of E modulus values and k values until the average area and maximum deflection of the pavement are bound using the ILLISLAB program. The E modulus and k value determined will normally accurately give the slab curvature measured with the FWD. The area and maximum deflection basin of individual slabs can be used to determine an E and k value, or the average of all the slabs can be used (excluding any very unrepresentative slabs). The mean area and maximum deflection were used herein to obtain an average E and k value for the pavement section.

38. The concrete modulus of elasticity E and the k value of the foundation are not the standard static E and k value measured by long-term static tests, but represent the dynamic response of the pavement to the FWD load, and consequently the moving aircraft wheel load. For example, for Test Area 5 (10.5-in. PCC), the following was obtained.

E modulus (dynamic) = 4,500,000 psi
Poisson's ratio = 0.20 (assumed)
k value (dynamic) = 315 pci

ERES has developed an empirical relationship between the measured dynamic modulus of elasticity of a standard beam and its standard third-point loading modulus of rupture. The estimated modulus of rupture of the concrete slab is 632 psi based on a dynamic modulus of elasticity of 4,500,000 psi.

39. The pavement model characterized as described was then loaded with each of the 13 critical aircraft. The critical location for the aircraft gear is at the joints. The critical joint having the lowest load transfer was determined. The aircraft gear was positioned so as to give the critical stress in the slab. This position was normally with a wheel load parallel to the joint (similar to standard Corps of Engineers and Federal Aviation Administration (FAA) design methods).

40. The critical tensile stress in the slab was then calculated for

each aircraft. These stresses are located at the bottom of the slab and parallel to the joint. The joint was modeled with a deflection load transfer.

41. The next step was to estimate the number of stress repetitions that the slab could withstand until cracking occurs. To accomplish this difficult task, ERES used a relationship between the ratio of the modulus of rupture to the critical stress in the slab and the number of actual coverages of the aircraft gear to cracking of the slab. This relationship was developed using field data from 52 Corps of Engineers test sections that were run over the past 40 years. The critical stress in each of these pavements was calculated using the ILLISLAB finite element program for the actual loading used. The dynamic modulus of elasticity of the concrete was used and an estimate of the repeated load k value was used in the stress calculation. The damage model derived from these data is shown below.

$$\log_{10} (\text{coverages}) = 2.27 \times \frac{MR}{STRESS} + 0.056 \qquad (A12)$$

where

$\log_{10}$ (coverages) = number of coverages to 50 percent slab cracking

MR = third-point modulus of rupture calculated from dynamic modulus of elasticity from FWD, psi

STRESS = critical stress in the slab using appropriate load transfer in the ILLISLAB finite element program, psi

42. Graphs of gross aircraft load versus the number of coverages to 50-, 25-, and 10-percent slab cracking were plotted for a given aircraft. The allowable aircraft gross load can then be read from these graphs for the specified pass intensity levels.

43. Pass-to-coverage ratios calculated using the normal distribution were used to convert coverages to passes. Allowable gross aircraft loads to 50-, 25-, and 10-percent slab cracking for the given pass load intensity levels are given. It must be remembered that these loadings are for the aircraft oriented in the critical direction (parallel to the joint with the lowest load transfer for this apron). If the joint had much higher load transfer, as would occur with mechanical load-transfer devices, the load-carrying capacity would be substantially higher. The load-transfer capability of the joints will always control the load-carrying capacity of the overall jointed concrete pavement.

44. Since the overlay is to be designed for only one aircraft, a simplification of the normal ERES procedures can be made. If more than one heavy aircraft were to use the pavement, a different analysis would be conducted to analyze the need for strengthening the pavement (using the Miner's cumulative damage law).

45. If past load damage were evident, the Miner's cumulative damage law would be employed as follows.

$$\text{Total damage} = \underbrace{\sum \frac{n_p}{N_p}}_{\substack{\text{past} \\ \text{damage}}} + \underbrace{\sum \frac{n_f}{N_f}}_{\substack{\text{future} \\ \text{damage}}} \qquad \text{(A13)}$$

46. If adequate data are available, then a summation of load damage can be made using the Miner's damage law. However, if there are inadequate past traffic data, then the amount of past damage can be estimated using existing load-associated slab cracking.

47. A series of stress calculations are made using the ILLISLAB finite element program over a range of overlay thicknesses for a given pavement and aircraft. The critical stress is still in the same location at the bottom of the slab parallel to the joint for the AC and the bonded PCC overlays. The critical stress for the unbonded PCC overlay is either at the bottom of the existing slab or at the bottom of the new PCC overlay at the joint. The moduli and Poisson's ratio used for the AC and PCC overlays are as follows:

$$\text{AC overlay:} \quad E = 350{,}000 \text{ psi}, \quad u = 0.35 \qquad \text{(A14)}$$

$$\text{PCC overlay:} \quad E = 4{,}000{,}000 \text{ psi}, \quad u = 0.20 \qquad \text{(A15)}$$

48. The same load transfer that exists in the base slab was used for the AC and PCC bonded overlay since they will not increase the load transfer at the joint. The load transfer for the unbonded PCC overlays was increased to that normally used in new design for joints with mechanical load transfer or tied keyways (75 percent).

49. The number of aircraft coverages until slab cracking for each overlay thickness was then calculated. The allowable coverages were converted to passes. A failure criteria of 25 percent cracked slabs is believed to be

reasonable for major rehabilitation purposes.

50. For the composite pavement section, the finite element model was used to model the critical joint area. The ILLISLAB model was used with the two layers (AC and PCC) bonded together. The pavement layers and subgrade support were characterized by back-calculating the modulus of elasticity of the asphalt concrete and concrete slab and the k value from the measured deflection basin. The area method was used.

51. FWD deflection tests were conducted at the slab center, transverse joint, longitudinal joint, and slab corner. Load-transfer tests were also taken across random cracks in the overlay. Six different slab areas were tested overall. The reflective crack/joint load transfer was determined. The determination of allowable loads and overlays followed the same approach as used for jointed concrete pavement.

52. For flexible pavement characterization, the general procedures used to determine the moduli values required modeling the pavement as a two-layered system and modeling the deflection basin to determine the subgrade modulus (Hoffman and Thompson 1981). With the subgrade modulus known, a factorial design was conducted with varying moduli values to match the deflection basin. This procedure provides a unique solution for the previously selected subgrade modulus used. Relationships were developed for each pavement structural section. The FWD deflection data plotted on these relationships provide the moduli for the two layers, completing the chatacterization with a unique match to the deflection basin measured in the field.

53. The AC modulus was found to be very sensitive to the modulus obtained for the subgrade. The base course, however, showed little sensitivity for the pavements analyzed in this study.

54. Flexible pavements will generally fail because of permanent deformation (rutting) or fatigue cracking of the AC layer. When cement-stabilized layers are used for the base course, the problem of fatigue failure in the cement-stabilized layer must be examined. Rutting is generally characterized by the vertical stress on the subgrade, the vertical strain on the subgrade, or the vertical deflection of the pavement surface. Fatigue cracking is generally related to the radial tensile strain that develops at the bottom of the AC layer or the stabilized layer. These pavement response parameters are related to the number of loads producing a response that will cause a specified level of failure to occur.

55. Critical stresses and strains were calculated at the interfaces of the layers. The multiple-wheel load (MWL) elastic-layered program was used to analyze the multiple-wheel gears of the aircraft and calculate the stresses and strains used in the analysis. The critical values were calculated as a function of the gross aircraft load. In these calculations, the gross aircraft loads were decreased in increments with the resulting tire pressure changing to keep the contact area the same for all load levels.

56. The MWL elastic-layered system was used in this analysis because the materials in the pavement structure were primarily granular and acted linearly. Excellent deflection matches were obtained with the elastic-layered analysis used in the characterization. The outputs of the program are the vertical stresses and strains at the subgrade, the vertical deflection of the surface, and the radial strain in the AC layer.

57. The failure criteria used in this analysis include radial strain in the AC and the vertical strain on the subgrade.

58. The rutting failure criterion used in the analysis was the one developed by Chou (1976). This relationship is in the following form:

$$\varepsilon_v = 5.511 \times 10^{-3} \left(\frac{1}{N_{cov}^{0.1532}} \right) \tag{A16}$$

where

ε_v = vertical strain on the subgrade

N_{cov} = number of coverages of the specified aircraft producing that strain

59. This equation was used to calculate the allowable strain for each aircraft being analyzed as a function of the number of coverages specified for that aircraft. The allowable strain calculated in this manner was used as the failure criteria in this analysis.

60. The French Shell method of evaluating fatigue damage is one of the most flexible procedures for evaluating fatigue in different asphalt materials (Bonnaure, Gravois, and Udron 1980). The equation is presented.

$$\varepsilon_r = (4.102 \times PI - 0.205 \times PI \times Vb + 1.049 \times Vb - 2.707) \times S_m^{-0.28} \times N_{cov}^{-0.2} \tag{A17}$$

where

ε_r = radial strain

PI = penetration index, assumed = 0

Vb = volumetric bitumen content, 15 percent

Sm = stiffness of the mix, N/m^2

N = number of coverages

61. For a totally nondestructive type of analysis, typical asphalt properties can be assumed that consider the condition of the pavement, the age of the asphalt materials used, and the properties of the original materials used. The temperature variation can be accounted for in the stiffness modulus of the AC.

62. The fatigue curve developed from the French Shell method represents the median of a large number of fatigue samples, and use of this curve should produce values representative of 50 percent wheel path area cracking in the pavement. A more accepted level of fatigue cracking is approximately 10 percent cracking. Curves were also calculated representing the strain and loadings that would produce cracking levels of 10 and 25 percent.

63. The pavement response values were obtained for each aircraft for each level of loading. Graphs were then prepared showing the relationship between the response values and the gross aircraft loadings.

64. The allowable strains for rutting and fatigue were calculated from the equations using the number of coverages. Different allowable loads are calculated for conditions of rutting--fatigue 50 percent, fatigue 25 percent, and fatigue 10 percent of the area. The comparison that produces the lowest allowable gross load between fatigue and rutting should be the one selected for a particular pavement. The acceptable level of fatigue cracking is an engineering management decision.

65. The modulus value for the AC surface layer could be changed for a seasonal analysis to show temperature influences. Additionally, the subgrade modulus value could be altered to indicate seasonal variability. The values determined in October 1982 are deemed representative of the Tampa, Fla., area; over a year or so no changes were made in this analysis (no frost problem existed and the water table was relatively high).

66. Because the limerock base appears to be cemented to some extent (the modulus value is much higher than nonstabilized granular materials), an analysis was carried out to examine the fatigue life of a cement-treated

soil. The analyses conducted relate primarily to true portland cement-stabilized materials, not naturally cementitious materials. The first method of analysis used Portland Cement Association data on fatigue of soil cement using the radius of curvature of the stabilized layer (Larsen and Nussbaum 1967). The damage model for a low quality cement-stabilized material is

$$R = \frac{Rc \times N^{0.032}}{1.05 - 0.042h} \tag{A18}$$

where

R = radius of curvature

Rc = critical radius of curvature = 7,000 in.

N = number of load repetitions the section will carry

h = thickness of stabilized layer

67. The second analysis used results from ERES employing AASHO road test data for the cement-stabilized layers and elastic-layer analysis to obtain appropriate critical strains. The damage model is

$$\log N_{2.5} = 8.559 - 3.488 \log \varepsilon \tag{A19}$$

where

$N_{2.5}$ = number of loads to reduce serviceability to a failure level

ε = strain in cement-treated material

68. Because the limerock base is not a true portland cement-stabilized layer, these analyses are more approximate than the rutting and fatigue analyses. These analyses cautiously use existing pavement conditions. The results do show a substantial reduction in allowable loading.

69. For overlay design the pavement section is characterized as previously described. It is then modeled with the aircraft placed on the pavement structure at its maximum load and the pavement response values calculated by the MWL program. The thickness of the overlay is varied and the response values for each thickness calculated. The allowable strains are then calculated for each aircraft using the field-developed equations presented in the previous section for the number of coverages of each aircraft. Overlay thicknesses are selected based on the rutting and fatigue analyses. These thicknesses would be increased somewhat if the pavement showed signs of load-related distress indicating that some fatigue or rutting damage had already

been produced by the previous traffic on the pavement.

70. For multiple-aircraft loadings, the Miner's fatigue damage concept is used to compute total damage from all aircraft using the pavement. This total damage is correlated to percent cracking of the pavement to determine the limiting criteria. This procedure of directly considering existing load transfer will give reduced allowable loads and increased overlay thickness if the load transfer is poor. Poor load transfer existed on both jointed concrete test areas.

R. W. Brandley (RWB)(1983)

71. The test program conducted by RWB consisted of the following:

a. A survey was performed to determine the condition of the existing pavements by visual observations.

b. Dynatest FWD tests using the Dynatest 24-kip unit were conducted.

c. Joint efficiency tests using loaded vehicles and cantilever deflection beam were carried out.

d. Tests using the WES 16-kip vibrator were conducted.

72. Each test site was visually inspected in some detail to determine the existing conditions of pavement at each test area. The purpose of this condition survey was to provide information on distress that had occurred in the pavements as the result of traffic.

73. The Dynatest FWD test equipment was used to conduct the FWD tests. At each location tested, the test load was dropped from such a height as to provide a load of approximately 830 kPa and a load of 1,500 kPa on a 5.91-in.-radius plate. Deflection readings were measured directly under the plate at distances of 200, 305, 610, 914, 1,524, and 2,438 mm away from the plate. These deflection measurements were automatically recorded.

74. On the PCC pavement sections, tests were conducted in the center of the slab, at the edge of the slab, and at the corner of the slab to determine the effect of load transfer in the slab itself. The tests conducted at the edge and corner of the slab were conducted in such a manner that the joint was located between the gauges set at 200 and 305 mm from the plate.

75. On the AC pavement sections, the tests were conducted both along the center line of the test section and 18 ft on each side of the test section. Representative values of deflection at each distance measured from

the center of the plate were determined. These data were used in a computer program for evaluation of the pavement sections.

76. On Test Areas 2 and 3, considerable variation occurred between the pavement section at the center of the taxiway and the section at the edge of the taxiway. To obtain information as to the relative effect of this change in section, a series of FWD tests was conducted across the taxiways, which provided a cross section of deflection across these taxiways.

77. The test data obtained on the PCC pavement sections were such as to determine the support characteristics of the pavement section at the center of the slab and also to get some indication of the load transfer at the joints. This was accomplished by applying the load adjacent to a joint and measuring the induced deflections on both sides of the joint.

78. WES made data from the WES 16-kip vibrator available for evaluation. The 16-kip vibrator test data were evaluated in a manner similar to that for the FWD data in that profiles were plotted of the deflections obtained and representative values of deflection at each test location and at each distance from the applied load were determined.

79. In all of the WES 16-kip vibrator tests, dynamic loads were applied and the imposed deflections were measured under the plate at a distance of 18, 36, and 60 in. from the plate. The plate diameter for the WES 16-kip vibrator was 18 in.

80. The office of RWB had developed a method of testing joints in PCC pavements sections to determine the effectiveness of the load transfer at the joints and the resistance to deflection at the joints under load. The test procedure consists of placing a cantilever deflection beam on the slab with two linear potentiometers located at the free end of the beam. The beam is set on the slab such that one of the potentiometers is located on one side of the joint and the other potentiometer is located on the other side of the joint. A rubber-tired wheel which imposes approximately the same total load as the aircraft using the pavements is then pulled or driven across the joint perpendicular to the joint and passes immediately adjacent to the location of the potentiometers. In this manner, the total relative deflection of the slab at the joint and the relative movement of one slab with respect to the other (slab rocking) as the wheel moves over the joint can be measured and recorded.

81. This type of testing was undertaken at Test Areas 1 and 5, which had a PCC pavement. The Air Force had agreed to furnish a loaded vehicle of

approximately 50,000 lb per single wheel; however, the only equipment available was a truck-mounted crane which had three axles. The rear axles had dual wheels, and each pair of duals was loaded to 7,000 to 8,000 lb. These loads were very light and did not adequately represent the wheel loadings on any of the design aircraft other than perhaps the F-16. Because this was the only equipment available, the tests were conducted using this equipment.

82. RWB used the fatigue analysis method (Brandley 1975) for pavement evaluation and design for subgrade support, the standard CBR method for flexible pavements, and the Westergaard method for rigid pavements for evaluation of the pavement section itself. The nondestructive test data were used at MacDill AFB to obtain modulus of elasticity values for each material within the pavement section and for the subgrade soils at each test location.

83. The moduli of elasticity calculations were made using the data from both the FWD tests and the WES 16-kip vibrator tests. Using the data from the FWD tests, the entire deflection basin was evaluated using the ELMOD and the ISSEM 4 programs employed by Dynatest Consulting, Inc. In addition, the program for the Boussinesq theory using the equivalent thickness theory was put to use. The N-layer theory as developed by Chevron Asphalt Institute was also utilized, in which the center deflection and the edge deflection are used in the N-layer computer program to compute the modulus of elasticity of the subgrade layers. The values assumed for the pavement layers were those obtained from the ELMOD or ISSEM 4 evaluations.

84. For the WES 16-kip vibrator, the Boussinesq equivalent thickness program and the N-layer theory were used with the deflections obtained from this test procedure to calculate modulus of elasticity values. Part of these variations in subgrade E-values calculated by each method can be accounted for by the fact that the Boussinesq equivalent thickness theory and the N-layer theory assume a linear elastic condition for the support materials; whereas, the ELMOD and ISSEM 4 programs allow stress-dependent characteristics. Applying a factor of 2 to 3 to the E-values obtained for the subgrade soils in the concrete sections at MacDill AFB produces subgrade E-values which are reasonably uniform throughout the site.

85. Using this type of evaluation, soil and pavement section parameters to be used in the evaluation and design were determined. The E-values for the pavement section itself used in the analysis were those obtained in evaluating the deflection basin data taken from the FWD tests. Using the modulus of

elasticity values and the aircraft loading at each pavement section, subgrade deflections for each aircraft were calculated using the N-layer theory. After subgrade deflection under each aircraft loading at each pavement section had been determined, the limiting subgrade deflection criteria were used to determine the allowable aircraft coverages to failure for each aircraft. One coverage is obtained on the critical pavement section for each two passes of aircraft over the pavement section depending on type of aircraft and location, i.e., taxiway or runway.

86. The pavement evaluation by the fatigue analysis method was then determined by comparing the allowable coverages to failure with the pass levels for each of the four levels of operation established for this study. Knowing the pass level required for each aircraft type at each test location, it is now a simple matter to determine the ability of the pavement section to carry the aircraft loading and to determine what overlays are required to strengthen the deficient pavement sections enough to carry the anticipated number of aircraft operations for each aircraft.

87. This same type of analysis can be used to determine the allowable load at which each aircraft can operate without failure of the subgrade for each pass level. All of this evaluation with the fatigue analysis method is for subgrade protection only and assumes that the pavement section is adequate to distribute the loads to the subgrade without failure of these materials themselves. It is necessary to evaluate the adequacy of the pavement section itself for support of the aircraft without failure in this pavement section. This analysis was conducted using standard procedures with CBR analysis for flexible pavement and the Westergaard analysis for rigid pavement. The minimum PCC overlay presented in this analysis is 12 in., even where a thinner section theoretically would perform. It is considered that a minimum 12-in. section is required to install the necessary load transfer at the joints.

88. Joint efficiency tests were conducted using the FWD, the WES 16-kip vibrator, and a moving wheel load with a cantilever-type deflection beam. Research conducted by RWB has shown that pavements 12 in. thick can tolerate slab rocking up to 0.020 in. without inducing stresses sufficient to cause failures. However, any slab rocking or relative deflection of magnitude greater than this will contribute to early failure. This 0.020-in. maximum slab rocking or deflection criteria for the edge of the slab has been determined for 12-in. concrete slabs. For thicker slabs, less deflection can

be tolerated; and for thinner slabs, more deflection can be tolerated.

89. It appears that the amount of movement measured under the FWD test when joint efficiency tests are conducted is so small that the joint efficiency cannot be properly evaluated. All joints move a certain amount, and it has been shown that joints can move up to 0.020 in. with 12-in. slabs without imposing serious stresses. The light loading of the FWD does not produce enough movement at the joint to determine whether adequate load transfer exists. The same analysis holds true for the WES 16-kip vibrator.

90. Full-scale testing is apparently still required for joint efficiency. While the data are not adequate because of lack of loading to confidently predict adequacy of load transfer, the data do indicate that adequate load transfer is available in Test Area 1 but that there are sections of Test Area 5 in which adequate load transfer will not be available.

Louis Berger International, Inc. (1983)

91. The report submitted by Berger consisted not only of the requested pavement evaluation in terms of allowable loads and overlays but also provided results of comparisons with different NDT equipment and different layer analyses. The method used by Berger for NDT evaluation is a combination of layered-elastic theory and a modified version of the WES DSM method (Hall 1978). This method can be implemented with the pavement profiler, FWD, or the WES 16-kip vibrator, and similar results would be obtained. The description given here will briefly discuss some of the Berger results using information from the report submitted by Berger.

92. The method used in the Berger report for determining the allowable gross aircraft load (AGAL) is the CBR method for flexible pavements and the Westergaard analysis for edge loading for rigid pavements. These methods are also the basis for the current DSM procedure, as outlined by Hall (1978).

93. The NDT data used to perform the pavement evaluation were collected with the Model 2000 pavement profiler which applied a peak-to-peak cyclic load of 4.5 kips at a frequency of 25 Hz. Deflection sensors are placed either 12, 24, and 36 in. or 12, 24, and 60 in. from the center of the load plate. One sensor is mounted at the center of the 18-in.-diam plate. Berger also made use of the data collected by WES with the WES 16-kip vibrator and the Model 8000 FWD (15 kip). The WES data were not used for upgrading the pavement

systems but for comparisons of the elastic parameters obtained for the subgrade and pavement.

94. For flexible pavements, the critical strain concept shows promise, but it is Berger's opinion that, in view of the range of critical strain values, this method requires site calibration. This can be done when past traffic records are available and when an opportunity is provided for NDT testing of both areas with satisfactory pavement sections and traffic-induced failures.

95. The method for determining a representative DSM value for each pavement based on measurements with the WES 16-kip vibrator is described in detail by Hall (1978). The DSM can be determined from measurements made with the pavement profiler using the following expression:

$$DSM = 0.8 \times \frac{P}{\Delta_o} \qquad (A20)$$

where

P = peak-to-peak load for Model 2000 pavement profiler (about 4.5 kips)

Δ_o = double amplitude of the pavement center deflection on an 18-in. diam plate

This is the design DSM which is equivalent to WES DSM ksi. In determining the representative (P/Δ_o) values to use for the pavement evaluation of the five test areas, the 50-percentile values obtained on both the center line and near wheel path were considered.

Flexible Pavements

$$ASWL = 0.0437 \times (DSM) \qquad (A21)$$

Rigid Pavements

$$ASWL = 0.01896 \times (DSM) \qquad (A22)$$

Composite Pavements

$$ASWL = 0.0172 \times (DSM) \qquad (A23)$$

where allowable single-wheel load (ASWL) is in kips and (DSM) is in ksi.

The following values of allowable single-wheel load were obtained:

Values, Single-Wheel Load	
Test Area	ASWL, kips
1	150
2	87
3	35
4	40
5	44

96. Because the CBR method was used in determining the ASWL in the WES study on flexible pavements, it is pertinent to compute the implied CBR of the subgrade associated with the ASWL for Test Areas 2 and 3. This requires converting the existing pavement thickness to an equivalent pavement thickness, T_t, having 3 in. of AC and 6 in. of high-quality base. Assuming that the AC has a 1.7 equivalency to subbase and a 1.4 equivalency to high-quality base (as assumed in the original WES study), T_t can be computed for the two flexible pavements if equivalencies are assigned for the existing AC and base materials. Based on the NDT moduli, it seems reasonable to assign an equivalency factor of 1.7 to the existing AC, 1.15 for the existing base in Test Area 2, and 1.05 for the existing base in Test Area 3. The representative values of the elastic moduli for the base course in Test Areas 2 and 3 are 100,000 and 50,000 psi, respectively.

97. Using the CBR equation and the ASWL determined from the DSM as outlined above, one can compute the associated CBR.

$$\mathrm{CBR} = \frac{\alpha^2 \times 1{,}000 \times (\mathrm{ASWL})}{8.1 \times (T_t^2 + \alpha^2 A/\pi)} \qquad \text{(A24)}$$

where

α = 0.94, for 24,000 [illegible]sses

ASWL = allowable single-wheel load, kips

T_t = equivalent thickness, sq in.

A = 254 sq in.

This gives a subgrade CBR of 9 for Test Area 2 and a CBR of about 14 for Test Area 3. These results are not consistent with the subgrade modulus E_3 of about 37,000 psi for Test Area 3 determined from the NDT testing.

98. An implied linear relationship between ASWL and DSM indicates that the measured DSM would increase proportionately to the square of the pavement thickness. This has not been observed at various sites. Therefore, for the

purposes of pavement evaluation, a better procedure is to evaluate the CBR of the subgrade using deflection bowls to determine the subgrade modulus E_3 and then evaluate the CBR using this subgrade modulus. The elastic modulus of the base E_2 and the asphalt layer E_1 determined from the interpretation of the deflection bowl are used to estimate the equivalency factors. These are used to determine the equivalent flexible pavement thickness T_t . The ASWL bowl is then computed using the CBR equation. This procedure yields a subgrade CBR of about 25 for Test Area 2 (as compare to 9) and a CBR of about 15 for Test Area 3 (as compared to 14). The equivalent flexible pavement thickness equals 31 and 14 for Test Areas 2 and 3, respectively. Consequently, the DSM procedure for determining ASWL for flexible pavement in Test Area 2 is very conservative; whereas, for Test Area 3 this procedure appears to be more reasonable.

99. The deflection bowls measured on rigid pavements can be used directly to determine all the parameters necessary for determining the ASWL if the flexural strength of the concrete is known. The following results were obtained.

Test Area	Thickness in.	DSM kips/in.	E_1 psi	k pci	ℓ in.
1	20.0	8,000	4,000,000	500	48
5	10.5	2,300	4,000,000	250	36

Using the above values for Test Area 5 with a C-141 aircraft, one can calculate the allowable gross load for 24,000 passes:

$$P_G = 0.0189 \times (DSM) \times (F_L) \times (T_C) \qquad (A25)$$

where

P_G = allowable gross load aircraft, kips

F_L = load factor, which depends on the characteristic length ℓ

T_C = traffic factor, which depends on the aircraft gear configuration and the required number passes

For Test Area 5, DSM = 2,300 , $\ell = 36$, $F_L = 7.4$, and $T_C = 0.95$, and

$$P_G = 0.0189 \times (DSM = 2,300) \times (F_L = 7.4) \times (T_C = 0.95) \cong 310 \text{ kips} \qquad (A26)$$

100. Using the rigid pavement evaluation curve for the same aircraft (C-141), an allowable gross load of 310 kips, 24,000 departures, and 10.5 in. of PCC pavement (with a $k = 250$ pci) yields a concrete flexural strength of 780 psi. PCC cores tested by splitting and converted to flexural strength by an empirical relationship produced flexural strengths ranging from 420 to 610 psi (AFESC 1980). Fifty percent of the reported flexural strengths were 500 psi or less. In view of the above and in the absence of a direct determination of the flexural strength, a flexural strength of 650 psi was assumed for the rigid pavement evaluation. The allowable gross load is therefore 260 kips from the C-141 evaluation curve. Therefore, the following expression was used for evaluating the rigid pavement of Areas 1 and 5.

$$P_G = 0.0159 \times (DSM) \times (F_L) \times (T_C) \tag{A27}$$

where $0.0159 = 0.0189\ (260/310)$. The allowable gross load is determined using this equation which has been developed for flexural strength of 650 psi.

101. Based on the similarity of the deflection bowls and the same design DSM for Test Areas 4 and 5 (DSM = 2,300), the same parameters can be used for pavement evaluation of Test Area 4 (composite pavement); i.e., $k = 250$ pci and ($\ell = 36.0$ in.), where determined previously for Test Area 5.

102. The equivalent thickness of PCC pavement is given by the following expression.

$$h_e = \frac{1}{F}\,(h + 0.4t) = 11.0 \text{ in.} \tag{A28}$$

where

$F = 0.8$

$h = 6$ in. (thickness of PCC)

$t = 7$ in. (thickness of AC overlay)

Following the same procedure outlined for Test Area 5,

$$P_G = 0.0172 \times (2{,}300) \times (7.4) \times 0.95 = \quad \text{kips} \tag{A29}$$

103. This implies a concrete flexural strength of 690 psi for an equivalent thickness of PCC of 11 in. Following the same procedure as outlined for Test Areas 1 and 5, the following expression was used for evaluating the rigid pavements of Test Area 4.

$$P_G = 0.0162 \times (DSM) \times (F_L) \times (T_C) \qquad (A30)$$

where $0.0162 = 0.0172\ (650/690)$.

104. The AGAL for flexible pavements is computed using the evaluation curves for flexible pavements for 13 aircraft groups. When using these curves, T_t values were used for thickness (e.g., $T_t = 31$ in. for Test Area 2 and 14 in. for Test Area 3). The subgrade CBR values were those determined from the subgrade modulus E_3 values found from interpretation of the deflection bowls (i.e., CBR = 25 for Test Area 2 and CBR = 15 for Test Area 3). Based on these CBR design curves, no load limitations exit for the 13 aircraft groups at all pass intensity levels for Test Area 2.

105. The load limitations for Test Area 3 are based on the design curves for each pass level. For example, the allowable gross load of aircraft group 11 (DC-10-30) and 3,000 passes is 430 kips.

106. In Test Area 3, the CBR of the subgrade associated with the DSM method is 14. The CBR of the subgrade from E_3 is 15. Because these two values are similar, it is of interest to determine the AGAL for Test Area 3 using the DSM method as outlined. The AGAL is determined by the following expression.

$$P_G = \frac{F_K \times (DSM)}{S \times (\%ESWL)} \times \frac{N_m}{NC} \times 100 \qquad (A31)$$

where

F_K = load factor depending on the number of wheels and the total aircraft coverages; F_K depends on the total number of passes and on the pass-to-coverage ratio for the aircraft

S = main gear load, percent

% ESWL = percent equivalent single-wheel load depends on equivalent flexible pavement thickness the aircraft

N_m = number of controlling wheels for computing (percent ESWL)

The following overlay thickness recommendations for each test area were determined.

Areas 1 and 2

107. No upgrading is required for the rigid pavement of Test Area 1 (20-in. concrete) and the flexible pavement of Test Area 2 (15-in. base plus 11-in. AC) to accommodate the design traffic of the B-747 or the DC-10-30.

Area 3

108. The design subgrade CBR is 15, and the equivalent thickness T_t = 14 in. Using the CBR curves, a total required flexible pavement thickness of T_t = 20 in. is determined for the B-747. In other words, DT_t = 20-14 = 6 in. of subbase. Based on an equivalency factor of 1 in. of AC = 1.7 to 2.0 in. of subbase, an overlay of 3.5 in. of AC is recommended for this aircraft. The actual overlay thickness will be based on the pavement elevation profile and the minimum overlay should be 3.0 in. For the DC-10-30 aircraft, the total required flexible pavement thickness is 17 in. Therefore, a minimum 1.75 to 2.0 in. of AC is recommended.

Area 4

109. The most economical overlay design is based on the flexible pavement analysis. The design subgrade CBR is 15. The existing 6.0 in. of PCC is assumed to be equivalent to 6.0 in. of high-quality base course. The equivalent existing pavement thickness T_t is therefore T_t = (6 base + 3 asphalt) + (7 - 3) × 1.7 = 15.8 in. Using the CBR design curve, a total required flexible pavement thickness of T_t = 20 in. is determined for the B-747. Therefore, the recommended overlay thickness is (20.0 - 15.8)/(1.8) = 2.3 , say 2.5 in. Following this same design procedure for the DC-10-30 results in a required AC overlay thickness of less than 1.5 in. In conclusion for Test Area 4, 2-1/2 and 1-1/2 in. of AC are recommended for the B-747 and DC-10-30, respectively.

Area 5

110. Based on the FAA design procedures for rigid pavements, the required total thickness of the PCC for Test Area 5 is 13 in. and 12 in. for the B-747 and DC-10, respectively. Because the existing pavement slabs are distress-free, the bonded or monolithic PCC overlay is recommended. In this case, the required thickness of the PCC is 13 - 10.5 = 2.5 in. and 12 - 10.5 = 1.5 in. for the B-747 and D-10-30, respectively. The joints in the overlay must be matched to thejoints in the existing pavement by both location and type.

111. Measurements of deflection bowls near joints were performed in Test Areas 1 and 5. The tests included:

- a. Measurement of deflection bowls on the same side of the joint where the load was applied.

b. Measurement of the deflection bowls on two sides of the joint.

The results are analyzed using the Westergaard theory, as summarized below. The load transfer efficiency of a joint is defined as

$$Zj - Z'j = (1 - j)(Ze - Z'e) \tag{A32}$$

where

Zj = deflection of loaded slab at joint with j-efficiency

$Z'j$ = deflection of adjacent slab

j = joint efficiency

Ze = deflection of loaded slab at joint with zero efficiency (free edge)

$Z'e$ = deflection of adjacent slab with zero efficiency at joint

When the load is applied on only one side of the joint, $Z'e = 0$. Therefore

$$j = 1 - \left(\frac{Zj - Z'j}{Ze}\right) \tag{A33}$$

The free edge deflection Ze can be either measured wherever a free edge condition exists or computed using the approximate Westergaard formulas as follows.

$$Ze = \frac{P\sqrt{2 + 1.2\mu}}{\sqrt{Eh^3k}}\left[1 - (0.76 + 0.4\mu)\frac{\overline{Y}}{\ell}\right] \tag{A34}$$

where

P = load

μ = Poisson's ratio of concrete

E = modulus of elasticity of concrete

h = slab thickness

k = subgrade modulus of reaction

$\overline{Y}$ = distance of center of gravity of load edge

$\ell = Eh^3/\left[12\left(1 - \mu^2\right)k\right]$

112. According to Westergaard, the deflections at the edge of a joint with efficiency j can also be computed using these equations:

$$Zj = \left(1 - \frac{1}{2}j\right) Ze + \frac{1}{2}\, j\, Z'e \tag{A35}$$

$$Z'J = \frac{1}{2}\, j\, Ze + \left(1 - \frac{1}{2}\, j\right) Z'e \qquad (A36)$$

In the case of the load being applied on one side of the joint $Z'e = 0$, the joint efficiency can be computed using either the first or second equation.

$$j = 2\ \frac{(Ze - Zj)}{Ze} \qquad (A37)$$

$$j = 2\ \frac{Z'j}{Ze} \qquad (A38)$$

Dividing the equation for Zj by the equation for $Z'j$ gives

$$j = \frac{2\ Z'j}{Zj + Z'j} \qquad (A39)$$

113. Two cases are dealt with for evaluating joint efficiency:

a. The deflection bowl is measured on one side of the joint where the load is applied. Equation A37 is used to compute the joint efficiency. The free edge deflection Ze is computed using Equation A34 and material properties (h, k) derived from pavement evaluation (Hertz theory) of the center load of the same slab. The deflection at the joint Zj is found from extrapolation of the measured deflections.

b. The deflection bowl is measured on both sides of the joint. The joint efficiency can be computed using:

(1) Equation A33 which comes from the definition of joint efficiency (Equation A1). (In this case, the free edge deflection Ze is computed using Equation A3 and material properties (h, k) derived from pavement evaluation (Hertz theory) of the center load of the same slab.)

(2) Equation A32 which comes from the approximate Equations A35 and A36 (In this case, Ze is not needed). The deflections Zj and $Z'j$ at the edge are found from extrapolation of the measured deflection. The main conclusion of the joint transfer analysis, both in Test Areas 1 and 5, is that the load-transfer efficiency of the joints may be taken as 0.5.

114. The following conclusions were made by Berger:

a. The pavement profiler, the 16-kip vibrator, and the WES FWD all have satisfactory instrumentation for measuring both applied force and resulting deflections. This was indicated by the almost identical deflection bowls for the 10.5-in. concrete pavement of Test Area 5 when normalized with respect to applied load.

b. The coefficient of variation of the normalized deflections is approximately 10 percent for each of the three NDT devices.

c. The shapes of the deflection bowls produced by the three NDT devices are sufficiently close to those predicted by the Hogg model, so that the model can be used in pavement evaluation.

d. Generally, good agreement was obtained between the moduli of the pavement layers as computed by the various methods outlined. The Hogg model can be used for determining the subgrade modulus E_3 and of the concrete E_1 for rigid pavements. For flexible pavments, E_1 , E_2 , and E_3 can be determined using the method of equivalent thicknesses. If E_1 is known, E_2 may be determined using the center deflection and the Burmister two-layer model, when combined with the determination of E_3 using the Hogg model. Reasonable results were obtained using these methods for analyzing deflection bowls produced by all three NDT devices.

e. The three NDT devices gave similar layer moduli for PCC, AC, and the subgrade. The moduli for the base course determined from the deflection bowls produced by the FWD were significantly lower than those obtained from analyzing the deflection bowls produced by either the pavement profiler or the 16-kip vibrator.

f. All of the layer moduli values for the five test areas obtained with the three NDT devices are reasonable.

ARE, Inc. (1983)

115. The data gathered for this project included physical property data or construction history data on the five pavement sections, traffic data as furnished by the sponsor, and NDT data acquired on location at MacDill AFB.

116. The only actual tests made on location at MacDill AFB were the NDT deflection tests. These tests were performed using a Dynaflect which is a rapid mobile NDT machine available since the early 1960's. The data include deflection readings for each of the five sensors which are part of the standard Dynaflect apparatus, sensor 1 being midway between the load test wheels and the other four sensors being spaced 1 ft apart on a radius from the center between the two load wheels. The test points were located for each of the five test areas using a grid pattern on the apron areas, and on the taxiways test points were located on each side of the center line on flexible pavements. On the rigid pavements, tests were performed at transverse joints and in the center of the same slab on which the test was done at the joint.

117. The numerical computation of elastic properties for each of the

five pavement cross sections includes the stress-strain analysis and the prediction of critical aircraft.

118. Normally, the first step in the analysis is a visual and graphical evaluation of the NDT deflection data, a process used to delineate different areas of pavement response to load. However, because these pavement areas were designated and are only approximately 1,000 ft in length, the technique of dividing pavement into various response sections was bypassed. For each of the areas, various statistical parameters were computed for further use in the analysis. The mean standard deviation and coefficient of variation were computed for each of the data groupings. The mean values of the deflections at all five sensors are the most important data elements that are used in the development of the materials properties for each of the five cross sections.

119. The next step in the analysis was to analytically characterize the elastic materials properties for each of the major layers in each of the five pavement cross sections. This is accomplished using a computer program called BASFIT. BASFIT is a deflection basin fitting program that predicts deflection values under a known load and loading conditions using the cross-section geometry furnished by the sponsor, which included known layer thicknesses together with construction history and word description of the materials. Approximate values of Poission's ratio were assigned along with approximate values of elastic moduli as the initial input to the program BASFIT. The program predicts the deflection basin response. Moduli are adjusted until the predicted basin sufficiently accurately simulates the measured basin using whatever field testing device is specified. In the case of this application the Dynaflect loading was used. This process is an iterative one and is generalized; i.e., it is not unique to any particular type of NDT load but could be used with any one that can be adequately described in terms of load and geometry.

120. Normally, the ARE design procedure takes into account the relative load magnitude of the NDT apparatus and the larger magnitude of actual aircraft load. As for clay or fine-grained soils, it is believed and has been shown from extensive laboratory work that as the loads increase, the elastic moduli decrease. However, the subgrade materials that prevail on all five sections at MacDill AFB are classified as sands, thus indicating that there would be no stress sensitivity characteristics associated with the subgrade soils. For this reason, further adjustments to the elastic

properties determined in the deflection basin fitting through the use of a BASFIT program need not be made.

121. Pavement evaluation computations were next accomplished using a series of computer programs referred to as ELSYM-5 and AIRPOD. ELSYM-5 is a five-layer elastic-layered analysis program publicly available, and AIRPOD is a first-generation airport pavement overlay design procedure in the form of a computer program developed in the late 1970's by ARE for use on civil airport evaluation and runway design projects. This program likewise is based on elastic-layered theory and uses fatigue criteria for the assessment of pavement damage and the remaining life under specified traffic circumstances. ELSYM-5 and AIRPOD have been used on many past projects. A brief description of the pavement life analysis built into the AIRPOD program follows.

122. The present amount of life remaining in the pavement and the projected future life are determined with the computer program AIRPOD. The program determines the allowable number of aircraft operations for the pavement using the following fatigue equations.

$$N = a \left(\frac{f}{\sigma}\right)^b \qquad (A40)$$

or

$$N = c \left(\frac{1}{\varepsilon}\right)^d \qquad (A41)$$

where

N = number of aircraft loads until failure (fatigue life)

f = concrete flexural strength, psi

σ = computed stress due to aircraft load on rigid pavement, psi

ε = computed strain due to aircraft load on flexible pavement, psi

a, b, c, d = constants

123. The program AIRPOD computes the stress and strain in the pavement using an elastic-layered theory subroutine. This computation requires the aircraft load and materials property inputs previously discussed. The number of aircraft passes until failure is determined for each individual aircraft.

124. The percentage of life remaining in the pavement is computed using an equation of the following form.

$$L_R = 100 - \left(\sum \frac{n}{N}\right) \cdot 100 \qquad \text{(A42)}$$

where

L_R = fatigue life remaining in the pavement

n = aircraft operations to date for an individual aircraft

N = allowable number of aircraft loads until failure of an individual aircraft

125. The program computes the amount of damage contributed by each aircraft n/N and then sums these damage ratios to determine the total damage from which the remaining life is calculated. The remaining life can be determined for any point in time by inputting the appropriate number of aircraft operations for each aircraft n up to that point in time. By computing the remaining life at various points in time, the estimated end of the pavement's useful fatigue life can be determined by projecting the relationship of remaining life to time.

126. To accomplish the pavement life analysis for those pavements with PCC layers, a concrete flexural strength was estimated. Based on engineering judgment and some of the generalized relationships available, it was determined that the concrete flexural strength for Test Area 1 on Taxiway 33 was 650 psi, Test Area 4 on Apron 1-A-1 was 700 psi, and Test Area 5 on Apron 1-A was 600 psi.

127. Using the stress and strain information previously computed and documented, the allowable number of aircraft loads was computed for each of the pavement areas. These allowable traffic levels together with the four pass intensity levels of traffic for each of the five pavement sections allowed the computation of the remaining life in each of the five pavments at each of the four pass intensity levels of aircraft traffic; allowable loads for the 13 aircrafts groups were then computed for each of the four pass intensity levels.

128. The computer program AIRPOD designs overlay thicknesses for either AC or PCC pavements using the same concepts as for the pavement life analysis. The materials inputs are the same as those determined for the remaining life analysis, except that properties of the proposed overlay material must be added as imputs. The traffic imput must include the projected number of future loads of each aircraft type. The program considers the amount of life remaining in the existing pavement when computing the overlay thickness.

129. The Air Force system uses an impulse load applied to the pavement surface. Analysis of collected time-domain accelerometer data by discrete Fourier transform techniques provides the phase angle/frequency information needed for pavement evaluation. Knowing the frequency f and phase angle θ a velocity versus wave length dispersion curve can be developed from the relationships.

$$T = \frac{360d}{\theta} \tag{A43}$$

and

$$v = f\lambda \tag{A44}$$

where

d = accelerometer spacing

θ = phase angle

v = phase velocity

f = frequency

λ = wavelength

130. Interpretation of the dispersion curves must be made by the operator to determine velocity values to be used for each layer in the pavement. These velocity values are used with known or assumed material densities γ and Poisson's ratio ν to determine the elastic moduli of the material layers. The shear modulus G is calculated from

$$G = V_s^2 \left(\frac{\gamma}{g} \right) \tag{A45}$$

where

G = shear modulus

V_s = shear wave velocity

V_s = (Vr/a)

V_r = Rayleigh wave velocity

a = varies from 0.875 for Poisson's ratio of 0.0 to 0.955 for Poisson's ratio of 0.5

γ = unit weight of materials

g = acceleration constant

E = Young's modulus is computed from: $E = 2(1 + \nu)G$

ν = Poisson's ratio (assumed)

Corrections are required in the shear wave velocity of subsurface layers to account for variations in the pavement surface. The following general relationship is used for any layer.

$$V_s = \sqrt{\frac{Gg}{\gamma}} \qquad \text{(A46)}$$

131. Specifically, for layer 2 (base course), the shear wave velocity from the dispersion curve is

$$V'_{s_2} = \sqrt{\frac{G_2 g}{\gamma_2}} \qquad \text{(A47)}$$

However, to correct for the velocity increase as the wave is propagated into the surface the following expression is used.

$$V_{s_2} = \sqrt{\frac{\gamma_1}{G_1} \; \frac{G'_2}{\gamma^2}} \; V'_{s_2} \qquad \text{(A48)}$$

where

V_{s_2} = actual shear wave velocity in the base course

G_1 = shear modulus for the surface layer

G'_2 = shear modulus for the base course using V'_{s_2}

V'_{s_2} = shear wave in the base course from the uncorrected dispersion curve

132. The procedure used is to first calculate shear modulus G for the surface layer and then to calculate G for subsurface layers using the uncorrected shear wave velocity. After shear wave velocities are corrected, then they are used to calculate shear modulus G and Young's modulus E values for each layer. These values are then used in the computer analysis.

133. The primary component of the Air Force nondestructive pavement evaluation system is the field equipment that collects data pertinent to the strength of the materials composing the pavement system. The field equipment

used by the Air Force is contained in a 1978 Ford parcel delivery van with a custom-engineered cargo area to meet air-transportability requirements, so important to the Air Force for rapid deployment capability. The total vehicle weight for field deployment is approximately 11,000 lb. The vehicle is equipped with an aircraft radio for direct communication with the airfield tower and safety beacons which make it highly visible from the air and ground while operating on the airfield.

134. Contained in the rear of the vehicle is a hydraulically operated impact hammer which provides the impulse energy required to obtain pavement response information through a series of pavement-mounted accelerometers. Operation of the system is by a programmable controller with manual override capability. Hammer weights can be varied from 100 to 500 lb by manual addition of weight to the hammer. The drop height can be varied from 0 to 36 in. The assembly is equipped with grippers that lift the hammer, release it, and then catch the hammer after the first impact to prevent the hammer from striking the pavement more than once.

135. Various types of impact plates are employed to enhance the signal frequency content. Typically, an aluminum plate is used. The impact plate is equipped with a switch which provides information for hydraulic control of the grippers and for triggering the data recording equipment.

136. Up to eight accelerometers are mounted to the pavement on 1/4-in.-diam steel studs 1/4 in. long. A quick-setting epoxy cement is used to attach the mounting studs to the pavement. The accelerometers are then screwed into the studs. Spacing between the accelerometers varies as to pavement type and thickness and requires some operating experience. The mounting operation can be completed in less than 20 min.

137. Each accelerometer is hooked up to a power supply and data acquisition equipment. The data acquisition equipment located in the front portion of the cargo area of the vehicle consists of an HP-9845B desktop computer with CRT display, hard copy printer, and 500-kilobyte memory. Data collected through an HP-6942 multiprogrammmer is transferred to the computer for analysis and stored on an HP-9895 floppy disk.

138. In-line filters can be put into the data acquisition system and are designed as gate-type low-pass filters to remove unwanted signals. Filters available to the operator are, 1,000, 2,000, and 5,000 Hz.

139. The computer is primarily used to compute Fast Fourier Transform

(FFT) for phase angle versus frequency and wave velocity versus wavelength (dispersion) plots immediately after the data are obtained. The operator must then decide whether or not the data are acceptable for storage on flexible disks. If they are not, then additional data are collected and analyzed as a separate event or are averaged with previously collected data. When sufficient data are collected for interpretation of the dispersion curve (based on operator experience), the data are stored on a flexible disk and a hard copy made.

140. It is from this hard copy that the operator selects the velocity values that will ultimately be used in the computer analysis for the load-carrying capability of the pavement. The computer analysis on a main-frame computer uses the Air Force-developed PREDICT code.

141. The PREDICT computer code is the second component of the Air Force nondestructive pavement evaluation system. The code uses the field data from the Nondestructive Pavement Testing (NDPT) van, the elastic moduli determined from the field velocity values, to calculate the stresses and strains produced in the pavement as a result of an aircraft wheel load. Stresses and strains are critical locations in the pavement and are compared with fatigue algorithms for the materials to predict the number of cycles to failure for the particular aircraft.

142. The input data required by the PREDICT code are:

a. Type of aircraft for analysis

b. Channelized or nonchannelized traffic analysis

c. Number of material layers composing the pavement

d. Aircraft wheel load and tire pressure

e. Concrete split tensile strength

f. For each material layer:

(1) Thickness

(2) Elastic modulus

(3) Poisson's ratio

(4) Soil type

(5) Void ratio

(6) Degree of saturation

(7) Plasticity index

143. The aircraft must be specified and selected from the aircraft available in the computer code aircraft library. The aircraft presently in

the library are the A-10, F-4, F-15, F-16, F-105, F-111, FB-111A, T-38, T-43, B-1, B-52, B-747, C-5, C-9A, C-130, C-141, KC-97, and KC-135.

144. The selection of a channelized or nonchannelized traffic analysis will depend on the location of the pavement on the airfield. Different values of a pass-to-coverage ratio are used for the channelized versus nonchannelized sections.

145. The number of layers composing the pavement must be determined from the as-built drawings or previously obtained destructive testing reports. However, some instances will occur when the NDT data from the dispersion curves may indicate a different number of material layers than the reports. An example of this may be a concrete pavement over a subgrade soil. Destructive tests indicate a two-layer system, but NDT may indicate a third layer that would be a compacted subgrade layer just beneath the concrete surface layer.

146. Concrete split tensile data are obtained from destructive test results. This material property is used in the evaluation process to determine the modulus of rupture of the concrete. The equation is given as

$$MR = 1.02T + 210.5 \tag{A49}$$

where

MR = modulus of rupture, psi

T = split tensile strength, psi

Calculated tensile stresses at the bottom of the concrete are converted to a percentage of the modulus of rupture and compared to a fatigue algorithm to predict the number of cycles.

147. Material layer thickness, soil type, void ratio, degree of saturation, and plasticity index can be obtained with some minor calculations from the destructive testing reports. Poisson's ratio must be selected as a representative value for the specific material.

148. The elastic modulus for each material layer, as stated earlier, is calculated from the dispersion curves developed in the NDT van.

149. The output of the PREDICT code has been minimized to provide an analysis summary for each pavement section input. The output specifies the number of operations for the concrete or AC surface course and the subgrade material. The number of operations were calculated from the predicted tensile

stress or strain in the surface layer and the subgrade compressive strain.

150. To prepare an allowable gross load table in the format shown in Headquarters, Department of the Air Force (1981), a minimum of three runs of the PREDICT code must be made for each airfield feature and each aircraft evaluated, varying the weights of that aircraft. These varying weights are then plotted versus their respective number of allowable operations, as determined by the code. The curve formed by these points is then used to select permissible aircraft weights at the operation or pass intensity levels corresponding with levels I through IV, as specified in Headquarters, Department of the Air Force (1981).

WES DSM Method (Hall and Alexander 1983)

151. The evaluation method for the DSM procedure is based on correlations between the nondestructive DSM measurements and the computed ASWL as determined on a number of inservice airfield pavements representing a range of pavement types and conditions. DSM is a ratio of dynamic load over deflection obtained with the WES 16-kip vibrator (Hall 1978). The ASWL's were computed from existing Corps of Engineers pavement design procedures, using in place pavement strength measurements determined through test pits and direct sampling procedures.

152. The WES 16-kip vibrator is an electrohydraulic steady-state vibratory loading system. The unit is contained in a 36-ft semitrailer along with supporting power supplies and automatic data recording equipment. A 16,000-lb preload is applied to the pavement with a superimposed dynamic load ranging up to 30,000 lb peak-to-peak. The dynamic load can be applied over a frequency range of 5 to 100 Hz, but the standard test frequency is 15 Hz. The dynamic load is measured with a set of three load cells mounted on an 18-in. diam load plate. Velocity transducers which are located on the load plate and at points away from the plate are calibrated to measure elastic deflection. Test results are recorded on X-Y plotters and a digital printer.

153. Data collected with the WES 16-kip vibrator are the DSM and deflection basins. DSM is obtained from the slope (load/deflection) of the dynamic load versus deflection data obtained by sweeping the force to maximum at a constant frequency of 15 Hz. This slope is taken at the higher force levels. Deflection basins are obtained by measuring deflections at distances of

18, 36, and 60 in. away from the center of the load plate. The deflection ratio Δ_{60}/Δ_{18} is used to determine the radius of relative stiffness ℓ for rigid pavements.

154. The conventional theory used to evaluate military airfield flexible pavements is based on a determination of strength parameters, such as the CBR, moisture, density, classification of materials, and other values, using criteria developed from performance studies. To use the proven performance of the conventional methodology, the nondestructive quantity of the DSM was directly correlated (Green and Hall 1975) to the ASWL, as determined from the standard evaluation procedure based on test-pit measurements. The measured DSM for flexible pavements is corrected to a commom pavement temperature of 70° F, because deflection measurements on AC are sensitive to temperature. A method adopted from the Asphalt Institute (1969) is used to determined the median temperature of the AC layer. This procedure uses the pavement surface temperature at the time of the test plus the previous 5-day air temperatures. This median pavement temperature is then used with relationships developed by WES to correct the measured DSM to 70° F. The temperature-corrected DSM values are used to determine the ASWL using the correlations developed. The ASWL is then converted to AGAL on any desired aircraft at any level of operations (passes) using existing analytical relationships found in the CBR procedure (Headquarters, Departments of the Navy, Army, and Air Force 1978). Overlay thickness requirements for aircraft loads greater than the existing capacity of the pavement can be determined from similar analysis. Once the allowable load is determined, an effective subgrade CBR can be computed. This CBR along with the existing pavement thickness (thickness from existing records or core borings) can be used with CBR procedure to compute AC overlay thickness. PCC overlays for use over flexible pavements cannot be determined with this evaluation.

155. The methodology for NDT evaluation of rigid pavements using the DSM method uses a correlation between the DSM measured at the slab center to the ASWL as determined from standard evaluation procedure based on test-pit measurements. This standard procedure for rigid pavements is based on the Westergaard analysis using material properties such as thickness, subgrade modulus, and flexural strength (Headquarters, Departments of the Army and Air Force 1979).

156. To determine the allowable loading for aircraft having gears with

different geometries, relationships between the loads of these aircraft and the ASWL are used. These relationships are based upon the equivalency of maximum bending stress in the concrete slab. The radius of relative stiffness ℓ is used to interrelate the ASWL to the wheel loads of different geometries through a ratio of the AGAL to the ASWL.

157. The radius of relative stiffness ℓ of a rigid pavement is obtained through deflection basin measurements. A correlation between ℓ determined from nondestructive deflection basin data and ℓ determined by the Westergaard theory gives the relationship between a ratio of deflections measured at points 18 and 60 in. from the center of the load plate as a function of ℓ.

158. The effects of stress repetition levels (aircraft passes) on the AGAL are considered by the use of traffic factors. The traffic factors are a function of the aircraft gear geometry, the lateral distribution of aircraft traffic on the pavement being evaluated, and the traffic volume and are independent of the pavement structure. The AGAL for a specified number of aircraft passes is computed from the equation (Hall 1978)

$$P_G = 0.0189(DSM)(F_L)(T_c) \qquad \text{(A50)}$$

where

F_L = load factor

T_c = traffic factor

159. Overlays of PCC or AC to strengthen existing PCC pavements are determined from overlay equations from the Corps of Engineers conventional procedure (Headquarters, Departments of the Army and Air Force 1979). These overlay equations consider the condition of the existing slabs, the anticipated degree of cracking to occur in the existing slab, and the structural requirements.

160. The procedure for evaluation of composite pavements is to convert AC overlay and PCC slab to an equivalent thickness of PCC and use the procedure for plain rigid pavement substituting the following equation for the AGAL: $P_G = 0.0172(DSM)(F_L)(T_c)$. The radius of relative stiffness ℓ for a composite pavement cannot be determined from reflection basin measurements. The subgrade modulus k can be estimated from the subgrade soil classification, and ℓ can be computed from the Westergaard analysis.

161. Overlays for composite pavements are determined in a manner similar that for rigid pavements except an equivalent slab concept is used for the composite section.

WES Layered-Elastic Method (Holl and Alexander 1983)

162. The layered-elastic methodology was developed under FAA-sponsored research (Bush 1980b) and was initially developed for light aircraft pavements. It has also been found applicable to heavy aircraft pavements (Alexander 1982). The general approach is to use a linear layered-elastic model with measured deflection basins to predict in situ modulus values for a one- to four-layer pavement system. Different NDT loadings are used to describe the nonlinear, stress-dependent modulus of the subgrade. Allowable aircraft loads and overlay thicknesses are determined using limited tensile strain at the bottom of the asphalt layer and vertical compressive strain at the top of the subgrade for flexible pavements. For rigid pavements, a limiting tensile stress at the bottom of the PCC layer is used.

163. The layered-elastic procedure was demonstrated with data from both the WES 16-kip vibrator (previously described) and a FWD. The FWD used by WES is a Dynatest Model 8000 (15 kip). A dynamic force is applied to the pavement surface by dropping a 440-lb weight onto a set of rubber cushions, resulting in an impulse loading. The applied force and pavement deflections are measured with load cells and velocity transducers. The drop height can be varied from 0 to 15.7 in. to produce an impact force from 0 to 15,000 lb. The load is transmitted to the pavement through an 11.8-in.-diam plate. The signal-conditioning equipment displays the resulting pressure in kilopascals and the maximum peak displacement in micrometres. As many as three displacement sensors may be recorded at one time by this data acquisition equipment.

164. FWD data collected were deflection basin measurements. Displacements were measured on the load plate and at distances of 12, 24, 36, and 48 in. away from the center of the load plate. Since this particular model has only two transducers for deflection basin measurement, the four deflection points were obtained by dropping the weight twice at each location and shifting the transducers to the additional spacings.

165. The computer program BISDEF was developed at WES to determine modulus values for pavement layers. BISDEF uses the Shell BISAR (Headquarters,

Department of the Army and Air Force 1979) multilayered linear elastic program. In this procedure, the thicknesses of the layers are determined from historical data or from cores. Poisson's ratios are assumed and a rigid boundary is placed at a depth of 20 ft. Initial modulus values are assumed for each layer as well as an upper and lower limit for the modulus. The layered-elastic program is used to calculate a deflection basin produced by the loading of the NDT device. The calculated basin is compared to the measured basin. If the basins do not agree, the modulus values are changed through an iterative procedure until a set of modulus values is determined, producing a basin from the layered-elastic theory that matches the basin measured with the NDT device. A match is considered adequate when the sum of the absolute values of the differences in the measured and calculated deflections is less than 10 percent. Hence, the average difference for each deflection is less than plus or minus 2.5 percent. For this study, a modulus value of 250,000 psi was assigned to the asphalt layers to account for seasonally higher temperatures than were encountered during the test period.

166. Allowable load-carrying capacities and required overlay thicknesses were evaluated using the WES-developed computer program AIRPAV. For a particular aircraft (gear configuration, load, pass intensity level, etc.), AIRPAV uses the modulus values determined from BISDEF and the BISAR program to compute stresses (for rigid pavement) and strains (for flexible pavement) that will occur in the pavement system. AIRPAV then calculates the limiting stress or strain values based on present Corps of Engineers design and evaluation criteria. The allowable load for the aircraft is determined by comparing the predicted stress or strain to the limiting value.

167. The evaluation of rigid pavements is based on the tensile stress at the bottom of the slab which is determined as follows.

$$\sigma_{All} = \frac{R}{A + B\left(\mathrm{LOG}_{10}\ \mathrm{COV}\right)} \qquad \text{(A51)}$$

where

R = PCC flexural strength

A = 0.58901

B = 0.35486

COV = aircraft coverages

The horizontal tensile strain at the bottom of the AC and the vertical subgrade strain are both considered in the evaluation of flexible pavements. The allowable AC strain criteria used is as follows (Heukelom and Klomp 1962):

$$\epsilon_{All_{(AC)}} = 10^{-A} \qquad \text{(A52)}$$

where

$$A = \frac{N + 2.665\left(LOG_{10}\ \frac{E_{AC}}{14.22}\right) + 0.392}{5.0}$$

$N = LOG_{10}$ (aircraft coverages)

E_{AC} = AC modulus

The allowable subgrade strains are computed using the following.

$$N = 10{,}000\left(\frac{A}{\epsilon_{All_{subg}}}\right)^{B} \qquad \text{(A53)}$$

where

N = repetitions

$A = 0.000247 + 0.000245 \log E_{subgrade}$

$B = 0.0658\ (E_{subgrade})^{0.559}$

168. For overlay computations, the required pavement thicknesses are computed by increasing the thickness of the upper layer until the stress or strain criteria are satisfied. AIRPAV accepts as input an initial thickness and uses an iterative procedure to close in on the actual thickness needed to support the aircraft under consideration. AC overlays on AC pavements are simply the difference between the required thickness and the existing AC thickness. Overlays were computed for the PCC pavements using the following.

$$\text{AC overlay} = 2.5\ (Fh_d - C_b h) \qquad \text{(A54)}$$

$$\text{PCC (partially bonded)} = \sqrt{h_d^2 = C_r h^2} \qquad \text{(A55)}$$

$$\text{PCC unbonded} = \sqrt[1.4]{h_d^{\ 1.4} - C_r h^{1.4}} \qquad \text{(A56)}$$

where

F = factor projecting the cracking that may be expected in existing PCC pavements

h_d = required thickness of PCC, in.

C_b = condition factor of existing pavement, ranges between 0.75 and 1.00

h = thickness of existing PCC pavement, in.

C_r = condition factor of existing pavement, ranges between 0.35 and 1.00

WES Evaluation of Load Transfer

169. The ability of joints in PCC slabs to transfer load is measured with the NDT device. The ratio of deflections measured on each side of the joint (deflection of unloaded slab/deflection of loaded slab) is related to joint efficiency or load transfer. The allowable loads determined at the slab centers can be reduced for poor joint transfer using load-reduction factors. These factors are a function of the deflection ratio.

170. This procedure was developed by first relating the deflection ratios to the percent edge stress. The maximum edge stress condition is a free edge with no load transfer. The edge stress is reduced as more load is transferred across the joint. The design use by the Air Force assumes 75-percent-maximum edge stress (25 percent is carried by adjacent slab). Computations were made with both the ILLISLAB program (Tabatabie and Barenberg 1979) and the WESLIQUID (Chou 1981) (both are finite element programs) for a range of pavement thicknesses and subgrade moduli k. By computing the allowable percent of design load at different deflection ratios, a relationship was developed between the deflection ratio and load-reduction factors. The procedure provided for reducing the allowable load determined at the slab center to account for the load-transfer capabilities at the joint. The load-reduction factor falls between 0.75 and 1.00.

APPENDIX B: TEST DATA

This appendix contains test data collected on the five test area pavements at MacDill AFB during the period 27 October-3 November 1982. The data presented herein were furnished by the following participants using the NDT equipment indicated:

Participant	NDT Equipment
Pavement Consultancy Services, Inc	PCS Falling Weight Deflectometer (FWD)
ARE, Inc.	ARE Dynaflect
Dynatest Consulting, Inc.	Dynatest Model 8000 FWD
ERES	Dynatest Model 8000 FWD
Louis Berger International, Inc	Berger Model 2000 Pavement Profiler
Reinard W. Brandley	Dynatest Model 8000 FWD Brandley Cantilever Beam
Waterways Experiment Station	WES 16-kip Vibrator WES 15-kip FWD (Dynatest)

TEST DATA FROM PAVEMENT CONSULTANCY

SERVICES, INC.

Data Collected with PCS Falling

Weight Deflectometer

TABLE 1

MACDILL AIRFORCE BASE TAMPA FLORIDA
Taxiway 33 Deflection measurements (27-10-82)

POSITION-IDENTIFICATION sect-code -		time hh.mm	dist. km	DEFLECTIONS (um/10kN) Delta 0	Delta 60	Delta 100	Delta 200	FORCE fwd. x10kN	Q-VALUES (-) Q 60	Q 100	Q 200
CENTRE LINE	1	11.41	0.0	5.9	5.8=	3.7	3.6	10.0	0.983	0.627	0.610
CENTRE LINE	2	11.44	0.023	6.3	6.2<	3.9	3.9	10.0	0.984	0.619	0.619
CENTRE LINE	3	11.45	0.046	5.7>	5.7	4.0	3.9	10.0	1.000<	0.702	0.684
CENTRE LINE	4	11.47	0.069	5.5	5.5>	3.7	3.5>	10.0	1.000	0.673	0.636
CENTRE LINE	5	11.49	0.092	6.4<	5.7	3.7	3.6	10.0	0.891	0.578	0.563
CENTRE LINE	6	11.50	0.116	6.1=	5.7	3.6>	3.6	10.0	0.934	0.590>	0.590
CENTRE LINE	7	11.52	0.139	6.1	6.1	4.0	4.0<	10.0	1.000	0.656	0.656
CENTRE LINE	8	11.53	0.161	6.3	5.4	3.5	3.3	10.0	0.857	0.556	0.524
CENTRE LINE	9	11.55	0.183	6.0	5.7	3.9	3.9	10.0	0.950	0.650	0.650
CENTRE LINE	10	11.56	0.206	6.0	5.7	3.8=	3.8	10.0	0.950	0.633	0.633
LEFT CL	11	12.02	0.0	6.1	5.8	3.9	3.8	10.0	0.951	0.639	0.623
LEFT CL	12	12.03	0.023	6.3	5.8	3.8	3.5	10.0	0.921	0.603	0.556
LEFT CL	13	12.05	0.046	6.2	6.0	3.8	3.8	10.0	0.968=	0.613	0.613=
LEFT CL	14	12.06	0.069	5.6	5.5	3.7	3.6	10.0	0.982	0.661	0.643
LEFT CL	15	12.07	0.092	6.3	5.8	3.6	3.6	10.0	0.921	0.571	0.571
LEFT CL	16	12.09	0.115	6.3	6.3	4.1<	3.9	10.0	1.000	0.651	0.619
LEFT CL	17	12.11	0.137	7.0	6.6	4.4	4.4	10.0	0.943	0.629=	0.629
LEFT CL	18	12.12	0.161	6.0	5.7	3.6	3.5	10.0	0.950	0.600	0.583
LEFT CL	19	12.13	0.183	6.2	5.8	3.7	3.7=	10.0	0.935	0.597	0.597
RIGHT CL	20	12.18	0.0	6.2	6.1	4.0	4.0	10.0	0.984	0.645	0.645
RIGHT CL	21	12.19	0.023	6.4	5.9	3.8	3.7	10.0	0.922>	0.594	0.578>
RIGHT CL	22	12.20	0.046	5.7	5.7	3.7	3.7	10.0	1.000	0.649	0.649<
RIGHT CL	23	12.22	0.069	5.8	5.8	3.9	3.7	10.0	1.000	0.672<	0.638
RIGHT CL	24	12.23	0.092	5.9	5.9	4.2	3.6	10.0	1.000	0.712	0.610
RIGHT CL	25	12.24	0.116	6.8	6.6	4.3	4.1	10.0	0.971	0.632	0.603
RIGHT CL	26	12.26	0.138	5.7	5.6	3.5	3.5	10.0	0.982	0.614	0.614
RIGHT CL	27	12.27	0.161	5.8	5.7	3.8	3.6	10.0	0.983	0.655	0.621
RIGHT CL	28	12.29	0.184	6.0	5.7	3.6	3.6	10.0	0.950	0.600	0.600

S T A T I S T I C S

		Delta 0	Delta 60	Delta 100	Delta 200	Q 60	Q 100	Q 200
85-PERCENTILE VALUES	(<)	6.4	6.2	4.1	4.0	0.999	0.668	0.649
MEAN VALUES	(=)	6.1	5.8	3.8	3.7	0.961	0.629	0.613
15-PERCENTILE VALUES	(>)	5.7	5.5	3.6	3.5	0.923	0.590	0.577

END

TABLE 5

MACDILL AIRFORCE BASE TAMPA FLORIDA
Taxiway 3-B Deflection measurements (27-10-82)

POSITION-IDENTIFICATION sect-code		time hh.mm	dist. km	DEFLECTIONS (um/10kN) Delta 0	Delta 60	Delta 100	Delta 200	FORCE fwd. x10kN	Q-VALUES (-) Q 60	Q 100	Q 200
-											
CENTRE LINE	1	14.07	0.0	29.3	14.3	7.7	4.0	10.0	0.488	0.263	0.137
CENTRE LINE	2	14.09	0.051	28.8)	16.1	8.5	4.1	10.0	0.559	0.295	0.142
CENTRE LINE	3	14.10	0.102	36.8	16.2	8.4=	4.0	10.0	0.440	0.228	0.109
CENTRE LINE	4	14.12	0.153	27.3	14.6)	8.1	3.7	10.0	0.535	0.297	0.136
CENTRE LINE	5	14.14	0.204	32.1	15.6	9.2	4.5(	10.0	0.517	0.287	0.140(
3.5M LEFT CL	6	14.21	0.0	34.3	19.0	9.8	4.5	10.0	0.554	0.286(	0.131
3.5M LEFT CL	7	14.23	0.026	33.3=	16.9	8.8	4.3	10.0	0.508	0.264	0.129=
3.5M LEFT CL	8	14.24	0.051	37.1(	19.3	9.9	4.6	10.0	0.520	0.267	0.124
3.5M LEFT CL	9	14.26	0.077	38.8	18.3(	9.4(	4.5	10.0	0.472)	0.242	0.116)
3.5M LEFT CL	10	14.27	0.104	33.6	16.8	8.3	4.2=	10.0	0.500	0.247	0.125
3.5M LEFT CL	11	14.29	0.129	31.4	16.1	7.9	4.1	10.0	0.513	0.252=	0.131
3.5M LEFT CL	12	14.31	0.159	32.0	17.4	8.8	4.5	10.0	0.544(	0.275	0.141
3.5M LEFT CL	13	14.32	0.185	30.1	16.9	8.5	4.4	19.0	0.561	0.282	0.146
3.5M LEFT CL	14	14.33	0.211	36.8	19.5	10.3	4.8	10.0	0.530	0.280	0.130
3.5M RIGHT CL	15	14.38	0.0	30.5	16.4=	8.0	4.2	10.0	0.538	0.262	3.138
3.5M RIGHT CL	16	14.40	0.025	34.5	16.4	7.6	4.1	10.0	0.475	0.220)	0.119
3.5M RIGHT CL	17	14.42	0.050	35.0	15.8	8.0	4.3	10.0	0.480	0.229	0.123
3.5M RIGHT CL	18	14.43	0.075	29.8	14.6	6.8	3.9)	10.0	0.490	0.228	0.131
3.5M RIGHT CL	19	14.48	0.101	38.4	16.2	7.6	4.2	10.0	0.122	0.198	0.109
3.5M RIGHT CL	20	14.50	0.126	30.5	14.4	6.9)	3.9	10.0	0.472	0.226	0.128
3.5M RIGHT CL	21	14.52	0.152	25.6	12.1	5.5	3.4	10.0	0.473	0.215	0.133
3.5M RIGHT CL	22	14.53	0.177	30.5	15.3	9.2	4.9	10.0	0.502=	0.302	0.131
3.5M RIGHT CL	23	14.59	0.202	41.5	18.2	8.9	4.5	10.0	0.439	0.214	0.108

S T A T I S T I C S

		Delta 0	Delta 60	Delta 100	Delta 200	Q 60	Q 100	Q 200
85-PERCENTILE VALUES	(()	37.1	18.3	9.5	4.5	0.542	0.286	0.140
MEAN VALUES	(=)	33.0	16.5	8.4	4.2	0.501	0.255	0.129
15-PERCENTILE VALUES	())	28.8	14.6	7.2	3.9	0.461	0.223	0.117

END

TABLE 11

MACDILL AIRFORCE BASE TAMPA FLORIDA

Taxiway 3 Deflection measurements (27-10-82)

POSITION-IDENTIFICATION sect-code		time hh.mm	dist. km	DEFLECTIONS (um/10kN) Delta 0	Delta 60	Delta 100	Delta 200	FORCE fwd. x10kN	Q-VALUES (-) Q 60	Q 100	Q 200
CENTRE LINE	1	15.16	0.0	46.9	24.5	11.3(	4.8	10.0	0.522	0.241	0.102
CENTRE LINE	2	15.18	0.050	48.8	25.6	12.1	5.4	10.0	0.525	0.248	0.111
CENTRE LINE	3	15.19	0.101	42.0	24.3	12.2	5.0)	10.0	0.579	0.290	0.119
CENTRE LINE	4	15.21	0.151	48.5	24.3	11.7	5.1	10.0	0.501	0.24[illegible]	0.105
CENTRE LINE	5	15.23	0.202	48.9	22.2	11.0	5.3	10.0	0.454(	0.225	0.108
CENTRE LINE	6	15.25	0.253	39.4	22.8	10.5	5.3	10.0	0.579	0.266	0.135
CENTRE LINE	7	15.27	0.303	51.8)	22.4	11.1	5.1	10.0	0.432	0.214(	0.098(
3.5M LEFT CL	8	15.31	0.0	82.4	24.4	10.3=	5.2=	10.0	0.296	0.125	0.063
3.5M LEFT CL	9	15.36	0.025	94.4	25.3	10.0	5.3	10.0	0.268	0.106)	0.056
3.5M LEFT CL	10	15.38	0.050	80.7	26.4(	11.2	5.8	10.0	0.327	0.139	0.072
3.5M LEFT CL	11	15.40	0.075	81.7	29.0	11.7	5.3	10.0	0.355=	0.143=	0.065
3.5M LEFT CL	12	15.41	0.100	78.1	26.2	10.4	5.0	10.0	0.335	0.133	0.064
3.5M LEFT CL	13	15.43	0.126	86.4	22.4	10.4	5.0	10.0	0.259	0.120	0.058
3.5M LEFT CL	14	15.45	0.151	89.9(	26.8	10.6	5.0	10.0	0.298	0.118	0.056
3.5M LEFT CL	15	15.47	0.176	81.8	24.0=	10.5	5.6	10.0	0.293	0.128	0.068
3.5M LEFT CL	16	15.48	0.201	79.5	20.4	9.0	5.2	10.0	0.257)	0.113	0.065
3.5M LEFT CL	17	15.50	0.226	76.8	22.8	9.5)	5.3	10.0	0.297	0.124	0.069
3.5M LEFT CL	18	15.52	0.251	76.5	22.1	10.9	5.4	10.0	0.289	0.142	0.071
3.5M LEFT CL	19	15.54	0.276	70.7	20.0	8.6	5.1	10.0	0.283	0.122	0.072
3.5M LEFT CL	20	15.5[illegible]	0.301	71.8	22.2	9.0	5.0	10.0	0.309	0.125	0.070
3.5M RIGHT CL	21	16.01	0.0	78.8	24.8	9.6	4.9	10.0	0.315	0.122	0.062
3.5M RIGHT CL	22	16.03	0.025	82.0	24.3	10.1	5.4	10.0	0.296	0.123	0.066
3.5M RIGHT CL	23	16.06	0.050	79.4	23.6	10.0	5.4	10.0	0.297	0.126	0.068
3.5M RIGHT CL	24	16.08	0.076	83.4	25.1	10.2	5.4	10.0	0.301	0.122	0.065
3.5M RIGHT CL	25	16.10	0.101	83.0	25.3	10.4	5.1	10.0	0.305	0.125	0.061
3.5M RIGHT CL	26	16.12	0.126	89.6	27.2	10.7	5.0	10.0	0.304	0.119	0.056
3.5M RIGHT CL	27	16.14	0.152	92.2	27.9	10.6	5.0	10.0	0.303	0.115	0.054)
3.5M RIGHT CL	28	16.16	0.177	94.5	26.4	11.8	5.5(	10.0	0.279	0.125	0.058
3.5M RIGHT CL	29	16.18	0.202	82.9	24.3	10.4	5.6	10.0	0.293	0.125	0.068
3.5M RIGHT CL	30	16.26	0.227	66.3	21.6)	8.8	5.1	10.0	0.326	0.133	0.077
3.5M RIGHT CL	31	16.22	0.252	70.9	25.8	9.8	5.3	10.0	0.364	0.138	0.075=
3.5M RIGHT CL	32	16.24	0.277	72.9=	20.3	7.9	4.3	10.0	0.278	0.108	0.066
3.5M RIGHT CL	33	16.26	0.302	72.5	20.8	8.8	5.1	10.0	0.287	0.121	0.070
S T A T I S T I C S											
85-PERCENTILE VALUES (()				89.8	26.4	11.4	5.5		0.443	0.205	0.096
MEAN VALUES (=)				73.5	24.1	10.3	5.2		0.346	0.150	0.075
15-PERCENTILE VALUES ())				57.2	21.8	9.3	5.0		0.248	0.096	0.054

END

TABLE 17

MACDILL AIRFORCE BASE TAMPA FLORIDA
Apron 1-A-1 Deflection measurements (27-10-82)

POSITION-IDENTIFICATION sect-code -		time hh.mm	dist. km	DEFLECTIONS (um/10kN) Delta 0	Delta 60	Delta 100	Delta 200	FORCE fwd. x10kN	Q-VALUES Q 60	Q 100	(-) Q 200
APRON 1-A-1	1	8.38	0.0	19.0>	17.9	12.2	7.5	10.0	0.942	0.642<	0.395
APRON 1-A-1	2	8.40	0.025	19.3	18.7	11.5	5.8	10.0	0.969	0.596	0.301=
APRON 1-A-1	3	8.43	0.050	22.8	21.8=	14.0	7.6=	10.0	0.956	0.614	0.333
APRON 1-A-1	4	8.45	0.075	42.8	40.3	24.3	12.3	10.0	0.942	0.568	0.287
APRON 1-A-1	5	8.49	0.0	27.4	27.6	17.8	10.0	10.0	1.007	0.650	0.365
APRON 1-A-1	6	8.51	0.025	26.6	27.9	17.1	9.4	10.0	1.049	0.643	0.353
APRON 1-A-1	7	8.53	0.050	26.6	24.6	15.8	7.4	10.0	0.925	0.594	0.278
APRON 1-A-1	8	8.54	0.075	36.2	35.9	20.4	12.9	10.0	0.992<	0.564	0.356<
APRON 1-A-1	9	9.00	0.0	31.5	30.5	17.9<	10.9<	10.0	0.968	0.568	0.346
APRON 1-A-1	10	9.07	0.025	24.9=	20.8	14.8=	8.3	10.0	0.835	0.594	0.333
APRON 1-A-1	11	9.09	0.050	29.4	24.2	16.8	7.0	10.0	0.823	0.571=	0.238>
APRON 1-A-1	12	9.10	0.075	32.8<	30.4<	22.1	12.4	10.0	0.927	0.674	0.378
APRON 1-A-1	13	9.12	0.0	26.4	18.9	12.1	5.1	10.0	0.716	0.458	0.193
APRON 1-A-1	14	9.14	0.025	21.0	15.9	11.1	5.5	10.0	0.757	0.529>	0.262
APRON 1-A-1	15	9.15	0.050	19.9	16.3	12.3	5.4	10.0	0.819	0.618	0.271
APRON 1-A-1	16	9.17	0.075	16.6	13.2	9.1	5.0	10.0	0.795>	0.548	0.301
APRON 1-A-1	17	9.19	0.0	22.2	18.3	11.8	4.9>	10.0	0.824	0.532	0.221
APRON 1-A-1	18	9.21	0.025	22.5	15.3>	10.3>	5.3	10.0	0.680	0.458	0.236
APRON 1-A-1	19	9.23	0.050	20.7	18.0	12.4	5.3	10.0	0.870=	0.599	0.256
APRON 1-A-1	20	9.25	0.075	19.9	16.6	11.2	5.4	10.0	0.834	0.563	0.271

S T A T I S T I C S

85-PERCENTILE VALUES	(<)	32.2	30.3	19.1	10.5		0.986	0.638	0.357
MEAN VALUES	(=)	25.4	22.7	14.7	7.7		0.881	0.579	0.299
15-PERCENTILE VALUES	(>)	18.6	15.0	10.4	4.8		0.777	0.520	0.240

END

TABLE 23

MACDILL AIRFORCE BASE TAMPA FLORIDA
Apron 1-A Deflection measurements (27-10-82)

POSITION-IDENTIFICATION sect-code		time hh.mm	dist. km	DEFLECTIONS (um/10kN) Delta 0	Delta 60	Delta 100	Delta 200	FORCE fwd. x10kN	Q-VALUES (-) Q 60	Q 100	Q 200
APRON 1-A	1	9.51	0.000	19.3	14.3	10.0	6.1	10.0	0.741	0.518	0.316
APRON 1-A	2	9.53	0.015	17.0	14.5	10.1)	5.8	10.0	0.853	0.594	0.341
APRON 1-A	3	9.55	0.030	16.8	15.5	10.6	6.2	10.0	0.923(	0.631(	0.369
APRON 1-A	4	9.56	0.045	19.3	16.2	11.3	6.0)	10.0	0.839	0.585	0.311
APRON 1-A	5	9.58	0.060	17.0	15.3	10.7	7.0(	10.0	0.900	0.629	0.412
APRON 1-A	6	10.03	0.000	18.1=	15.1	10.4	6.4	10.0	0.834	0.575)	0.354
APRON 1-A	7	10.04	0.015	17.8	15.4	10.5	6.3	10.0	0.865	0.590	0.354
APRON 1-A	8	10.07	0.030	18.8	16.7	11.5	6.7	10.0	0.888	0.612	0.356
APRON 1-A	9	10.09	0.045	18.9	17.1(	11.6	6.1	10.0	0.905	0.614	0.323)
APRON 1-A	10	10.11	0.060	17.9	15.5	10.4	6.4	10.0	0.866	0.581	0.358=
APRON 1-A	11	10.16	0.030	19.0	17.1	11.9	7.9	10.0	0.900	0.626	0.416
APRON 1-A	12	10.18	0.045	18.2	16.4	11.2	6.9	10.0	0.901	0.615	0.379
APRON 1-A	13	10.19	0.060	17.4	15.4	10.8=	7.0	10.0	0.885	0.621	0.402
APRON 1-A	14	10.22	0.000	21.1	18.7	12.8	6.8	10.0	0.886	0.607	0.322
APRON 1-A	15	10.23	0.015	17.3	15.3	10.8	6.3	10.0	0.884	0.624	0.364
APRON 1-A	16	10.24	0.030	18.8	17.2	10.8	6.9	10.0	0.915	0.574	0.367
APRON 1-A	17	10.26	0.045	18.3	15.3	10.6	6.3	10.0	0.836)	0.579	0.344
APRON 1-A	18	10.27	0.060	15.8	14.9	9.9	6.3	10.0	0.943	0.627	0.399(
APRON 1-A	19	10.31	0.000	21.5	18.1	12.7	6.9	10.0	0.842	0.591	0.321
APRON 1-A	20	10.32	0.015	17.8	16.6	11.8(	7.6	10.0	0.933	0.663	0.427
APRON 1-A	21	10.33	0.030	20.4	17.6	11.9	6.4	10.0	0.863	0.583	0.314
APRON 1-A	22	10.35	0.045	19.4(	16.5	11.3	6.4	10.0	0.851	0.582	0.330
APRON 1-A	23	10.36	0.060	16.6)	15.1	10.6	6.8	10.0	0.910	0.639	0.410
APRON 1-A	24	10.39	0.000	17.4	16.1=	11.2	6.1	10.0	0.925	0.644	0.351
APRON 1-A	25	10.40	0.015	16.9	14.9	10.2	5.6	10.0	0.882=	0.604=	0.331
APRON 1-A	26	10.41	0.030	16.1	14.7)	10.1	6.5=	10.0	0.913	0.627	0.404
APRON 1-A	27	10.43	0.045	16.7	14.4	9.8	5.8	10.0	0.862	0.587	0.347
APRON 1-A	28	10.44	0.060	16.8	15.0	10.3	6.4	10.0	0.893	0.613	0.381

S T A T I S T I C S

85-PERCENTILE VALUES (<)				19.6	17.1	11.7	7.0		0.922	0.635	0.397
MEAN VALUES (=)				18.1	15.9	10.9	6.5		0.880	0.605	0.361
15-PERCENTILE VALUES (>)				16.6	14.7	10.1	6.0		0.837	0.575	0.325

END

TEST DATA FROM ARE, INC.

Data Collected with ARE Dynaflect

MACDILL AIR FORCE BASE
DYNAFLECT MEASUREMENTS

LOCATION : TAMPA, FL.
PAVEMENT ID : TAXIWAY 33, AREA 1

PROJECT NO: AF-8
CLIENT : U.S. AIR FORCE
DATE : 10/82

RDG NO	STATION	DYNAFLECT READINGS #1	#2	#3	#4	#5	TEMP.	TIME	I/E	C/M
1	0.00	.470	.420	.340	.310	.252	0.	1115	1	1
5	1.00	.330	.300	.237	.213	.186	0.		1	1
9	2.00	.330	.300	.240	.213	.180	0.		1	1
13	3.00	.340	.300	.258	.222	.198	0.	1135	1	1
17	4.00	.390	.360	.320	.267	.234	0.		1	1
21	5.00	.310	.270	.234	.204	.183	0.		1	1
25	6.00	.267	.240	.210	.174	.156	0.	1149	1	1
	MEAN =	.348	.313	.263	.229	.198				
	STD.DEV =	.065	.060	.048	.045	.033				
	COEF.VAR=	18.676	19.064	18.424	19.704	16.800				
	#OF PTS =	7								
2	.12	.147	.147	.138	.126	.126	0.		1	2
6	1.12	.162	.162	.153	.141	.135	0.		1	2
10	2.12	.150	.150	.141	.126	.126	0.		1	2
14	3.12	.162	.162	.159	.150	.141	0.		1	2
18	4.12	.189	.189	.186	.171	.165	0.		1	2
22	5.12	.159	.159	.150	.141	.132	0.		1	2
26	6.12	.138	.138	.129	.123	.114	0.		1	2
	MEAN =	.158	.158	.151	.140	.134				
	STD.DEV =	.016	.016	.018	.017	.016				
	COEF.VAR=	10.257	10.257	12.243	12.201	11.954				
	#OF PTS =	7								
3	.50	.390	.340	.300	.225	.207	0.		2	1
7	1.50	.330	.300	.231	.204	.180	0.	1127	2	1
11	2.50	.300	.255	.222	.186	.171	0.		2	1
15	3.50	.390	.360	.310	.240	.219	0.		2	1
19	4.50	.400	.370	.330	.261	.249	0.		2	1
23	5.50	.243	.213	.192	.159	.144	0.		2	1
27	6.50	.310	.264	.219	.189	.159	0.		2	1
	MEAN =	.338	.300	.258	.209	.190				
	STD.DEV =	.059	.059	.054	.035	.037				
	COEF.VAR=	17.344	19.697	20.988	16.763	19.411				

MACDILL AIR FORCE BASE
DYNAFLECT MEASUREMENTS

LOCATION : TAMPA, FL.
PAVEMENT ID ; TAXIWAY 33, AREA 1

PROJECT NO: AF-8
CLIENT : U.S. AIR FORCE
DATE : 10/82

RDG NO	STATION	DYNAFLECT READINGS #1	#2	#3	#4	#5	TEMP.	TIME	I/E	C/M
4	.62	.162	.156	.153	.144	.135	0.		2	2
8	1.62	.150	.150	.138	.132	.126	0.		2	2
12	2.62	.156	.156	.153	.141	.132	0.		2	2
16	3.62	.168	.168	.162	.153	.147	0.		2	2
20	4.62	.192	.192	.186	.177	.168	0.		2	2
24	5.62	.135	.135	.132	.117	.111	0.		2	2
28	6.62	.150	.150	.141	.132	.123	0.		2	2
	MEAN =	.159	.158	.152	.142	.135				
	STD.DEV =	.018	.018	.018	.019	.018				
	COEF.VAR=	11.268	11.314	11.924	13.382	13.708				
	#OF PTS =	7								

MACDILL AIR FORCE BASE
DYNAFLECT MEASUREMENTS

LOCATION : TAMPA, FL.
PAVEMENT : TAXIWAY 3B, AREA 2

PROJECT NO: AF-8
CLIENT : U.S. AIR FORCE
DATE : 10/82

RDG NO	STATION	DYNAFLECT READINGS #1	#2	#3	#4	#5	TEMP.	TIME	I/E C/M
1	0.00	.400	.350	.255	.231	.177	0.	259	3
3	1.00	.380	.320	.228	.186	.159	0.		3
5	2.00	.440	.360	.249	.198	.168	0.		3
7	3.00	.410	.350	.237	.189	.150	0.		3
9	4.00	.360	.310	.219	.177	.144	0.	313	3
11	5.00	.340	.264	.186	.156	.129	0.		3
13	6.00	.390	.340	.225	.198	.168	0.		3
15	7.00	.480	.400	.320	.234	.198	0.	321	3
	MEAN =	.400	.337	.240	.196	.162			
	STD.DEV =	.044	.040	.039	.026	.021			
	COEF.VAR=	11.100	11.874	16.100	13.334	13.141			
	#OF PTS =	8							
2	.50	.440	.390	.310	.231	.201	0.		4
4	1.50	.430	.380	.300	.231	.192	0.	306	4
6	2.50	.450	.400	.310	.222	.183	0.		4
8	3.50	.420	.360	.249	.186	.153	0.		4
10	4.50	.400	.350	.249	.195	.162	0.		4
12	5.50	.370	.330	.240	.189	.156	0.		4
14	6.50	.460	.410	.300	.237	.201	0.		4
	MEAN =	.424	.374	.280	.213	.178			
	STD.DEV =	.031	.029	.032	.022	.021			
	COEF.VAR=	7.310	7.691	11.419	10.382	11.773			
	#OF PTS =	7							
16	.84	.400	.350	.255	.207	.177	0.		5
	MEAN =	.400	.350	.255	.207	.177			
	STD.DEV =	0.000	0.000	0.000	0.000	0.000			
	COEF.VAR=	0.000	0.000	0.000	0.000	0.000			
	#OF PTS =	1							

MACDILL AIR FORCE BASE
DYNAFLECT MEASUREMENTS

LOCATION : TAMPA, FL.
PAVEMENT ID : TAXIWAY 3, AREA 3

PROJECT NO: AF-8
CLIENT : U.S. AIR FORCE
DATE : 10/82

RDG NO	STATION	DYNAFLECT READINGS #1	#2	#3	#4	#5	TEMP.	TIME	I/E C/M
1	0.00	.790	.570	.360	.237	.180	0.	401	3
3	1.00	.790	.590	.400	.300	.219	0.		3
5	2.00	.800	.570	.370	.243	.216	0.		3
7	3.00	.810	.590	.390	.264	.201	0.		3
9	4.00	.990	.670	.410	.270	.201	0.		3
11	5.00	.960	.630	.390	.267	.201	0.		3
13	6.00	.990	.670	.440	.258	.228	0.	417	3
15	7.00	.900	.600	.390	.246	.210	0.		3
17	8.00	.800	.600	.380	.258	.201	0.		3
19	9.00	.800	.600	.370	.2[illegible]0	.195	0.		3
21	10.00	.830	.600	.400	.300	.210	0.		3
	MEAN =	.860	.608	.391	.259	.206			
	STD.DEV =	.083	.035	.022	.026	.013			
	COEF.VAR=	9.687	5.687	5.657	10.115	6.304			
	#OF PTS =	11							

RDG NO	STATION	#1	#2	#3	#4	#5	TEMP.	TIME	I/E C/M
2	.50	.900	.590	.400	.243	.219	0.		4
22	.62	.900	.600	.380	.225	.189	0.		4
4	1.50	.990	.700	.460	.320	.240	0.		4
6	2.50	.960	.670	.430	.300	.225	0.		4
8	3.50	.790	.580	.380	.258	.198	0.		4
10	4.50	.580	.490	.370	.252	.228	0.		4
12	5.50	.900	.640	.420	.300	.219	0.		4
14	6.50	.900	.630	.410	.300	.222	0.		4
16	7.50	.810	.600	.380	.258	.207	0.		4
18	8.50	.770	.550	.350	.240	.183	0.		4
20	9.50	.810	.580	.370	.249	.195	0.		4
	MEAN =	.846	.603	.395	.268	.211			
	STD.DEV =	.113	.057	.032	.031	.018			
	COEF.VAR=	13.349	9.505	8.105	11.723	8.572			
	#OF PTS =	11							

MACDILL AIR FORCE BASE
DYNAFLECT MEASUREMENTS

LOCATION : TAMPA, FL.
PAVEMENT ID : APRON 1A1, AREA 4

PROJECT NO: AF-8
CLIENT : U.S. AIR FORCE
DATE : 10/82

RDG NO	STATION	DYNAFLECT READINGS #1	#2	#3	#4	#5	TEMP.	TIME	I/E C/M
26	.55	.450	.430	.390	.350	.310	0.		
	MEAN =	.450	.430	.390	.350	.310			
	STD.DEV =	0.000	0.000	0.000	0.000	0.000			
	COEF.VAR=	0.000	0.000	0.000	0.000	0.000			
	#OF PTS =	1							
1	0.00	.400	.380	.340	.290	.246	0.	1006	A
2	.50	.340	.330	.310	.258	.234	0.		A
3	1.00	.400	.380	.350	.310	.267	0.		A
4	1.50	.500	.490	.450	.390	.350	0.		A
5	2.00	.360	.350	.330	.267	.246	0.		A
	MEAN =	.400	.386	.356	.303	.269			
	STD.DEV =	.062	.062	.055	.053	.047			
	COEF.VAR=	15.411	16.033	15.334	17.392	17.509			
	#OF PTS =	5							
10	.50	.380	.370	.350	.300	.267	0.		B
9	1.00	.430	.420	.390	.370	.320	0.		B
8	1.50	.510	.500	.460	.400	.360	0.		B
7	2.00	.410	.390	.340	.300	.258	0.		B
6	2.50	.340	.340	.330	.261	.231	0.	1017	B
	MEAN =	.414	.404	.374	.326	.287			
	STD.DEV =	.063	.061	.053	.057	.052			
	COEF.VAR=	15.334	15.117	14.224	17.469	18.088			
	#OF PTS =	5							
11	0.00	.430	.410	.380	.310	.285	0.		C
12	.50	.440	.440	.430	.390	.370	0.		C
13	1.00	.580	.500	.400	.300	.261	0.		C
14	1.50	.490	.480	.450	.390	.340	0.		C
15	2.00	.820	.700	.580	.450	.360	0.		C
	MEAN =	.552	.506	.448	.368	.323			
	STD.DEV =	.161	.114	.079	.063	.048			
	COEF.VAR=	29.194	22.516	17.533	17.014	14.802			
	#OF PTS =	5							

MACDILL AIR FORCE BASE
DYNAFLECT MEASUREMENTS

LOCATION : TAMPA, FL.
PAVEMENT ID : APRON 1A1, AREA 4

PROJECT NO: AF-8
CLIENT : U.S. AIR FORCE
DATE : 10/82

RDG NO	STATION	DYNAFLECT READINGS #1	#2	#3	#4	#5	TEMP.	TIME	I/E C/M
20	.50	.400	.380	.350	.270	.258	0.		D
19	1.00	.460	.430	.390	.330	.300	0.		D
18	1.50	.410	.400	.370	.320	.270	0.		D
17	2.00	.490	.490	.440	.360	.300	0.		D
16	2.50	.400	.370	.360	.320	.267	0.		D
	MEAN =	.432	.414	.382	.320	.279			
	STD.DEV =	.041	.048	.036	.032	.020			
	COEF.VAR=	9.460	11.659	9.329	10.126	7.051			
	#OF PTS =	5							
21	0.00	.530	.490	.450	.400	.360	0.		E
22	.50	.350	.340	.320	.258	.204	0.		E
23	1.00	.560	.500	.420	.310	.273	0.		E
24	1.50	.440	.400	.370	.330	.300	0.		E
25	2.00	.560	.510	.390	.300	.267	0.	1047	E
	MEAN =	.488	.448	.390	.320	.281			
	STD.DEV =	.091	.075	.049	.052	.057			
	COEF.VAR=	18.747	16.659	12.692	16.291	20.138			
	#OF PTS =	5							

MACDILL AIR FORCE BASE
DYNAFLECT MEASUREMENTS

LOCATION : TAMPA, FL.
PAVEMENT ID : APRON 1A, AREA 5

PROJECT NO: AF-8
CLIENT : U.S. AIR FORCE
DATE : 10/82

RDG NO	STATION	DYNAFLECT READINGS #1	#2	#3	#4	#5	TEMP.	TIME	I/E	C/M
1	0.00	.620	.560	.480	.400	.350	0.	121	E	1
3	.50	.700	.610	.500	.420	.350	0.		E	1
5	1.00	.550	.500	.410	.360	.310	0.		E	1
7	1.50	.760	.630	.490	.400	.330	0.		E	1
9	2.00	.640	.560	.440	.390	.330	0.		E	1
	MEAN =	.654	.572	.464	.394	.334				
	STD.DEV =	.080	.051	.038	.022	.017				
	COEF.VAR=	12.213	8.863	8.150	5.561	5.010				
	#OF PTS =	5								
2	.06	.520	.500	.440	.380	.320	0.		E	2
4	.56	.580	.560	.480	.430	.350	0.		E	2
6	1.06	.540	.520	.460	.400	.340	0.		E	2
8	1.56	.510	.490	.440	.380	.320	0.		E	2
	MEAN =	.538	.518	.455	.398	.333				
	STD.DEV =	.031	.031	.019	.024	.015				
	COEF.VAR=	5.759	5.982	4.208	5.945	4.511				
	#OF PTS =	4								
10	0.00	.650	.570	.480	.390	.340	0.		I	1
12	.50	.650	.570	.460	.390	.330	0.		I	1
14	1.00	.720	.600	.500	.400	.340	0.		I	1
16	1.50	.750	.640	.530	.430	.350	0.		I	1
18	2.00	.540	.480	.410	.340	.300	0.		I	1
	MEAN =	.662	.572	.476	.390	.332				
	STD.DEV =	.081	.059	.045	.032	.019				
	COEF.VAR=	12.244	10.298	9.465	8.309	5.794				
	#OF PTS =	5								
11	.06	.500	.480	.440	.380	.330	0.		I	2
13	.56	.520	.490	.420	.370	.310	0.		I	2
1	1.06	.560	.550	.500	.420	.350	0.		I	2
17	1.56	.570	.540	.460	.380	.300	0.		I	2
19	2.06	.410	.400	.360	.300	.207	0.		I	2
	MEAN =	.512	.492	.436	.370	.299				
	STD.DEV =	.064	.060	.052	.044	.055				
	COEF.VAR=	12.460	12.144	11.874	11.781	18.406				
	#OF PTS =	5								

MACDILL AIR FORCE BASE
DYNAFLECT MEASUREMENTS

LOCATION : TAMPA, FL.
PAVEMENT ID : APRON 1A, AREA 5

PROJECT NO: AF-8
CLIENT : U.S. AIR FORCE
DATE : 10/82

RDG NO	STATION	DYNAFLECT READINGS #1	#2	#3	#4	#5	TEMP.	TIME	I/E	C/M
20	0.00	.560	.510	.440	.370	.320	0.		M	1
22	.50	.540	.500	.440	.370	.320	0.		M	1
24	1.00	.570	.530	.460	.380	.340	0.	142	M	1
26	1.50	.560	.510	.450	.360	.330	0.		M	1
28	2.00	.550	.490	.420	.350	.300	0.		M	1
	MEAN =	.556	.508	.442	.366	.322				
	STD.DEV =	.011	.015	.015	.011	.015				
	COEF.VAR=	2.051	2.920	3.356	3.115	4.606				
	#OF PTS =	5								
21	.06	.490	.480	.430	.360	.310	0.	140	M	2
23	.56	.560	.540	.490	.390	.330	0.		M	2
25	1.06	.560	.540	.490	.400	.340	0.		M	2
27	1.56	.510	.490	.440	.370	.320	0.		M	2
29	2.06	.500	.490	.440	.340	.310	0.		M	2
	MEAN =	.524	.508	.458	.372	.322				
	STD.DEV =	.034	.029	.029	.024	.013				
	COEF.VAR=	6.415	5.806	6.440	6.418	4.049				
	#OF PTS =	5								

TEST DATA FROM DYNATEST CONSULTING, INC.

Data Collected with Dynatest Model 8000
Falling Weight Deflectometer

Test Area #1: Centerslab tests, morning of Oct. 29.

Input File: TA1-1

Date: OCT 29 1982 Temp: 20.6 C.
Roadway: TEST AREA #1 (20"PCC)
Load Radius (mm): 150
Sensor Positions (mm):
0 200 300 600 1200 1800 2400
for d1 d2 d3 d4 d5 d6 d7

Left row of slabs

Sta.	Station	Pressure	d1	d2	d3	d4	d5	d6	d7
125-150	6.000C	1534	73	67	65	60	49	39	31
	6.000C	1551	77	67	64	59	49	39	30
275-300	12.000C	1550	69	64	62	57	47	36	28
	12.000C	1555	72	65	63	57	47	36	29
425-450	18.000C	1559	77	70	67	62	52	42	35
	18.000C	1557	77	70	68	63	52	42	35
575-600	24.000C	852	39	36	35	31	27	23	18
	24.000C	1164	53	49	46	42	35	32	26
[illegible]	24.000C	1570	68	62	61	57	47	39	34
	24.000C	1566	66	64	61	56	46	39	33

Center row of slabs

Sta.	Station	Pressure	d1	d2	d3	d4	d5	d6	d7
→50	2.100C	849	42	40	38	35	29	25	23
	2.100C	1169	57	52	50	47	36	33	27
	2.100C	1562	72	66	63	59	49	40	35
	2.100C	1564	78	68	65	61	52	42	36
→200	8.100C	1523	71	63	62	57	45	38	34
	8.100C	1516	68	63	62	55	45	37	34
→350	14.100C	1527	67	65	63	59	48	40	33
	14.100C	1537	68	66	63	61	49	40	33
→500	20.100C	1541	71	70	69	63	53	44	37
	20.100C	1535	87	70	66	62	54	43	39
→650	26.100C	845	39	38	35	32	27	24	21
	26.100C	1146	51	48	45	42	35	29	27
	26.100C	1539	68	65	61	57	47	39	36
	26.100C	1549	69	63	59	55	46	38	34

Right row of slabs

Sta.	Station	Pressure	d1	d2	d3	d4	d5	d6	d7
→100	4.200C	1537	77	71	67	63	52	43	35
	4.200C	1540	75	70	66	62	51	43	35
→250	10.200C	1517	71	66	63	58	49	38	31
	10.200C	1531	72	67	64	61	50	40	33
→400	16.200C	1524	71	67	63	59	49	37	29
	16.200C	1514	73	66	63	59	48	38	29
→550	22.200C	1575	70	64	63	58	46	37	29
	22.200C	1520	75	65	63	58	48	36	28
→700	28.200C	1558	[illegible]	68	64	59	48	38	31
	28.200C	1546	67	66	63	5[illegible]	48	37	29

Test Area #1: Corners & Edges, afternoon Oct. 29.

Input File: TA1-2

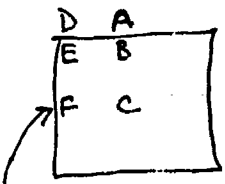
Date: OCT 29 1982 Temp: 34 C.
Roadway: TEST AREA #1(20"PCC)
Load Radius (mm): 150
Sensor Positions (mm): -200 -300
0 200 300 600 900 ~~-100~~ ~~-200~~
For d1 d2 d3 d4 d5 d6 d7

See File TA1-1 & Slab Diagram below!

Station	Pressure	d1	d2	d3	d4	d5	d6	d7
6.000A	1557	98	94	85	74	64	83	79
6.000A	1557	90	91	84	73	63	81	76
6.000B	1542	97	86	80	70	62	98	91
6.000B	1541	94	96	79	69	61	97	[illegible]
12.000A	1537	65	98	79	69	61	77	77
12.000A	1548	82	83	76	66	58	73	69
12.000B	1541	83	76	71	63	56	81	74
12.000B	1532	83	76	72	66	58	83	77
24.000A	847	55	55	45	40	35	48	47
24.000A	1121	72	75	60	53	47	65	63
24.000A	1534	101	103	78	67	59	85	80
24.000A	1546	97	102	76	65	57	83	77
24.000B	845	54	49	43	39	35	57	41
24.000B	1125	73	66	61	53	45	75	56
24.000B	1536	97	90	82	71	62	102	72
24.000B	1536	100	91	84	72	62	104	73
12.000D	1468	163	161	71	64	57	130	123
12.000D	1435	145	155	70	63	57	124	118
12.000E	1510	173	158	146	128	109	180	86
12.000E	1484	160	149	135	116	100	163	86
12.000F	1522	108	103	96	88	79	100	96
12.000F	1525	106	98	90	83	74	94	91
18.000D	1509	219	277	88	78	67	194	1[illegible]
18.000D	1513	208	228	86	77	67	187	175
18.000E	1510	153	142	129	112	93	159	129
18.000E	1523	147	136	124	106	91	153	133
18.000F	1533	111	106	1[illegible]	93	85	104	98
1[illegible]00F	1524	102	103	9[illegible]	90	82	101	96
2.100A	1531	101	111	79	70	60	94	89
[illegible].100A	1541	106	109	[illegible]1	71	63	92	89
2.100B	1531	135	127	115	98	84	147	63
2.100B	1539	127	123	112	95	81	142	65
14.100A	1515	116	119	73	65	58	100	95
14.100A	1514	110	111	72	63	57	94	88
14.100B	1543	103	91	86	75	65	106	79

14.100B	1534	94	89	84	72	63	102	82
20.100A	1523	128	133	68	63	55	113	108
20 100A	1521	123	131	67	62	54	109	105
20.100B	1522	156	134	125	100	92	162	60
20.100B	1522	143	125	117	100	85	152	61
2.100D	1519	142	155	70	64	56	125	117
2.100D	1523	141	153	70	64	57	122	113
2.100E	1523	143	133	120	102	87	153	60
2.100E	1524	140	129	117	99	85	149	63
2.100F	1500	110	105	99	91	82	104	101
2.100F	1499	112	104	99	90	81	105	100
8.100D	856	97	107	43	36	35	86	80
8.100D	1134	128	141	56	50	44	111	104
8.100D	1463	167	172	71	63	56	142	134
8.100D	1474	164	173	71	63	56	142	134
8.100E	829	81	73	70	60	51	87	40
8 100E	1111	110	99	92	79	68	115	54
8.100E	1552	145	136	126	106	91	159	69
8.100E	1550	149	136	127	107	92	157	66
8.100F	840	69	65	63	57	59	66	63
8 100F	1125	92	89	84	78	69	88	85
8 100F	1538	120	120	113	103	92	116	114
8.100F	1526	123	119	112	101	91	115	111
20 100D	1501	332	437	78	69	60	297	276
20 100D	1500	228	254	114	99	87	205	193
20.100E	1509	135	132	122	110	99	141	128
20.100E	1555	176	126	117	105	95	133	127
20.100F	1502	165	158	164	152	135	160	157
20 100F	1499	166	158	153	142	127	157	156
26.100D	846	114	123	38	35	31	98	91
26 100D	1125	158	170	49	44	40	132	124
26.100D	1485	210	227	59	54	50	176	165
26.100D	1474	207	228	61	55	50	177	166
26 100E	845	117	106	38	84	68	128	38
26.100E	1131	149	136	124	105	88	161	52
26 100E	1533	193	179	164	140	116	215	68
26.100E	1533	194	179	169	140	117	219	68
26.100F	839	53	53	48	45	40	49	47
26.100F	1113	71	68	62	57	51	64	61
26 100F	1557	98	87	85	78	70	88	85
26 100F	1557	97	74	82	73	68	81	74
10 200A	1508	92	100	85	74	55	85	81
10 200A	1513	90	97	83	71	63	82	78
10 200B	1538	90	85	78	69	62	95	85
10 200B	1540	93	82	76	68	[illegible]	93	86

16.200A	1523	120	138	64	58	52	111	105
16.200A	1529	126	136	64	59	53	109	103
16.200P	1527	123	115	106	90	79	135	61
16 200B	1525	126	115	107	93	79	134	65
22.200A	1501	92	99	80	69	62	83	78
22 200A	1496	93	96	78	68	59	81	76
22.200B	1527	88	81	75	65	57	93	76
22.200B	1521	88	80	76	65	57	91	76



No joint transfer obtained during this round of testing for Joint F!

Test Area #1: Corners & Edges (Cont'd), afternoon of Oct. 29.

Date: OCT 29 1982 Temp: 31 C
Roadway TEST AREA #1(20"PCC)
Load Radius (mm): 150
Sensor Positions (mm):
0 200 300 600 900 -199 -299

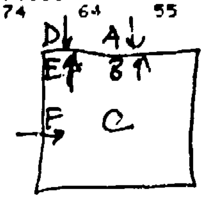
Station	Pressure	d1	d2	d3	d4	d5	d6	d7
4.200D	1527	179	195	165	145	126	169	163
4 200D	1518	174	189	162	143	123	165	161
4.200E	1522	1?4	176	163	144	125	191	163
4.200E	1527	178	173	161	142	124	187	166
4.200F	1479	155	147	141	135	122	146	145
4 200F	1475	144	142	137	128	119	141	137
16.200D	1534	160	156	138	126	109	144	140
16.200D	1533	157	161	140	120	110	142	135
16.200E	1492	153	147	138	123	108	161	146
16.200E	1466	156	146	138	124	109	161	146
16.200F	1406	138	134	130	123	112	132	129
16.200F	1488	138	132	128	119	110	130	127
28.200D	1516	152	168	138	138	101	138	133
28.200D	1526	146	188	135	117	98	134	129
28.200E	1520	159	152	138	120	104	166	129
28.200E	1519	154	144	132	117	100	158	132
28.200F	1524	139	144	137	125	114	140	135
28.200F	1531	142	142	133	121	110	135	[illegible]

Test Area #1: All tests, morning of Nov. 1.

Input File: AREA#1

Date: NOV 1 1982 Temp: 30.5 C
Roadway: TEST AREA #1 [20"PCC]
Load Radius (mm) 150
Sensor Positions (mm):
0 200 305 610 914 1524 2438

Station	Pressure	d1	d2	d3	d4	d5	d6	d7
2.200C	833	43	42	39	37	34	29	18
2.200C	1524	73	71	67	62	56	47	32
2.200C	1530	74	72	67	62	57	47	31
2.200B	850	65	66	50	43	38	29	19
2.200B	1535	109	117	87	74	65	48	31
2.200B	1540	107	114	83	71	63	46	28
4.100C	838	47	45	42	40	36	[illegible]	19
4.100C	1528	[illegible]	79	73	67	62	51	34
4.100C	1527	80	78	72	68	61	51	35
4.100B	844	84	87	35	31	29	25	17
4.100B	1511	135	143	59	50	47	37	25
4.100B	1514	136	148	60	54	49	39	27
4.100F	847	78	80	42	38	33	26	17
4.100F	1512	139	155	75	67	59	46	31
4.100F	1514	138	150	74	65	58	45	31
4.100E	841	116	121	43	40	36	29	20
4.100E	1512	176	194	91	75	68	53	33
4.100E	1515	179	187	88	77	69	53	35
6.000C	836	46	41	39	36	34	27	18
6.000C	1525	74	70	66	60	55	45	29
6.000C	1531	75	72	67	61	55	45	30
6.000B	838	64	65	48	41	37	27	18
6.000B	1510	107	116	83	71	63	46	29
6.000B	1513	106	110	82	71	62	46	35
13.200C	833	45	44	41	37	35	29	20
13.200C	1530	73	74	70	66	60	49	33
13.200C	1531	74	72	68	62	57	46	31
13.200B	836	59	60	52	46	40	31	19
13.200B	1529	100	108	90	81	68	52	32
13.200B	1532	98	104	87	79	67	51	30
14.100C	832	42	40	38	36	32	27	21
14.100C	1520	74	69	66	59	54	44	31
14.100C	1536	75	70	66	60	55	44	31
14.100B	839	78	82	36	32	30	24	17
14.100B	1514	132	143	60	53	50	38	29
14.100B	1519	133	146	60	53	49	38	29
15.000C	833	44	42	39	36	33	27	19
15.000C	1537	79	72	68	61	55	44	32
15.000C	1540	76	72	68	62	56	45	31
15.000B	843	68	71	44	38	33	25	16
15.000B	1523	117	124	76	67	59	44	29
15.000F	1528	117	124	77	67	59	45	31
23.200C	830	43	39	37	34	31	25	17
23.200C	1535	71	67	64	58	53	41	28
23.200C	1543	74	70	66	59	53	43	29
23.200B	836	79	91	38	34	30	24	16
23.200B	1506	139	166	66	58	50	39	26
23.200B	1512	136	179	63	55	49	37	26
25.100C	838	43	39	38	34	31	26	16
25.100C	1526	79	73	65	59	53	43	28
25.100C	1531	76	74	68	61	56	45	30
25.100B	836	76	82	30	27	23	19	13
25.100B	1499	138	157	53	48	43	35	24
25.100B	1503	133	149	51	48	42	35	24
25.100F	815	70	76	35	31	27	22	15
25.100F	1490	125	135	61	54	47	35	24
25.100F	1496	123	136	60	53	47	37	26
25.100E	826	82	85	41	37	33	25	18
25.100E	1509	136	150	80	74	62	48	32
25.100E	1515	202	140	77	63	60	46	28
27.000C	821	43	39	37	34	33	26	15
27.000C	1515	75	69	67	63	56	44	28
27.000C	1537	76	70	67	63	56	44	29
27.000B	637	68	70	43	38	34	26	16
27.000B	1509	114	123	74	64	56	40	25
27.000B	1513	305	123	74	64	55	42	29



Joint Transfer obtained on all corners & edges by placing FWD in the shown direction.

SHUNTVAL in VOLTS 7.07325
STEP 3 "T2"

TA2->:56 t', 8 'Lt of Centerline
Station ~~71+79 LT~~
TEST POINT FOR ALL!

Ld.(lbs)	9059	9143	13888	13888
Df1(mil)	5.4	5.2	8.7	8.7
Df2(mil)	3.7	3.6	6.1	6.1
Df3(mil)	2.4	2.3	3.9	4.0
Df4(mil)	1.6	1.5	2.7	2.7
Df5(mil)	1.1	1.[illegible]	1.9	1.9
Df6(mil)	.9	[illegible]	1.5	1.5
Df7(mil)	4.5	4.3	7.1	7.1
Area(in)	21.4	21.4	21.7	21.8
dsm(kpi)	1679	1759	1603	1603
DSM(kpi)	1370			

TA2->:60
Station ~~74+79~~ LT
TEST POINT FOR ALL!

Ld.(lbs)	18229	18201	23613	23473
Df1(mil)	11.8	11.9	16.3	16.3
Df2(mil)	8.3	8.4	11.7	11.6
Df3(mil)	5.4	5.5	7.6	7.6
Df4(mil)	3.6	3.6	5.1	5.1
Df5(mil)	2.5	2.6	3.5	3.5
Df6(mil)	1.9	2.0	2.6	2.6
Df7(mil)	9.8	9.8	13.6	13.5
Area(in)	21.8	21.9	22.0	22.0
dsm(kpi)	1549	1536	1449	1437
DSM(kpi)	1175			

→ Date OCT 30 1982 Temp 33.6 C
Roadway TEST AREAS 2,3 &4/MCOIL
Time 14 50

Load Radius [a] = ~~6 in~~ 150mm
r's=0 12 24 36 48 60 in. 200mm

Results, printed out in lbs. & mils for "T2", Test Area #2.

Input File: TA2-1

Test Area #2: Summary of FWD tests (1st drop only) run Oct. 29.

NOTE: A = Cl. 1 Cracks near plate
B = Cl. 2 Cracks near plate

Date: OCT 29 1982 Temp: 30 C
Roadway: TEST AREA #2 (11"AC)
Load Radius (mm): 150
Sensor Positions (mm):
0 200 300 600 900 1200 1500

(in feet)

← 15' Left of Center →

Station	Pressure	d1	d2	d3	d4	d5	d6	d7
-0.000A	1503	407	349	302	210	145	102	[illegible]
-100.000A	1482	410	309	264	186	128	91	[illegible]
-200.000	1480	462	356	302	200	174	93	68
-300.000	1480	444	341	286	189	127	90	69
-400.000	1454	585	427	342	202	35	85	6[illegible]
-500.000A	1492	457	335	266	156	[illegible]	[illegible]	49
-600.000A	1484	450	35[illegible]	296	196	125	90	65
-700.000B	1470	515	420	359	[illegible]	161	108	77

← 1' Rt. of ℄ →

Station	Pressure	d1	d2	d3	d4	d5	d6	d7
50.100A	1507	350	261	235	164	11[illegible]	95	64
150.100A	[illegible]	345	293	[illegible]	176	121	86	65
250.[illegible]	1507	302	258	222	[illegible]	105	75	56
350.100A	1483	315	275	239	169	119	[illegible]	64
450.100A	1496	303	[illegible]	225	166	119	86	6[illegible]
550.100	1560	[illegible]	224	200	153	11[illegible]	8[illegible]	66
650.100	1486	[illegible]	276	244	183	133	[illegible]	72

← 15' Right of Center →

Station	Pressure	d1	d2	d3	d4	d5	d6	d7
[illegible] 200A	1443	471	347	285	186	123	87	66
-100.200A	1446	475	319	256	159	103	73	55
-200.200	1430	567	392	[illegible]	195	124	[illegible]	[illegible]5
-300.[illegible]00	1456	500	363	29[illegible]	184	119	83	[illegible]
-400.[illegible]	1464	349	292	24[illegible]	164	113	82	61
-500.200A	1487	360	293	251	151	97	66	50
-600.200[illegible]	1497	394	341	293	[illegible]5	142	101	75
-700.[illegible]	1423	613	486	394	241	149	100	72

Input File: AP#

Test Area #2: All tests run Nov. 1.

Date: NOV 1 1982 Temp: 33 C
Roadway: TEST AREA #2 (11" AC)
Load Radius (mm): 150
Sensor Positions (mm):
0 200 305 610 914 1524 2438

(in feet)

A

New Centerline

Station	Pressure	d1	d2	d3	d4	d5	d6	d7
25.000C	829	159	133	114	81	58	34	19
25.000C	1470	295	250	218	154	110	62	35
25.000C	1482	291	244	214	151	108	65	34
75.000C	833	182	154	133	90	63	34	19
75.000C	1488	339	293	250	168	116	61	34
75.000C	1482	333	294	248	165	114	61	37
125.000C	852	202	165	139	93	63	35	20
125.000C	1455	373	29[illegible]	259	173	119	62	33
125.000C	1453	363	292	254	170	118	62	35
175.000C	817	208	171	145	94	62	32	18
175.000C	1443	378	309	269	178	118	61	35
175.000C	1444	371	303	265	175	115	60	35
225.000C	857	155	137	117	81	56	33	18
225.000C	1468	297	254	223	156	108	59	36
225.000C	1467	286	247	217	150	105	57	29
275.000C	853	173	149	130	92	65	35	20
275.000C	1472	323	277	243	173	122	67	35
275.000C	146[illegible]	317	[illegible]	27[illegible]	169	12[illegible]	[illegible]	[illegible]
325.000C	815	181	153	135	92	64	35	20
325.000C	1450	333	288	246	173	118	63	35
325.000C	1457	329	282	243	169	117	63	36
375.000C	843	169	143	125	86	5[illegible]	33	18
375.000C	1477	314	265	235	165	114	61	34

New Centerline

18' Left of ℄

375.000C		1484	310	261
230	161	112	59	33
425.000C		842	180	141
118	79	54	31	19
425.000C		1457	327	259
216	147	101	55	33
425.000C		1450	322	250
213	146	102	55	32
475.000C		853	190	146
123	86	62	35	19
475 000C		1499	354	271
235	162	119	66	34
475.000C		1499	346	271
232	160	119	67	37
525.000C		807	168	142
124	94	71	40	22
525.000C		1495	314	269
235	178	133	73	37
525.000C		1515	308	266
230	176	130	71	38
575.000C		848	160	130
114	82	58	33	18
575.000C		1487	300	245
214	153	108	58	31
575.000C		1487	289	242
213	152	108	59	32
625.000C		847	166	140
119	82	57	32	20
625.000C		1458	307	267
227	157	107	59	35
625.000C		1460	306	274
224	154	107	67	36
675.000C		850	170	147
129	94	68	35	21
675.000C		1506	324	292
248	180	129	68	37
675.000C		1489	313	276
242	175	126	68	38
0.000L		836	308	231
185	118	77	41	24
0.000L		1460	541	419
338	217	144	73	39
0.000L		1465	521	411
332	213	142	74	40
100.000L		844	302	178
144	99	68	36	21
100.000L		1478	497	321
263	183	125	66	35
100.000L		1465	470	317
259	180	123	67	37
200.000L		818	291	238
194	120	76	38	22
200.000L		1404	524	413
347	217	138	70	39
200 000L		1410	498	403
334	205	131	67	35
300.000L		845	294	213
173	109	70	36	21
300.000L		1459	516	371
308	198	127	65	37
300.000L		1446	494	352
299	189	123	63	33
400.000L		814	441	287
221	121	70	35	20
400.000L		1389	732	497
384	213	127	61	35
400 000L		1393	699	476
366	206	126	63	38

18' Rt. of ℄

500.000L		847	301	245
198	118	74	38	23
500.000L		1433	544	440
362	221	137	65	38
500.000L		1435	527	423
347	209	132	67	37
600.000L		829	324	234
183	103	62	33	20
600 000L		1433	570	417
332	192	117	62	40
600.000L		1430	544	406
320	186	115	62	39
700.000L		850	325	246
206	126	79	40	25
700.000L		1432	567	430
363	225	143	70	40
700.000L		1414	549	414
351	218	142	73	43
0.000R		828	302	236
186	111	74	39	21
0.000R		1440	529	420
335	203	134	69	37
0.000R		1465	514	410
331	200	133	70	40
100.000R		845	374	228
172	95	59	32	19
100.000R		1434	615	378
300	171	106	57	31
100.000R		1440	581	365
290	164	104	57	31
200.000R		839	393	266
222	118	72	37	21
200.000R		1425	649	439
377	204	126	63	35
200.000R		1433	615	423
359	198	124	63	33
300.000R		847	346	266
197	111	67	35	21
300.000R		1442	595	450
342	198	124	64	36
300.000R		1435	568	432
328	190	119	62	35
400.000R		852	243	196
165	100	63	35	22
400 000R		1462	431	355
295	183	118	61	35
400.000R		1461	421	345
287	178	115	61	59
400.000R		1465	422	344
286	177	115	64	36
400.000R		1458	416	347
284	176	116	61	37
500.000R		847	334	251
184	93	52	26	17
500.000R		1443	543	394
298	151	86	42	25
500.000R		1439	522	376
285	146	83	43	25
600 000R		845	341	260
209	128	79	40	22
600.000R		1425	595	462
376	231	147	72	38
600.000R		1430	565	442
361	224	145	75	41
700.000R		830	543	360
290	148	84	40	23
700.000R		1383	869	596
481	257	147	68	40
700.000R		1390	800	560
449	243	144	71	40
~~1.000r~~		~~844~~	~~153~~	~~136~~
~~112~~	~~75~~	~~50~~	~~29~~	~~16~~
~~1.000r~~		~~1515~~	~~260~~	~~244~~
~~202~~	~~137~~	~~93~~	~~50~~	~~31~~
~~1.000r~~		~~1522~~	~~275~~	~~242~~
~~198~~	~~135~~	~~92~~	~~52~~	~~32~~

Input File: #2-500

Test Area #2: All tests run laterally across runway at Station #500 on Nov. 1, 82

NOTE:
r = right of centerline
l = left of centerline.

Date: NOV 1 1982 Temp: 37 C
Roadway: ACROSS TAXIWAY (T.A.#2)
Load Radius (mm): 150
Sensor Positions (mm):
0 200 305 610 914 1524 2438

(in Ft.) right (r) or left (l) of ℄

Station	Pressure	d1	d2	d3	d4	d5	d6	d7
1.000r	849	150	130	106	72	49	28	19
1 000r	1511	277	235	195	133	90	51	32
1.000r	1512	278	240	197	134	92	52	32
4.0001	850	183	152	127	77	47	25	17
4.0001	1468	336	277	236	141	87	45	32
4.0001	1466	329	270	231	138	84	45	31
8.0001	848	235	176	142	80	48	25	17
8 0001	1437	430	311	257	143	86	46	36
8.0001	1434	416	301	248	139	82	47	34
12.0001	850	236	204	139	70	41	25	18
12.0001	1437	424	345	252	127	76	48	35
12 0001	1436	409	336	241	120	73	46	34
16.0001	844	347	232	162	83	46	27	20
16.0001	1423	58	377	276	139	76	47	33
16.0001	1423	553	363	264	134	75	47	34
21 0001	836	434	285	213	90	47	31	22
21.0001	1391	691	450	339	147	77	51	38
21 0001	1395	643	427	325	145	76	49	36
26.0001	813	632	369	231	84	45	28	23
26.0001	1381	909	530	340	131	78	46	39
26 0001	1385	841	499	318	127	77	49	40
31.0001	823	445	312	224	104	55	31	547
31.0001	1394	714	510	360	170	90	55	1738
31.0001	1396	681	488	348	167	92	58	1747
1 000r	862	161	138	112	75	51	30	20
1.000r	1498	295	241	203	135	92	54	34
1 000r	1488	293	239	201	133	90	53	35
4.000r	853	158	128	108	74	51	31	19
4.000r	1474	289	230	201	133	91	54	32
4.000r	1475	28[illegible]	229	198	133	91	54	33
8.000r	863	204	168	134	79	48	27	18
8.000r	1514	377	307	239	139	84	44	28
8.000r	1516	369	296	233	137	83	45	30
12.000r	857	203	155	127	72	45	24	16
12.000r	1454	367	281	230	131	82	44	29
12.000r	1449	356	272	222	126	90	42	28
16.000r	860	233	166	133	77	46	25	19
16.000r	1448	410	286	234	135	78	43	31
16.000r	1450	399	281	228	131	79	45	32
21 000r	849	335	239	184	90	50	31	22
21.000r	1422	544	382	295	144	84	50	33
21.000r	1429	525	371	285	142	84	52	34
26.000r	857	336	288	219	110	61	32	23
26.000r	1426	564	468	363	183	105	58	42
26 000r	557	188	160	121	62	38	22	18
26.000r	1122	411	323	261	133	80	45	32
26 000r	1440	540	438	344	176	104	59	42
26.000r	1439	528	430	338	173	103	58	40
31.000r	1101	651	429	328	155	67	44	37
31 000r	1392	789	507	393	189	83	58	49
31.000r	534	260	175	134	65	33	22	18
31.000r	1101	565	358	286	137	66	44	38
31.000r	832	405	277	211	103	51	33	31
31.000r	1400	728	486	376	180	84	59	53
31 000r	1401	709	476	368	178	82	57	35

Input File: TA3-1

Test Area #3 : All tests run Oct. 29.

NOTE:
A = Cl. 1 Cracks near plate
B = Cl. 2 — " —

Date: OCT 29 1983 Temp: 32 C
Roadway: TEST AREA #3 (5.5"AC)
Load Radius (mm): 150
Sensor Positions (mm):
0 200 300 600 900 1200 1500
(in ft.)

4' Rt. of Centerline

15' Rt of Centerline

Station	Pressure	d1	d2	
d3	d4	d5	d6	d7
50 100		1513	718	644
533	341	211	132	88
50.100		1509	672	585
489	333	195	130	88
150.100B		851	440	366
305	176	105	67	47
150 100B		1134	554	459
735	225	136	90	63
150 100B		1476	725	631
596	284	180	110	81
150 100B		1476	709	596
489	296	177	121	87
250 100		1448	909	703
556	333	210	131	84
250.100		1471	823	635
514	314	205	132	90
350.100		1528	775	676
593	372	225	136	83
350.100		1538	731	633
549	349	215	136	89
450 100		1500	654	[illegible]
491	288	168	104	71
450 100		1510	618	544
459	278	169	108	76
550.100B		853	557	425
345	190	106	65	45
550.100B		1095	693	530
431	243	141	90	63
550.100B		1409	913	705
599	326	187	119	83
550.100B		1434	897	653
557	323	188	122	87
650.100B		1385	965	802
597	296	165	108	76
650.100B		1427	862	722
553	277	172	118	87
750 100		1431	899	645
507	280	176	120	82
750 100		1494	791	595
459	263	171	118	84
750.100		1521	626	544
472	297	182	121	84
750 100		1521	567	506
427	274	173	117	84
950 100		872	475	384
305	160	92	59	42
950.100		1125	569	463
366	241	120	81	61
950.100		1504	736	624
500	271	161	106	75
950.100		1503	718	584
2458	26[illegible]	160	108	78
.200		804	987	705
526	226	99	53	35
.200		1087	1035	74
557	252	121	73	57
.200		1397	1274	90
703	321	156	92	67
200		1393	1202	874
669	310	155	96	70
100 200		1395	1289	93
732	330	156	96	72
100 200		1387	1061	78
602	287	153	106	82
200.200		1389	1263	87
622	243	110	76	63
200 200		1392	1043	72
527	225	122	89	72
300 200		1397	1484	105
797	323	140	81	61
300.200		1405	1252	89
681	301	148	92	69
400.200		820	973	66
501	198	80	43	3
400.200		1091	1117	77
594	253	112	66	48
400 200		1411	1391	102
764	334	151	88	63
400 200		1415	1343	98
755	331	154	92	67
500 200		1370	1577	112
811	325	141	90	59
500 200		1393	1331	95
701	309	153	97	72
600 200		136	1635	116
878	379	173	97	58
600.200		1359	1382	99
771	356	123	113	82
700 200		1402	1223	89
653	304	148	91	68
700 200		1416	1050	78
589	283	158	106	82
800 200		801	741	49
354	140	73	48	39
800 200		1055	838	56
407	182	98	68	59
800 200		1377	1035	72
529	241	128	87	68
800.200		1366	999	68
518	241	133	94	74
900 200		139	1228	83
585	230	107	72	58
900.200		1399	1045	70
510	218	116	83	66
1000.200		1388	1124	78
575	239	114	73	57
1000.200		1366	969	67
504	228	125	87	68
0.000A		1413	1305	94
692	295	141	88	67
0 000A		1426	1103	79
605	281	150	90	76
100.000		1375	1654	118
884	329	124	74	63
100.000		1384	1239	89
667	273	131	90	76
200 000		1365	1387	170
2706	325	155	92	67
200.000		1375	1084	81
585	322	141	93	83
300.000		837	800	57
475	214	104	60	42
300.000		1105	921	68
535	251	128	82	58
300.000		1422	1154	92
716	328	171	106	73
300.000		1432	1114	86
683	318	170	106	77

12' Left of Centerline

400.000B		1387	1534	1154
878	3[illegible]	176	96	68
400.000B		1400	1301	972
742	344	170	104	75
500.000B		1389	1604	1062
795	328	148	85	62
500.000B		1406	1282	377
639	282	149	99	74
600.000A		1391	1442	976
754	317	148	92	71
600.000A		1407	1187	845
629	284	150	102	79
700.000A		818	801	555
392	154	76	54	43
700.000A		107[illegible]	918	645
467	200	108	77	61
700.000A		1395	1124	815
608	266	142	99	78
700.000A		1389	1077	781
579	259	144	102	83
800.000		1404	1148	852
635	287	17[illegible]	87	68
800.000		1405	975	697
543	259	13[illegible]	94	76
900.000		1378	1287	868
650	248	114	74	60
900.000		1393	1076	730
553	229	121	84	68
1000.000		1391	1213	895
646	276	132	84	65
1000.000		1384	990	709
526	241	131	91	73

Input File: AR#3-1

Test Area #3: All tests
run. Nov. 1.

Date: NOV 1 1982 Temp 38 C
Roadway: TEST AREA #3 (5.5"AC)
Load Radius (mm): 150
Sensor Positions (mm):
0 200 305 610 914 1524 2438

Station (A Pt.)	Pressure	d1	d2	d3	d4	d5	d6	d7
25.000C	858	503	384	299	160	92	40	36
25.000C	1469	811	559	490	266	156	67	51
25.000C	1472	772	600	468	259	156	71	42
75 600C	861	378	299	254	158	99	48	23
75 000C	1506	648	511	429	265	169	79	[illegible]
75.000C	1500	626	499	416	259	168	82	46
125 000C	845	372	298	251	156	99	45	27
125.000C	1463	651	519	437	275	173	79	44
125.000C	1460	626	490	420	263	168	80	46
175.000C	866	391	323	270	164	99	42	24
175 000C	1527	695	548	529	291	180	75	42
175.000C	1522	673	511	527	280	171	79	43
225.000C	860	413	337	285	176	107	47	30
225.000C	1492	721	580	503	300	182	77	50
225.000C	579	230	186	152	93	58	31	19
225.000C	858	372	289	241	147	93	44	28
225.000C	1133	501	390	327	202	127	60	70
225.000C	1493	728	545	462	283	178	81	47
275.000C	873	344	285	240	151	96	45	24
275 000C	1143	442	371	305	193	123	60	34
275.000C	1543	607	516	425	269	172	78	42
325 000C	864	361	300	260	168	108	46	25
325 000C	1137	461	378	325	211	136	61	32
325.000C	1519	628	522	448	289	187	82	42
375.000C	839	553	419	337	200	118	44	23
375 000C	1447	952	675	56[illegible]	333	203	90	3[illegible]
375.000C	1447	896	686	543	325	200	86	43
425.000C	858	366	249	201	131	91	54	31
425.000C	1504	674	438	371	246	170	100	48
425.000C	1506	658	439	365	244	171	100	53
475.000C	851	482	352	280	167	102	45	27
475.000C	1451	870	637	496	293	182	78	31
475.000C	1463	828	575	473	287	183	78	40
525.000C	867	391	332	280	170	102	43	24
525.000C	1505	699	602	501	303	185	80	54
525.000C	1513	678	573	484	295	183	84	48
575.000C	856	462	347	274	151	93	45	23
575.000C	1478	798	563	471	263	165	79	32
575.000C	1454	768	581	462	263	167	85	67
625.000C	834	516	382	296	159	95	44	26
625.000C	1417	934	645	529	282	174	81	48
625.000C	1407	1183	611	506	268	177	85	48
625.000C	832	467	352	271	150	96	48	27
625.000C	1445	815	582	507	273	172	81	44
625.000C	1421	815	606	500	273	174	82	49
675.000C	831	549	390	294	149	86	43	25
675.000C	1417	930	642	486	257	152	74	46
675.000C	1423	866	607	468	246	154	80	48
725.000C	863	363	293	240	147	92	45	25
725.000C	1513	655	513	442	261	162	81	42
725.000C	1506	634	462	415	229	160	80	48
775.000C	846	441	343	251	137	87	44	25
775.000C	1463	768	567	428	228	151	76	45
775.000C	1463	732	522	410	220	147	78	47
825.000C	844	442	354	270	144	81	41	23
825.000C	1438	722	585	452	248	145	76	43
825.000C	1454	700	570	434	245	150	78	43
875.000C	871	362	292	241	150	96	43	24
875.000C	1503	657	512	431	266	171	79	39
875.000C	1512	642	487	414	258	168	78	44
925.000C	862	316	257	216	136	88	44	25
925.000C	1500	567	460	393	246	159	79	46
925.000C	1502	544	429	371	236	155	79	46
975.000C	844	359	303	236	143	93	[illegible]5	25

975.000C		1470	590	508
417	254	164	80	45
975.000C		1456	601	484
397	244	160	80	46
0.000R		791	1011	681
467	170	80	38	21
0.000R		1367	1415	956
700	281	139	78	39
0.000R		1377	1302	878
656	276	145	74	44
100.000R		806	843	601
403	151	75	44	28
100.000R		1376	1135	849
606	256	135	76	47
100.000R		1381	1106	792
580	257	143	85	49
200.000R		800	923	629
427	151	75	42	25
200.000R		1364	1280	952
624	246	129	75	46
200.000R		1377	1174	803
584	239	134	81	49
300.000R		809	906	657
469	193	87	38	24
300.000R		1368	1297	927
683	296	145	71	43
300.000R		1366	1201	885
641	287	148	77	77
500.000R		794	1010	715
508	203	94	37	23
500.000R		1364	1404	892
721	295	148	68	40
500.000R		1369	1305	849
565	283	150	75	46
500.000R		813	796	553
383	152	83	45	25
500.000R		1372	1262	929
645	273	147	76	45
500.000R		1373	1240	869
647	275	148	79	45
600.000R		797	1104	802
577	236	108	39	24
600.000R		1361	1483	974
813	352	173	74	44
600.000R		1365	1367	925
726	337	175	83	49
700.000R		806	906	552
429	190	97	46	29
700.000R		1356	1277	848
629	295	159	83	52
700.000R		1369	1169	786
588	283	159	86	49
800.000R		811	740	520
367	157	82	40	26
800.000R		1375	1077	750
545	249	140	75	45
800.000R		1377	988	690
510	238	140	78	48
900.000R		804	933	631
444	182	84	35	24
900.000R		1375	1297	884
519	261	131	64	40
900.000R		1382	1182	788

Input File: AR#3-2

(cont'd) [Nov. 1)

Test Area #3

Date: NOV 1 1982 Temp: 36.5 C
Roadway: TEST AREA #3 (5.5"AC)
Load Radius (mm): 150
Sensor Positions (mm):
0, 200, 305 610 914 1524 2438
(in Pt)

Station		Pressure	d1	d2
d3	d4	d5	d6	d7
0.000L		800	980	680
480	183	89	40	22
0.000L		1370	1318	887
672	274	140	74	43
0.000L		1379	1186	826
616	258	141	74	44
100.000L		786	1195	779
513	169	72	42	29
100.000L		1370	1445	1014
680	235	112	74	50
100.000L		1381	1284	945
620	229	117	78	49
200.000L		815	880	587
398	143	70	40	26
200.000L		1396	1234	822
561	226	116	66	41
200.000L		1412	1185	799
548	256	233	66	39
300.000L		810	803	573
415	150	79	40	25
300.000L		1436	1179	893
1506	253	125	64	36
300.000L		1446	1122	815
639	258	137	72	48
400.000L		794	1047	720
508	189	78	30	21
400.000L		1367	1479	990
738	302	139	61	39
400.000L		1372	1377	924
701	302	153	72	46
500.060L		794	1000	656
436	151	65	32	23
500.000L		1376	1350	932
628	244	122	59	41
500.000L		1380	1243	1408
595	248	137	74	48
600.000L		798	914	614
412	144	67	36	25
600.000L		1374	1280	670
616	244	127	70	44
600.000L		1373	1192	790
583	248	138	80	48
700.000L		796	831	564
390	146	66	35	24
700.000L		1379	1151	782
561	237	125	68	44
700.000L		1374	1076	747
541	240	135	77	48
800.000L		784	796	556
389	146	67	35	25
800.000L		1374	1106	809
566	234	122	66	45
800.000L		1379	1072	862
537	234	130	76	49
900.000L		808	792	547
356	127	58	32	23
900.000L		1386	1061	766
502	201	104	59	40
900.000L		1387	981	708
485	205	113	66	42
1000.000L		819	653	456
334	126	58	33	21
1000.000L		1388	944	659
496	209	110	62	40
1000.000L		1390	888	629
474	211	121	71	45

SHUNT val in VOLTS: 7.076 STEP: 3

TA2-/2 96 T3 0+62 10.5' Lt. of Centerline.
Station ~~50+0'11~~
BGN T3

Ld.(lbs)	7997	8154	12914	~~12942~~
Df1(mil)	22.1	18.9	29.2	[illegible]
Df2(mil)	10.1	8.8	14.3	[illegible]
Df3(mil)	3.6	3.3	5.6	5.6
Df4(mil)	1.4	1.6	2.7	2.8
Df5(mil)	.9	1.1	1.5	1.9
Df6(mil)	.9	.9	1.6	1.7
Df7(mil)	14.7	12.6	19.9	19.1
Area(in)	13.8	14.2	14.7	14.9
dsm(kpi)	362	431	443	[illegible]
DSM(kpi)	524			

TA2-/2 100
Station ~~50+0'11~~
BGN T3

Ld.(lbs)	17198	17237	22121	22042
Df1(mil)	35.9	35.2	45.2	43.9
Df2(mil)	18.1	18.0	[illegible]	23.4
Df3(mil)	7.4	7.5	[illegible]	9.8
Df4(mil)	3.5	3.8	4	4.9
Df5(mil)	2.4	2.6	3.2	3.4
Df6(mil)	2.1	2.2	3.7	2.8
Df7(mil)	25.1	24.7	32.7	31.4
Area(in)	15.1	15.3	15.6	15.7
dsm(kpi)	479	490	483	502
DSM(kpi)	547			

Prev cmt (t3) temp=34.5 C Oct. 30, 1982.

Results, printed out in lbs. & mils for "T3", Test Area #3.

d = 150 mm (5.91")

r's = 0", 12", 24", 36", 48", 60" & 200mm
DF1 DF2 DF3 DF4 DF5 DF6 DF7

Input File: AR#4-2

Test Area # 4: A few select points from Oct. 30.

Note: E = edge
I = interior
C = corner

Date: 19821030 Temp 34
Roadway TEST SECT #4 (COMPOSITE)
Load Radius (mm) 150
Sensor Positions (mm)
0 200 305 610 914 1219 1524

	Station		Pressure	d1	d2
	d3	d4	d5	d6	d7
~Sta.	11 230E		1450	328	335
	239	180	137	107	81
35A *	11 100I		1459	216	193
	180	152	127	104	[illegible]
	11 220E		1453	295	[illegible]
	216	168	132	102	[illegible]
	12 320C		1524	[illegible]	[illegible]
~Sta.	203	157	124	95	[illegible]
	12 230E		1459	287	[illegible]
150A	226	175	135	[illegible]	91
*	12 100I		1464	226	201
	191	157	132	107	86
	12 220E		1447	343	360
	170	137	112	93	71
	41 320C		1440	479	450
~Sta.	203	165	135	107	91
	41 230E		1550	378	385
35D	198	157	170	102	81
	41 220E		1476	330	353
	190	147	114	91	74
~Sta.	42 230E		1478	447	493
	208	168	135	107	84
150D *	42 100I		1459	269	251
	239	203	168	137	109
~Sta.	31 230E		1479	434	445
95C	236	191	152	122	97
*	31 100I		1456	305	294
	254	211	173	142	114
	32 320C		1439	576	577
~Sta.	315	234	193	145	114
225C	32 330E		1473	384	395
	[illegible]	208	165	127	94
*	32 100I		1468	[illegible]	211
	200	175	147	132	99
	32 220E		1452	363	305
	[illegible]	180	147	117	91
Sta. 350 *	[illegible] 100I		1439	244	231
	21[illegible]	173	140	112	91

These FWD points were read in by hand from test results which were only printed out. All unneeded "drops" & test points are eliminated from this file.

Input File: AREA#4

Test Area #4: All tests run Nov. 1. Planes covered most of the area, so only points from Sta.'s 0-50' were run. NOTE: T = Test Point T4 A, B, C, D, E & F, see below.

Date: NOV 1 1982 Temp ~~[illegible]~~ 33-C
Roadway TEST AREA #4 (COMPOSIT) C
Load Radius (mm) 150
Sensor Positions (mm)
0 200 305 610 914 1524 2438
8 16 14 36 60 [illegible]

	Station		Pressure	d1	d2
	d3	d4	d5	d6	d7
A	4 000T		527	[illegible]	68
	64	55	45	23	15
	4 000T		515	[illegible]	58
	66	57	47	32	17
	4 000T		827	129	131
	[illegible]	94	79	52	28
	4 000T		830	130	119
	110	96	79	52	29
	4 000T		1087	174	157
	146	127	105	69	37
	4 000T		1091	173	158
	147	127	107	68	35
	4 000T		1455	230	209
	193	156	139	90	45
	4 000T		1458	229	205
Test Point "T4"	193	166	139	90	45
	4 000T		536	79	72
	69	64	47	31	16
	4 000T		533	80	72
	70	63	46	31	19
	4 000T		842	133	117
	113	102	76	50	29
	4 000T		841	131	119
	114	104	79	52	29
	4 000T		1104	174	158
	152	139	105	69	39
	4 000T		1104	174	159
	153	140	105	63	38
	4 000T		1478	223	211
	200	183	139	90	48
	4 000T		1472	227	212
	201	183	139	90	48
	50 500C		849	137	127
Approx. Sta. 50 E	[illegible]	105	86	54	[illegible]
	50 500C		1104	179	[illegible]
	156	138	111	71	[illegible]
	50 500C		1458	234	218
	203	178	142	92	4[illegible]
*	50 500C		1457	233	2[illegible]
	202	17[illegible]	141	90	46
	50 500B		876	159	166
	121	98	77	43	25
	50 500B		1098	203	210
	159	129	102	63	35
	50 500B		1452	269	275
	21[illegible]	171	137	83	47
	50 500B		1459	269	273
	208	169	134	83	47

Approx. Sta. 50 D — Approx Sta. 50 B — Approx Sta. 20 A

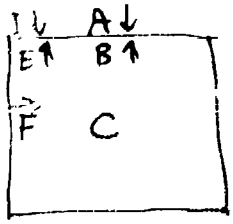
50 400C		845	140	125
117	[illegible]	83	53	29
50 400C		1105	184	166
156	131	109	73	39
50 400C		1452	240	212
201	171	143	94	48
50 400C		1453	239	211
200	170	141	94	48
50 400B		829	195	205
118	93	80	53	30
50 400B		1085	245	255
153	128	104	69	40
50 400B		1469	325	338
201	166	136	87	50
50 400E		1471	321	340
199	165	134	86	50
50 400E		843	224	244
119	96	78	50	31
50 400E		1094	282	304
149	120	96	62	38
50 400E		1453	370	401
195	157	126	91	51
50 400E		1458	365	399
189	152	122	78	50
50 200C		831	202	16
141	111	84	54	32
50 200C		1105	267	221
187	146	111	72	42
50 200C		1503	351	298
249	196	14[illegible]	93	55
50 200C		1508	349	298
245	190	144	93	52
50 200B		824	169	170
136	107	83	51	29
50 200E		1099	217	219
177	139	108	64	38
50 200B		1456	290	293
235	185	143	85	50
50 200B		1456	283	288
233	182	141	84	49
20 100C		858	145	147
132	105	84	5[illegible]	27
20 100C		1129	310	201
180	143	114	72	40
20 100C		1470	406	260
238	191	151	[illegible]	50
20 100C		1469	406	269
237	183	150	94	51
20 100E		839	279	243
143	110	84	53	28
20 100E		11[illegible]	304	304
197	149	115	68	36
20 100B		1440	402	395
269	[illegible]	149	91	47
20 100B		1442	405	397
265	198	149	89	49
20 300C		842	158	1
129	109	88	58	29
20 300C		1115	207	182
170	144	116	77	39
20 300C		1469	279	236
226	191	155	99	50
20 300C		1464	272	235
225	190	154	99	51
20 300B		849	188	197
120	99	79	52	31

Approx Sta. 20 [illegible] C

New smaller cracks in AC.

At a definite joint

20.300B		1112	245	260
158	129	105	69	39
20.300B		1469	326	332
209	173	139	87	51
20 300B		1465	327	339
204	168	136	86	50
20 300c		830	179	170
150	125	95	61	32
20.300c		1087	232	215
194	159	126	78	39
20.300c		1440	312	280
258	212	169	104	51
20 300c		1436	307	283
254	209	166	101	51
20 300c		841	169	160
143	120	94	59	31
20.300c		1092	228	213
191	158	126	77	39
20.300c		1448	299	287
254	209	166	102	50
20.300c		1439	302	277
252	208	165	101	49
20 300c		839	174	162
143	9	95	59	31
20.300c		1093	230	214
191	159	125	77	39
20 300c		1439	301	289
251	208	164	100	50
20 300c		1435	307	283
253	205	166	104	51
20.300d		870	154	144
136	113	93	60	31
20 300d		1157	203	192
179	147	121	79	41
20 300d		1575	268	247
238	198	161	105	52
20 300d		1528	270	253
237	197	161	103	52
20 300f		866	156	182
171	142	112	66	32
20 300f		1131	251	233
216	177	140	84	41
20 300f		1467	331	304
285	234	196	110	51
20 300f		1456	330	306
284	234	125	111	54
20 300g		860	200	
153	120	92	55	
20 300g		1113	2	
197	149	114	77	
20 300g		1457		
259	197	152		
20 300g		1463		
259	197	152	90	



↑↓ = Direction of Sensor

Input File: TA5-1

Test Area #5: All tests run, morning & evening of Oct. 29, 1982.

[Centerslab Tests] = C

Date: OCT 29 1982 Temp. 26.2 C
Roadway: TEST AREA #5 (10.5"PCC)
Load Radius (mm): 150
Sensor Positions (mm):
0 230 300 600 1200 1800 2400
8 12 24 36 48 96

Slab #	Station	Pressure	d1	d2	d3	d4	d5	d6	d7
E1	5 010C	1510	232	220	209	[illegible]	135	101	44
	5.010C	1517	[illegible]	218	209	182	133	100	
H2	8 020C	1529	231	226	215	192	142	89	[illegible]
	5 020C	1533	235	227	217	193	142	90	44
	12 030C	840	130	127	116	101	71	42	21
	12.030C	1142	[illegible]	162	156	135	95	6	30
L3	12 030C	1538	234	227	210	131	127	88	40
	12 030C	1535	233	227	210	191	126	87	41
	7 040C	1523	259	256	238	202	173	79	52
C4	3.040C	1521	267	252	237	200	131	78	51
	3 040C	1523	267	253	239	201	134	80	53
G5	7 050C	1515	261	260	239	207	142	88	59
	7 050C	1504	261	250	238	205	141	88	59
K6	11 060C	1506	241	224	221	190	129	81	50
	11 060C	1508	240	232	[illegible]	189	129	91	52
N7	14 070C	1524	210	201	189	166	117	74	47
	14 070C	1527	207	200	187	163	111	73	47
F8	6 080C	1509	248	[illegible]	231	202	[illegible]	88	
	6 080C	1514	250	[illegible]	231	203	141	[illegible]	[illegible]
J9	10 090C	845	175	[illegible]	[illegible]	[illegible]	70	44	[illegible]
	10 090C	[illegible]	246	[illegible]	159	[illegible]	[illegible]	53	41
	10 090C	1499	273	225	212	[illegible]	127	87	53
	10 090C	[illegible]	[illegible]	224	214	186	[illegible]	87	56
N10	14 100C	[illegible]	209	204	139	165	116	76	50
	14 100C	1507	207	[illegible]	188	[illegible]	116	76	50
A11	1 110C	1522	258	250	239	212	151	96	57
	1 110C	1516	255	251	[illegible]	213	153	97	61
	1 120C	1494	240	271	214	[illegible]	131	82	52
E12	9 120C	1496	238	230	215	189	130	82	50
I13	9 130C	840	152	147	140	120	73	47	25
	9 130C	1128	209	196	188	161	106	64	37
	9 130C	1451	274	[illegible]	251	215	143	[illegible]	50
	9 130C	1500	278	[illegible]	252	218	145	96	54
M14	13 140C	1499	240	275	221	197	141	[illegible]	66
	13 140C	1487	242	[illegible]	219	195	140	96	66
E15	5 150C	828	134	128	122	[illegible]	74	47	[illegible]
	5 150C	1114	179	[illegible]	163	[illegible]	98	62	[illegible]
	5 150C	1521	238		212	185	127	81	
	5 150C	1513	235	[illegible]	213	194	129	91	50
I16	9 160C	1509	201	194	182	160	113	75	50
	9 160C	1513	199	193	179	158	112	77	48
M17	13 170C	1512	220	217	203	175	124	73	50
	13 170C	1506	220	215					

Input File: TA5-2

NOTE: See below for location of tests on each slab.
[Pos. F Not run w Joint Efficiency]

Date: OCT 29 1982 Temp: [illegible]
Roadway: TEST AREA #5 (10"PCC)
Load Radius (mm): 150
Sensor Positions (mm):
0 200 300 600 900 ~~[illegible]~~ -200 ~~[illegible]~~ -300

Slab #	Station	Pressure	d1	d2	d3	d4	d5	d6	d7
E1	5 [illegible]0A	1464	437	482	[illegible]	110	94	374	347
	5 010A	1469	417	462	130	114	97	354	325
	5 010B	1465	449	[illegible]	356	279	214	507	115
	5 010B	1454	426	367	334	261	199	479	129
	5 010C	1488	229	230	215	189	161	223	213
	5 010C	1497	214	214	204	173	148	207	200
	5 010D	1455	658	762	113	99	88	572	529
	5 010D	1452	[illegible]	714	118	105	93	650	519
	5 010E	1442	745	616	550	436	332	870	151
	5 010E	1430	691	603	556	436	326	780	152

Input File: TA5-2b

Date: OCT 29 1982 Temp: 28 C
Roadway: TEST AREA #5
Load Radius (mm): 150
Sensor Positions (mm): -200 -300
0 200 300 600 900 ~~-100~~ ~~-200~~

	Station	Pressure	d1	d2	d3	d4	d5	d6	d7
	5 010F	1475	384	390	383	352	312	374	36[illegible]
	5 010F	1477	374	379	366	339	303	359	379
H2	8 020A	1451	481	550	129	110	95	414	381
	8 020A	1463	468	534	132	113	97	395	366
	8.020B	1487	461	402	365	287	218	529	129
	8.020B	1467	435	360	348	269	204	499	137
L3	12 030D	852	375	424	81	71	58	324	304
	12.030D	1123	450	504	128	111	90	389	367
	12 030D	1449	546	591	198	168	139	471	454
	12 030D	1442	540	590	199	167	137	464	429
	12.030E	848	394	352	324	262	203	451	131
	12.030E	1113	462	406	379	305	238	553	204
	12.030E	1443	543	484	451	365	282	617	283
	12 030E	1439	536	483	448	361	279	608	288
	12 030F	846	195	192	183	168	149	189	193
	12 030F	1117	241	240	226	204	192	234	227
	12 030F	1494	305	303	285	253	229	295	297
	12 030F	1492	303	301	282	257	227	291	283
C4	3 040A	1462	547	635	126	109	92	462	420
	3.040A	1473	526	616	131	112	95	445	402
	3 040B	1461	538	465	418	318	237	608	136
	3.040B	1470	516	442	396	299	223	580	142
G5	7.050D	1427	980	1129	182	156	130	918	852
	7.050D	1425	978	2280	188	152	138	910	821
	7.050E	1434	745	665	627	507	386	840	277
	7 050E	1431	717	623	598	502	367	803	290
	7 050F	1473	511	426	418	389	323	414	405
	7 050F	1468	412	405	395	359	314	397	387
K6	11.060A	1485	396	439	176	145	117	339	314
	11.060A	1489	385	425	183	151	122	326	304
	11.060B	1461	397	341	317	246	129	172	205
	11.060B	1462	377	325	296	272	177	434	215
	11 060C	1512	230	223	209	184	153	217	209
	11 060C	1508	216	209	195	169	143	202	195
N7	14 070D	1444	569	631	213	177	145	506	468
	14 070D	1439	563	621	214	177	145	494	458
	14 070E	1442	633	569	530	426	333	786	138
	14 070E	1445	617	553	520	411	321	825	139
	14 070F	1504	332	331	324	303	274	324	313
	14.070F	1494	324	321	312	299	260	312	302
F8	6 080D	1437	821	1229	160	137	115	760	691
	6 080D	1436	800	1339	158	136	115	729	708
	6.080E	1442	766	700	661	528	420	886	336
	6.080E	1439	728	665	629	506	398	836	350
	6.080F	1474	433	427	416	379	379	422	410
	6.080F	1474	416	405	392	356	315	401	390
J9	10.090A	832	238	264	118	96	77	207	191
	10 090A	1100	297	329	167	175	107	255	239
	10 090A	1458	379	414	233	186	148	328	395
	10 090A	1468	385	414	234	187	149	326	304
	10 090B	823	261	226	208	163	126	295	80
	10 090B	1120	321	281	257	201	155	360	134
	10 090B	1454	406	358	237	259	201	460	199
	10 090B	1469	403	355	224	255	197	453	197
	10 090C	853	125	120	114	101	87	118	115
	10 090C	1123	161	153	146	128	108	152	148
	10 090C	15 4	214	206	196	171	144	203	195
	10 090C	1492	210	204	192	168	142	201	194
N 0	14.100D	1452	667	722	240	203	165	574	521
	14 100D	1449	616	648	247	209	170	603	510
	14 100E	1450	690	652	577	465	370	781	212
	14 100E	1446	671	627	571	452	355	768	222
	14 100F	1487	315	321	304	280	250	302	292
	14 100F	1496	303	300	288	265	236	288	281
A11	1 110A	1481	428	502	243	200	160	466	352
	1 110A	1474	406	450	243	198	160	359	333
	1.110B	1477	448	398	368	297	233	504	174
	1.110B	1475	425	375	349	278	219	478	184
	5 120D	1443	671	771					

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C12  187   159    136   596   542
      5.1200       1438   666   771
     179   152    129   601   536
      5 120E       1445   703   613
     583   430    352   838   195
      5 120E       1432   690   597
     575   461    347   798   197
      5.120E       1442   413   395
     384   345    304   392   379
      5 120E       1445   387   379
     365   327    285   374   362
      9.130A        849   268   299
I13  170   133    104   233   216
      9.130A       1125   329   365
     241   188    144   285   266
      9.130A       1455   414   453
     323   246    190   358   335
      9.130A       1454   410   452
     318   249    190   356   333
      9.130B        832   310   267
     243   195    137   354    87
      9 130B       146[illegible]   494   426
     386   296    221   [illegible]   211
      9 130B       14[illegible]   478   415
     375   287    212   541   214
      9 130C        849   146   139
     171   114     94   137   [illegible]32
      9.130C       1478   24[illegible]   237
     221   190    156   236   226
      9.130C       1470   233   231
     215   184    152   231   217
      9.130D        832   349   392
     229   187    149   314   290
      9.130[illegible]       1448   525   575
     425   336    262   483   440
      9 130D       1452   525   574
     427   336    264   471   438
      9 130E        834   408   360
     335   267    203   494   110
      9.130E       1450   591   517
     489   393    304   685   257
      9 130E       1445   584   473
     486   389    304   655   255
      9.130F       1496   313   313
     295   263    230   312   303
      9 130F       1502   305   302
     285   254    220   301   293
      13 140A      1475   434   507
M14  318   256    197   379   353
      13.140A      1464   420   474
     330   255    197   366   336
      13.140B      1481   397   351
     326   261    205   434   375
      13 140B      1477   382   337
     314   251    196   416   363
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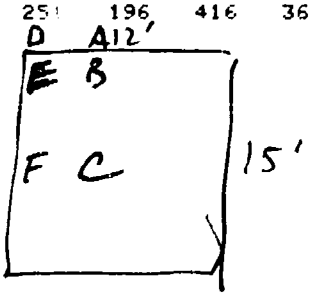
E15, I16 & M17 from Nov. 1.



TEST DATA FROM DRES CONSULTANTS, INC.

Data Collected with Dynatest Model 8000
Falling Weight Deflectometer

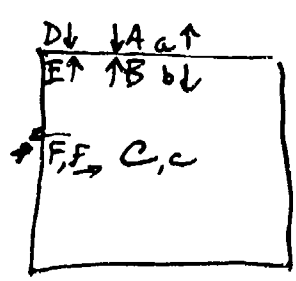
Input File: AR#5-1

Test Area #5: All tests run, morning of Nov. 1.
NOTE: See direction of Sensors & location of test points on Slabs below!

Date: NOV 1 1982 Temp: 22.5 C
Roadway: TEST AREA #5 [10.5"PCC]
Load Radius (mm): 150
Sensor Positions (mm):
0 200 305 610 914 1524 2438
8 12 24 36 60 96

Slab	Station	Pressure	d1	d2	d3	d4	d5	d6	d7
E1 (repeat!)	5.010A	1461	501	611	121	105	88	62	44
	5.010A	1461	476	531	[illegible]	107	92	64	38
	5.010C	1521	227	224	208	181	152	105	67
	5.010C	1518	219	212	201	174	146	101	66
	5.010B	[illegible]	479	702	117	99	86	60	37
	5.010B	1451	467	536	122	105	90	63	41
	5.010D	1425	773	953	131	113	95	68	45
	5.010D	1434	758	1074	132	114	97	71	45
	5.010E	1431	783	1018	[illegible]	122	102	71	42
	[illegible]010E	1431	777	846	147	124	107	74	44
	5.010F	1460	440	[illegible]	299	230	173	103	37
	5.010F	1474	475	459	291	224	171	102	40
E15 (cont'd) From Oct.29	5.150F	849	256	294	74	61	50	34	25
	5.150F	1153	309	349	[illegible]	103	82	53	[illegible]
	5.150F	1547	380	[illegible]	182	148	119	74	[illegible]
	5.150F	[illegible]	367	445	184	151	120	79	79
	5.150A	855	249	[illegible]	93	[illegible]	61	41	[illegible]
	5.150A	1129	304	[illegible]	141	115	92	61	34
	5.150A	1479	373	420	200	160	127	78	44
	5.150A	1481	367	414	195	157	124	77	47
	5.150C	852	120	115	109	93	79	55	34
	5.150C	1138	161	152	146	124	104	72	45
	5.150C	1504	211	205	193	165	138	92	59
	5.150C	1507	212	202	190	163	136	91	58
	5.150B	843	220	247	96	80	64	42	26
	5.150B	1124	271	298	153	122	97	61	35
	5.150B	1473	334	374	251	173	136	83	46
	5.150B	1476	329	364	299	173	138	83	45
	5.150D	835	484	393	222	157	125	80	36
	5.150D	1111	463	502	288	212	168	107	50
	5.150D	1451	555	1433	403	283	220	141	63
	5.150D	1442	552	1081	396	282	223	139	64
	5.150D	836	398	440	198	160	129	80	37
	5.150D	1108	468	496	267	211	185	107	51
	5.150D	1442	543	[illegible]	357	273	223	139	61
	5.150D	1438	548	601	359	274	222	137	61
	5.150E	838	321	[illegible]	176	143	111	68	[illegible]
	5.150E	1154	382	[illegible]	244	194	155	97	[illegible]
	5.150E	1523	461	[illegible]	346	261	204	127	56
	5.150E	1522	459	483	340	269	205	133	58
I16 (cont'd) Oct. 29	[illegible]160A	850	197	223	112	87	69	42	23
	9.160A	1487	308	339	[illegible]	174	136	81	43
	9.160A	1496	306	332	237	172	134	81	44
	9.160C	848	102	[illegible]	92	81	67	47	28
	9.160C	1506	185	179	168	143	121	84	51
	9.160C	1506	185	176	168	144	121	84	51
	9.160B	847	202	226	105	84	67	42	25
	9.160B	1491	315	343	217	168	131	79	43
	9.160B	1495	309	337	216	167	130	79	45
M17 (cont'd) From Oct.29	13.170C	844	113	108	103	88	74	53	34
	13.170C	1497	206	190	183	156	130	87	56
	13.170C	1504	201	191	182	156	130	86	56
	13.170E	844	336	297	172	136	115	63	30
	13.170E	1489	416	436	311	250	198	116	54
	13.170E	1481	420	437	318	247	194	116	55
	13.170D	848	286	313	136	109	86	53	28
	13.170D	1472	437	462	292	224	177	107	51
	13.170D	1481	436	461	297	227	180	110	54
	13.170F	832	176	236	144	109	85	50	25
	13.170F	1529	291	318	270	200	153	92	44
	13.170F	1533	289	311	259	200	152	88	43
B3	2.030A	847	251	285	64	55	47	75	22
	2.030A	[illegible]	[illegible]	443	140	115	93	[illegible]	36
	2.030A	1486	399	434	141	115	96	60	37
	2.030B	842	278	236	215	169	118	67	27
	2.030B	1466	469	402	364	270	200	110	47
	2.030B	1476	462	392					

```
355    262     195    110    45
 2.030C         851    128    121     J8
117     98     82     54     28
 2.030C        1496    225    216
206    174     145    91     53
— 2 030C       1499    225    213
203    172     142    90     50
 2.030b         847    [illegible]47    283
 66     56     48     35     21
 2 030b        1478    419    476
113     97     84     59     38
 2 030b        1486    418    477
118    100     86     61     39
10.020A         826    275    310     G11
J2   77     65     55     39     24
10.020A        1459    433    492
160    132     107    69     39
10.020A        1466    435    493
156    130     106    71     40
10 020C         841    128    122
118    101     85     56     31
10 020C        1510    229    219
209    181     151    96     54
—10.020C       1517    229    220
209    181     152    97     55
10.020B         847    257    290
 75     63     53     35     23
10.020B        1489    402    448
193    157     125    78     43
10.020B        1483    394    445
194    158     126    79     45
10.020F         825    282    321
 69     59     50     36     22
10.020F        1470    436    523
173    141     112    71     31
10.020F        1485    430    486
172    142     113    73     35
N4  14.040C     849    239    271
 68     58     49     35     20
14.040C        1480    393    443
[illegible]    115     94     62     37
— [illegible]040C    1486    384    432
[illegible]    115     95     64     38
[illegible]0B   847    252    289
[illegible]     56     47     34     19
[illegible]040B    1476    429    490
[illegible]    102     86     61     35
[illegible]040B    1474    419    479
[illegible]    107     90     [illegible]     37

Input  File: AR#5-2

Date: NOV 1 19[illegible]   Temp  28 5 .
[illegible]: TEST AREA #5 [11.5"PCC]
[illegible] Radius (mm): 150
[illegible] Positions (mm):
 0   200   [illegible]   61[illegible]   [illegible]   1524  2438

 [illegible]      Pressure      d1      d2
  d3      d4       d5      d6      d7

F5  6 050C         840    142    132
127    108     89     58     30
 6.050C        1496    [illegible]    23[illegible]
224    191     158    101    58
—6 050C        150[illegible]    247    238
224    191     15[illegible]    101    56
 6 050F        [illegible]    262    301
 82     71     59     41     23
 6.050F        14[illegible]    458    510
147    125     105    72     35
 6 050F        1467    441    499
147    119     106    73     34
A7  1 070c      846    148    138
[illegible]    115     93     59     29
[illegible]070c    1500    2[illegible]    252
[illegible]    202     1[illegible]    109    51
— [illegible]70c    1505    260    247
[illegible]    200     16[illegible]    107    52
[illegible] 070F      846    228    253
101     84     69     46     23
 1 070F        146[illegible]    365    401
234    188     151    93     40
 1 070F        147[illegible]    357    390

230    186     149    93     43
10[illegible]           810    [illegible]    124
118    102     84     54     25
10 [illegible]0C   1495   229    222
21[illegible]    192     151    96     47
—10 [illegible]    1515   231    226
212    [illegible]     153    96     49
10.080E         840    227    250
100     91     66     41     24
10 080B        1496    363    399
224    177     1[illegible]    83     45
10 080B        [illegible]498    353    389
217    170     [illegible]    82     45
 7.110A         [illegible]22    249    [illegible]
 77     67     55     38     23
 7 110A        1469    429    4[illegible]
135    [illegible]     95     54     37
 7 [illegible]        1484    421    4[illegible]
13[illegible]           [illegible]9     63     [illegible]
 7 1[illegible]         833    2[illegible]    [illegible]
217    [illegible]     125    73     [illegible]
 [illegible]10b        1479    43[illegible]    377
[illegible]    263     201    116    46
 7 110b        1488    420    371
[illegible]4    259     198    117    49
 7 110C         821    128    121
117    102     86     [illegible]     28
 7 110C        1487    231    224
2[illegible]0    182     154    103    55
—7 110C        1504    231    223
211    183     155    103    56
 7 110E         839    257    289
 78     66     56     40     23
 7 110B        1470    425    480
151    125     103    67     79
 7 110E        1474    437    498
153    128     104    69     40
 7 110[illegible]         824    237    206
130    151     118    69     27
 7 110[illegible]        1472    410    364
334    262     206    121    41
 7 110[illegible]        1486    410    356
333    256     203    123    41
 7.110F         842    219    248
 80     70     57     39     20
 7 110F        1488    399    453
135    11[illegible]     99     70     38
 7.110F        1497    399    454
135    116     99     71     38
 7.110E         629    442    492
141    117     97     61     31
 7.110E        1448    698    713
402    314     246    148    67
 7.110E        1434    690    708
410    315     245    147    67
12.120C         838    130    122
L12  119    103     83     59     27
12 120C        1498    232    220
212    194     155    103    52
—12 120C       1496    231    220
213    194     155    105    52
12.120F         838    254    288
 6[illegible]     57     49     37     21
12 120F        1478    410    455
166    135     109    73     35
12 120F        1482    404    449
164    135     109    75     37
```



Interior Slab FWD Deflection Results from
Apron 1-A (10-1/2 in. PCC)

Station	D1*	D2	D3	D4	Area	Wt (lbf)
O15I	8.1**	7.6	6.4	5.4	30.8	25106
K15I	8.5	7.7	6.6	5.5	30.0	23764
G15I	8.9	8.1	6.9	5.8	30.3	23672
C15I	8.8	8.0	6.9	5.7	30.2	24042
L11I	8.2	7.5	6.5	5.4	30.5	23913
H11I	9.5	8.8	7.6	6.5	30.8	23871
D11I	9.6	8.9	7.7	6.4	30.9	23831
M7I	8.9	8.0	6.9	5.7	30.0	23902
I7I	9.0	8.5	7.3	6.2	31.1	23669
F7I	9.8	9.1	7.8	6.7	30.9	23781
N3I	8.1	7.5	6.2	5.2	30.2	23778
J3I	8.9	8.3	7.1	5.9	30.7	23812
F3I	9.1	8.2	7.1	6.0	30.2	24092
B3I	8.7	8.1	6.9	5.7	30.5	23851
Ave.	8.864	8.164	6.993	5.864	30.507	23935

*D1 = Def. in Center of Plate
D2, D3, D4 = Def. 12, 36, 48 ins. from plate
**Deflection ins. x 10^{-3}

Slab Edge (15 ft. side) FWD Deflection Results
from Apron 1-A (10-1/2 in. PCC)

Slab	Load	D1	D2	LT*	LT adj.**
O15E1	23249	15.8	6.7	42	46
K15E1	23588	15.7	7.3	47	51
G15E1	23204	16.0	7.2	45	49
C15E1	24445	12.5	8.8	70	76
L11E1	23557	14.6	8.7	59	64
H11E1	23507	18.3	5.3	29	31
D11E1	23840	15.2	8.4	56	61
M7E1	23666	12.0	10.1	83	90
I7E1	24081	13.1	11.0	84	91
F7E1	23560	15.7	12.1	77	84
N3E1	23475	13.8	8.7	63	68
J3E1	23688	14.8	10.5	71	77
F3E1	23731	13.9	11.5	83	90
E3E1	23353	16.7	7.8	47	51
Ave.		14.864	8.864	61	66

*LT = D2/D1
**LTx1.0857 (Adjustment for slab bending 8.864/8.164)

Slab Edge (12.5 ft. side) FWD Deflection Results
from Apron 1-A

Slab	Load	D1	D2	LT	LT adj.*
O15E2	23663	14.5	6.7	46	50
K15E2	23579	14.1	8.6	61	66
G15E2	23428	16.0	7.8	49	53
C15E2	23495	13.8	8.3	60	65
L11E2	23314	15.4	6.9	45	49
H11E2	23537	18.6	7.8	42	46
D11E2	23406	19.6	5.2	26	28
M7E2	23378	18.4	4.2	23	25
I7E2	23277	18.7	7.3	39	42
F7E2	22938	21.0	6.1	29	31
N3E2	23397	15.9	4.5	28	30
J3E2	23268	17.5	6.5	37	40
F3E2	23562	17.5	6.4	37	40
B3E2	23271	19.9	5.1	26	28
Ave.		17.21	6.53	39	42

* LT x 8.864/8.164

Slab Corner FWD Deflection Results from
Apron 1-A

Slab	Load	D1	D2	LT	LT adj.
O15C	22584	28.2	16.5	58	63
K15C	22868	22.6	15.4	68	74
G15C	23221	23.9	14.3	60	65
C15C	23557	18.3	14.2	77	84
L11C	23336	18.9	11.1	59	64
H11C	23008	26.8	17.4	65	71
D11C	23179	25.3	4.8	19	21
M7C	22896	22.7	4.9	21	23
I7C	23078	22.1	9.1	41	45
F7C	22961	26.9	5.5	21	23
N3C	22840	27.5	6.9	25	27
J3C	22924	25.8	9.5	37	40
F3C	23307	26.6	10.1	38	41
B3C	22935	28.9	5.3	18	20
Ave.		24.61	10.36	43	47

Interior Slab FWD Deflection Results for
Apron 1-A-1 (AC/PCC)

Slab	Load	D1	D2	D3	D4	Area
A1	23179	8.5	7.1	6.0	5.0	27.9
A2	23260	8.9	7.5	6.2	5.2	28.0
D1	23627	9.2	7.5	6.4	5.3	27.5
D2	23176	10.6	9.4	8.0	6.6	29.4
C1	23137	12.0	10.0	8.3	6.8	27.7
C2	23316	9.0	7.9	6.9	5.8	29.6
Ave.	23282	9.7	8.2	7.0	5.8	28.35

Longitudinal Edge Joint FWD Deflection Results
for Apron 1-A-1 (AC/PCC)

Slab	Load	D1	D2	LT	LT adj.*
A1E1	23039	12.9	9.4	73	86
A2E1	23159	11.3	8.9	79	93
D1E1	23829	14.9	7.8	53	63
D2E1	23482	17.6	8.2	47	56
C1E1	23501	17.1	9.3	54	64
C2E1	23403	15.1	10.2	67	79
Ave.		14.8	9.0	62	73

* LT x 9.7/8.2

Transverse Edge Joint FWD Deflection Results
for Apron 1-A-1 (AC/PCC)

Slab	Load	D1	D2	LT	LT adj.*
A1E2	23078	11.6	8.5	74	88
A2E2	22980	13.5	6.7	50	59
D1E2	23454	13.0	7.1	54	64
D2E2	23039	10.2	9.2	90	100
C1E2	23198	10.4	9.0	87	100
C2E2	23073	14.3	8.9	62	73
Ave.		12.2	8.2	70	81

* LT x 9.7/8.2

Corner FWD Deflection Results for Apron 1-A-1
(AC/PCC)

Slab	Load	D1	D2	LT	LT adj.*
A1C	23498	14.8	11.1	75	89
A2C	24207	13.5	8.0	59	70
D1C	22882	17.3	8.0	46	54
D2C	23002	16.0	15.0	94	100
C1C	23739	12.1	10.5	86	100
C2C	22857	21.1	12.4	59	70
Ave.		15.8	10.8	70	81

* LT x 9.7/8.2

FWD Deflection Taken at Random Cracks in AC for
Apron 1-A-1 (AC/PCC)

Slab	Load	D1	D2	LT	LT adj.*
C2E3	23159	10.7	9.3	87	100
C2E4	23411	9.6	9.0	93	100
D1E3	23792	9.6	8.5	88	100
D1E4	23159	9.8	8.5	87	100
A1E3	23935	10.0	8.3	83	98
A1E4	23206	9.1	7.6	84	99
A2E3	23210	9.2	8.1	88	100
A2E4	23030	10.4	8.4	80	95
Ave.		9.8	8.5	86	99

* LT x 9.7/8.2

Slab Interior FWD Deflection Results for Taxiway 33 (FCC)

Slab	Load	D1	D2	D3	D4	Area
675B1	25114	3.1	2.8	2.6	2.4	31.0
690A1	24506	2.8	2.5	2.3	2.2	31.6
625B1	24467	3.3	3.0	2.8	2.6	32.1
450C1	24092	3.6	3.3	3.0	2.7	32.0
375C1	24148	3.1	2.7	2.4	2.2	30.1
325B1	24306	2.9	2.6	2.5	2.3	31.6
300B1	24200	2.8	2.5	2.3	2.7	31.8
225C1	24218	2.8	2.6	2.4	2.2	31.9
150A1	24064	2.8	2.5	2.3	2.1	31.8
75B1	24770	3.1	2.8	2.6	2.3	30.9
Ave.	24446	3.02	2.73	2.51	2.32	31.45

Longitudinal Joint FWD Deflection Results for
Taxiway 33 (PCC)

Slab	Load	D1	D2	LT	LT adj.*
675BE1	24170	4.9	3.0	61	67
600AE1	24655	5.2	2.3	44	49
525BE1	24562	4.7	3.5	73	81
450CE1	24299	7.8	2.5	33	36
375AE1	24047	6.7	1.9	28	31
300BE1	24350	4.5	3.2	71	79
300BE1	24478	4.8	3.9	81	90
225CE1	24148	7.9	2.1	27	30
150AE1	24056	6.6	2.5	37	41
75BE1	24591	5.3	4.0	75	83
Ave.	FWD Plate on Outer Slab $\bar{A}$			36	40
	FWD Plate on Inner Slab $\bar{B}$			72	80
	FWD Plate on Outer Slab C			30	33 (critical)

* LT x 3.02/2.73

Transverse Joint FWD Deflection Results for
Taxiway 33 (PCC)

Slab	Load	D1	D2	LT	LT adj.*
675BE2	25223	6.1	2.0	33	36
600AE2	24591	6.5	2.3	35	39
525BE2	24330	5.8	1.9	33	36
450CE2	24546	4.1	3.5	87	96
375AE2	23924	5.2	3.2	62	69
300BE2	24170	4.7	2.8	59	65
300BE2	23857	6 1	2.3	38	42
225CE2	24050	6.4	3.5	56	62
150AE2	24403	5.7	3.9	67	74
75BE2	24187	8.7	1.8	21	23
Ave.	Plate on Outer Slab A			55	61
	Plate on Inner Slab B			37	40
	Plate on Outer Slab C			72	79

* LT x 3.02/2.73

Slab Corner FWD Deflection Results for Taxiway 33 (PCC)

Slab	Load	D1	D2	LT	LT adj.*
675BC	24125	8.2	4.0	48	53
600AC	25145	10.4	3.4	33	36
525BC	24039	10.0	4.4	44	49
450CC	24582	7.2	6.2	87	96
375AC	23154	9.4	4.1	43	48
300BC	23442	10.9	2.6	24	27
300BC	23336	14.3	2.0	14	15
225CC	24064	14.7	6.0	41	45
150AC	24683	10.4	8.7	84	93
75BC	23538	20.9	1.9	9	10
Ave.	Plate on Outer Slab A			53	59
	Plate on Inner Slab B			28	31
	Plate on Outer Slab C			64	71

* LT x 3.02/2.73

FWD Deflections for Taxiway 3B

Position	Load	D_1	D_2	D_3	D_4	D_5	D_6	Area
Centerline								
Sta. 50	25092	11.8*	8.9	6.3	4.5	3.3	2.4	23.8
150	23762	12.4	9.5	6.6	4.5	3.3	2.5	23.7
250	23694	11.0	8.2	5.7	3.9	2.9	2.2	23.3
350	24198	11.5	8.5	6.2	4.4	3.1	2.4	23.7
450	24162	11.8	8.9	6.4	4.5	3.3	2.5	23.9
550	24372	9.9	7.8	5.7	4.3	3.2	2.4	24.9
650	23739	12.2	9.4	6.9	5.0	3.7	2.8	29.5
Averages	24140	11.61						23.97
8-10' Right								
Sta. 100	23717	14.1	9.9	6.1	3.9	2.8	2.1	21.3
300	23146	18.2	12.2	7.6	5.0	3.4	2.6	20.6
600	23955	14.8	11.3	8.0	6.6	4.0	3.0	24.0
Averages	23606	15.70						21.97
8-10' Left								
Sta. 200	23165	19.3	18.1	8.2	6.3	3.7	2.9	20.9
400	24378	17.0	11.9	7.7	5.0	3.5	2.5	21.5
600	23638	15.0	10.8	7.5	5.1	3.7	2.8	22.7
Averages	23727	17.10						21.70
18-20' Right								
Sta. 200	22758	23.7	14.6	7.8	4.9	3.3	2.5	18.6
400	23215	17.6	12.0	7.2	4.6	3.2	2.5	20.7
600	23050	23.3	15.7	9.7	6.2	4.1	3.0	20.6
Averages	23007	21.5						19.97
18-20' Left								
Sta. 100	23310	17.0	12.4	8.2	6.6	3.8	2.7	22.4
300	22629	14.0	14.0	8.3	6.3	3.6	2.8	20.3
600	22636	25.2	13.6	7.3	4.4	2.8	2.2	17.0
Averages	22858	21.03						19.90

*[illegible] $\times 10^{-3}$

FWD Deflection for Taxiway 3

Position	Load	D_1	D_2	D_3	D_4	D_5	D_6	Area
Centerline								
Sta. 950	23179	22.6	15.5	8.8	5.7	3.9	3.0	20.6
650	22266	27.1	17.4	10.9	7.1	4.8	3.4	20.1
750	22112	26.1	16.1	9.7	6.2	4.4	3.2	19.3
850	23579	21.7	16.0	10.4	6.7	4.6	3.4	22.4
550	23070	24.6	16.9	10.9	7.3	4.9	3.4	21.3
450	25011	24.5	17.9	11.0	6 7	4.3	2.9	21.8
350	24509	23.4	18.0	11.9	7.8	5.0	3.4	23.3
250	22552	29.2	18.6	11.7	7.7	5.2	3.6	20.0
150	22470	30.6	18.9	11.4	7.0	4.4	2.9	19.3
50	25058	22.1	16.8	10.9	7.1	4.7	3.3	22.9
Averages	23381	25.19						21.08
10' Right								
Sta. 200	22235	39.5	20.0	9.0	5.1	3.6	2.9	15.6
400	22026	40.9	22.6	10.3	5.6	3.6	2.9	16.5
600	22233	50.2	29.0	13.9	7.2	4.4	3.2	17.1
800	21869	59.9	34.3	14.5	6.6	3.7	2.7	16.4
Averages	22090	45.08						16.55
10' Left								
Sta. 100	22085	50.5	26.3	10.8	5.2	3.5	2.8	15.4
300	22938	45.8	25.9	11.5	6.2	4.1	3.2	16.6
500	21757	55.6	28.1	11.7	5.8	3.7	2.7	15.2
700	22059	45.4	23.6	9.9	5.5	3.8	3.1	15.6
900	22177	43.2	21.9	9.2	4.8	3.2	2.6	15.3
Averages	22203	48.10						15.62

TEST DATA FROM LOUIS BERGER
INTERNATIONAL, INC.

Data Collected with Model 2000
Pavement Profiler

MacDill AFB, Florida

L.B.I.I.

PAVEMENT DEFLECTION SURVEY

FROM:
TO: AREA #4

Facility:

PAVEMENT TYPE:

STARTING POINT:

THICKNESS: INCH

TEMPERATURE: °c TIME:

DATE:
TIME START: 7:15

STATION	READING 1 r=0	READING 2 r=	READING 3 r=	READING 4 r=	LOAD KIP	AT TEST POINT cracks or rut	AT TEST POINT patch	REMARKS: GENERAL CONDITIONS
T4A	144	135	114	98	4.49			
T4A	65	63	49	45	2.23			
T4B	58	57	45	41	2.24			
T4B	123	121	96	58	4.48			
T4B	123	122	100	54	4.51			2 Feet back
T4B	62	55	48	27	2.23			" " "
T4C	85	64	50	30	2.23			" " "
T4C	185	134	102	67	4.52			" " "
B41	130	128	118	67	4.49			0
B41	65	62	44	31	2.18			0
B42	67	64	49	31	2.18			50'
B42	142	136	103	61	4.49			50'
B43	158	127	99	62	4.51			100'

REMARKS AND SKETCHES: UNITS:

TIME FINISH:

MacDill AFB, Florida

PAVEMENT DEFLECTION SURVEY

L.B.I.I.

FROM: AREA # 4
TO:

Facility:

PAVEMENT TYPE:

STARTING POINT:

THICKNESS: INCH

TEMPERATURE: °c TIME:

DATE:

TIME START:

STATION	READING 1 r=0	READING 2 r=	READING 3 r=	READING 4 r=	RANGE, LOAD KIP	AT TEST POINT cracks or rut	AT TEST POINT patch	REMARKS: GENERAL CONDITIONS
B43	71	60	44	29	2.19	*		100'
B44	57	52	41	30	2.20	*		150'
B44	117	115	79	60	4.49	*		150'
B45	174	162	118	64	4.52	*		210'
B45	82	75	55	30	2.21	*		210'
C1A	264	222	163	84	4.51	*		Before Joint
C1B	253	331	80	52	4.50	*		After Joint
D1A	200	178	121	75	4.51	*		Before Joint
D1B	221	254	84	57	4.48	*		After Joint
D2	260	252	240	150	4.48	*		
D2	123	116	101	68	2.22	*		

REMARKS AND SKETCHES: UNITS:

TIME FINISH:

* = 2 ft back

MacDill AFB, Florida

L.B.I.I.

PAVEMENT DEFLECTION SURVEY

FROM:
TO:

Facility:

PAVEMENT TYPE: AREA

STARTING POINT:

THICKNESS: INCH

TEMPERATURE: °C TIME: 4√

DATE:
TIME START: [illegible]

STATION	READING 1 r=0	READING 2 r=	READING 3 r=	READING 4 r=	RANGE, LOAD KIP	AT TEST POINT cracks or rut	AT TEST POINT patch	REMARKS: GENERAL CONDITIONS
D3	202	171	137	80	4.46	*		100'
D3	93	88	68	40	2.19	*		100'
D41	126	123	116	43	4.48	*		151' before J
D42	162	140	89	52	4.49	*		151' after J
D5	132	123	93	87	4.48	*		200'
D5	66	59	45	28	2.24	*		200'
C2A	188	162	132	81	4.48	*		Before J
C2B	199	202	143	87	4.51	*		After J
T4A	66	72	66	25	2.25	*		
T4A	69	73	64	70	2.19			
T4A	141	138	148	113	4.52			Test point
T4A	140	158	144	51	451	*		
T4A	151	147	129	126	4.51			
T4A	149	145	129	47		*		

UNITS:

TIME FINISH:

REMARKS AND SKETCHES:

* = 2 ft back – sensor [illegible]

MacDill AFB, Florida

L.B.I.I.

PAVEMENT DEFLECTION SURVEY

FROM: AREA #1
TO:

Facility:

STARTING POINT:

PAVEMENT TYPE:

THICKNESS: INCH

DATE:

TEMPERATURE: °C TIME:

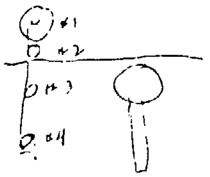
TIME START: 9:20

STATION	READING 1 r=0	READING 2 r=	READING 3 r=	READING 4 r=	RANGE, LOAD KIP	AT TEST POINT cracks or rut	AT TEST POINT patch	REMARKS: GENERAL CONDITIONS
T1A	46	43	37	27	4.50	*		
T1B	50	44	43	32	4.52	*		
T1C	9	9	8	5	1.08	*		
T1C	19	18	16	11	2.22	*		
T1C	29	28	25	17	3.32	*		
T1C	41	39	34	23	4.53	*		
T1D	54	53	47	36	4.49	*	C.L.	4+00 Center
T1E^A	131	115	92	53	4.51	*	C.L.	B Joint 5+00
T1E^B	96	109	27	21	4.52		C.L.	A. Joint " "
T1F	44	43	38	27	4.49		C.L.	MID SLAB
T1F^A	93	73	62	35	4.51		C.L.	B. Joint 4 shots on slab
T1F^B	88	100	31	26	4.52		C.L.	A. Joint D1, D2 on next slab
T1G	40	38	34	22	4.51		C.L.	MID SLAB

TIME FINISH:

UNITS:

REMARKS AND SKETCHES:



MacDill AFB, Florida

L.B.I.1.

PAVEMENT DEFLECTION SURVEY

FROM:
TO: AREA #1

Facility:

PAVEMENT TYPE:

STARTING POINT:

THICKNESS: INCH

DATE:

TEMPERATURE: °C TIME:

TIME START:

STATION	READING 1 r=0	READING 2 r=	READING 3 r=	READING 4 r=	RANGE, LOAD KIP	AT TEST POINT cracks or rut	AT TEST POINT patch	REMARKS: GENERAL CONDITIONS
T1A	37	36	31	23	4.53	*	C.C.L.	MID SLAB
T1 J^A	85	63	56	31	4.49	*		B. Joint Long. Joint
T1 J^B	80	99	28	22	4.51	*		A. Joint Long. Joint
T1 K	45	42	35	26	4.54	*		MID SLAB
T1K^A	113	86	78	48	4.48	*		B Free Edge
T1K^B	537	334	157	62	4.50	*		C.L. of Shoulder
T1K^B	250	139	72	28	2.21	*		C.L. of Shoulder

REMARKS AND SKETCHES: UNITS:

TIME FINISH:

MacDill AFB, Florida

L.B.I.I.

PAVEMENT DEFLECTION SURVEY

FROM:
TO: Area #5

Facility:

STARTING POINT:

PAVEMENT TYPE:

THICKNESS: INCH

DATE:

TEMPERATURE: °c TIME:

TIME START: 10:10

STATION	READING 1 r=0	READING 2 r=	READING 3 r=	READING 4 r=	RANGE, LOAD KIP	AT TEST POINT cracks or rut	patch	REMARKS: GENERAL CONDITIONS
F5C	176	168	137	80	4.49	*		Peat - Center
F5E	232	203	152	68	4.53	*		Peat - edge
3A	155	149	120	60	4.51	*		Center
3C	155	148	118	63	4.52	*		Center
3E	230	236	172	71	4.52	*		edge Before
3E	130	107	78	31	2.22	*		edge Before
3E-F	99	110	39	19	2.21	*		after Joint
3E-F	235	254	87	44	4.54	*		After Joint
3I	166	159	126	67	4.53	*		Center
3I	79	76	61	31	2.20	*		Center
3I	130	107	73	32	2.20	*		edge
3I	299	247	178	76	4.52	*		edge
3I-J	215	244	77	40	4.47	*		After J.

31-J

REMARKS AND SKETCHES: 102 113 37 18 2.25 *

UNITS:

TIME FINISH: "

MacDill AFB, Florida

PAVEMENT DEFLECTION SURVEY

L.B.I.I.

FROM:
TO: [illegible]

FACILITY:

STARTING POINT

PAVEMENT TYPE:

THICKNESS: INCH

TEMPERATURE: °C TIME:

DATE:

TIME START [illegible]

STATION	READING 1	READING 2	READING 3	READING 4	FAILURE LOAD KIP	AT TEST POINT		REMARKS GENERAL CONDITIONS
314	[illegible]	68	[illegible]	[illegible]	[illegible]	✓		[illegible]
314	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	✓		[illegible]
314	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	✓		[illegible]
314	102	[illegible]	[illegible]	[illegible]	[illegible]	✓		[illegible]
314	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	✓		[illegible]
314	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	✓		[illegible]
310	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	✓		[illegible]
310	127	[illegible]	[illegible]	[illegible]	[illegible]	✓		[illegible]
310	111	81	62	[illegible]	[illegible]	✓		[illegible]
310	[illegible]	[illegible]	141	[illegible]	4.93	✓		[illegible]
310	131	[illegible]	[illegible]	[illegible]	[illegible]	✓		[illegible]
310	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	✓		[illegible]

TIME FINISH

REMARKS AND SKETCHES: UNITS:

MacDill AFB, Florida

PAVEMENT DEFLECTION SURVEY

FROM
TO [illegible]

PAVEMENT TYPE

THICKNESS

TEMPERATURE

FACILITY

DATE

REMARKS

GENERAL CONDITIONS

STATION	READING	READING	READING	READING	[illegible]	[illegible]	[illegible]	GENERAL CONDITIONS
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

MacDill AFB, Florida

L.B.I.I.

PAVEMENT DEFLECTION SURVEY

FROM: Area #5
TO:

Facility:

STARTING POINT:

PAVEMENT TYPE:

THICKNESS: INCH

TEMPERATURE: °C TIME:

DATE: 11-23

TIME START:

STATION	READING 1 r=0	READING 2 r=	READING 3 r=	READING 4 r=	RANGE, LOAD KIP	AT TEST POINT: cracks or rut	AT TEST POINT: patch	REMARKS: GENERAL CONDITIONS
14N	217	170	128	52	4.55	*		Edge -4" from edge
14N	241	183	136	52	4.52	*		Edge at edge
14N	110	88	62	24	2.19	*		Edge at edge
14N	195	163	115	44	4.49	*		On Edge
14N	92	74	54	20	2.21	*		On Edge
14N	89	73	56	24	2.25	*		Edge -8"
14N	196	165	117	51	4.52	*		Edge -8"
14N	154	136	104	51	4.56	*		Edge -20"
14N	71	62	47	22	2.26	*		Edge -20"
17O	144	128	114	61	4.46	*		Center
17M	157	148	118	54	4.54	*		Center
17H	147	141	114	58	4.58	*		Center
17E	154	146	125	60	4.46	*		Center

TIME FINISH:

REMARKS AND SKETCHES:

UNITS:

MacDill AFB, Florida

PAVEMENT DEFLECTION SURVEY

L.B.I.I.

FROM:
TO: AREA 5

Facility:

PAVEMENT TYPE:

STARTING POINT:

THICKNESS: INCH

TEMPERATURE: °C TIME:

DATE:

TIME START: 11:39

STATION	READING 1 r=0	READING 2 r=	READING 3 r=	READING 4 r=	RANGE, LOAD KIP	AT TEST POINT cracks or rut	AT TEST POINT patch	REMARKS: GENERAL CONDITIONS
17C	174	170	139	67	4.51	x		Center
17A	155	151	123	62	4.53	x		" "
10A	198	191	154	70	4.52	x		" "
10D	152	144	118	62	4.53	x		" "
10H	200	198	167	89	4.54	x		" "

REMARKS AND SKETCHES:

UNITS:

TIME FINISH: 11:48

MacDill AFB, Florida

L.R.I.I.

PAVEMENT DEFLECTION SURVEY

FROM:
TO: Area 2

Facility:

STARTING POINT:

PAVEMENT TYPE:

THICKNESS: INCH

TEMPERATURE: °C TIME:

DATE:

TIME START 12 56

STATION	READING 1 r=0	READING 2 r=	READING 3 r=	READING 4 r=	LOAD KII	AT TEST POINT cracks or rut	AT TEST POINT patch
0	217	151	72	64	4.50		
0							
1	174	121	77	52	4.53		
1	75	48	22	23	[illegible]		
2	93	63	39	28	2.20		
2	[illegible]	156	87	57	[illegible]		
3	225	171	99	69	4.51		
3	92	62	43	32	2.21		
4	81	51	35	27	[illegible]		
4	187	123	80	58	4.55		
5	159	118	76	47	4.50		
5	71	52	31	22	2.22		
6	76	56	38	27	2.20		

REMARKS:

GENERAL CONDITIONS

[illegible]

[illegible]

TIME FINISH:

REMARKS AND SKETCHES:

UNITS:

MacDill AFB, Florida

PAVEMENT DEFLECTION SURVEY

[illegible]

FROM:
TO: [illegible]

FACILITY:

STARTING POINT:

PAVEMENT TYPE:

THICKNESS: INCH

TEMPERATURE °F TIME

DATE:
TIME START

STATION	READING 1	READING 2	READING 3	READING 4	[illegible]	AT TEST POINT [illegible]	AT TEST POINT [illegible]
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	No [illegible]	
7	[illegible]	[illegible]	111	[illegible]	[illegible]		
7	[illegible]	[illegible]	[illegible]	77	[illegible]		
7	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
6	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
5	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
4	111	[illegible]	[illegible]	[illegible]	[illegible]		
3	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		

REMARKS:

GENERAL CONDITIONS

[illegible]

[illegible]

[illegible]

TIME FINISH

REMARKS AND SKETCHES

UNITS:

MacDill AFB, Florida

PAVEMENT DEFLECTION SURVEY L.B.I.I.

FROM: TO: [illegible]	Facility:
PAVEMENT TYPE: THICKNESS: INCH TEMPERATURE: °C TIME:	STARTING POINT:
	DATE: TIME START:

STATION	READING 1	READING 2	READING 3	READING 4	LOAD FIF	AT TEST POINT cracks or rut	AT TEST POINT patch	REMARKS: GENERAL CONDITIONS
3	32	60	4-	32	2.22			@ ℄
2	64	52	34	27	2.22			
2	152	111	74	52	4.49			
1	143	107	68	47	4.50			
1	66	46	36	22	2.22			
0	66	51	34	26	2.21			
0	144	109	75	52	4.47			
7	536	356	226	149	4.49			RIGHT LANE
7	211	151	97	65	2.18			≈ 30' from ℄
6	266	145	86	66	2.22			
6	455	294	197	132	4.47			
5	340	251	151	106	4.49			

REMARKS AND SKETCHES: UNITS:

TIME FINISH:

MacDill AFB, Florida

PAVEMENT DEFLECTION SURVEY

L.B.I.I.

FROM:
TO: AREA 2

Facility:

PAVEMENT TYPE:

STARTING POINT:

THICKNESS: INCH

TEMPERATURE: °C TIME:

DATE:

TIME START:

STATION	READING 1 r=0	READING 2 r=	READING 3 r=	READING 4 r=	LOAD KIP	AT TEST POINT: cracks or rut	AT TEST POINT: patch	REMARKS: GENERAL CONDITIONS
5	148	113	66	46	2.23			RIGHT LANE
4	142	108	57	40	2.16			~30' from ℄
4	353	265	142	85	4.51			
3	373	276	165	106	4.46			
3	152	117	66	49	2.19			
2	168	121	65	41	2.24			
2	355	284	146	87	4.46			
1	327	228	129	81	4.48			
1	142	100	57	37	2.26			
0	134	104	61	39	2.21			
0	303	240	138	93	4.47			
0	194	159	104	74	4.49			LEFT LANE, 10' off ℄

TIME FINISH:

REMARKS AND SKETCHES:

UNITS:

MacDill AFB, Florida

L.B.I.I.

PAVEMENT DEFLECTION SURVEY

FROM:
TO: AREA 2

Facility:

PAVEMENT TYPE:

STARTING POINT:

THICKNESS: INCH

DATE:

TEMPERATURE: °c TIME:

TIME START:

STATION	READING 1 r=0	READING 2 r=	READING 3 r=	READING 4 r=	LOAD KIP	AT TEST POINT cracks or rut	patch	REMARKS: GENERAL CONDITIONS
0	80	67	44	32	2.18			LEFT LANE
1	76	59	35	26	2.19			≈ 10', off CL
1	174	153	85	58	4.52			
2	198	156	95	69	4.49			
2	89	70	44	33	2.25			
3	88	67	43	34	2.21			
3	194	151	94	71	4.51			
4	220	161	96	66	4.48			
4	89	65	39	28	2.18			
5	72	53	41	21	2.21			
5	170	129	65	41	4.47			
6	158	131	81	63	4.64			
6	71	58	38	29	2.23			

REMARKS AND SKETCHES: UNITS

TIME FINISH:

7	88	72	47	35	2.17
7	203	171	112	81	4.54

MacDill AFB, Florida

PAVEMENT DEFLECTION SURVEY

L.B.T.I.

FROM:
TO: AREA 2 PROFILE

Facility:

STARTING POINT:

PAVEMENT TYPE:

THICKNESS: INCH

DATE:

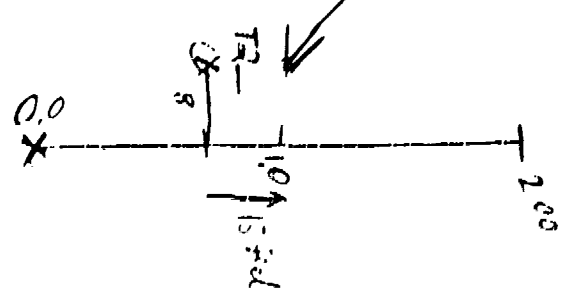
TEMPERATURE: 30 °c TIME:

TIME START:

STATION	READING 1 r=0"	READING 2 r="	READING 3 r="	READING 4 r="	LOAD KIP	AT TEST POINT cracks or rut	patch	REMARKS: GENERAL CONDITIONS
1	191	143	82	55	4.49			10' from C.L. (RIGHT)
2	164	134	84	55	4.47			5' " " "
3	165	118	67	55	4.5	—		@ C.L.
4	182	135	80	57	4.51	T2		5' from C.L. (LEFT)
5	79	60	37	37	2.24	T2		5' " " "

TIME FINISH:

REMARKS AND SKETCHES: UNITS:



MacDill AFB, Florida

PAVEMENT DEFLECTION SURVEY

L.B.I.I.

FROM:
TO: AREA # 3

Facility:

STARTING POINT:

PAVEMENT TYPE:

THICKNESS: INCH

TEMPERATURE: °C TIME:

DATE:

TIME START: 2:28

STATION	READING 1 r=0	READING 2 r=	READING 3 r=	READING 4 r=	LOAD KIP	AT TEST POINT cracks or rut	AT TEST POINT patch	REMARKS: GENERAL CONDITIONS
0	235	158	77	49	2.20			RIGHT LANE
0	617	423	191	115	4.46			12' off C.L.
1	601	393	197	136	4.53			
1	232	154	80	54	2.23			
2	238	148	70	48	2.19			
2	593	394	176	107	4.44			
3	722	509	236	146	4.52			
3	282	190	91	56	2.26			
4	265	172	86	55	2.23			
4	737	464	222	135	4.52			
5	713	456	226	140	4.50			
5	259	170	88	58	2.24			

REMARKS AND SKETCHES: UNITS:

TIME FINISH:

MacDill AFB, Florida

PAVEMENT DEFLECTION SURVEY

L.B.I.I.

FROM:
TO: APEH # 3

Facility:

STARTING POINT:

PAVEMENT TYPE:

THICKNESS: INCH

TEMPERATURE: °C TIME:

DATE:

TIME START: 2:37

STATION	READING 1 r=0	READING 2 r=	READING 3 r=	READING 4 r=	LOAD KIP	AT TEST POINT cracks or rut	AT TEST POINT patch	REMARKS: GENERAL CONDITIONS
6	218	142	78	53	2.23			RIGHT LANE ≈ 12' from C.L.
6	588	333	195	127	4.51			
7	600	377	184	118	4.49			
7	230	145	76	52	2.20			
8	214	136	73	43	2.23			
8	549	336	172	111	4.50			
9	499	394	178	108	4.48			
9	209	153	74	48	2.27			
10	179	124	66	47	2.21			
10	442	309	146	102	4.50			

REMARKS AND SKETCHES:

UNITS:

TIME FINISH:

MacDill AFB, Florida

L.B.I.I.

PAVEMENT DEFLECTION SURVEY

FROM:
TO: AREA #3

Facility:

PAVEMENT TYPE:

STARTING POINT:

THICKNESS: INCH

DATE:

TEMPERATURE: °C TIME:

TIME START: 2:46

STATION	READING 1 r=0	READING 2 r=	READING 3 r=	READING 4 r=	LOAD KIP	AT TEST POINT cracks or rut	AT TEST POINT patch	REMARKS: GENERAL CONDITIONS
10	384	233	145	105	4.47			@ C.L.
10	178	102	65	59	2.24			
9	133	95	60	40	2.21			
9	311	247	141	100	4.48			
8	270	192	139	101	4.50			
8	129	88	62	42	2.21			
7	133	96	57	41	2.21			
7	308	221	129	89	4.43			
6	334	212	170	125	4.47			
6	159	113	72	54	2.21			
5	151	114	75	55	2.24			
5	369	237	182	133	4.47			

REMARKS AND SKETCHES: UNITS:

TIME FINISH:

MacDill AFB, Florida

PAVEMENT DEFLECTION SURVEY

L.B.I.I.

FROM: AREA # 3
TO:

Facility:

PAVEMENT TYPE:

STARTING POINT:

THICKNESS: INCH

DATE:

TEMPERATURE: °C TIME:

TIME START: 2.59

STATION	READING 1 r=0	READING 2 r=	READING 3 r=	READING 4 r=	RANGE, LOAD KIP	AT TEST POINT cracks or rut	AT TEST POINT patch	REMARKS: GENERAL CONDITIONS
4	451	324	193	136	4.48			@ CL
4	164	122	69	53	2.21			
3	145	109	73	56	2.23			
3	336	261	172	128	4.51			
2	301	213	116	94	4.51			
2	127	94	61	42	2.22			
1	133	114	75	55	2.23			
1	316	266	173	126	4.47			
0	321	263	159	112	4.52			
0	142	104	69	47	2.22			

REMARKS AND SKETCHES: UNITS:

TIME FINISH:

MacDill AFB, Florida

PAVEMENT DEFLECTION SURVEY

FROM
TO: AFCP #3

PAVEMENT TYPE

THICKNESS: INCH

TEMPERATURE °C TIME

FACILITY:

STARTING POINT

DATE

TIME START

STATION	READING 1	READING 2	READING 3	READING 4	[illegible]	AT TEST POINT		REMARKS GENERAL CONDITIONS
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]			

TIME FINISH

REMARKS AND SKETCHES

MacDill AFB, Florida

PAVEMENT DEFLECTION SURVEY

FROM
TO

PAVEMENT TYPE

THICKNESS

TEMPERATURE

FACILITY:

STARTING POINT

DATE

REMARKS

GENERAL CONDITION

STATION	READING 1	READING 2	READING 3	READING 4	RANGE	AT TEST POINT	
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		

MacDill AFB, Florida

L.B.I.I.

PAVEMENT DEFLECTION SURVEY

FROM.
TO AREA # 3

Facility:

PAVEMENT TYPE:

STARTING POINT:

THICKNESS: INCH

TEMPERATURE: °C TIME:

DATE:

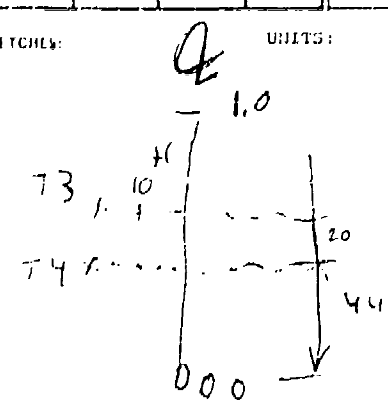
TIME START: 330

STATION	READING 1 r=0	READING 2 r=	READING 3 r=	READING 4 r=	LOAD KIP	AT TEST POINT cracks or rut	AT TEST POINT patch	REMARKS: GENERAL CONDITIONS
T3	101	73	37	25	1.10			T3
T3	233	166	81	53	2.20			T3
T3	404	251	132	81	3.33			T3
T3	651	446	184	111	4.49			T3
A	110	72	40	24	1.14			T4
B	245	141	76	48	2.24			T4
C	381	231	123	74	3.31			T4
D	633	426	182	113	4.49			T4

REMARKS AND SKETCHES:

UNITS:

TIME FINISH:



MacDill AFB, Florida

L.B.I.I.

PAVEMENT DEFLECTION SURVEY

FROM:
TO: AREA #3

Facility:

PAVEMENT TYPE: T3- PROFILE

THICKNESS: INCH

TEMPERATURE: °C TIME:

STARTING POINT:

DATE:

TIME START: 3:42

STATION	READING 1 r=0	READING 2 r=	READING 3 r=	READING 4 r=	LOAD KIP	AT TEST POINT cracks or rut	AT TEST POINT patch	REMARKS: GENERAL CONDITIONS
1	460	291	167	105	4.49			LEFT LANE 5' off ℄
1	183	120	73	38	2.21			" " "
2	137	106	70	45	2.24			on ℄
2	305	235	154	107	4.49			on ℄
3	449	316	186	99	4.49			RIGHT LANE, 5' off ℄
3	192	137	62	53	2.24			" " "
4	226	179	85	53	2.20			" " 10' off ℄
4	627	407	215	126	4.49			" " "
5	729	465	173	117	4.49			" ", 22' off ℄
5	307	255	85	56	2.24			" " "
6	404	314	129	80	2.20			" ", 32' off ℄
6	1036	728	326	197	4.49			" " "

MacDill AFB, Florida

L.b.I.I.

PAVEMENT DEFLECTION SURVEY

FROM:
TO: APRN A[illegible]

PAVEMENT TYPE:

THICKNESS: INCH

TEMPERATURE: °C TIME:

Facility:

STARTING POINT:

DATE:

TIME START: [illegible]

STATION	READING 1 r=0	READING 2 r=	READING 3 r=	READING 4 r=	LOAD KIP	AT TEST POINT [illegible]	[illegible]	REMARKS GENERAL CONDITIONS
[illegible]	1038	607	305	210	[illegible]			[illegible]
[illegible]	460	33[illegible]	157	105	2.21			[illegible]
	298	241	86	6.3	[illegible]			[illegible]
	752	[illegible]	19[illegible]	10.8	[illegible]			" " "

TIME FINISH:

REMARKS AND SKETCHES: UNITS:

TEST DATA FROM REINARD W. BRANDLEY

Data Collected with Dynatest Model
8000 Falling Weight Deflectometer
and Brandley Cantilever Beam

TABLE NO A2

Load Radius 150 mm — FWD DATA - TEST AREA #1 — McDILL AFB

20" PCC — Nov. 1, 1982

Sta	Offset	Load kPa	Temp °C	Deflection in Microns at Distance R from Load mm: R=0	R=200	R=305	R=610	R=914	R=1524	R=2438
Center of Slab										
[illegible]	[illegible]	1527	33	74	72	67	62	57	47	32
[illegible]	℄	1518		80	79	73	67	61	51	35
[illegible]	2.5 L	1528		75	71	67	61	55	45	30
[illegible]	[illegible]	1530		74	73	69	64	58	47	32
[illegible]	℄	1528		75	70	66	59	54	44	31
[illegible]	[illegible]	1539		78	72	68	62	56	45	31
[illegible]	[illegible]	1539		73	68	65	59	53	42	29
[illegible]	℄	1526		77	73	66	60		44	29
[illegible]	2.5 L	1526		75	69	67	63	56	44	27
[illegible]										
[illegible]	[illegible]	833		43	42	39	37	34	29	18
[illegible]	℄	838		47	45	42	40	36	31	19
[illegible]	[illegible]	836		46	41	39	36	34	27	18
[illegible]	[illegible]	833		45	44	41	37	35	29	20
[illegible]	℄	[illegible]		46	40	38	36	32	27	[illegible]
[illegible]	[illegible]	[illegible]		44	42	39	36	33	27	15
[illegible]	[illegible]	836		43	39	37	34	31	25	17
[illegible]	℄	834		43	37	38	34	31	26	16
[illegible]	[illegible]	831		43	39	37	34	33	26	15
Edge of Slab										
[illegible]	[illegible]	[illegible]		108	116	95	73	64	47	37
[illegible]	[illegible]	1513		136	148	60	52	48	38	[illegible]
	[illegible]	1513		[illegible]	123	75	66	59	46	31
[illegible]	[illegible]	[illegible]		107	113	83	71	63	46	[illegible]
[illegible]	[illegible]	[illegible]		79	106	98	80	68	52	31
[illegible]	[illegible]	[illegible]		[illegible]	146	60	53	47	38	27
[illegible]	[illegible]	[illegible]		111	124	77	67	58	47	30
[illegible]	[illegible]	[illegible]		[illegible]	112	65	57	50	37	26
[illegible]	[illegible]	[illegible]		135	153	52	31	27	32	16
	[illegible]	[illegible]		125	135	61	54	47	35	[illegible]
[illegible]	[illegible]	[illegible]		109	[illegible]	[illegible]	64	55	41	37
Corner of Slab										
[illegible]	℄	[illegible]		177	190	90	76	68	53	34
[illegible]	℄	[illegible]		136	145	78	68	61	47	30

TABLE A3

Area 2 — 11" AC — FWD DATA - TEST AREA # 2. — McDill AFB

Load Radius 150 mm — 18 Ft Right of ℄ — Nov 1, 1982

STA	Line	Load KPa	Load lb	R=0	R=200	R=305	R=610	R=914	R=1524	R=2438	Temp
0+00	2:69	828		302	236	186	111	74	39	21	
		1452		521	415	333	202	134	70	38	38°
											13:30 h
1+00	2:72	845		374	228	172	95	59	32	19	
		1437		598	371	295	167	105	57	31	
2+00	2:75	839		393	266	222	118	72	37	21	
		1424		632	431	368	201	125	63	34	
3+00	2:78	847		346	266	197	111	67	35	21	
		1438		581	441	335	194	122	63	35	
4+00	2.82	852		243	196	165	100	63	35	22	
		1462		422	345	287	178	115	63	36	
4+00	2.83	1458		416	347	284	176	116	61	37	
5+00	2:86	847		334	251	184	93	52	26	17	
		1441		533	385	291	149	84	43	25	
6+00	2:89	845		341	260	209	128	79	40	22	
		1427		580	452	368	228	146	74	39	
7+00	2:92	830		543	360	250	148	84	40	23	
		1387		834	578	465	250	148	70	40	

TABLE A4

FWD DATA - TEST AREA #2 McD.11 AFC

Area 2 11" AC 18 ft Left of ℄ Nov. 1, 1982

Load Radius 150 mm

Sta	Line	Load KPa	lb	Deflection μ #1 (0)	#2 (200)	#3 (305)	#4 (610)	#5 (914)	#6 (1524)	#7 (2438)	Temp °C
0+00	2:45	836		308	231	185	118	77	41	24	13:10
		1462		531	415	335	215	143	73	39	
1+00	2:48	844		302	178	144	99	68	36	21	
		1471		483	319	261	181	124	67	36	
2+00	2:51	818		291	238	194	120	76	38	22	
		1407		511	408	340	211	135	68	37	
3+00	2:54	845		294	213	173	109	70	36	21	
		1448		505	362	304	194	125	64	35	
4+00	2:57	814		441	287	221	121	70	35	20	
		1391		716	486	375	210	127	62	37	
5+00	2:60	847		301	245	198	118	79	38	23	
		1434		535	431	354	215	134	66	37	
6+00	2:63	829		324	234	193	103	62	23	20	
		1431		557	411	326	189	116	62	39	
7+00	2:66	850		325	246	206	126	79	40	25	28.0°
		1423		556	422	357	222	143	71	41	13:50

TABLE A5

Area 2 11" AC — FWD DATA - TEST AREA No 2 — McDill AFB
Load Radius 150 mm — 2' R of Center Line — Nov 1, 1982

STA	Line	Load kPa	Load lb	R=0	R=200	R=305	R=610	R=914	R=1219	R=1524	Temp °C
0+25	2:3	829		159	132	114	81	58	34	19	33
		1476		293	247	216	152	109	63	35	
0+75	2:6	813		182	154	133	90	63	34	19	
		1485		336	208	249	167	115	61	35	
1+25	2:9	852		202	165	139	93	63	35	20	
		1454		368	354	256	171	119	62	34	
1+75	2:12	817		208	171	145	94	62	32	18	
		1444		374	306	267	176	117	60	35	
2+25	2:15	857		155	137	117	81	56	33	18	
		1468		250	230	220	153	106	58	33	
2+75	2:18	853		173	148	130	92	65	35	20	11:40 A
		1470		320	276	241	171	121	66	35	
[illegible]	2:21	819		181	152	135	92	69	35	20	
		1453		331	281	244	171	118	63	35	
3+75	2:24	843		169	143	125	86	59	33	18	
		1480		312	263	233	163	113	60	34	
4+2[illegible]	2:27	842		180	141	118	79	54	31	19	
		1453		324	234	215	147	102	55	33	
[illegible]	2:30	853		170	146	123	86	62	35	19	
		1499		320	271	233	161	119	66	35	
[illegible]	2:33	867		168	142	124	94	71	40	22	
		1505		311	267	237	177	131	72	37	
[illegible]	2:36	848		160	130	114	82	58	33	18	
		1487		295	243	214	153	108	58	31	
6+25	2:39	847		166	140	114	82	57	32	20	
		1454		307	270	225	155	107	63	36	
475	2:42	850		170	147	129	94	68	35	21	
		1477		313	218	245	179	85	35	21	

TABLE A6

Area No3 5½"AC | Nov 1, 1982 | McDill AFB

Load Radius 150mm

FWD DATA

T/W Center line.

STA	Line	Load KPa	Load lb	Deflection in Microns at Distance R from Load - mm: R=0	R=200	R=305	R=610	R=914	R=1524	R=2438	Temp °C
0+25	#3:3	858		503	374	299	160	92	40	36	38
		1470		792	578	419	263	156	69	47	
0+75	3:6	861		378	299	254	158	99	48	23	
		1503		637	505	423	262	168	80	44	
1+25	3:9	845		372	298	251	156	99	45	27	1440 k.
		1461		638	505	428	269	171	86	45	
1+75	3:12	866		391	323	276	164	99	42	24	
		1524		684	530	528	285	176	77	43	
[illegible]	3:15	579		230	186	152	93	58	31	19	
		860		392	313	263	162	100	45	29	
		1133		501	390	327	202	127	60	70	
		1493		724	562	482	292	179	79	48	
2+75	3:21	873		344	285	240	151	96	45	24	
		1143		442	371	305	193	123	60	34	
		1543		607	576	425	269	172	78	42	
3+25	3:24	864		361	300	260	168	108	46	25	
		1137		461	378	325	211	136	61	32	
		1519		670	522	448	289	187	82	42	
3+75	3:27	939		553	419	337	200	118	44	23	34
		1447		924	681	555	329	201	83	41	
4+25	3:30	858		368	249	201	131	91	54	31	
		1505		666	438	368	245	170	100	50	
4+75	3:33	851		402	252	285	167	102	45	27	
		1457		849	[illegible]	485	270	103	75	36	
5+25	3:36	867		391	332	280	170	102	43	27	
		1509		680	588	492	299	184	82	51	
5+75	33	[illegible]		[illegible]	347	[illegible]	[illegible]	73	45	23	
		1466		[illegible]	367	467	263	166	82	50	

TABLE A6 Cont

Area No 3 5½" AC — Nov 1, 1982 — McDill AFB

Load Radius 150 mm

FWD DATA

T/W Centerline – Cont.

STA	Line	Load KPa	Load lb	Deflection in Microns at Distance R From Load – mm: R=0	R=200	R=305	R=610	R=914	R=1524	R=2438	Temp °C
6+25	3:42	834		516	382	296	159	95	44	26	
		1412									
6+25	3:45	832		467	352	271	150	96	48	27	
		1433		815	594	503	273	173	81	46	
6+75	3:48	831		548	390	259	149	86	43	25	
		1420		898	624	477	257	153	77	47	
7+25	3:51	863		363	293	240	147	92	45	25	
		1510		644	487	429	245	161	81	45	
7+75	3:54	846		441	343	251	137	87	44	25	
		1463		750	545	419	224	149	77	46	
8+25	3:57	844		442	354	270	144	81	41	23	
		1441		711	577	543	246	147	77	43	
8+75	3:60	871		362	292	241	150	96	43	24	
		1508		649	500	422	262	169	78	42	
9+25	3:63	862		316	257	216	136	88	44	25	
		1501		556	445	382	241	157	79	46	
9+75	3:66	844		359	303	236	143	93	45	25	
		1463		610	495	407	249	162	80	46	

TABLE [illegible] 7

AREA NO 3 — FWD Test DATA — McDill AFB

Load Radius 150mm — 18' L of Taxiway ℄ — Nov 1, 1982

STA	Line	LOAD KPa	LOAD lb	Deflection in Microns at Distance R From Load - mm R=0	R=200	R=305	R=610	R=914	R=1524	R=2438	Temp °C
0+00	2:3	800		980	680	480	183	89	40	22	
		1375		1252	856	644	266	140	74	43	
1+00	2:6	786		1195	779	573	169	72	42	29	
		1375		1310	980	650	231	114	76	49	
2+00	2:9	815		880	587	398	143	70	40	26	
		1404		1210	811	555	241	116	66	40	
3+00	2:12	810		803	573	415	158	79	40	25	
		1441		1150	854	639	255	131	66	42	
4+00	2:15	794		1047	720	508	189	78	30	21	
		1370		1326	959	720	302	145	66	42	
5+00	2:18	794		1000	656	436	151	65	32	23	34.0
		1378		1245	932	612	246	128	67	44	
6+00	2:21	798		914	614	412	144	67	36	25	
		1374		1235	830	600	246	132	75	46	
7+50	2:24	796		831	564	390	146	66	35	24	
		1376		1113	763	551	238	130	73	46	
8+00	2:27	784		796	556	389	146	67	35	25	
		1376		1067	388	552	234	126	71	47	
9+00	2:30	808		792	547	356	127	58	32	23	
		1388		1121	738	494	203	109	62	41	
10+00	2:33	819		655	456	334	126	52	33	21	
		1389		914	644	485	210	115	67	42	

73.2 73.1 72.6 [illegible] [illegible] [illegible] 57.1 54.2 44.6 [illegible] 47.6 ← Load 25000 lb Defl in mils [illegible]

↓ 4' ↓ 4' ↓ 4' ↓ 4' ↓ 2' ↓ 2' ↓ 4' ↓ 4' ↓ 4' ↓ 4' ↓

Cross Section Sta. 400 = 56" [illegible]

TABLE A8

5½" AC FWD TEST DATA McDill AFB

Load Radius 150 mm 13'R of Taxiway Centerline Nov 1, 1983

Area No 3

STA	Line	LOAD KPa	lb	R=0	R=200	R=305	R=610	R=914	R=1524	R=2435	Temp °C
0+00	3:69	791		1011	651	467	170	80	38	21	
		1372		1358	818	678	275	142	72	41	
1+00	3:72	806		843	601	409	151	75	44	28	36.5
		1378		1146	821	593	257	139	90	48	1520 hr
2+00	3:75	800		923	629	427	151	75	42	25	
		1370		1227	877	594	242	131	78	47	
3+00	3:78	809		906	657	469	193	87	38	29	
		1367		1247	906	662	292	146	74	43	
4+00	3:81	794		1010	715	508	203	94	37	23	
		1366		1355	870	693	289	149	71	43	
5+00	3:84	813		796	553	383	152	93	45	25	
		1372		1251	898	646	274	147	77	45	
6+00	3:87	797		1104	802	577	236	108	39	24	
		1363		1425	950	770	343	174	78	46	
7+00	3:90	806		906	592	429	190	97	46	29	
		1363		1222	816	609	286	159	84	50	
8+00	3:93	811		740	520	367	157	82	40	26	
		1376		1032	720	527	243	140	76	46	
9+00	3:96	804		933	631	444	182	84	35	24	
		1378		1239	840	574	253	131	65	44	

TABLE A4

McDILL AFB — WD DATA [illegible]

TEST AREA No. 4, [illegible]

Test Location	Pavement Temp °C	Load kN	Deflection [illegible]						
			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
T.P. 74	36.0	1436	110	205	173	166	142	90	91
TP 74		1415	225	212	161	183	137	96	98
0130 1		1430	234	218	176	176	192	9[illegible]	92
0130 4		1435	164	214	210	170	183	81	9[illegible]
0128 6		1426	340	3[illegible]	201	111	192	97	98
0130 0		1470	323	337	[illegible]	166	135	81	[illegible]
[illegible]		1435	328	408	191	139	119	83	[illegible]
0130 B		1505	[illegible]	172	177	161	156	91	88
0130 B		1443	[illegible]	170	437	189	192	81	[illegible]
0120 A		1470	456	[illegible]	134	158	141	97	[illegible]
[illegible] A		1471	[illegible]	[illegible]	[illegible]	146	149	87	98
0110 C		1465	[illegible]	[illegible]	[illegible]	19[illegible]	135	97	[illegible]
0110 C		1457	317	332	[illegible]	178	138	81	[illegible]
[illegible]		1437	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		1533	[illegible]	[illegible]	[illegible]	178	151	129	[illegible]
[illegible]		1456	311	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]		14[illegible]	318	[illegible]	[illegible]	147	13[illegible]	[illegible]	[illegible]

TABLE [illegible] A10

[illegible] [illegible] [illegible] 11/1/8[illegible]

[illegible] [illegible] [illegible]

Test No.	Test Location	Pavement Temp °F	Load lb	Deflection in Mils at Distance R' from Load Line [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Middle of Slab										
[illegible]	C	101	[illegible]	311	303	191	164	137	91	58
[illegible]	C		[illegible]	231	223	210	182	154	103	55
[illegible]	C		1602	263	230	236	201	167	108	51
[illegible]	C		1802	246	230	224	191	161	141	57
[illegible]	C		[illegible]	225	214	204	173	143	90	51
[illegible]	C		[illegible]	253	218	204	117	149	103	66
[illegible]	C		[illegible]	203	196	182	136	170	86	56
[illegible]	C		[illegible]	182	199	168	143	121	84	[illegible]
[illegible]	C		[illegible]	231	210	211	184	153	104	[illegible]
[illegible]	C		[illegible]	236	251	211	182	151	97	48
[illegible]	C		–	–	–	–	–	–	–	–
[illegible]	C		1913	229	219	209	181	157	96	54
Edge of Slab										
[illegible]	A		[illegible]	370	[illegible]	[illegible]	180	[illegible]	77	43
[illegible]	A		[illegible]	337	317	[illegible]	[illegible]	[illegible]	83	[illegible]
[illegible]	A		[illegible]	311	[illegible]	183	[illegible]	114	[illegible]	[illegible]
[illegible]	A		[illegible]	[illegible]	477	[illegible]	117	[illegible]	[illegible]	38
[illegible]	A		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	A		[illegible]	311	[illegible]	[illegible]	[illegible]	[illegible]	70	[illegible]
[illegible]	A		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	130	[illegible]	[illegible]
[illegible]	A		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	A		[illegible]	418	[illegible]	[illegible]	98	83	60	[illegible]
[illegible]	A		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	70	63	[illegible]
[illegible]	A		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	08	61	[illegible]
[illegible]	A		[illegible]	438	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	A		[illegible]	110	[illegible]	[illegible]	[illegible]	[illegible]	10	[illegible]
[illegible]	A		[illegible]	[illegible]	333	[illegible]	[illegible]	[illegible]	81	[illegible]
[illegible]	A		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	130	[illegible]	[illegible]
[illegible]	A		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	A		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	71	[illegible]	30
[illegible]	A		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	A		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	08	[illegible]	[illegible]
[illegible]	A		[illegible]	[illegible]	[illegible]	118	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	A		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	A		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Corner of Slab										
[illegible]	C		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	C		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	C		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	C		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	C		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	46
[illegible]	C		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

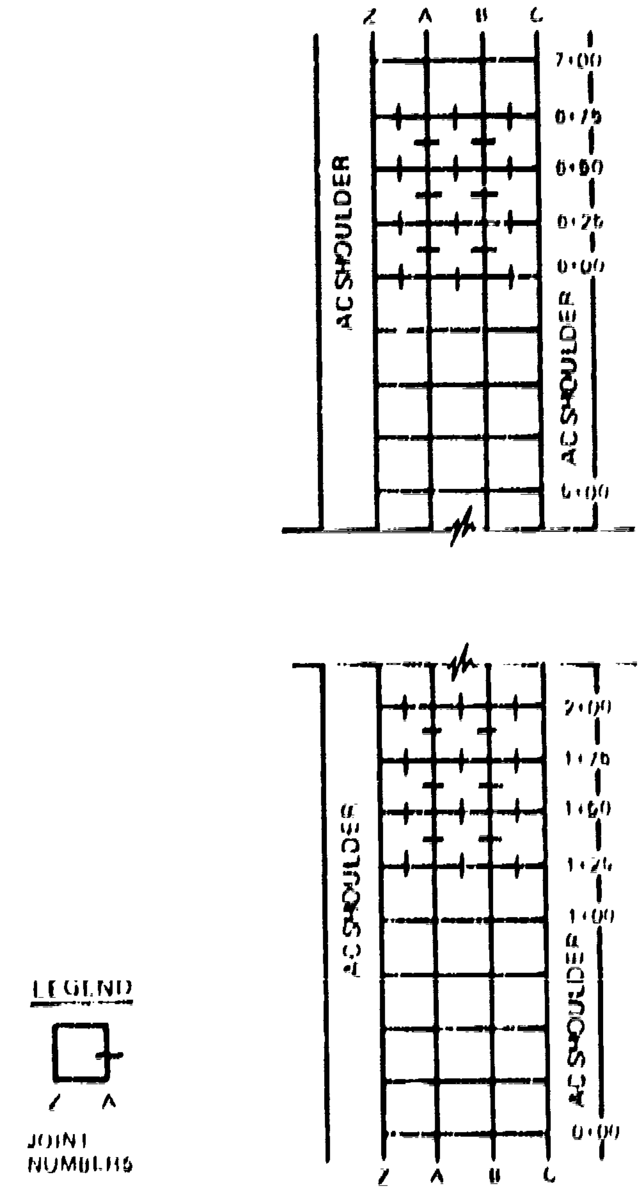
APPENDIX C

PCC JOINT EFFICIENCY TEST DATA:

INDEX, PLATES and TABLES

PLATES

TABLES



SLAB TESTING
MCDILL AFB
11-2-82
TEST AREA 1

PLATE C1

Table C1 McDill AFB

Plate Testing - Slab Rocking
November 7, 1982
Test Site #1

	Joint No.	Slab Rocking - inch Wheel #1	Wheel #2
[illegible]	125 150 A	.001	.001
[illegible]	125 150 B	.001	0
[illegible]	150 175 A	.002	.001
[illegible]	150 175 B	.001	.001
	175 200 A	.002	.001
	175 200 B	.002	.002
	200 2-A	0	.001
	175 2-A	.001	.001
	150 2-A	.001	0
	125 2-A	.002	.001
	125 A-B	.002	.002
	150 A-B	.006	.003
	175 A-B	.001	.001
	200 A-B	.003	.002
	200 B-C	0	0
	175 B-C	0	0
	150 B-C	0	.001
	125 B-C	0	0
	600 B-C	.001	0
	675 B-C	0	0
	650 B-C	.001	0
	625 B-C	.002	0
	675 A-B	.001	.003
	650 A-B	.002	.002
	625 A-B	.002	.001
	600 A-B	.001	0
	600 2-A	.001	.002
	625 2-A	.001	.002
	650 2-A	.001	.001
	675 2-A	.001	[illegible]

TABLE C1 (cont)
McDill AFB

SLAB TESTING
NOVEMBER 2, 1982
Test Site No 1

Joint No.	SLAB ROCKING-INCH Wheel #1	Wheel #2
650-675A	.002	.001
650-675B	.001	.002
625-650A	.002	.002
625-650B	.001	.001
600-625 A	.003	.001
600-625 B	.003	.002

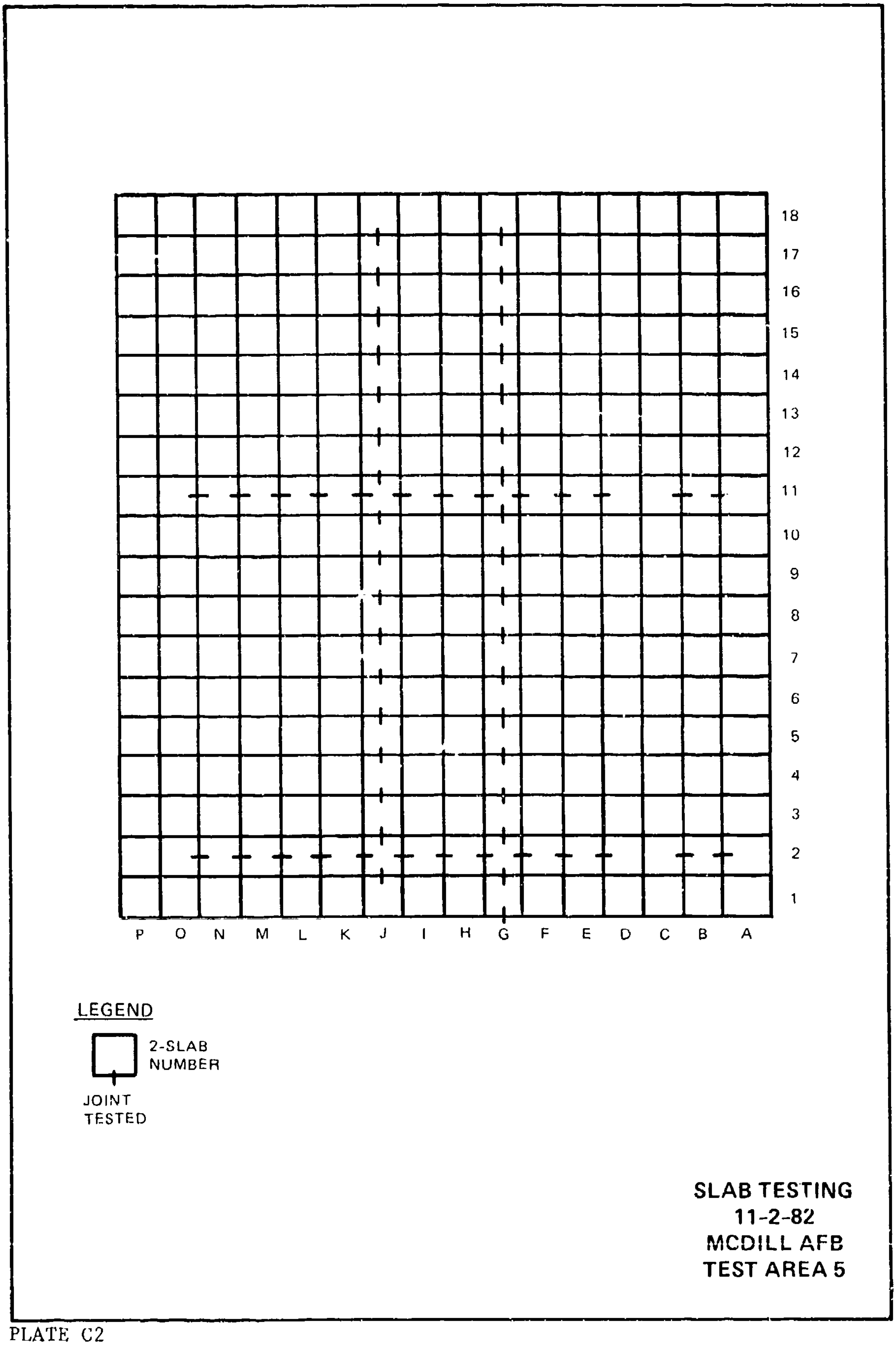

18
17
16
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
P O N M L K J I H G F E D C B A
LEGEND
2-SLAB NUMBER
JOINT TESTED
SLAB TESTING
11-2-82
MCDILL AFB
TEST AREA 5

PLATE C2

TABLE C2

Slab Testing – Slab Rocking
November 2, 1982
Test Area #5

MacDill AFB

Joint No.		SLAB ROCKING – INCH Wheel #1	Wheel #2
See	J 1-2	.010	.003
attached	J 2-3	.008	.007
sketch	J 3-4	.005	.003
	J 4-5	.010	.007
	J 5-6	.007	.005
	J 6-7	.006	.006
	J 7-8	.004	.002
	J 8-9	.008	.004
	J 9-10	.003	.002
	J 10-11	.006	.004
	J 11-12	.006	.001
	J 12-13	.006	.003
	J 13-14	.005	.002
	J 14-15	.005	.002
	J 15-16	.004	.002
	J 16-17	.004	.002
	J 17-18	.002	.002
	G 17-18	.004	.002
	G 16-17	.004	.002
	G 15-16	.004	.003
	G 14-15	.006	.001
	G 13-14	.006	.004
	G 12-13	.006	.005
	G 11-12	.006	.002
	G 10-11	.007	.004
	G 9-10	.004	.003
	G 8-9	.009	.005
	G 7-8	[illegible]	.005
	G 6-7	.009	.005
	G 5-6	.007	.004
	G 4-5	.003	.004
	G 3-4	.003	.006
	G 2-3	.007	.004
	G 1-2	.005	.003
	G 0-1	.003	.003

TABLE C-2 (Cont)

Construction - Slab Rocking — MacDill AFB

November 2, 1982

Test Slab #3

Joint No.	Slab Rocking - Inch: Wheel #1	Slab Rocking - Inch: Wheel #2
2 N-O	.004	.002
2 M-N	.010	.004
2 L-M	.006	.003
2 K-L	.007	.003
2 J-K	.006	.003
2 I-J	.006	.003
2 H-I	.005	.003
2 G-H	.005	.004
2 F-G	.005	.003
2 E-F	.006	.004
2 D-E	.007	.004
2 B-C	.004	.005
2 A-B	.002	.002
11 A-B	.008	.005
11 B-C	.009	.003
11 D-E	.005	.003
11 E-F	.024	.003
11 F-G	.007	.004
11 G-H Corner	.010	.006
11 G-H Middle	.005	.006
11 H-I	.006	.005
11 I-J	.004	.003
11 J-K	.006	.003
11 K-L	.005	.002
11 L-M	.006	.002
11 M-N	.007	.005
11 N-O	.003	.005

TEST DATA FROM WATERWAYS EXPERIMENT STATION

Data Collected with WES 16-kip vibrator
and WES Falling Weight Deflectometer
(Dynatest 15-kip FWD)

Table 2

Pavement Condition Rating

of Test Areas

Test Area	PCI	Rating
1	100	Excellent
2	62	Good
3	46	Fair
4	48	Fair
5	95	Excellent

Table 3

Test Data - WES 16-Kip Vibrator

Test Area	Test No.	Station or Location	Date	Time	Surface Temperature °F	DSM kips/in.	Temperature Correction Factor	Corrected DSM kips/in.	Force lb	Deflection, mils Distance from Center of Plate, in. 0	18	36	60
1	A-1	0+12.5	2 Nov 82	1437		6240			15,047	2.31	1.70	1.44	1.17
	A-4	0+87.5		1436		5760			14,643	2.45	1.92	1.62	1.31
	A-7	1+62.5		1435		5840			14,841	2.44	1.85	1.52	1.21
	A-10	2+37.5		1434		6600			14,514	2.02	1.66	1.37	1.09
	A-13	3+12.5		1433		6640			14,480	2.07	1.54	1.26	1.00
	A-16	3+87.5		1433		6040			14,910	2.38	1.89	1.57	1.23
	A-19	4+62.5		1432		5640			14,463	2.50	2.02	1.67	1.33
	A-22	5+37.5		1431		6320			14,895	2.30	1.86	1.53	1.23
	A-25	6+12.5		1430		6240			14,732	2.30	1.84	1.54	1.24
	A-28	6+87.5		1428	94.6	6360			14,854	2.30	1.86	1.57	1.31
	B-2	0+37.5		1438		6400			15,052	2.20	1.75	1.46	1.18
	B-5	1+12.5		1439		6280			14,03[illegible]	2.14	1.71	1.43	1.17
	B-8	1+87.5		1440		5400			14,585	2.68	1.73	1.46	1.18
	B-11	2+62.5		1441		5560			14,69[illegible]	2.62	1.57	1.31	1.05
	B-14	3+37.5		1442		6880			14,349	2.05	1.57	1.32	1.06
	B-17	4+12.5		1443		5440			14,715	2.67	1.80	1.51	1.22
	B-20	4+87.5		1444		5240			14,444	2.72	1.77	1.46	1.15
	B-23	5+62.5		1444		6920			14,925	2.14	1.70	1.42	1.14
	B-26	6+37.5		1445		6560			14,495	2.20	1.71	1.43	1.17
	C-3	0+62.5		1421		5400			14,223	2.58	1.92	1.63	1.33
	C-6	1+37.5		1421		6360			14,584	2.20	1.76	1.48	1.20
	C-9	2+12.5		1422		6000			14,091	2.19	1.68	1.40	1.11
	C-12	2+87.5		1423		7000			14,466	2.00	1.65	1.37	1.09
	C-15	3+62.5		1424		5880			14,672	2.36	1.80	1.51	1.21
	C-18	4+37.5		1424		5320			14,930	2.71	2.11	1.79	1.44
	C-21	5+12.5		1425		6920			14,704	2.06	1.58	1.28	1.01
	C-24	5+87.5		1426		4400			14,340	3.12	1.83	1.56	1.28
	C-27	6+62.5		1427		5840			14,614	2.39	1.85	1.57	1.30
2	T-2	0+84 8 ft lf	1 Nov 82	0458	85.8	1860	1.10	2046	4,299	1.47	0.03	0.54	0.37
									9,790	4.08	2.82	1.40	0.90
									14,480	6.63	4.59	2.24	1.37

(Continued)

(Sheet 1 of 6)

Table 3 (Continued)

Test Type	Test No.	Station or Location	Date	Time	Surface Temperature °F	DSM kips/in.	Temperature Correction Factor	Corrected DSM kips/in.	Force lb	Deflection, mils: Distance from Center of Plate, in. 0	18	36	60
2	A-0+00	22 ft Lt	1 Nov 82	0402	90.0	1370	1.12	1534	14,793	9.15	6.06	2.74	1.51
	A-1+00			0401		1420		1590	15,056	8.95	5.79	2.70	1.65
	A-2+00			0400		1270		1422	15,686	9.73	5.69	2.73	1.67
	A-3+00			0359		1360		1523	14,484	9.04	5.75	2.72	1.78
	A-4+00			0358		1120		1254	14,081	10.48	6.39	2.83	1.84
	A-5+00			0355		1540		1725	14,706	8.32	4.35	2.03	1.47
	A-6+00			0357		1250		1400	14,336	9.67	6.13	2.83	1.83
	A-7+00			0356		1110		1243	14,616	11.15	6.86	3.15	2.03
	B-0+00	12 ft Lt		0350		1620		1814	14,330	7.36	4.80	2.45	1.37
	B-0+50			0349		1670		1870	14,731	7.65	5.22	2.53	1.44
	B-1+00			0346		1820		2038	14,239	6.56	4.45	2.27	1.33
	B-1+50			0339		1960		2195	14,918	6.69	5.03	2.39	1.33
	B-2+00			0334		1660		1859	14,770	7.72	5.11	2.64	1.52
	B-2+50			0334		1600		1792	14,368	7.90	5.38	2.86	1.64
	B-3+00			0333		1680		1882	15,030	7.80	5.26	2.73	1.65
	B-3+50			0333		1670		1870	14,316	7.39	5.18	2.76	1.75
	B-4+00			0332	91.0	1460	1.13	1650	14,802	8.71	5.86	2.88	1.76
	B-4+50			0332		1710		1932	14,721	7.61	5.40	2.69	1.56
	B-5+00			0331		2220		2509	14,553	5.99	3.52	1.75	1.19
	B-5+50			0330		1840		2079	14,457	7.11	4.89	2.65	1.63
	B-6+00			0330		1880		2124	14,739	6.97	4.65	2.62	1.55
	B-6+50			0329		1550		1751	14,873	8.30	6.19	2.96	1.72
	B-7+00			0328		1530		1729	14,830	8.37	5.88	3.12	1.78
	C-0+00	Center line		0403	90.0	2060	1.12	2307	14,478	6.05	4.13	2.09	1.24
	C-1+00			0404		2260		2531	14,893	5.87	3.84	2.00	1.22
	C-2+00			0405		1900		2128	14,453	6.76	4.16	2.26	1.40
	C-3+00			0405		1720		1926	14,974	7.60	5.03	2.75	1.68
	C-4+00			0406	89.0	2040		2285	14,[illegible]	6.47	4.49	2.50	1.59
	C-5+00			0407		2480		2778	14,495	5.48	3.23	1.92	1.43
	C-6+00			0407		1840		2061	14,513	6.76	4.59	2.45	1.58
	C-7+00			0408	89.4	1900		2128	14,344	6.77	4.71	2.71	1.65

(Continued)

(Sheet 2 of 6)

Table 3 (Continued)

Test Area	Test No.	Station or Location	Date	Time	Surface Temperature °F	DSM kips/in.	Temperature Correction Factor	Corrected DSM kips/in.	Force lb	Deflection, mils, Distance from Center of Plate, in.: 0	18	36	60
2	D-0+00	12 ft rt	1 Nov 82	0314	91.0	1820	1.13	2057	17,973	6.62	4.47	2.09	1.13
	D-0+50			0315		1720		1944	14,569	7.40	4.73	2.11	1.18
	D-1+00			0316		2120		2396	15,186	6.34	4.09	1.82	1.01
	D-1+50			0317		1760		1989	14,594	7.28	4.62	2.14	1.22
	D-2+00			0318	91.5	1740		1966	14,628	7.27	4.57	2.15	1.30
	D-2+50			0320	91.0	2030		2293	14,491	6.29	4.23	1.97	1.21
	D-3+00			0322		1620		1831	14,752	7.79	4.97	2.38	1.43
	D-3+50			0323		1660		1876	14,633	7.70	5.03	2.57	1.57
	D-4+00			0324		1900		2147	15,293	7.17	4.82	2.44	1.44
	D-4+50			0324		1700		1921	14,673	7.48	5.07	2.46	1.35
	D-5+00			0325		2400		2712	14,726	5.56	3.61	1.54	1.06
	D-5+50			0326		1680		1898	14,350	7.38	4.97	2.62	1.57
	D-6+00			0326		1760		1989	14,354	7.03	4.46	2.44	1.50
	D-6+50			0326		1610		1819	14,768	7.69	5.08	2.35	1.36
	D-7+00			0327		1500		1695	14,672	8.32	5.64	2.61	1.46
	E-0+00	22 ft rt		0350	90.9	1540	1.12	1725	14,309	8.02	5.41	2.53	1.48
	E-1+00			0351		1500		1680	14,572	8.20	4.65	2.08	1.22
	E-2+00			0352		1490		1669	14,514	8.55	5.87	2.58	1.52
	E-3+00			0352		1300		1456	14,753	9.48	5.98	2.64	1.62
	E-4+00			0353		1490		1832	14,787	7.24	4.93	2.35	1.52
	E-5+00			0354		1950		2061	14,837	7.33	4.88	1.95	1.36
	E-6+00			0355		1120		1366	13,655	10.46	7.65	3.06	1.81
	E-7+00			0355		1050		1176	14,712	11.51	6.92	2.97	1.74
3	T-?	C-62 10.5 ft lt		0455	86.0	920	1.10	1002	4,238	2.83	1.57	0.72	0.47
									10,642	8.40	4.87	2.02	1.38
									14,214	12.45	7.37	2.90	1.94
	A-0+50	12 ft lt		0444	87.0	880		968	14,724	13.53	8.35	3.22	2.02
	A-1+50			0442		820		902	14,709	14.92	8.92	3.41	2.19
	A-2+50			0442		730		803	14,553	15.00	10.40	3.92	2.22
	A-3+50			0443		800		880	14,547	14.03	9.25	3.54	2.07
	A-4+50			0440		920		1012	14,677	13.34	8.86	4.22	2.44
	A-5+50			0443		840		924	14,587	14.34	8.53	3.64	2.25
	A-6+50			0439		850		935	14,355	13.57	8.54	3.47	2.25

(Continued)

(Sheet 3 of 6)

Table 3 (Continued)

Test Area	Test No.	Station or Location	Date	Time	Surface Temperature °F	DSM kips/in.	Temperature Correction Factor	Corrected DSM kips/in.	Force lb	Deflection, mils, Distance from Center of Plate, in.: 0	12	24	36
3	A-7+50	712 ft lt	[illegible] Nov 82	[illegible]	88.0	[illegible]	1.10	1078	14,8[illegible]	12.52	7.65	3.00	2.06
	A-8+50			04[illegible]		[illegible]		957	14,7[illegible]	11.38	7.42	2.85	1.40
	A-9+50			04[illegible]		[illegible]		1034	14,506	12.39	7.52	3.00	1.90
	C-0+00	Center line		04[illegible]		[illegible]		1177	14,481	11.80	7.47	3.61	2.03
	C-1+00			04[illegible]	88.[illegible]	[illegible]		1075	14,7[illegible]	12.57	8.51	4.28	2.30
	C-2+00			0420	88.0	1000		1100	14,673	11.47	7.42	3.75	2.28
	C-3+00			0421		1000		1100	14,752	11.90	8.22	4.03	2.31
	C-4+00			0422		860		946	14,624	13.52	8.14	3.86	2.17
	C-5+00			0422		980		1078	14,573	12.22	8.23	3.84	2.24
	C-6+00			0423		880		968	14,725	13.25	8.96	4.41	2.55
	C-7+00			0424		1020		1122	15,010	12.11	7.86	3.58	2.30
	C-8+00			0424		1220		1342	14,339	10.11	6.77	3.50	2.17
	C-9+00			0425		1080		1188	14,446	10.77	7.32	3.24	1.95
	C-10+00			0426		1060		1166	14,612	11.34	7.23	3.49	2.11
	B-0+00	712 ft rt		0445	87.0	820		902	14,691	14.03	8.46	3.29	1.96
	B-1+00			0446		920		1012	14,755	13.12	8.35	3.53	2.23
	B-2+00			0447		880		968	14,928	13.73	8.91	3.35	2.15
	B-3+00			0448		790		869	14,876	14.53	9.46	3.46	2.06
	B-4+00			0448		710		781	14,653	15.90	10.91	3.57	2.17
	B-5+00			0449		770		847	14,654	15.23	10.53	3.57	2.07
	B-6+00			0449		680		748	14,395	16.68	10.68	4.00	2.43
	B-7+00			0450		870		957	14,722	14.04	9.52	3.75	2.36
	B-8+00			0450		990		1089	14,265	12.45	7.95	3.18	2.11
	B-9+00			0451		950		1045	14,836	12.78	7.58	2.92	1.78
	B-10+00			0452	86.5	1120		1232	14,745	11.29	7.03	2.62	1.72
4	T-4		2 Nov 82	1538	101.0	2840	1.16	3294	4,245	1.40	1.25	0.92	0.66
									9,1[illegible]	3.38	2.93	2.11	1.46
									14,467	4.90	4.15	2.97	2.07
	1			1513	101.0	2420		2807	14,751	5.89	4.84	3.35	2.27
	2			1514	100.7	2480		2877	14,326	5.71	5.03	3.71	2.60
	J-3			1516	101.0	1900		2204	14,846	7.36	5.81	3.76	2.38
	4			1517	101.0	1940		2250	14,218	6.93	5.60	3.92	2.59

(Continued)

(Sheet 4 of 6)

Table 3 (Continued)

Test Area	Test No.	Station or Location	Date	Time	Surface Temperature °F	DSM kips/in.	Temperature Correction Factor	Corrected DSM kips/in.	Force lb	Deflection, mils: Distance from Center of Plate, in. 0	18	36	60
4	5		2 Nov 82	1518	101.0	2580	1.16	2993	14,348	5.48	4.54	3.27	2.26
	6			1520		2620		3039	14,611	5.47	4.42	3.20	2.32
	7			1521		2160		2506	14,618	6.56	5.56	3.99	2.77
	J-8			1524		1780		2065	14,529	7.51	5.14	3.15	2.12
	9			1532		2300		2668	14,737	6.26	5.23	3.59	2.43
	10			1542		2360		2738	14,739	6.12	5.11	3.40	2.32
	J-11			1544		1940		2250	14,432	7.04	5.64	3.74	2.56
	12			1546		2300		2668	14,966	6.34	5.22	3.62	2.53
	J-13			1547		1330		1543	14,618	10.09	7.99	4.93	3.40
	14			1549		1720		1995	14,571	8.07	6.90	5.33	4.18
	15			1551		1910		2216	14,535	7.46	6.25	4.45	3.32
	16			1552		2000		2320	14,735	7.19	6.04	4.46	3.08
5	A-1			0838		2620			14,322	5.32	3.95	2.80	2.10
	E-1			0840		2780			14,184	5.05	4.21	3.06	2.17
	I-1			0840		2400			14,657	6.04	4.48	3.11	2.07
	M-1			0841		2740			14,779	5.38	4.54	3.27	2.35
	N-3			0844		2800			14,462	5.16	4.03	2.92	2.20
	J-3			0853		2520			14,574	5.59	4.55	3.23	2.31
	F-3			0855		2500			14,593	5.79	4.29	2.99	2.03
	B-3			0855		2900			14,416	4.95	4.01	2.75	1.97
	G-5			0900		2220			14,937	6.62	5.19	3.77	2.81
	K-5			0901		2380			14,619	5.80	4.46	3.09	2.21
	0-5			0903		2720			14,575	5.30	4.03	2.92	2.16
	M-7			0907		2720			14,482	5.23	4.23	2.94	2.08
	I-7			0909		2520			14,350	5.64	4.35	3.20	2.34
	F-7			0909		2360			14,650	5.76	4.43	3.09	2.14
	D-9			0920		2380			14,300	5.87	4.73	3.35	2.22
	F-9			0922		2480			14,301	5.55	4.62	3.34	2.43
	J-9			0923		2620			14,492	5.40	4.25	3.12	2.33
	0-11			0929		2760			14,893	5.24	4.20	3.17	2.44
	K-11			0930		2700			14,620	5.29	4.09	2.97	2.15
	G-11			0931		2400			14,051	5.68	4.31	3.11	2.16

(Continued)

(Sheet 5 of 6)

Table 3 (Concluded)

Test Area	Test No.	Station or Location	Date	Time	Surface Temperature °F	DSM kips/in.	Temperature Correction Factor	Corrected DSM kips/in.	Force lb	Deflection, mils: Distance from Center of Plate, in. 0	18	36	60
5	C-11		2 Nov 82	0931		2380			14,674	6.01	5.04	3.72	2.64
	A-13			0933		2340			14,664	6.05	5.10	3.60	2.49
	E-13			0934		2740			14,464	5.27	4.38	3.22	2.40
	I-13			0934		2440			14,581	5.96	4.97	3.48	2.31
	M-13			0935		2760			14,401	5.07	4.12	2.97	2.26
	N-15			0937		2720			14,595	5.17	4.03	2.92	2.13
	J-15			0933		2520			15,087	5.88	4.73	3.40	2.50
	F-15			0939		2580			14,584	5.53	4.28	3.06	2.16
	B-15			0939		2720			14,522	5.27	4.18	3.02	1.99
	C-17			0941		2720			14,530	5.26	4.52	5.63	2.18
	G-17			0943		2700			14,748	5.41	4.49	3.34	2.47
	K-17			0944		2200			14,545	6.55	5.38	4.09	2.96
	O-17			0945		2900			14,863	5.06	4.09	3.00	2.17
	L-18			0948		2600			14,952	5.69	4.78	3.60	2.72
	H-18			0949		2740			14,619	5.30	4.32	3.12	2.28

(Sheet 6 of 6)

Table 4

Test Data—WES 16-Kip Vibrator—Joint Tests

Test Area	Test No.	Station or Location	Date	Time	Surface Temperature °F	DSM Edge of Slab kips/in.	Force lb	Deflection, mils, Distance from Center of Plate, in. 0	Deflection, mils, Distance from Center of Plate, in. 18	Deflection Ratio
1	TJ-1	C3-C2	2 Nov 82	1152	89.1	4720	14,270	2.93	2.32	0.79
	TJ-2	C12-C11		1158		4700	14,872	3.47	2.16	0.61
	TJ-3	C21-C20		1200		5720	14,403	2.44	1.69	0.69
	TJ-4	A22-A23		1210		3420	14,735	4.20	1.93	0.46
	TJ-5	A13-A14		1211		5800	14,579	2.40	2.05	0.83
	TJ-6	A4-A5		1213		4960	14,743	2.82	2.35	0.83
	TJ-7	B2-B1		1215		3580	14,582	4.03	1.59	0.39
	TJ-8	B11-B10		1218		5520	14,523	2.55	1.89	0.74
	TJ-9	B20-B19		1219		3600	14,592	4.08	1.58	0.39
	TJ-10	B26-B25		1220		4560	14,325	3.06	1.85	0.60
	LJ-11	A1-B1		1224		3660	14,368	3.87	1.77	0.47
	LJ-12	B5-A5		1226		4080	14,479	3.31	1.98	0.60
	LJ-13	B8-C8		1227		3650	13,851	3.71	1.58	0.43
	LJ-14	C12-B12		1229		5040	14,525	2.80	1.88	0.67
	LJ-15	A16-B16		1230		3840	14,097	3.67	1.30	0.35
	LJ-16	C18-B18		1232		3760	14,281	3.78	1.42	0.38
	LJ-17	B20-C20		1233		3640	14,156	4.09	1.35	0.33
	LJ-18	B23-A23		1236		5500	14,497	2.47	1.75	0.71
	LJ-19	B26-C26		1252		3900	14,928	3.66	2.12	0.58
5	TJ-1	J15-J16		1019		2100	4,566	1.98	1.66	0.84
							10,009	4.55	3.83	0.84
							14,586	6.71	5.59	0.83
	TJ-2	J12-J11		1021		1790	14,403	7.54	4.97	0.66
	TJ-3	J9-J10		1023		2007	14,378	6.75	5.75	0.85
	TJ-4	J6-J7		1025		1610	14,767	8.76	5.22	0.59
	TJ-5	J3-J4		1026		1770	14,611	7.89	6.36	0.81
	TJ-6	G5-G4		1029		1570	14,647	8.76	5.86	0.67
	TJ-7	G8-G7		1030		1850	14,237	7.51	6.22	0.83
	TJ-8	G11-G10		1031		1740	14,904	7.91	6.13	0.77
	TJ-9	G14-G13		1032		1700	14,157	7.92	4.65	0.59
	TJ-10	G17-G16		1033		2309	14,617	6.27	5.15	0.83
	LJ-11	A1-B1		1049		1740	14,601	7.87	3.91	0.50
	LJ-12	L1-I1		1048		1320	14,700	10.15	3.49	0.34
	LJ-13	G1-H1		1046		1580	14,606	8.12	5.92	0.71
	LJ-14	I1-J1		1045		1770	14,763	7.81	4.86	0.62
	LJ-15	H1-N1		1044		1680	14,823	8.62	4.06	0.47
	LJ-16	C11-D11		1038		1310	14,417	10.08	4.78	0.47
	LJ-17	G11-F11		1039		1560	14,235	8.67	5.17	0.60
	LJ-18	K11-J11		1040		1900	14,618	7.13	5.43	0.76
	LJ-19	G11-H11		1041		1900	14,061	7.10	3.13	0.47
	J1	J2-I2		1052		1840	14,560	7.22	5.49	0.76
	2	J2		1056		2500	14,777	5.61	4.75	0.85
	J3	K2-J2		1057		1800	14,410	7.34	5.04	0.69
	J4	J2-I1		1108		1700	14,552	7.87	4.88	0.62
	J5	J3-J2		1108		1680	14,527	7.96	5.56	0.70
	J6	J2-I1		1104		1470	14,424	9.07	3.83	0.42
	J7	J3-I2		1105		1190	14,466	9.30	7.07	0.76

Table 5

Test Data - Falling Weight Deflectometer

Test Area	Test No.	Station or Location	Date	Time	Surface Temperature °F	Force lb	Deflection, mils, Distance from Center of Plate, in. 0	12	24	36	48
1	A-1	0+12.5	3 Nov 82		91.0	14,428	1.77	1.57	--	1.42	--
						14,269	1.73	1.54	--	1.53	--
						14,428	1.73	--	1.38	--	1.14
						14,476	1.73	--	1.42	--	1.06
	A-4	0+87.5				14,587	2.01	1.73	--	1.50	--
						14,587	2.01	1.73	--	1.42	--
						14,506	1.89	--	1.61	--	1.26
						14,571	1.97	--	1.61	--	1.30
	A-7	1+62.5		10:50	91.3	14,365	2.01	1.69	--	1.34	--
						14,460	2.05	1.73	--	1.30	--
						14,380	2.05	--	1.50	--	1.14
						14,317	2.01	--	1.50	--	1.18
	A-10	2+37.5			91.0	14,476	2.05	1.54	--	1.42	--
						14,380	2.01	1.65	--	1.49	--
						14,269	2.05	--	1.57	--	1.18
						14,396	2.01	--	1.57	--	1.18
	A-13	3+12.5				14,317	2.13	1.57	--	1.42	--
						14,412	2.09	1.57	--	1.42	--
						14,444	2.17	--	1.46	--	1.14
						14,396	2.05	--	1.50	--	1.18
	A-16	3+87.5				14,317	2.20	1.61	--	1.30	--
						14,269	2.17	1.69	--	1.34	--
						14,253	2.17	--	1.55	--	1.26
						14,285	2.20	--	1.50	--	1.26
	A-19	4+62.5			92.0	14,285	2.17	1.81	--	1.34	--
						[illegible]	2.13	1.85		1.30	--
						14,333	2.09	--	1.61	--	1.34
						14,317	2.17	--	1.65	--	1.34
	A-22	5+37.5				14,365	1.97	1.69	--	1.30	--
						14,396	2.05	1.65	--	1.34	--
						14,317	2.01	--	1.57	--	1.22
						14,380	1.93	--	1.54	--	1.26
	A-25	6+12.5				14,285	1.89	1.46	--	1.22	--
						14,285	1.77	1.54	--	1.22	--
						14,285	1.69	--	1.50	--	1.14
						14,301	1.81	--	1.42	--	1.10
	A-28	6+87.5				14,333	1.73	1.50	--	1.22	--
						14,380	1.73	1.46	--	1.22	--
						14,285	1.69	--	1.46	--	1.14
						14,333	1.69	--	1.38	--	1.18
	B-2	0+37.5				14,126	1.89	1.57	--	1.30	--
						14,174	1.89	1.50	--	1.34	--
						14,301	1.89	--	1.46	--	1.14
						14,253	1.85	--	1.46	--	1.14
	B-5	1+12.5				14,476	1.85	1.65	--	1.42	--
						14,333	1.85	1.73	--	1.42	--
						14,333	2.01	--	1.57	--	1.30
						14,349	1.97	--	1.61	--	1.26

(Continued)

(Sheet 2 of 15)

Table 5 (Continued)

Test Area	Test No.	Station or Location	Date	Time	Surface Temperature °F	Force lb	Deflection, mils — Distance from Center of Plate, in. 0	12	24	36	48
1	B-8	1+87.5	3 Nov 82		92.0	14,253	1.73	1.57	--	1.30	--
						14,333	1.73	1.57	--	1.30	--
						14,301	1.73	--	1.42	--	1.18
						14,349	1.77	--	1.50	--	1.14
	B-11	2+62.5				14,158	1.61	1.50	--	1.22	--
						14,126	1.65	1.54	--	1.26	--
						14,206	1.69	--	1.54	--	1.10
						14,174	1.73	--	1.46	--	1.14
	B-14	3+37.5				14,301	1.85	1.57	--	1.30	--
						14,333	1.69	1.54	--	1.30	--
						14,333	1.77	--	1.42	--	1.18
						14,365	1.73	--	1.42	--	1.22
	B-17	4+12.5				14,317	1.81	1.77	--	1.38	--
						14,269	1.77	1.85	--	1.42	--
						13,936	1.81	--	1.46	--	1.22
						14,285	1.73	--	1.50	--	1.26
	B-20	4+87.5				14,444	1.81	1.61	--	1.38	--
						14,460	1.85	1.65	--	1.38	--
						14,460	1.81	--	1.38	--	1.22
						14,460	1.81	--	1.42	--	1.18
	B-23	5+62.5				14,365	1.73	1.42	--	1.22	--
						14,380	1.61	1.46	--	1.14	--
						14,301	1.65	--	1.30	--	1.06
						14,301	1.65	--	1.26	--	1.06
	B-26	6+37.5				14,333	1.65	1.50	--	1.26	--
						14,365	1.65	1.50	--	1.26	--
						14,380	1.69	--	1.34	--	1.10
						14,365	1.65	--	1.38	--	1.10
	C-3	0+62.5				14,237	1.89	1.69	--	1.42	--
						14,253	1.89	1.54	--	1.42	--
						14,269	1.89	--	1.69	--	1.34
						15,159	1.97	--	1.77	--	1.38
	C-6	1+37.5				14,110	1.85	1.77	--	1.34	--
						14,222	1.85	1.85	--	1.30	--
						14,301	1.85	--	1.54	--	1.14
						14,222	1.81	--	1.50	--	1.14
	C-9	2+12.5				14,094	1.65	1.54	--	1.26	--
						14,126	1.77	1.61	--	1.30	--
						14,237	1.69	--	1.26	--	1.18
						14,110	1.73	--	1.26	--	1.30
	C-12	2+87.5			93.0	14,253	1.97	1.65	--	1.46	--
						14,349	1.93	1.69	--	1.46	--
						14,333	1.93	--	1.85	--	1.30
						14,380	1.93	--	1.61	--	1.18
	C-15	3+62.5				14,444	1.81	1.61	--	1.34	--
						14,476	1.81	1.61	--	1.34	--
						14,221	1.81	--	1.54	--	1.22
						14,476	1.81	--	1.57	--	1.26

(Continued) (Sheet 2 of 15)

Table 5 (Continued)

Test Area	Test No.	Station or Location	Date	Time	Surface Temperature °F	Force lb	Deflection, mils: Distance from Center of Plate, in. 0	12	24	36	48
1	C-18	4+37.5	3 Nov 82		93.0	14,174	2.20	1.81	--	1.54	--
						14,269	2.13	1.85	--	1.54	--
						14,349	2.20	--	1.61	--	1.38
						14,301	2.24	--	1.77	--	1.38
	C-21	5+12.5				14,476	1.65	1.50	--	1.22	--
						14,492	1.57	1.18	--	1.26	--
						14,285	1.61	--	1.34	--	1.10
						14,460	1.61	--	1.26	--	1.14
	C-24	5+87.5				13,983	1.97	1.50	--	1.18	--
						14,237	1.89	1.54	--	1.22	--
						14,285	1.93	--	1.42	--	1.10
						14,269	1.93	--	1.38	--	1.10
	C-27	6+62.5		11:30		14,142	1.97	1.50	--	1.30	--
						14,333	1.97	1.61	--	1.30	--
						13,999	1.97	--	1.46	--	1.14
						14,078	1.97	--	1.42	--	1.26
2	T-2	0+84 8 ft lf		2:10	97.0	4,036	2.17	1.50	--	0.63	--
						4,052	2.24	1.54	--	0.63	--
						3,988	2.32	--	0.94	--	0.47
						4,020	2.28	--	0.94	--	0.47
						8,755	5.08	3.54	--	1.42	--
						8,771	5.04	3.54	--	1.42	--
						8,740	5.31	--	2.28	--	1.06
						8,740	5.31	--	2.28	--	1.06
						14,174	8.62	6.06	--	2.44	--
						14,253	8.70	6.10	--	2.52	--
						14,206	8.74	--	3.90	--	1.77
						14,190	8.66	--	3.86	--	1.77
	A-0+00	≈22 ft lf			98.0	13,983	14.80	8.62	--	3.15	--
						14,094	14.09	8.62	--	3.19	--
						14,047	13.70	--	5.08	--	2.20
						--	--	--	--	--	--
	A-1+00					14,110	12.13	8.15	--	2.87	--
						14,126	12.09	8.15	--	2.91	--
						14,047	12.52	--	4.84	--	2.01
						14,110	12.32	--	4.84	--	2.05
	A-2+00				97.0	14,158	16.38	9.41	--	2.68	--
						14,126	15.63	9.25	--	2.72	--
						14,126	15.43	--	4.96	--	1.93
						14,158	15.31	--	5.04	--	1.93
	A-3+00					14,078	14.57	9.02	--	2.87	--
						14,094	14.45	9.06	--	2.83	--
						14,031	15.75	--	4.92	--	--
						14,031	14.92	--	4.80	--	1.89
	A-4+00					14,078	20.08	10.35	--	2.72	--
						14,126	18.90	10.08	--	2.80	--
						14,126	18.19	--	4.80	--	1.93
						14,110	18.74	--	4.96	--	1.93

(Continued)

(Sheet 3 of 15)

Table 5 (Continued)

Test Area	Test No.	Station or Location	Date	Time	Surface Temperature °F	Force lb	Deflection, mils — Distance from Center of Plate, in. 0	12	24	36	48
2	A-5+00	≈22 ft lf	3 Nov 82		97.0	14,063	15.24	7.72	--	1.73	--
						14,078	15.00	7.72	--	1.69	--
						14,031	16.77	--	3.50	--	1.26
						14,031	15.79	--	3.43	--	1.30
	A-6+00	≈22 ft lf				14,063	19.92	10.31	--	2.83	--
						14,078	18.27	10.00	--	2.83	--
						14,063	17.68	--	4.80	--	2.01
						14,078	17.28	--	4.84	--	2.01
	A-700					13,729	17.28	10.39	--	2.99	--
						14,047	17.28	10.83	--	3.03	--
						13,935	18.70	--	5.31	--	1.93
						14,031	17.80	--	5.28	--	2.01
	B-0+00	≈12 ft lf				14,063	10.28	6.97	--	2.83	--
						--	--	--	--	--	--
						14,174	10.24	--	4.41	--	1.93
						14,190	10.24	--	4.41	--	1.97
	B-0+50					14,078	9.90	6.46	--	2.68	--
						14,094	9.84	6.40	--	2.68	--
						14,063	11.02	--	4.09	--	1.89
						14,047	10.16	--	4.13	--	1.93
	B-1+00					14,206	9.37	5.87	--	2.52	--
						14,126	8.98	5.94	--	2.56	--
						14,142	10.00	--	3.86	--	1.81
						--	--	--	--	--	--
	B-1+50					14,190	8.11	5.75	--	2.56	--
						14,221	7.99	5.75	--	2.68	--
						14,190	8.03	--	3.82	--	1.89
						14,253	7.91	--	3.66	--	1.85
	B-2+00					14,237	9.72	6.65	--	2.68	--
						14,221	9.69	6.50	--	2.40	--
						14,206	9.80	--	4.09	--	1.77
						14,253	9.76	--	4.13	--	1.85
	B-2+50					13,872	11.61	6.77	--	2.68	--
						14,015	11.18	6.81	--	2.72	--
						14,031	11.14	--	4.33	--	1.93
						14,126	11.18	--	4.33	--	1.93
	B-3+00					14,158	9.69	3.94	--	1.73	--
						14,206	9.37	4.02	--	1.77	--
						14,174	9.41	--	6.46	--	2.52
						14,206	9.53	--	6.50	--	2.44
	B-3+50					13,999	10.51	6.30	--	2.44	--
						14,063	10.20	6.34	--	2.48	--
						14,063	9.96	--	3.70	--	1.61
						14,094	9.96	--	3.98	--	1.69
	B-4+00					14,190	9.65	6.54	--	2.44	--
						14,158	9.57	6.57	--	2.44	--
						14,126	9.41	--	4.06	--	1.77
						14,142	9.49	--	4.09	--	1.81
	B-4+50					14,158	9.33	6.06	--	2.28	--
						14,190	9.09	6.06	--	2.36	--
						14,110	8.94	--	3.70	--	1.50
						14,174	8.94	--	3.66	-	1.61

(Continued)

(Sheet 4 of 15)

Table 5 (Continued)

Test Area	Test No.	Station or Location	Date	Time	Surface Temperature °F	Force lb	Deflection, mils — Distance from Center of Plate, in. 0	12	24	36	48
2	B-5+00	12 ft lt	3 Nov 82		97.0	14,094	9.21	5.39	--	1.54	--
						14,206	9.29	5.43	--	1.61	--
						14,126	9.69	--	2.80	--	1.14
						14,190	9.45	--	2.83	--	1.14
	B-5+50					14,063	8.31	5.63	--	2.44	--
						14,206	8.15	5.67	--	2.48	--
						14,206	8.11	--	3.78	--	1.77
						14,190	8.03	--	3.74	--	1.77
	B-6+00					14,158	7.40	5.47	--	2.28	--
						14,301	7.36	5.63	--	2.36	--
						14,142	7.44	--	3.54	--	1.69
						14,237	7.52	--	3.58	--	1.73
	B-6+50					--	10.83	7.01	--	2.80	--
						13,999	10.59	7.01	--	2.76	--
						13,983	10.39	-	4.33	--	2.05
						14,063	10.47	--	4.37	--	2.09
	B-7+00					14,094	10.08	7.20	--	2.80	--
						14,253	10.20	7.32	--	2.87	--
						14,158	10.59	--	4.76	--	2.09
						14,237	10.35	--	4.72	--	2.09
	C-0+00	Center line			98.0	14,126	9.02	5.04	--	2.24	--
						14,110	8.78	5.17	--	2.20	--
						14,078	9.33	--	3.43	--	1.61
						--	--	--	--	--	--
	C-1+00					14,158	6.77	4.65	--	2.05	--
						14,206	6.81	4.65	--	2.01	--
						14,237	6.77	--	3.39	--	1.65
						14,237	6.89	--	3.07	--	1.46
	C-2+00					14,110	8.39	4.76	--	1.97	--
						14,158	8.23	5.08	--	2.20	--
						14,110	8.90	--	3.31	--	1.61
						14,094	8.58	--	3.27	--	1.69
	C-3+00					14,047	11.22	5.91	--	2.44	--
						14,094	10.43	5.91	--	2.48	--
						14,094	9.92	--	3.70	--	1.73
						14,078	9.72	--	3.74	--	1.73
	C-4+00					14,078	9.49	5.35	--	2.20	--
						--	--	--	--	--	--
						14,015	10.59	--	3.46	--	1.54
						14,047	9.96	--	3.46	--	1.54
	C-5+00					13,983	8.11	4.53	--	1.81	--
						13,999	7.83	[illegible]	--	1.85	--
						14,094	7.56	--	2.91	--	1.42
						14,094	7.40	--	2.91	--	1.42
	C-6+00					13,967	9.72	4.88	--	2.13	--
						14,047	9.49	4.88	--	2.20	--
						14,047	11.50	--	3.27	--	1.61
						14,015	10.31	--	3.31	--	1.61
	C-7+00			2:50		14,110	9.49	6.30	--	2.87	--
						14,110	9.17	6.22	--	2.87	--
						14,094	9.09	--	4.13	--	2.01
						14,063	8.98	--	4.17	--	2.01

(Continued) (Sheet 5 of 15)

Table 5 (Continued)

Test Area	Test No.	Station or Location	Date	Time	Surface Temperature °F	Force lb	Deflection, mils: Distance from Center of Plate, in. 0	12	24	36	48
2	D-0+00	≈12 ft rt	3 Nov 82		97.0	14,190	9.06	6.22	--	2.44	--
						14,317	9.09	6.46	--	2.44	--
						14,301	9.02	--	3.82	--	1.73
						14,333	9.13	--	3.82	--	1.73
	D-0+50					14,349	10.00	6.61	--	2.36	--
						14,349	9.96	6.65	--	2.36	--
						14,206	10.12	--	3.78	--	1.65
						14,301	9.96	--	3.86	--	1.69
	D-1+00					14,253	8.58	5.43	--	1.97	--
						14,237	8.39	5.35	--	2.05	--
						14,237	8.27	--	3.23	--	1.42
						14,158	8.31	--	3.58	--	1.30
	D-1+50					14,142	11.22	7.28	--	2.52	--
						14,174	11.10	7.36	--	2.56	--
						14,174	11.77	--	4.02	--	1.77
						14,174	11.42	--	4.09	--	1.77
	D-2+00					14,206	10.55	6.85	--	2.32	--
						14,269	10.35	6.69	--	2.40	--
						14,269	10.39	--	3.90	--	1.61
						14,285	10.31	--	3.86	--	1.65
	D-2+50					14,110	8.50	5.75	--	2.09	--
						14,269	8.43	5.83	--	2.17	--
						14 174	8.86	--	3.27	--	1.46
						14,253	8.62	--	3.35	--	1.46
	D-3+00					14,174	11.38	7.09	--	2.40	--
						14,190	10.79	7.01	--	2.44	--
						14,142	10.43	--	3.82	--	1.73
						14,221	10.39	--	3.90	--	1.73
	D-3+50					14,158	10.31	6.61	--	2.44	--
						14,206	10.28	6.57	--	2.40	--
						14,142	10.55	--	3.94	--	1.73
						14,158	10.47	--	3.94	--	1.77
	D-4+00					14,094	9.33	5.51	--	2.28	--
						14,158	9.06	5.43	--	2.20	--
						14,158	8.86	--	3.31	--	1.54
						14,190	8.82	--	3.39	--	1.57
	D-4+50					14,221	9.33	6.38	--	2.56	--
						14,269	9.29	6.54	--	2.60	--
						14,174	9.53	--	4.02	--	1.81
						14,221	9.41	--	4.06	--	1.81
	D-5+00					14,174	9.13	5.12	--	1.73	--
						14,190	8.90	5.08	--	1.73	--
						14,126	8.70	--	2.95	--	1.22
						14,158	8.62	--	3.03	--	1.22
	D-5+50					14,063	9.17	6.26	--	2.64	--
						14,174	9.02	6.46	--	2.76	--
						14,126	9.84	--	4.17	--	1.93
						14,126	9.21	--	4.13	--	2.05

(Continued)

Table 5 (Continued)

Test Area	Test No.	Station or Location	Date	Time	Surface Temperature °F	Force lb	Deflection, mils — Distance from Center of Plate, in. 0	12	24	36	48
2	D-6+00	≈12 ft rt	3 Nov 82		97.0	14,110	9.92	6.10	--	2.52	--
						14,174	9.25	6.10	--	2.56	--
						14,126	8.82	--	3.78	--	1.81
						14,206	8.86	--	3.82	--	1.89
	D-6+50					14,047	10.20	6.50	--	2.48	--
						14,110	10.20	6.57	--	2.48	--
						14,063	10.59	--	3.98	--	1.73
						14,078	10.31	--	3.98	--	1.77
	D-7+00					14,110	12.56	8.03	--	2.76	--
						14,158	12.20	7.91	--	2.80	--
						14,174	11.97	--	4.61	--	2.01
						14,174	11.97	--	4.69	--	2.01
	E-0+00	≈22 ft rt				14,126	12.76	8.11	--	2.83	--
						14,094	12.68	7.99	--	2.83	--
						14,047	12.95	--	4.80	--	2.13
						--	--	--	--	--	--
	E-1+00					14,063	13.43	7.68	--	2.20	--
						14,142	12.80	7.56	--	2.24	--
						14,142	12.72	--	3.94	--	1.65
						14,158	12.64	--	3.94	--	1.65
	E-2+00					14,078	12.91	8.11	--	2.64	--
						14,158	12.95	8.15	--	2.72	--
						14,094	13.27	--	4.53	--	1.89
						14,094	13.07	--	4.53	--	1.89
	E-3+00					14,047	16.89	8.90	--	2.60	--
						14,078	15.47	8.74	--	2.64	--
						14,078	14.76	--	4.53	--	1.89
						14,110	14.61	--	4.37	--	1.89
	E-4+00					14,047	10.28	7.01	--	2.32	--
						14,110	10.79	7.17	--	2.44	--
						14,047	11.54	--	4.09	--	1.65
						14,094	11.06	--	4.09	--	1.69
	E-5+00					14,063	12.52	7.52	--	1.97	--
						14,110	12.09	7.32	--	1.89	--
						14,110	12.05	--	3.39	--	1.30
						14,126	11.97	--	3.43	--	1.34
	E-6+00					14,047	15.47	9.88	--	3.23	--
						14,078	15.35	9.84	--	3.27	--
						14,031	16.61	--	5.43	--	2.28
						14,047	16.34	--	5.51	--	2.32
	E-7+00					13,904	23.46	11.54	--	2.87	--
						13,951	21.46	11.02	--	2.95	--
						14,047	20.55	--	5.20	--	2.13
						14,078	20.31	--	5.16	--	2.13
3	T-3				92.0	3,957	9.57	4.25	--	0.75	--
						3,909	9.33	4.13	--	0.75	--
						3,988	11.02	--	1.38	--	0.51
						3,941	10.12	--	1.42	--	0.51

(Continued) (Sheet 7 of 15)

Table 5 (Continued)

Test Area	Test No.	Station or Location	Date	Time	Surface Temperature °F	Force lb	Deflection, mils — Distance from Center of Plate, in. 0	12	24	36	48
3	T-3	≈22 ft rt	3 Nov 82		92.0	8,708	18.50	9.09	--	1.69	--
						8,724	18.46	9.17	--	1.61	--
						8,708	19.65	--	3.15	--	1.22
						8,724	19.13	--	3.15	--	1.22
						14,078	27.72	14.61	--	2.56	--
						14,047	27.68	14.76	--	2.60	--
						14,047	29.13	--	5.08	--	1.85
						14,047	28.82	--	5.16	--	1.89
	A-0+50	≈12 ft lf				14,094	27.99	15.04	--	2.83	--
						14,110	24.40	14.76	--	2.91	--
						14,078	26.42	--	5.63	--	1.93
						14,126	25.98	--	5.63	--	1.89
	A-1+50					13,983	29.25	15.43	--	3.35	--
						13,999	27.72	15.28	--	3.54	--
						14,047	26.97	--	6.22	--	2.48
						14,078	26.97	--	6.46	--	2.52
	A-2+50					13,983	27.95	15.91	--	4.02	--
						13,983	27.68	15.83	--	4.13	--
						14,047	29.09	--	7.52	--	2.56
						13,983	28.39	--	7.28	--	2.36
	A-3+50					14,063	29.57	16.26	--	3.54	--
						14,470	28.23	15.83	--	3.50	--
						13,951	27.40	--	6.42	--	2.24
						14,063	27.09	--	6.38	--	2.20
	A-4+50					13,872	21.34	11.61	--	4.17	--
						13,999	21.50	11.02	--	4.21	--
						13,872	22.87	--	5.98	--	3.07
						13,904	22.28	--	6.06	--	3.07
	A-5+50					13,983	27.56	14.88	--	3.39	--
						13,935	26.42	14.53	--	3.39	--
						13,951	25.79	--	6.34	--	2.32
						13,951	25.47	--	6.34	--	2.32
	A-6+50					13,872	28.62	14.80	--	2.99	--
						13,904	28.03	14.76	--	3.11	--
						13,856	30.59	--	5.79	--	2.17
						13,920	29.29	--	5.79	--	2.20
	A-7+50					13,920	26.97	13.19	--	2.76	--
						13,888	25.55	12.87	--	2.80	--
						13,920	25.51	--	5.08	--	2.01
						13,920	25.91	--	5.08	--	2.05
	A-8+50					13,872	24.84	13.90	--	2.64	--
						13,904	25.00	13.46	--	2.60	--
						13,872	27.17	--	5.28	--	1.85
						13,920	25.67	--	5.24	--	1.89
	A-9+50					13,840	27.56	14.41	--	3.15	--
						13,888	26.85	14.29	--	3.11	--
						13,840	26.34	--	5.94	--	2.17
						13,856	26.18	--	6.02	--	2.20

(Continued)

(Sheet 8 of 15)

Table 5 (Continued)

Test Area	Test No.	Station or Location	Date	Time	Surface Temperature °F	Force lb	Deflection, mils — Distance from Center of Plate, in. 6	12	24	36	48
3	C-0+00	Center line	3 Nov 82	3:43	92.1	13,824	15.31	10.47	--	3.67	--
						14,031	15.55	10.63	--	3.78	--
						14,078	16.18	--	6.34	--	2.40
						14,047	15.83	--	6.22	--	2.20
	C-1+00				92.5	14,063	17.48	11.10	--	4.17	--
						14,078	17.13	10.98	--	4.21	--
						13,824	16.38	--	6.46	--	2.52
						13,983	16.61	--	6.61	--	2.80
	C-2+00					14,047	16.18	10.24	--	3.31	--
						14,094	16.10	10.12	--	3.35	--
						14,156	16.73	--	5.79	--	2.20
						14,078	16.50	--	5.71	--	2.24
	C-3+00					14,063	16.73	11.02	--	4.21	--
						13,999	16.20	10.91	--	4.21	--
						13,967	16.02	--	6.34	--	2.60
						14,015	15.91	--	6.38	--	2.52
	C-4+00					13,951	23.39	13.90	--	4.21	--
						13,935	23.27	13.78	--	4.06	--
						13,983	24.25	--	7.05	--	2.68
						13,904	23.54	--	6.97	--	2.72
	C-5+00				91.6	14,031	20.03	12.01	--	3.90	--
						14,015	19.89	11.85	--	3.90	--
						13,951	19.37	--	6.38	--	2.52
						13,920	19.06	--	6.42	--	2.56
	C-6+00					14,015	20.00	11.18	--	4.13	--
						14,047	19.84	11.27	--	4.13	--
						14,047	20.94	--	6.57	--	2.95
						13,999	20.28	--	6.54	--	2.91
	C-7+00					14,078	17.28	10.63	--	3.43	--
						14,047	16.97	10.63	--	3.54	--
						14,047	16.77	--	5.31	--	2.09
						14,110	16.77	--	5.43	--	2.17
	C-8+00					13,300	15.39	8.82	--	3.35	--
						12,632	15.43	8.78	--	3.43	--
						13,792	15.94	--	5.39	--	2.40
						13,792	15.63	--	5.31	--	2.44
	C-9+00					14,015	18.78	10.12	--	3.11	--
						14,094	18.11	10.16	--	3.07	--
						14,063	17.60	--	5.24	--	2.13
						14,110	17.48	--	5.12	--	2.13
	C-10+00			4:30	90.8	13,808	15.71	9.53	--	3.31	--
						14,015	15.94	9.65	--	3.43	--
						14,031	16.54	--	5.51	--	2.44
						14,047	16.22	--	5.51	--	2.60
	B-0+00	12 ft rt			92.0	13,935	30.31	15.43	--	3.11	--
						13,935	28.46	15.04	--	3.15	--
						13,792	27.32	--	6.06	--	2.09
						13,920	27.13	--	5.91	--	2.13

(Continued) (Sheet 9 of 15)

Table 5 (Continued)

Test Area	Test No.	Station or Location	Date	Time	Surface Temperature °F	Force lb	Deflection, mils: Distance from Center of Plate, in. 0	12	24	36	48
3	B-1+00	≈12 ft rt	3 Nov 82		92.0	13,840	25.39	14.33	--	3.27	--
						13,904	24.96	14.21	--	3.31	--
						13,920	27.48	--	6.14	--	2.32
						13,935	26.30	--	6.22	--	2.28
	B-2+00					13,920	31.38	15.31	--	2.83	--
						13,935	29.88	15.00	--	2.83	--
						13,935	29.49	--	5.47	--	2.09
						13,935	29.02	--	5.39	--	2.01
	B-3+00					13,888	31.50	17.09	--	3.31	--
						13,888	30.98	17.13	--	3.39	--
						13,872	33.94	--	6.89	--	2.20
						13,920	32.72	--	6.73	--	2.24
	B-4+00					13,951	34.29	18.07	--	3.62	--
						13,888	30.67	16.65	--	3.46	--
						13,792	31.30	--	7.68	--	2.28
						13,904	31.14	--	7.76	--	2.24
	B-5+00					13,935	32.32	17.36	--	3.35	--
						13,935	31.18	16.97	--	3.43	--
						13,935	30.43	--	6.97	--	2.17
						13,888	30.04	--	7.13	--	2.17
	B-6+00					13,904	30.55	20.75	--	4.02	--
						13,935	30.47	[illegible].48	--	4.02	--
						13,920	32.28	--	7.72	--	2.56
						13,888	31.14	--	7.87	--	2.56
	B-7+00					14,031	25.55	13.66	--	3.31	--
						13,983	24.72	13.54	--	3.35	--
						13,999	24.37	--	6.10	--	2.28
						13,983	24.13	--	6.18	--	2.36
	B-8+00					13,888	24.41	12.91	--	2.87	--
						13,935	24.13	12.95	--	2.99	--
						13,920	25.75	--	5.47	--	2.01
						13,920	24.84	--	5.55	--	2.05
	B-9+00					13,856	27.60	13.90	--	2.56	--
						13,856	26.46	13.58	--	2.68	--
						13,872	25.47	--	5.16	--	1.81
						13,856	26.42	--	5.24	--	1.85
	B-10+00					13,792	23.62	11.57	--	2.60	--
						13,983	22.60	11.61	--	2.68	--
						13,920	23.98	--	4.76	--	1.85
						13,967	25.24	--	4.76	--	1.85
4	T-4				0	4,338	1.77	1.42	--	1.02	--
						4,290	1.69	1.42	--	0.98	--
						4,306	1.73	--	1.18	--	0.94
						4,338	1.69	--	1.18	--	0.94
						8,771	3.31	2.91	--	2.05	--
						9,010	3.39	2.95	--	2.13	--
						8,946	3.39	--	2.48	--	1.54
						9,137	3.50	--	2.52	--	1.65

(Continued) (Sheet 10 of 15)

Table 5 (Continued)

Test Area	Test No.	Station or Location	Date	Time	Surface Temperature °F	Force lb	Deflection, mils — Distance from Center of Plate, in. 0	12	24	36	48
4	T-4		3 Nov 82		86.0	14,063	5.08	4.57	--	3.27	--
						14,126	5.12	4.57	--	3.31	--
						14,078	5.04	--	3.90	--	2.52
						14,126	5.08	--	3.82	--	2.60
	1					14,221	5.79	5.04	--	3.46	--
						14,285	5.83	5.16	--	3.58	--
						14,206	5.83	--	4.29	--	2.87
						14,285	5.83	--	4.33	--	2.99
	2					14,221	6.10	5.16	--	3.62	--
						14,221	6.02	5.16	--	3.54	--
						14,190	5.87	--	4.41	--	3.03
						14,221	5.87	--	4.25	--	2.83
	J-3					14,031	7.87	4.76	--	3.15	--
						14,047	7.83	4.65	--	3.03	--
						14,078	7.83	--	3.94	--	2.44
						14,063	7.83	--	3.90	--	2.48
	4			5:45		14,094	7.36	5.94	--	4.25	--
						14,126	7.32	5.98	--	4.33	--
						14,126	7.36	--	5.24	--	3.58
						14,126	7.36	--	5.24	--	3.35
	5					14,078	5.79	4.84	--	3.27	--
						14,174	5.83	4.88	--	3.35	--
						14,142	5.91	--	4.29	--	2.80
						14,190	5.87	--	4.29	--	2.72
	6					14,126	5.43	4.45	--	3.07	--
						14,142	5.43	4.45	--	3.11	--
						14,126	5.59	--	3.78	--	2.46
						14,158	5.31	--	3.82	--	2.48
	7					13,935	7.95	5.20	--	3.46	--
						13,951	7.83	5.20	--	3.43	--
						13,967	8.43	--	4.41	--	2.91
						13,983	8.27	--	4.45	--	2.95
	J-8					14,031	8.11	5.94	--	3.43	--
						14,047	8.07	5.94	--	3.50	--
						14,015	8.07	--	4.41	--	2.64
						14,031	8.03	--	4.45	--	2.60
	9					13,983	7.72	6.10	--	3.70	--
						14,094	7.64	6.22	--	3.86	--
						14,063	7.76	--	4.92	--	2.95
						14,078	7.64	--	4.84	--	2.99
	10					14,174	6.10	5.08	--	3.50	--
						14,206	6.06	5.20	--	3.58	--
						14,237	6.14	--	4.45	--	2.83
						14,237	6.10	--	4.45	--	2.80
	J-V					14,094	6.34	5.98	--	3.50	--
						13,951	6.22	5.83	--	3.43	--
						14,031	6.30	--	4.69	--	2.72
						14,094	6.22	--	4.69	--	2.76

(Continued)

Table 5 (Continued)

Test Area	Test No.	Station or Location	Date	Time	Surface Temperature °F	Force lb	Deflection, mils Distance from Center of Plate, in. 0	12	24	36	48
4	12		3 Nov 82		86.0	14,126	7.52	5.67	--	3.50	--
						14,174	7.72	5.71	--	3.50	--
						14,110	7.68	--	4.57	--	2.72
						14,158	7.80	--	4.57	--	2.72
	J-13					14,047	12.48	5.28	--	3.43	--
						14,078	12.44	5.28	--	3.43	--
						13,872	12.24	--	4.13	--	2.56
						14,047	12.36	--	4.13	--	2.56
	14					14,174	7.36	6.30	--	4.37	--
						14,285	7.44	6.38	--	4.45	--
						14,221	7.40	--	5.55	--	3.58
						14,206	7.44	--	5.51	--	3.54
	15					14,047	7.60	6.38	--	4.45	--
						14,142	7.64	6.46	--	4.45	--
						14,078	7.56	--	5.28	--	3.62
						14,094	7.56	--	5.28	--	3.39
	16			6:30		14,174	6.30	5.28	--	3.74	--
						14,126	6.34	5.24	--	3.70	--
						14,078	6.38	--	4.57	--	2.99
						14,094	6.26	--	4.57	--	2.95
5	A-1			0820	78.4	14,809	5.00	4.65	--	3.54	--
						14,746	4.96	4.65	--	3.50	--
						14,746	4.96	--	4.25	--	3.11
						14,714	5.00	--	4.37	--	3.15
	E-1				79.0	14,619	5.71	4.80	--	3.70	--
						14,571	5.51	4.76	--	3.66	--
						14,571	5.51	--	4.17	--	2.95
						14,603	5.71	--	4.21	--	2.99
	I-1				80.0	14,635	6.02	5.43	--	3.90	--
						14,539	5.94	5.47	--	3.94	--
						14,555	5.94	--	4.61	--	3.27
						14,555	5.79	--	4.65	--	3.27
	M-1					14,698	5.31	4.84	--	3.43	--
						14,651	5.20	4.88	--	3.43	--
						14,651	5.35	--	3.86	--	2.83
						14,619	5.31	--	4.06	--	2.76
	N-3					14,619	5.28	4.29	--	2.95	--
						14,365	5.24	4.29	--	2.95	--
						14,508	4.92	--	3.46	--	2.52
						14,571	4.84	--	3.50	--	2.48
	J-3				81.0	14,524	5.28	4.80	--	3.31	--
						14,619	5.35	4.72	--	3.31	--
						14,651	5.35	--	4.25	--	2.80
						14,651	5.35	--	4.21	--	2.80
	F-3					14,714	5.20	4.88	--	3.50	--
						14,698	5.20	4.84	--	3.50	--
						14,666	5.20	--	4.21	--	3.03
						14,603	5.24	--	4.21	--	2.99

(Continued) (Sheet 12 of 15)

Table 5 (Continued)

Test Area	Test No.	Station or Location	Date	Time	Surface Temperature °F	Force lb	Deflection, mils: Distance from Center of Plate, in. 0	12	24	36	48
5	B-3		3 Nov 82		81.0	14,619	5.16	4.41	--	3.97	--
						14,603	5.12	4.53	--	3.23	--
						14,555	5.16	--	3.90	--	2.60
						14,635	5.04	--	3.90	--	2.56
	G-5					14,444	5.98	5.39	--	3.90	--
						14,508	6.02	5.43	--	3.90	--
						14,555	5.98	--	4.72	--	3.23
						14,476	5.94	--	4.72	--	3.27
	K-5					14,539	5.31	4.65	--	3.22	--
						14,492	5.35	4.72	--	3.27	--
						14,555	5.28	--	3.98	--	2.68
						14,555	5.39	--	3.98	--	2.68
	O-5				82.0	14,508	4.92	4.37	--	2.87	--
						14,523	4.88	4.37	--	2.80	--
						14,539	4.96	--	3.74	--	2.40
						14,476	4.80	--	3.74	--	2.36
	M-7					14,444	4.92	4.45	--	3.03	--
						14,476	4.92	4.45	--	3.15	--
						14,428	5.12	--	3.70	--	2.68
						14,476	5.00	--	3.74	--	2.64
	I-7					14,444	5.04	4.57	--	3.27	--
						14,396	5.08	4.61	--	3.27	--
						14,412	5.08	--	4.02	--	2.91
						14,444	5.08	--	3.94	--	2.91
	F-7					14,253	5.67	4.96	--	3.35	--
						14,285	5.79	5.00	--	3.35	--
						14,333	5.55	--	4.25	--	2.80
						14,317	5.63	--	4.25	--	2.80
	D-9					14,253	5.71	5.16	--	3.23	--
						14,253	5.71	5.16	--	3.27	--
						14,174	5.83	--	4.29	--	2.99
						14,221	5.83	--	4.41	--	2.87
	F-9				83.0	14,396	5.39	4.88	--	3.39	--
						14,396	5.47	4.88	--	3.43	--
						14,365	5.35	--	4.06	--	2.80
						14,380	5.35	--	4.09	--	2.83
	J-9					14,365	5.04	4.53	--	3.54	--
						14,365	5.00	4.61	--	3.58	--
						14,285	5.08	--	3.94	--	3.23
						14,349	5.08	--	4.09	--	3.19
	O-11					14,333	4.61	4.29	--	3.07	--
						14,380	4.69	4.25	--	3.11	--
						14,333	4.53	--	3.82	--	2.80
						14,412	4.61	--	3.78	--	2.80
	K-11				84.0	14,285	5.51	4.21	--	3.23	--
						14,221	5.35	4.37	--	3.19	--
						14,206	5.28	--	3.82	--	2.44
						14,190	5.28	--	4.06	--	2.72
	G-11					14,190	4.92	4.88	--	3.27	--
						14,237	4.96	4.92	--	3.27	--
						14,253	5.09	--	4.05	--	2.72
						14,206	4.96	--	4.02	--	2.72

(Continued)

(Sheet 13 of 15)

Table 5 (Continued)

Test Area	Test No.	Station or Location	Date	Time	Surface Temperature °F	Force lb	Deflection, mils: Distance from Center of Plate, in.: 0	12	24	36	48
5	C-11		3 Nov 82		84.0	14,180	5.28	4.96	--	3.5[illegible]	--
						14,428	5.28	4.92	--	3.[illegible]	--
						14,444	5.39	--	4.53	--	2.72
						14,460	5.35	--	4.61	--	2.87
	A-13					14,174	6.18	5.20	--	3.4[illegible]	--
						14,221	6.10	5.28	--	3.5[illegible]	--
						14,126	6.10	--	4.45	--	2.95
						14,158	6.10	--	4.49	--	2.87
	E-13				85.0	14,428	5.08	4.45	--	3.1[illegible]	--
						14,492	5.00	4.49	--	3.1[illegible]	--
						14,412	5.00	--	3.78	--	2.64
						14,412	5.04	--	3.86	--	2.64
	I-13					14,396	5.67	4.84	--	3.35	--
						14,333	5.51	4.88	--	3.35	--
						14,349	5.83	--	4.09	--	2.76
						14,285	5.67	--	4.21	--	2.76
	G-13					14,158	4.88	4.37	--	3.35	--
						14,174	4.96	4.45	--	3.35	--
						14,206	5.08	--	3.94	--	2.87
						14,158	4.96	--	3.99	--	2.91
	K-15					14,476	4.84	4.21	--	3.03	--
						14,508	4.72	4.25	--	3.0[illegible]	--
						14,555	4.76	--	3.74	--	2.52
						14,587	4.84	--	3.74	--	2.56
	J-15					14,237	5.20	4.69	--	3.07	--
						14,237	5.20	4.65	--	3.07	--
						14,190	5.28	--	3.86	--	2.56
						14,221	5.31	--	3.78	--	2.50
	F-15					14,206	5.08	4.57	--	3.15	--
						14,158	4.96	4.65	--	3.15	--
						14,301	5.04	--	4.29	--	2.64
						14,190	5.00	--	4.06	--	2.59
	B-15				86.0	14,460	5.28	4.65	--	3.35	--
						14,476	5.28	4.69	--	3.35	--
						14,444	5.[illegible]	--	4.21	--	2.68
						14,444	5.24	--	4.13	--	2.70
	C-17					14,365	5.24	4.45	--	3.15	--
						14,349	5.35	4.53	--	3.1[illegible]	--
						14,285	5.39	--	3.70	--	2.52
						14,253	5.31	--	3.82	--	2.52
	G-17					14,206	5.08	4.53	--	3.15	--
						14,190	5.08	4.41	--	3.11	--
						14,285	5.00	--	3.74	--	2.68
						14,190	4.96	--	3.74	--	2.60
	E-17					14,380	5.20	5.04	--	3.50	--
						14,444	5.28	5.04	--	3.5[illegible]	--
						14,349	5.35	--	3.90	--	2.80
						14,365	5.43	--	4.09	--	2.83
	I-18					14,301	4.80	4.21	--	2.95	--
						14,380	4.84	4.25	--	2.9[illegible]	--
						14,301	4.88	--	3.58	--	2.44
						14,428	4.92	--	3.60	--	2.48

(Continued)

(Sheet 1[illegible] of 15)

Table 5 (Concluded)

Test Area	Test No.	Station or Location	Date	Time	Surface Temperature °F	Force lb	Deflection, mils: Distance from Center of Plate, in. 0	12	24	36	48
5	H-18		3 Nov 82		86.0	14,317	4.72	4.29	--	3.03	--
						14,412	4.65	4.21	--	3.03	--
						14,380	4.76	--	3.46	--	2.52
						14,428	4.69	--	3.62	--	2.52
	J-6				87.0	4,211	1.50	1.34	--	1.10	--
						4,227	1.57	1.42	--	0.94	--
						4,115	1.54	--	1.14	--	0.75
						4,195	1 38	--	1.14	--	0.79
						9,153	3.07	2.95	--	2.01	--
						9,184	3.15	2.83	--	2.01	--
						9,105	3.07	--	2.40	--	1.77
						9,153	3.15	--	2.44	--	1.77
						14,206	4.76	4.45	--	2.87	--
						14,237	4.76	4.41	--	2.87	--
						14,237	4.76	--	3.62	--	2.64
						14,237	4.80	--	3.58	--	2.64

(Sheet 15 of 15)

Table 6

Test Data - Falling Weight Deflectometer - Joint Tests

Test Area	Test No.	Station or Location	Date	Time	Surface Temperature °F	Force lb	Deflection, mils Distance from Center of Plate, in. 0	12	36	Deflection Ratio
1	TJ-1	C3-C2	3 Nov 82		91.0	14,349	2.80	2.24	1.69	0.80
						14,316	2.68	2.20	1.65	0.82
	TJ-2	C12-C11			90.0	14,412	2.68	2.44	1.69	0.91
						14,412	2.68	2.36	1.65	0.88
	TJ-3	C21-C20			90.0	14,459	2.52	1.81	1.38	0.72
						14,444	2.52	1.77	1.38	0.70
	TJ-4	A22-A23			87.0	14,428	2.87	1.93	1.50	0.67
						14,476	2.87	1.93	1.54	0.67
	TJ-5	A13-A14		10:20	86.5	14,476	2.48	2.20	1.54	0.89
						14,492	2.48	2.20	1.50	0.89
	TJ-6	A4-A5				14,380	2.60	2.36	1.77	0.90
						14,555	2.60	2.36	1.77	
	TJ-7	B2-B1			88.0	14,492	5.39	1.10	0.91	0.20
						14,476	5.39	1.06	0.87	0.20
	TJ-8	B11-B10			87.0	14,460	3.27	1.42	1.06	0.43
						14,396	3.19	1.38	1.06	0.43
	TJ-9	B20-B19			87.0	14,237	5.24	1.38	1.10	0.26
						14,221	5.28	1.54	1.10	0.29
	TJ-10	B26-B25			87.0	14,523	3.66	1.26	1.02	0.34
						14,317	3.62	1.34	0.98	0.37
	LJ-11	A1-B1			88.0	14,444	2.91	2.17	1.54	0.75
						14,539	2.91	2.17	1.50	0.75
	LJ-12	B5-A5			88.0	14,444	3.86	1.69	1.22	0.44
						14,317	3.66	1.57	1.18	0.43
	LJ-13	B8-C8			88.0	14,396	4.13	1.34	0.98	0.32
						14,460	4.13	1.34	1.02	0.32
	LJ-14	C12-B12			89.0	14,301	3.27	1.93	1.42	0.59
						14,428	3.19	1.89	1.42	0.59
	LJ-15	A16-B16			89.0	14,476	4.69	1.26	1.02	0.27
						14,364	4.69	1.30	1.06	0.27
	LJ-16	C18-B18			89.0	14,333	5.35	1.54	1.22	0.29
						14,365	5.28	1.54	1.18	0.29
	LJ-17	B20-C20			89.0	14,365	5.39	1.22	1.02	0.23
						14,396	5.43	1.22	0.98	0.23
	LJ-18	B23-A23			90.0	14,285	2.87	1.77	1.34	0.62
						14,396	2.87	1.69	1.30	0.56
	LJ-19	B26-C26			90.0	14,285	2.56	2.09	1.46	0.82
						14,428	2.56	2.05	1.42	0.80
5	TJ-1	J15-J16			87.0	14,285	9.09	5.51	3.19	0.61
						14,317	8.98	5.39	3.15	0.60
	TJ-2	J12-J13			87.0	14,253	11.46	3.11	2.17	0.27
						14,269	11.50	3.03	2.17	0.26

(Continued)

Table 6 (Concluded)

Test Area	Test No.	Station or Location	Date	Time	Surface Temperature °F	Force lb	Deflection, mils Distance from Center of Plate, in. 0	12	36	Deflection Ratio
5	TJ-3	J9-J10	3 Nov 82		87.0	14,269	8.31	7.28	4.09	0.88
						14,317	8.27	7.24	4.02	0.88
	TJ-4	J6-J7			87.0	14,237	12.95	3.11	2.24	0.24
						14,237	12.91	3.11	2.17	0.24
	TJ-5	J3-J4			87.0	14,349	10.00	6.22	3.66	0.62
						14,396	9.96	6.26	3.62	0.63
	TJ-6	G5-G4			87.0	14,285	13.94	3.03	2.09	0.22
						14,269	13.94	3.03	2.09	0.22
	TJ-7	G8-G7			86.0	14,349	11.65	6.69	3.62	0.57
						14,380	11.69	6.73	3.70	0.58
	TJ-8	G11-G10			86.0	14,333	11.97	4.61	2.87	0.39
						14,221	11.85	4.57	2.87	0.39
	TJ-9	G14-G13		0930	86.2	14,253	11.02	5.71	3.46	0.52
						14,301	10.91	5.75	3.43	0.53
	TJ-10	G17-G16			86.0	14,317	7.36	5.39	3.19	0.73
						14,380	7.32	5.39	3.15	0.74
	LJ-11	A1-B1			78.0	14,587	13.03	3.70	2.24	0.28
						14,603	12.91	3.35	2.13	0.26
	LJ-12	E1-F1			79.0	14,682	16.54	2.91	1.97	0.18
						14,635	16.42	2.95	2.01	0.18
	LJ-13	G1-H1			79.0	14,746	14.53	4.45	2.83	0.31
						14,682	14.45	4.53	2.87	0.31
	LJ-14	I1-J1			79.0	14,619	15.63	4.17	2.76	0.27
						14,555	15.51	4.21	2.80	0.27
	LJ-15	M1-N1			80.0	14,555	12.80	2.72	1.97	0.21
						14,571	12.72	2.72	1.97	0.21
	LJ-16	C11-B11			84.0	14,269	13.98	3.46	2.24	0.25
						14,206	13.78	3.50	2.28	0.25
	LJ-17	G11-F11			84.0	14,365	13.31	3.43	2.28	0.26
						14,365	13.03	3.43	2.24	0.26
	LJ-18	K11-J11			83.0	14,253	13.23	3.66	2.44	0.28
						14,253	13.31	3.70	2.32	0.28
	LJ-19	O11-N11		0900	83.3	14,269	12.99	2.36	1.77	0.18
						14,253	13.11	2.36	1.77	0.18

Table 7

Air Temperature Data

Date 1982	Maximum Temperature °F	Minimum Temperature °F
20 Oct	85	68
21 Oct	84	69
22 Oct	84	70
23 Oct	72	63
24 Oct	68	56
25 Oct	72	52
26 Oct	75	53
27 Oct	78	58
28 Oct	81	62
29 Oct	82	65
30 Oct	83	68
31 Oct	82	71
1 Nov	84	68
2 Nov	84	66
3 Nov	83	71