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# COMPARATIVE STUDY OF NONDESTRUCTIVE PAVEMENT TESTING, WES NDT METHODOLOGIES

by

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This report describes a demonstration of nondestructive airfield pavement evaluation procedures conducted by the US Army Engineer Waterways Experiment Station (WES) using both the WES 16-kip vibrator and a Dynatest falling weight deflectometer (FWD). The nondestructive tests (NDT) were conducted at MacDill Air Force Base on five pavement test areas consisting of asphaltic concrete, portland cement concrete, and composite pavements. Two methods of data analysis were used. The dynamic stiffness modulus (DSM) (Continued)			

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method used dynamic deflection data from the WES 16-kip vibrator with a correlation analysis developed a number of years ago by WES. This method uses a correlation between the DSM (a load-deflection ratio) and the allowable load on a single wheel as derived from traditional test pit methods. The second analysis scheme used measured deflection basins at the pavement surface and layered elastic theory. Elastic moduli are computed by matching measured deflection basins with computed basins. Limiting stress/strain is then used to compute allowable aircraft loadings. This method was used with data from both the WES 16-kip vibrator and the FWD. Also demonstrated was a method of determining joint load transfer and of making appropriate adjustments to the allowable load to account for lack of load transfer. *Keywords:*

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PREFACE

The pavement evaluation study described in this report was part of a demonstration study conducted for the Air Force Engineering and Services Center (AFESC), Tyndall Air Force Base, Florida. The work was requested by HQ AFESC/DEM on Project Order No. F-82-74. The work described herein consisted of demonstration of three nondestructive testing methodologies for pavement evaluation using the US Army Engineer Waterways Experiment Station (WES) 16-kip vibrator and a falling weight deflectometer. The field tests were conducted on 2 November 1982 at MacDill Air Force Base on five selected test areas.

The WES evaluation team was composed of Messrs. Don R. Alexander, Dennis Mathews, and Charles W. Dorman, Pavement Systems Division (PSD), Geotechnical Laboratory (GL), Joe C. Ables, Instrumentation Services Division, and L. B. VanLandingham, Engineering and Construction Services Division. This report was prepared by Messrs. Jim W. Hall, Jr., and Don R. Alexander, PSD, under the general supervision of Dr. William F. Marcuson III, Chief, GL, and under the direct supervision of Dr. Thomas D. White, Chief, PSD.

COL Tilford C. Creel, CE, and COL Robert C. Lee, CE, were Commanders and Directors of WES during the conduct of the study. COL Allen F. Grum, USA, was Director of WES during the preparation and publication of this report. Mr. Fred R. Brown and Dr. Robert W. Whalin were Technical Directors.

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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:

<u>Multiply</u>	<u>By</u>	<u>To Obtain</u>
Fahrenheit degrees	5/9	Celsius degrees or Kelvins*
feet	0.3048	metres
inches	2.54	centimetres
kips (force)	4448.222	newtons
kips (force) per inch	1751.268	newtons per centimetre
mils	0.0254	millimetres
pounds (force)	4.448222	newtons
pounds (force) per square inch	6894.757	pascals
square feet	0.09290304	square metres

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\* 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, WES NDT METHODOLOGIES

### COMPARATIVE STUDY OF NONDESTRUCTIVE PAVEMENT TESTING

#### Introduction

##### Background

1. The Air Force Engineering and Services Center (AFESC), Tyndall Air Force Base, Florida, requested that the US Army Engineer Waterways Experiment Station (WES) perform an evaluation of nondestructive test (NDT) procedures for airfield pavement evaluation. The overall objective of this project was to have a series of demonstrations of various NDT equipment and methodologies for determination of allowable aircraft loadings. WES was to be one of the participants in the demonstrations using equipment and methodologies developed by WES for nondestructive airfield pavement evaluation.

2. WES has been involved in NDT since the early 1950's,<sup>1-6</sup> and through several research programs has developed both equipment and analytical methodologies for NDT pavement evaluation. These studies have been sponsored by the Air Force,<sup>7-9</sup> Federal Aviation Administration,<sup>10,11</sup> and the Army.<sup>12</sup> The WES 16-kip\* vibrator was fabricated in 1970 for use in testing of heavy-duty airfield pavements. The analytical procedure termed the DSM (dynamic stiffness modulus) method, which is based on a correlation analysis, was developed for this large vibratory test device. Later studies developed a theoretically based procedure where measured deflection basins are used to back-calculate elastic moduli of pavement layers using an elastic-layered theory. This theoretical approach is applicable to the WES 16-kip device or falling weight deflectometer (FWD).

3. Both methodologies, DSM method and layered-elastic procedure using test data from the WES 16-kip vibrator and the FWD, are demonstrated in this report.

##### Objective and scope

4. The objective of the work described in this report is to demonstrate the nondestructive pavement evaluation methodologies developed at WES and to

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\* A table of factors for converting non-SI units of measurement to SI (metric) units is presented on page 3.

include the results of these methods in the overall study being performed for AFESC where comparisons are to be made with established standard Air Force evaluations based on test pit methods. In order to achieve the objective, tests were conducted on five selected pavement sections at MacDill Air Force Base using both the WES 16-kip vibrator and a FWD (Dynatest Model 8000). The DSM procedure was used to analyze data from the WES 16-kip vibrator to compute allowable aircraft loads and overlay requirements. Data from both test devices were used with the elastic-layered method to compute elastic modulus (E-values) for each pavement layer and subgrade, and then compute allowable loads and overlays.

### Description of Tests

#### Test areas

5. Five test areas were selected at MacDill AFB as shown on the airfield layout in Figure 1. Information as to the pavement structural properties was obtained from a pavement evaluation report prepared by USAFESC dated July 1980. A summary of physical property data for these pavements is shown in Table 1. The surface condition of the test areas was rated using the Pavement Condition Index (PCI) and the PCI ratings are shown in Table 2.

6. The size of each test area was approximately 50,000 sq ft, but the dimensions of each area varied as shown in Figures 2 through 6. These figures also show the locations of the tests conducted.

#### Test equipment and procedures

7. 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 deflection. Test results are recorded on X-Y plotters and a digital printer.

8. 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  $\Delta_{60}/\Delta_{18}$  is used to determine the radius of relative stiffness,  $l$ , for rigid pavements.

9. The FWD used by WES is a Model 8000. A dynamic force is applied to the pavement surface by dropping a 440-lb weight on to a set of rubber cushions which results 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 1 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 (30-cm) plate. The signal conditioning equipment displays the resulting pressure in kilopascals and the maximum peak displacement in micrometers. As many as three displacement sensors may be recorded.

10. 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 three 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.

11. Both the WES 16-kip vibrator and the FWD were used to measure relative deflections across joints in the PCC test sections. The set-up for these measurements is shown in Figure 7.

#### Test data

12. Data collected on each of the test areas with the WES 16-kip vibrator are presented in Tables 3 and 4. Table 3 shows the DSM measurements and deflection basins to be used for evaluation. Table 4 gives deflection measurements made on joints in the portland cement concrete (PCC) slabs in Test Areas 1 and 5. Similar test data for the FWD are given in Tables 5 and 6.

13. Air temperatures in terms of daily maximums and minimums were obtained from the MacDill AFB weather station for 20 October to 3 November. These temperatures are shown in Table 7. Temperatures of the asphaltic concrete (AC) pavement surfaces were recorded periodically during the testing as indicated in Tables 3 and 5.

## ANALYSIS OF TEST DATA USING DSM METHOD

14. The evolution of the DSM methodology nondestructive evaluation is well documented,<sup>10,12</sup> and details of the procedure will not be presented here. The methodology is based on correlations between the nondestructive DSM measurements and the computed allowable single-wheel load (ASWL) as determined on a number of in-service airfield pavements representing a range of pavement types and conditions. The ASWL were computed from existing Corps of Engineers (CE) pavement design procedures, using in-place pavement strength measurements determined through test pits and direct sampling procedures.

### Flexible Pavement Evaluation

15. The conventional theory used to evaluate military airfield flexible pavements is based on a determination of strength parameters, such as the California Bearing Ratio (CBR), moisture, density, classification of materials, and other values, using limitations and criteria developed from performance studies. To utilize the proven performance of the conventional methodology, the nondestructive quantity of the DSM was directly correlated to the ASWL as determined from the conventional method. The measured DSM for flexible pavements is corrected to a common pavement temperature of 70°F because deflection measurements on AC are sensitive to temperature. A method adopted from the Asphalt Institute<sup>13</sup> is used to determine 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 with relationships from Reference 12 to determine allowable gross aircraft loads ( $P_G$ ) on any desired aircraft at any level of operations (passes) using:

$$P_G = \frac{F_k(\text{DSM})}{S(\%ESWL)} \times \frac{Nm}{Nc} \times 100$$

where

- $F_k$  = load factor obtained from curves in reference 12  
S = factor that accounts for load on nose gear

%ESWL = equivalent single wheel load in percent

Nm = number of main gear wheels

Nc = number of controlling wheels (number of main gear wheels used to develop the %ESWL curves)

This relationship was developed from correlations between DSM and ASWL with the ASWL determined from test pit data. Existing analytical relationships from the CBR procedure were then used to make the translation to multiple-wheel aircraft. 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 can be used with the CBR procedure to compute AC overlay thickness. PCC overlays for use over flexible pavements cannot be determined with this methodology. The computations for this DSM procedure for flexible pavement evaluation have been computerized on a program called FLEXEVAL.

#### Rigid Pavement Evaluation

16. The methodology for NDT evaluation of rigid pavements using the DSM method is also well documented,<sup>10,12</sup> and will not be presented in detail. The procedure uses a correlation between the DSM measured at the slab center to the ASWL as determined from the conventional evaluation criterion. This criterion is the Westergaard analysis using material properties such as thickness, subgrade modulus, and flexural strength.

17. 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 DSM has been correlated to ASWL. The radius of relative stiffness  $\ell$  is obtained from a correlation of measured deflection ratio to  $\ell$ . From the Westergaard analysis,  $\ell$  is related to a load factor  $F_L$  which is simply a ratio of ASWL to the wheel load on any aircraft of interest. Thus,  $F_L$  interrelates ASWL to the wheel loads of different aircraft geometries.

18. The radius of relative stiffness  $\ell$  of a rigid pavement is obtained through deflection basin measurements. A correlation<sup>12</sup> between  $\ell$  determined from nondestructive deflection basin data and  $\ell$  determined from 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  $\ell$ .

19. The effects of stress repetition levels (aircraft passes) on the allowable gross aircraft load are considered by the use of a traffic factor. The traffic factor is a function of the aircraft gear geometry, the lateral distribution of aircraft traffic on the pavement being evaluated, and the traffic volume and is independent of the pavement structure. The allowable gross aircraft load for a specified number of aircraft passes is computed from the equation

$$P_G = 0.0189(DSM)(F_L)(T_C)$$

where

$F_L$  = load factor obtained from curves in Reference 12

$T_C$  = traffic factor obtained from curves in Reference 12

20. Overlays of PCC or AC to strengthen existing PCC pavements are determined from overlay equations from the CE conventional procedure. 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. The DSM procedure for rigid pavements has been computerized on the program RIGEVAL.

#### Composite pavements

21. 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. The correlation between DSM and ASWL on composite pavements is different from plain PCC pavement, and this results in the following equation for the allowable gross aircraft load  $P_G = 0.0172(DSM) \times (F_L)(T_C)$  for composite pavements. The radius of relative stiffness  $\ell$  for composite pavement cannot be determined from the deflection ratio measurements. The subgrade modulus  $k$  can be estimated from the subgrade soil classification,  $\ell$  can then be computed from appropriate relationships in the Westergaard analysis, and then the  $F_L$  factors are obtained from the same curves as used for plain PCC pavements.

22. Overlays for composite pavements are determined in a manner similar

to that for rigid pavements except an equivalent slab concept is used for the composite section. The RIGIVAL computer program can be used for composite pavement evaluation.

#### ANALYSIS OF TEST DATA USING LAYERED-ELASTIC METHOD

23. The layered-elastic methodology was developed under FAA-sponsored<sup>14</sup> research and has been described in literature.<sup>15</sup> The method was initially developed for light aircraft pavements, but has been found applicable to heavy aircraft pavements.<sup>16</sup> The general approach is to use a linear layered-elastic model with measured deflection basins to predict in situ modulus values for up to a four-layer pavement system. Measurements are made using at least two different NDT loadings in order to define 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.

#### Determination of Layer Modulus Values

24. The computer program BISDEF was developed at WES to determine modulus values for pavement layers. BISDEF uses the Shell BISAR 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 a lower limit for the modulus. The layered-elastic program is used to calculate a deflection basin produced by loading the NDT device, which is compared to the measured basin. If the basins do not agree, modulus values are changed iteratively until the modulus values produce 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 temperatures seasonally higher than encountered during testing.

#### Determination of Allowable Aircraft Loads

25. 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 used modulus values determined from BISDEF and the BISAR program to compute stresses (rigid pavement) and strains (flexible pavement) that will occur in the pavement system. AIRPAV then calculates the limiting stress or strain values from the criteria in the CE layered-elastic design methods.<sup>17,18</sup> Allowable load for the aircraft is determined by comparing the predicted stress or strain to the limiting value.

#### Limiting Stresses and Strains: AIRPAV

##### Rigid pavements

26. The evaluation is based on the tensile stress at the bottom of the slab which is determined as follows:<sup>17</sup>

$$\sigma_{All} = \frac{R}{A+B \log_{10} COV}$$

where

$\sigma_{All}$  = allowable tensile stress, psi

R = PCC flexural strength, psi

A = 0.58901

B = 0.35486

COV = aircraft coverages

##### Flexible pavements

27. The horizontal tensile strain at the bottom of the AC and the vertical subgrade strain are both considered in the evaluation of the flexible pavements. The allowable AC strain criterion used is as follows:<sup>19</sup>

$$\epsilon_{All(AC)} = 10^{-A}$$

where

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

$$N = \text{LOG}_{10} (\text{Aircraft Coverages})$$

$$E_{AC} = \text{AC modulus, psi}$$

28. The allowable subgrade strains are computed using the following:<sup>18</sup>

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

where

$$N = \text{repetitions}$$

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

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

$$E_{\text{subgrade}} = \text{Young's modulus of the subgrade, psi}$$

#### Overlay calculations

28. The required pavement thicknesses are computed by increasing the thickness of the upper layer until the stress or strain criterion is satisfied. AIRPAV accepts as input an initial new 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:

$$\text{AC overlay} = 2.5 [Fh_d - C_b h]$$

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

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

F = factor which projects 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

### Evaluation of Load Transfer

29. The ability of joints in PCC slabs to transfer load is measured with the NDT device in the configuration shown in Figure 7. 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.

30. This procedure was developed by first relating the deflection ratios to the percent maximum edge stress. This is shown in Figure 8. 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 used by the Air Force assumes 75 percent maximum edge stress (25 percent is carried by adjacent slab). The data points shown in Figure 8 were computed with both the ILLISLAB<sup>20</sup> program and the WESLIQUID<sup>21</sup> program (both are finite element programs). A range of pavement thicknesses and subgrade moduli  $k$  were used in this development. The 75 percent stress corresponds to a deflection ratio of 0.76, and this would be for 100 percent of the design load (load factor of 1.00). The condition of 100 percent maximum stress would occur at a deflection ratio of 0.0 (no load transfer), and would allow for only 75 percent of the design load (load factor of 0.75). By computing the allowable percent of design load at different deflection ratios, the relationship of Figure 9 can be obtained. Figure 9 then provides the procedure for reducing the allowable load determined at the slab center to account for the load transfer capabilities at the joint. As can be seen the load reduction factor falls between 0.75 and 1.00.

### ANALYSIS OF TEST RESULTS

31. Allowable aircraft loads were computed for 13 aircraft groups each at four pass levels. The evaluation was made for the controlling aircraft in each group. Table 8 shows these aircraft and the pass levels for each. Note

that the pass levels are not the same for all aircraft. Also overlay thickness requirements were computed for the B-747 at 10,000 passes and for the DC-10-30 at 1000 passes. Each allowable load or overlay thickness is for a specified aircraft and pass level. Effects of mixed traffic were not considered for this demonstration project. These computations for allowable loads and overlay thicknesses were made using three analysis procedures: (a) The DSM method using test data from the WES 16-kip vibrator, (b) the layered-elastic procedure using test data from the WES 16-kip vibrator, and (c) the layered-elastic procedure using test data from the FWD.

32. In addition, an analysis of the load transfer at joints between PCC slabs in Test Areas 1 and 5 was made. A reduction factor for the allowable loads based on reduced load transfer is determined.

#### Allowable Loads - DSM Method

33. For each of the five test areas an average DSM value was used for evaluation. For the rigid pavements in Test Areas 1 and 5, a representative radius of relative stiffness  $\ell$  was determined from deflection ratios of  $\Delta_{60}/\Delta_{18}$ . The computer programs FLEXEVAL for flexible pavements and RIGEVAL for rigid and composite pavements were used to compute the allowable loads and overlay requirements. Allowable load determinations were made for each of 13 aircraft at four different pass levels. Results are shown in Table 9. As shown, Test Areas 1, 2, and 4 can withstand the design aircraft loads at the indicated traffic levels. Areas 3 and 5 will require overlay thicknesses for some aircraft at the higher pass levels. Area 4, which is the composite pavement, was evaluated as a flexible pavement. Consideration of this area as an equivalent rigid section produces significantly lower allowable loads.

#### Allowable Loads - Layered-Elastic Method

34. A representative measured deflection basin was selected for each test area for use with a layered-elastic procedure. The BISDEF program then determined a set of modulus values for each pavement layer that would produce a computed deflection basin that would match the measured basin. The modulus values determined in this manner are shown in Tables 10 and 11 along with a comparison of the deflection basin match for the WES 16-kip vibrator and the

FWD. In these tables the computed modulus values are denoted as  $E_C$ . The values used to make allowable load computations are denoted as  $E_D$ . For most conditions  $E_D$  is simply a rounded-off value of  $E_C$ . In a few cases, however,  $E_D$  values were assigned that were considered more appropriate for evaluation. For AC pavement layers, an  $E_D$  of 250,000 was assigned for evaluation since this is considered to be more of an average value throughout the year. For Test Area 1 the limerock base layer was ignored in the computations for  $E_C$ . When this layer was considered, unrealistic  $E_C$  values were produced. For the composite pavement of Test Area 4, the old PCC layer was assigned a much lower  $E_D$  (considered as a base course) than the computed  $E_C$ , and the section was analyzed as a flexible pavement.

35. Allowable loads for the 13 aircraft based on the layered-elastic procedure using the  $E_D$  values from Tables 10 and 11 are presented in Table 12 for the WES 16-kip vibrator and in Table 13 for the FWD.

#### Load Reduction for Joint Load Transfer

36. Results of joint tests conducted on Test Areas 1 and 5 are shown in Table 4 for the WES 16-kip vibrator and in Table 6 for the FWD. A deflection ratio has been computed in each table for the deflection of the unloaded slab divided by the deflection of the loaded slab. For the WES 16-kip vibrator the ratio is  $\Delta_{18}/\Delta_0$  and for the FWD it is  $\Delta_{12}/\Delta_0$ . The deflection ratios can then be used with Figure 9 to determine the load reduction factor. The load reduction factor can then be used to reduce the allowable load as determined at the center of the slabs. Table 14 shows the load reduction factors determined from the deflection ratios.

37. The allowable loads determined from testing at the slab centers have not been reduced by these factors for this report. These results are presented to demonstrate this technique. Only limited work has been conducted to validate this approach to joint evaluation.

#### Overlay Thickness Requirements

38. Overlay thicknesses were computed for each of the five test areas for two load requirements: (a) a DC-10-30 aircraft with design load of 590 kips at 1000 passes, and (b) a B-747 aircraft with design load of 780 kips at

10,000 passes. The computations were made with the DSM method, the layered-elastic method with WES 16-kip vibrator, and the layered-elastic method with FWD. Results are shown in Table 15. The DSM method indicates AC overlay is only required for Test Area 3. No PCC overlays are shown for the flexible pavements (Test Areas 2, 3, and 4) because they cannot be obtained with the DSM method. The layered-elastic method using both the WES 16-kip vibrator and the FWD indicate overlays for Test Area 5 only.

#### SUMMARY

39. Nondestructive testing was performed on five pavement test areas at MacDill AFB using both the WES 16-kip vibrator and the Dynatest FWD. The test results were used to compute allowable aircraft loads for 13 military aircraft and to compute overlay thickness requirements for two aircraft types. Analytical procedures developed by WES were used to make the computations. These consist of the DSM method used with data from the WES 16-kip vibrator and a layered elastic procedure used with data from either the WES 16-kip vibrator or the FWD. The WES 16-kip vibrator applies a vibratory load at specified frequency, while the FWD uses an impact loading. Both devices measure the deflection of the pavement surface at various points from the load point.

40. The NDT methodologies were demonstrated on two flexible pavements, two rigid pavements, and one composite pavement. The DSM procedure uses empirically derived relationships of the measured DSM correlated to allowable single-wheel load from the standard evaluation procedures. The layered elastic methods use the measured deflection basins with computer codes to calculate elastic moduli for the pavement layer. These moduli are then used in the computer codes along with limiting stress and strain values to make the evaluations. A method of evaluating the load transfer of joints between PCC slabs was also demonstrated.

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Table 1  
Summary of Physical Property Data

Test Area	Facility Identification	Facility Length ft	Width ft	General Condition	Overlay Pavement		Pavement		Base		Subbase		Subgrade	
					Thick-ness in.	Descrip-tion	Thick-ness in.	Descrip-tion	Thick-ness in.	Descrip-tion	Thick-ness in.	Descrip-tion	Thick-ness in.	Descrip-tion
1	Taxiway 33	2150	200	Excellent			20.0	PCC	11.0	Lime rock stabilized sand (SP-SM)				Sand (SP-SM)
2	Taxiway 3-B	3200	75	Good			11.0	AC	11.0	Lime rock (SM)	4.0	Lime rock (SM)		Sand (SP)
3	Taxiway 3	4600	75	Fair			5.5	AC	8.5	Lime rock (SM)	5.5	Sand (SP-SM)		Sand (SP)
4	Apron 1-A-1	600	Varies	Good	7.0	AC	6.0	PCC						Sand (SP)
5	Apron 1-A	Varies	Varies	Excellent			10.5	PCC						Sand (SP)

Table 2  
Pavement Condition Rating  
of Test Areas

<u>Test Area</u>	<u>PCI</u>	<u>Rating</u>
1	100	Excellent
2	62	Good
3	46	Fair
4	48	Fair
5	95	Excellent

Table 3  
Test Data - WFS 16-Kip Vibrator

Test Area	Test No.	Station or Location	Date	Time	Surface Temperature of	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	94.6	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		6660			14,480	2.07	1.54	1.26	1.00	
	A-16	3+87.5		1433		6060			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		6360			14,854	2.30	1.86	1.57	1.31	
	B-2	0+37.5		1438		6400			15,053	2.20	1.75	1.46	1.18	
	B-5	1+12.5		1439		6280			14,035	2.14	1.71	1.43	1.17	
	B-8	1+87.5		1440		5400			14,588	2.68	1.73	1.46	1.18	
	B-11	2+62.5	1441	5560	14,692	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. 1f	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 Area	Test No.	Station or Location	Date	Time	Surface Temperature of	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 lf	1 Nov 82	0402	90.0	1370	1.12	1534	14,793	9.15	6.06	2.74	1.51
	A-1+00			1420		1590		15,056	8.95	5.79	2.70	1.65	
	A-2+00			1422		1422		14,686	9.73	5.69	2.73	1.67	
	A-3+00			1360		1523		14,484	9.04	5.75	2.72	1.78	
	A-4+00			1120		1254		14,081	10.48	6.39	2.83	1.84	
	A-5+00			1540		1725		14,706	8.32	4.35	2.03	1.47	
	A-6+00			1250		1400		14,336	9.67	6.13	2.83	1.83	
	A-7+00			1110		1243		14,616	11.15	6.86	3.15	2.03	
	B-0+00			1620		1814		14,330	7.36	4.80	2.45	1.37	
	B-0+50			1670		1870		14,731	7.65	5.22	2.53	1.44	
	B-1+00	1820	2038	14,239	6.56	4.45	2.27	1.33					
	B-1+50	1960	2195	14,918	6.69	5.03	2.39	1.33					
	B-2+00	1660	1859	14,770	7.72	5.11	2.64	1.52					
	B-2+50	1600	1792	14,368	7.90	5.38	2.86	1.64					
	B-3+00	1680	1882	15,030	7.80	5.26	2.73	1.65					
	B-3+50	1670	1870	14,316	7.39	5.18	2.76	1.75					
	B-4+00	1460	1650	14,802	8.71	5.86	2.88	1.76					
	B-4+50	1710	1932	14,721	7.61	5.40	2.69	1.56					
	B-5+00	2220	2509	14,553	5.99	3.52	1.75	1.19					
	B-5+50	1840	2079	14,457	7.11	4.89	2.65	1.63					
	B-6+00	1880	2124	14,739	6.97	4.65	2.62	1.55					
	B-6+50	1550	1751	14,873	8.30	6.19	2.96	1.72					
	B-7+00	1530	1729	14,830	8.37	5.88	3.12	1.78					
	C-0+00	2060	2307	14,478	6.05	4.13	2.09	1.24					
	C-1+00	2260	2531	14,893	5.87	3.84	2.00	1.22					
	C-2+00	1900	2128	14,453	6.76	4.16	2.26	1.40					
	C-3+00	1720	1926	14,974	7.60	5.03	2.75	1.68					
	C-4+00	2040	2285	14,514	6.47	4.49	2.50	1.59					
	C-5+00	2480	2778	14,495	5.48	3.23	1.92	1.43					
	C-6+00	1840	2061	14,513	6.76	4.59	2.45	1.58					
	C-7+00	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 of	DSM kips/in.	Temperature Correction Factor	Corrected DSM kips/in.	Force lb	Deflection, mils			
										Distance from Center of Plate, in.			
										0	18	36	60
3	A-7+50	≈12 ft lf	1 Nov 82	0430	88.0	980	1.10	1078	14,837	12.52	7.65	3.09	2.06
	A-8+50			0429		870		957	14,704	13.39	7.42	2.85	1.90
	A-9+50			0428		940		1034	14,506	12.39	7.51	3.00	1.90
	C-0+00	Center line		0417		1070		1177	14,681	10.89	7.47	3.61	2.03
	C-1+00			0418		980		1078	14,792	12.57	8.51	4.28	2.50
	C-2+00			0420		1000		1100	14,673	11.47	7.42	3.75	2.29
	C-3+00			0421		1000		1100	14,782	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	14,873	12.22	8.23	3.84	2.24
	C-6+00			0423		880		968	14,778	13.28	8.96	4.41	2.65
C-7+00		0424		1020		1122	15,010	12.11	7.86	3.59	2.30		
C-8+00		0424		1220		1342	14,339	10.11	6.77	3.50	2.17		
C-9+00		0425		1080		1188	14,496	10.77	7.12	3.24	1.95		
C-10+00		0426		1060		1166	14,612	11.34	7.23	3.49	2.11		
B-0+00	≈12 ft rt	0445		820	87.0	902	14,691	14.03	8.96	3.29	1.96		
B-1+00		0446		920		1012	14,785	13.12	8.35	3.53	2.23		
B-2+00		0447		880		968	14,928	13.73	8.91	3.35	2.18		
B-3+00		0448		790		869	14,806	14.53	9.46	3.46	2.06		
B-4+00		0448		710		781	14,653	15.90	10.91	3.67	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	4.09	2.43		
B-7+00		0450		870		957	14,722	14.04	9.52	3.75	2.39		
B-8+00		0450		990		1089	14,705	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		1120	86.5	1232	14,745	11.29	7.03	2.62	1.70		
4	T-4		2 Nov 82	1538	101.0	2840	1.16	3294	4,245	1.40	1.25	0.92	0.66
	1			1513	101.0	2420		2807	9,987	3.38	2.93	2.11	1.46
	2			1514	100.7	2480		2877	14,467	4.90	4.15	2.97	2.07
	J-3			1516	101.0	1900		2204	14,751	5.89	4.84	3.35	2.27
4			1517	101.0	1940		2250	14,326	5.71	5.03	3.71	2.60	
								14,896	7.36	5.81	3.76	2.38	
								14,218	6.93	5.60	3.92	2.59	

(Sheet 4 of 6)

(Continued)

Table 3 (Continued)

Test Area	Test No.	Station or Location	Date	Time	Surface Temperature of	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		2620	14,322	5.32	3.95	2.80	2.10
		E-1						0840		2780		2780	14,184	5.05	4.21	3.06	2.17
		I-1						0840		2400		2400	14,657	6.04	4.48	3.11	2.07
		M-1						0841		2740		2740	14,779	5.38	4.54	3.27	2.35
N-3				0844		2800		2800	14,462	5.16	4.03	2.92	2.20				
J-3				0853		2520		2520	14,574	5.59	4.55	3.23	2.31				
F-3				0855		2500		2500	14,593	5.79	4.29	2.99	2.03				
B-3				0855		2900		2900	14,416	4.95	4.01	2.75	1.97				
G-5				0900		2220		2220	14,937	6.62	5.19	3.77	2.81				
K-5				0901		2380		2380	14,619	5.80	4.46	3.09	2.21				
O-5				0903		2720		2720	14,575	5.30	4.03	2.92	2.16				
M-7				0907		2720		2720	14,482	5.23	4.23	2.94	2.08				
I-7				0909		2520		2520	14,350	5.64	4.35	3.20	2.34				
F-7				0909		2360		2360	14,650	5.76	4.43	3.09	2.14				
D-9				0920		2380		2380	14,300	5.87	4.73	3.35	2.22				
F-9				0922		2480		2480	14,301	5.55	4.62	3.34	2.43				
J-9			0923		2620		2620	14,492	5.40	4.25	3.12	2.33					
O-11			0929		2760		2760	14,893	5.24	4.20	3.17	2.44					
K-11			0930		2700		2700	14,620	5.29	4.09	2.97	2.15					
G-11			0931		2400		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 of	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

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.		Deflection Ratio		
								0	18			
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		4200	14,872	3.42	2.10	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	14,578	2.40	2.00	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	3.82	1.79	0.47		
	LJ-12	B5-A5		1226		4080	14,479	3.31	1.98	0.60		
	LJ-13	B8-C8		1227		3640	13,853	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	14,607	3.67	1.30	0.35		
	LJ-16	C18-B18		1232		3760	14,283	3.78	1.47	0.38		
	LJ-17	B20-C20		1233		3420	14,156	4.09	1.35	0.33		
	LJ-18	B23-A23		1236		5560	14,205	2.47	1.75	0.71		
	LJ-19	B26-C26		1252		3960	14,928	3.68	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-J13		1021		1790	14,403	7.54	4.97	0.66		
	TJ-3	J9-J10		1023		2000	14,378	6.76	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		1760	14,352	7.92	4.65	0.59		
	TJ-10	G17-G16		1033		2300	14,617	6.22	5.15	0.83		
	LJ-11	A1-B1		1049		1740	14,601	7.87	3.93	0.50		
	LJ-12	E1-F1		1048		1320	14,700	10.15	3.49	0.34		
	LJ-13	G1-H1		1046		1580	14,406	8.32	5.92	0.71		
	LJ-14	I1-J1		1045		1770	14,743	7.81	4.86	0.62		
	LJ-15	M1-N1		1044		1680	14,823	8.62	4.02	0.47		
	LJ-16	C11-B11		1038		1330	14,417	10.08	4.28	0.42		
	LJ-17	G11-F11		1039		1560	14,235	8.67	5.17	0.60		
	LJ-18	K11-J11		1040		1960	14,618	7.13	5.43	0.76		
	LJ-19	O11-N11		1041		1960	14,061	7.10	3.33	0.47		
	J1	J2-I2		1052		1840	14,560	7.22	5.46	0.76		
	2	J2		1056		2500	14,772	5.61	4.75	0.85		
	J3	K2-J2		1057		1800	14,410	7.34	5.04	0.69		
	J4	J2-J1		1108		1700	14,552	7.87	4.88	0.62		
	J5	J3-J2		1108		1680	14,525	7.96	5.56	0.70		
	J6	J2-J1		1104		1470	14,424	9.09	3.83	0.42		
J7	J3-J2	1105	1390	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	--	1.38	--	
						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	--	1.50	--
							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	--	1.46	--
							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	--	1.38	--			
				14,253	2.17	--	1.54	--	1.26			
				14,285	2.20	--	1.50	--	1.26			
A-19	4+62.5		92.0	14,285	2.17	1.81	--	1.54	--			
				14,333	2.13	1.85	--	1.50	--			
				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	1.89	--	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 1 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				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			
	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	9.96	6.46	--	2.68	--				
										14,094	9.84	6.46	--	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	--	3.86	--	1.85
	B-2+00					14,237	9.72	6.65	--	2.68	--				
										14,221	9.69	6.50	--	2.60	--
										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 lf	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	5.12	--	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	4.53	--	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	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)

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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.				
							0	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				92.0	14,063	17.48	11.10	--	4.17	--
						14,078	17.13	10.98	--	4.21	--
						13,824	16.18	--	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	--
						14,158	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	16.30	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				91.0	14,031	20.63	12.01	--	3.90	--
						14,015	19.80	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	--	2.40
	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	17.48	--	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				86.0	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	--	2.48
						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)

(Sheet 11 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	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				78.4	14,309	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	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	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	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 of	Force lb	Deflection, mi.s				
							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	--	3.07	--
						14,603	5.12	4.53	--	3.23	--
						14,555	5.16	--	3.90	--	2.60
						14,635	5.04	--	3.90	--	2.56
						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
						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
G-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
						14,444	4.92	4.45	--	3.03	--
						14,476	4.92	4.45	--	3.15	--
K-5					82.0	14,428	5.12	--	3.70	--	2.68
						14,476	5.00	--	3.74	--	2.64
						14,444	5.04	4.57	--	3.27	--
O-5					82.0	14,396	5.08	4.61	--	3.27	--
						14,412	5.08	--	4.02	--	2.91
						14,444	5.08	--	3.94	--	2.91
						14,253	5.67	4.96	--	3.35	--
M-7					82.0	14,285	5.79	5.00	--	3.35	--
						14,333	5.55	--	4.25	--	2.80
						14,317	5.63	--	4.25	--	2.80
I-7					82.0	14,253	5.71	5.16	--	3.23	--
						14,253	5.71	5.16	--	3.27	--
						14,174	5.83	--	4.29	--	2.99
F-7					83.0	14,221	5.83	--	4.41	--	2.87
						14,396	5.39	4.88	--	3.39	--
						14,396	5.47	4.88	--	3.43	--
D-9					83.0	14,365	5.35	--	4.06	--	2.80
						14,380	5.35	--	4.09	--	2.83
						14,365	5.04	4.53	--	3.54	--
F-9					83.0	14,365	5.00	4.61	--	3.58	--
						14,285	5.08	--	3.94	--	3.23
						14,349	5.08	--	4.09	--	3.19
J-9					83.0	14,333	4.61	4.29	--	3.07	--
						14,380	4.69	4.25	--	3.11	--
						14,333	4.53	--	3.82	--	2.80
O-11					84.0	14,412	4.61	--	3.78	--	2.80
						14,285	5.51	4.21	--	3.23	--
						14,221	5.35	4.37	--	3.19	--
K-11					84.0	14,206	5.28	--	3.82	--	2.44
						14,190	5.28	--	4.06	--	2.72
						14,190	4.92	4.88	--	3.27	--
G-11					84.0	14,237	4.96	4.92	--	3.27	--
						14,253	5.00	--	4.06	--	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	14,380	5.28	4.96	--	3.50	--
						14,428	5.28	4.92	--	3.43	--
						14,444	5.39	--	4.53	--	2.72
						14,460	5.35	--	4.61	--	2.87
A-13					84.0	14,174	6.18	5.20	--	3.46	--
						14,221	6.10	5.28	--	3.58	--
						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	--	3.11	--
						14,492	5.00	4.49	--	3.15	--
						14,412	5.00	--	3.78	--	2.64
						14,412	5.04	--	3.86	--	2.64
I-13					85.0	14,396	5.67	4.84	--	3.31	--
						14,333	5.51	4.88	--	3.31	--
						14,349	5.83	--	4.09	--	2.76
						14,285	5.67	--	4.21	--	2.76
M-13					85.0	14,158	4.88	4.37	--	3.31	--
						14,174	4.96	4.45	--	3.35	--
						14,206	5.08	--	3.94	--	2.87
						14,158	4.96	--	3.90	--	2.91
N-15					85.0	14,476	4.84	4.21	--	3.03	--
						14,508	4.72	4.25	--	3.07	--
						14,555	4.76	--	3.74	--	2.52
						14,587	4.84	--	3.74	--	2.56
J-15					85.0	14,237	5.20	4.49	--	3.07	--
						14,237	5.20	4.45	--	3.07	--
						14,190	5.28	--	3.86	--	2.56
						14,221	5.31	--	3.98	--	2.56
F-15					85.0	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	--	2.56
B-15					86.0	14,460	5.28	4.65	--	3.35	--
						14,476	5.28	4.69	--	3.35	--
						14,444	5.35	--	4.21	--	2.68
						14,444	5.24	--	4.13	--	2.76
C-17					86.0	14,365	5.24	4.45	--	3.15	--
						14,349	5.35	4.53	--	3.19	--
						14,285	5.39	--	3.70	--	2.52
						14,253	5.31	--	3.82	--	2.52
G-17					86.0	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
K-17					86.0	14,380	5.20	5.04	--	3.50	--
						14,444	5.28	5.04	--	3.50	--
						14,349	5.35	--	3.90	--	2.80
						14,365	5.43	--	4.09	--	2.83
L-18					86.0	14,301	4.80	4.21	--	2.91	--
						14,380	4.84	4.25	--	2.91	--
						14,301	4.88	--	3.58	--	2.44
						14,428	4.92	--	3.66	--	2.48

(Continued)

(Sheet 14 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

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			Deflection Ratio		
							Distance from Center of Plate, in.					
							0	12	36			
1	TJ-1	C3-C2	3 Nov 82		91.0	14,349	2.80	2.24	1.69	0.80		
	TJ-2	C12-C11			90.0	14,412	2.68	2.44	1.69	0.91		
	TJ-3	C21-C20			90.0	14,459	2.52	1.81	1.38	0.72		
	TJ-4	A22-A23			87.0	14,428	2.87	1.93	1.50	0.67		
	TJ-5	A13-A14			10:20	86.5	14,476	2.48	2.20	1.54	0.89	
	TJ-6	A4-A5					14,380	2.60	2.36	1.77	0.90	
	TJ-7	B2-B1					88.0	14,492	5.39	1.10	0.91	0.20
	TJ-8	B11-B10					87.0	14,460	3.27	1.42	1.06	0.43
	TJ-9	B20-B19					87.0	14,237	5.24	1.38	1.10	0.26
	TJ-10	B26-B25					87.0	14,523	3.66	1.26	1.02	0.34
LJ-11	A1-B1			88.0	14,444	2.91	2.17	1.54	0.75			
LJ-12	B5-A5			88.0	14,444	3.86	1.69	1.22	0.44			
LJ-13	B8-C8			88.0	14,396	4.13	1.34	0.98	0.32			
LJ-14	C12-B12			89.0	14,301	3.27	1.93	1.42	0.59			
LJ-15	A16-B16			89.0	14,476	4.69	1.26	1.02	0.27			
LJ-16	C18-B18			89.0	14,333	5.35	1.54	1.22	0.29			
LJ-17	B20-C20			89.0	14,365	5.28	1.54	1.18	0.29			
LJ-18	B23-A23			90.0	14,285	2.87	1.77	1.34	0.62			
LJ-19	B26-C26			90.0	14,285	2.56	2.09	1.46	0.82			
5	TJ-1	J15-J16			87.0	14,285	9.09	5.51	3.19	0.61		
	TJ-2	J12-J13			87.0	14,253	11.46	3.11	2.17	0.27		

(Continued)

Table 6 (Concluded)

Test Area	Test No.	Station or Location	Date	Time	Surface Temperature °F	Force lb	Deflection, mils			Deflection Ratio	
							Distance from Center of Plate, in.				
							0	12	36		
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			86.2	0930	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	83.3	0900	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

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<u>Date</u> <u>1982</u>	<u>Maximum</u> <u>Temperature</u> <u>°F</u>	<u>Minimum</u> <u>Temperature</u> <u>°F</u>
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

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Table 8

Pass Levels for Pavement Evaluation

Aircraft Group	Controlling Aircraft	Pass Levels 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 (DC-10-30)	15,000	3,000	500	100
12	E-4	15,000	3,000	500	100
13	B-52	15,000	3,000	500	100

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Table 9

NONDESTRUCTIVE PAVEMENT EVALUATION RESULTS

DSM METHOD

Number of Passes	Allowable Aircraft Load, kips												
	C-123	F-4	F-111	C-130	C-9	T-43	B-727	KC-135	C-141	C-5A	KC-10A	E-4	B-52
	Area 1 DSM = 6053 $l = 42.8$												
300,000	60	60	120	175	110	150	175	335	345	770	590	780	490
50,000	60	60	120	175	110	150	175	335	345	770	590	780	490
15,000	60	60	120	175	110	150	175	335	345	770	590	780	490
3,000	60	60	120	175	110	150	175	335	345	770	590	780	490
500	--	--	--	175	110	150	175	335	345	770	590	780	490
100	--	--	--	--	--	--	--	--	--	--	590	780	490
	Area 2 DSM = 1986												
300,000	60	60	120	175	110	150	175	335	345	770	590	780	490
50,000	60	60	120	175	110	150	175	335	345	770	590	780	490
15,000	60	60	120	175	110	150	175	335	345	770	590	780	490
3,000	60	60	120	175	110	150	175	335	345	770	590	780	490
500	--	--	--	175	110	150	175	335	345	770	590	780	490
100	--	--	--	--	--	--	--	--	--	--	590	780	490
	Area 3 DSM = 949												
300,000	60	59	70	175	110	131	144	251	237	702	406	535	298
50,000	60	60	82	175	110	150	162	275	261	721	472	616	347
15,000	60	47	96	175	110	150	175	328	321	770	569	779	433
3,000	60	60	120	175	110	150	175	335	345	770	590	780	490
500	--	--	--	175	110	150	175	335	345	770	590	780	490
100	--	--	--	--	--	--	--	--	--	--	590	780	490
	Area 4 DSM = 2446												
300,000	60	60	120	175	110	150	175	335	345	770	590	780	490
50,000	60	60	120	175	110	150	175	335	345	770	590	780	490
15,000	60	60	120	175	110	150	175	335	345	770	590	780	490
3,000	60	60	120	175	110	150	175	335	345	770	590	780	490
500	--	--	--	175	110	150	175	335	345	770	590	780	490
100	--	--	--	--	--	--	--	--	--	--	590	780	490
	Area 5 DSM = 2588 $k = 300$												
300,000	60	60	93	175	110	148	161	335	345	770	590	780	490
50,000	60	60	113	175	110	150	175	335	345	770	590	780	490
15,000	60	60	120	175	110	150	175	335	345	770	590	780	490
3,000	60	60	120	175	110	150	175	335	345	770	590	780	490
500	--	--	--	175	110	150	175	335	345	770	590	780	490
100	--	--	--	--	--	--	--	--	--	--	590	780	490

Table 10

MODULUS VALUES FROM LAYERED-ELASTIC PROCEDURE  
WES 16-KIP VIBRATOR

Test Area	Layer 1		Layer 2		Subgrade		Deflection Basin, mils				
	Thickness	Material	Thickness	Material	Material	Modulus	$\Delta_0$	$\Delta_{18}$	$\Delta_{36}$	$\Delta_{60}$	
1	20	PCC			Sand	$E_c = 3,216,989$ $E_D = 3,200,000$	Measured	2.30	1.84	1.54	1.24
							Computed	2.21	1.86	1.53	1.13
2	10	AC	15	Limerock	Sand	$E_c = 535,039$ $E_D = 250,000$	Measured	7.27	4.87	2.15	1.30
							Computed	7.41	4.57	2.43	1.18
3	5	AC	8.5	Limerock	Sand	$E_c = 1,000,000$ $E_D = 250,000$	Measured	13.73	8.91	3.35	2.18
							Computed	14.04	8.25	3.87	1.79
4	6	AC	6	PCC	Sand	$E_c = 1,075,723$ $E_D = 250,000$	Measured	6.56	5.56	3.99	2.77
							Computed	6.51	5.49	4.17	2.66
5	10.5	PCC			Sand	$E_c = 4,197,303$ $E_D = 4,200,000$	Measured	5.55	4.62	3.34	2.43
							Computed	5.41	4.66	3.54	2.29

 $E_c$  = modulus computed $E_D$  = modulus used for evaluation

Table 11

MODULUS VALUES FROM LAYERED-ELASTIC PROCEDURE  
FALLING WEIGHT DEFLECTOMETER

Test Area	Layer 1		Thickness	Layer 2		Subgrade		Deflection Basin, mills						
	Thickness	Material		Modulus	Material	Modulus	Material	Modulus	$\Delta_0$	$\Delta_{12}$	$\Delta_{24}$	$\Delta_{36}$	$\Delta_{48}$	
1	20	PCC	$E_c = 3,952,462$				Sand	$E_c = 46,947$	Measured	1.93	1.52	1.40	1.20	1.10
			$E_D = 3,950,000$					Computed	1.88	1.58	1.40	1.23	1.06	
2	10	AC	$E_c = 407,511$		15	Limerock	Sand	$E_c = 39,048$	Measured	10.01	6.63	3.82	2.36	1.67
			$E_D = 250,000$					Computed	10.13	6.50	3.98	2.48	1.62	
3	5	AC	$E_c = 306,000$		8.5	Limerock	Sand	$E_c = 24,108$	Measured	28.07	16.04	6.40	3.52	2.22
			$E_D = 250,000$					Computed	28.24	15.64	6.57	3.42	2.24	
4	6	AC	$E_c = 556,144$		6	PCC	Sand	$E_c = 18,032$	Measured	7.55	5.96	5.24	4.29	3.46
			$E_D = 250,000$					Computed	7.33	5.98	5.17	4.28	3.46	
5	10.5	PCC	$E_c = 5,891,802$				Sand	$E_c = 20,272$	Measured	5.21	4.86	4.21	3.50	3.01
			$E_D = 5,900,000$					Computed	5.24	4.80	4.20	3.57	2.97	

Table 12

NONDESTRUCTIVE PAVEMENT EVALUATION RESULTS  
 LAYERED-ELASTIC METHOD, WES 16-KIP VIBRATOR

Number of Passes	Allowable Aircraft Load, kips												
	C-123	F-4	F-111	C-130	C-9	T-43	B-727	KC-135	C-141	C-5A	KC-10A	E-4	B-52
	<u>Area 1</u>												
300,000	60	60	120	--	--	--	--	--	--	345	770	--	--
50,000	60	60	120	175	110	150	175	335	345	770	590	--	490
15,000	60	60	120	175	110	150	175	335	345	770	590	780	490
3,000	60	60	120	175	110	150	175	335	345	770	590	780	490
500	--	--	--	175	110	150	175	335	345	770	590	780	490
100	--	--	--	--	--	--	--	--	--	--	590	780	490
	<u>Area 2</u>												
300,000	60	60	112	--	--	--	--	--	--	345	770	--	--
50,000	60	60	120	175	110	150	175	335	345	770	590	780	490
15,000	60	60	120	175	110	150	175	335	345	770	590	780	490
3,000	60	60	120	175	110	150	175	335	345	770	590	780	490
500	--	--	--	175	110	150	175	335	345	770	590	780	490
100	--	--	--	--	--	--	--	--	--	--	590	780	490
	<u>Area 3</u>												
300,000	60	49	80	--	--	--	--	--	--	322	770	--	--
50,000	60	60	108	175	110	150	175	335	345	770	590	780	420
15,000	60	60	115	175	110	150	175	335	345	770	590	780	490
3,000	60	60	120	175	110	150	175	335	345	770	590	780	490
500	--	--	--	175	110	150	175	335	345	770	590	780	490
100	--	--	--	--	--	--	--	--	--	--	590	780	490
	<u>Area 4</u>												
300,000	60	60	120	--	--	--	--	--	--	345	770	--	--
50,000	60	60	120	175	110	150	175	335	345	770	590	780	490
15,000	60	60	120	175	110	150	175	335	345	770	590	780	490
3,000	60	60	120	175	110	150	175	335	345	770	590	780	490
500	--	--	--	175	110	150	175	335	345	770	590	780	490
100	--	--	--	--	--	--	--	--	--	--	590	780	490
	<u>Area 5</u>												
300,000	60	60	74	--	--	--	--	--	--	245	770	--	--
50,000	60	60	84	165	110	118	130	263	269	770	451	631	217
15,000	60	60	92	172	110	130	142	288	309	770	515	723	248
3,000	60	60	107	175	110	149	163	330	345	770	590	780	295
500	--	--	--	175	110	150	175	335	345	770	590	780	295
100	--	--	--	--	--	--	--	--	--	--	590	780	357

Table 13

NONDESTRUCTIVE PAVEMENT EVALUATION RESULTS  
LAYERED-ELASTIC METHOD, FALLING WEIGHT DEFLECTOMETER

Number of Passes	Allowable Aircraft Load, kips												
	C-123	F-4	F-111	C-130	C-9	T-43	B-727	KC-135	C-141	C-5A	KC-10A	E-4	B-52
						<u>Area 1</u>							
300,000	60	60	120	--	--	110	150	--	345	770	--	--	--
50,000	60	60	120	175	110	150	175	335	345	770	590	780	490
15,000	60	60	120	175	110	150	175	335	345	770	590	780	490
3,000	60	60	120	175	110	150	175	335	345	770	590	780	490
500	--	--	--	175	110	150	175	335	345	770	590	780	490
100	--	--	--	--	--	--	--	--	--	--	590	780	490
						<u>Area 2</u>							
300,000	60	60	108	--	--	110	150	--	345	770	--	--	--
50,000	60	60	120	175	110	150	175	335	345	770	590	780	455
15,000	60	60	120	175	110	150	175	335	345	770	590	780	490
3,000	60	60	120	175	110	150	175	335	345	770	590	780	490
500	--	--	--	175	110	150	175	335	345	770	590	780	490
100	--	--	--	--	--	--	--	--	--	--	590	780	490
						<u>Area 3</u>							
300,000	52	32	44	--	--	82	90	--	177	522	--	--	--
50,000	60	43	61	147	102	111	136	183	220	652	364	494	207
15,000	60	47	73	175	110	133	163	227	296	770	474	655	289
3,000	60	50	79	175	110	145	175	304	323	770	514	712	342
500	--	--	--	175	110	--	--	332	--	--	554	768	371
100	--	--	--	--	--	--	--	--	--	--	590	780	490
						<u>Area 4</u>							
300,000	60	60	120	--	--	110	150	--	345	770	--	--	--
50,000	60	60	120	175	110	150	175	335	345	770	590	780	490
15,000	60	60	120	175	110	150	175	335	345	770	590	780	490
3,000	60	60	120	175	110	150	175	335	345	770	590	780	490
500	--	--	--	175	110	150	175	335	345	770	590	780	490
100	--	--	--	--	--	--	--	--	--	--	590	780	490
						<u>Area 5</u>							
300,000	60	60	69	--	--	100	109	--	215	669	--	--	--
50,000	60	60	78	149	110	119	129	231	235	729	398	555	190
15,000	60	60	86	164	110	137	148	290	270	770	454	635	217
3,000	60	60	99	175	110	150	175	335	325	770	542	760	259
500	--	--	--	175	110	150	175	335	325	770	590	780	313
100	--	--	--	--	--	--	--	--	--	--	590	780	313

Table 14

## RESULTS OF JOINT EVALUATIONS

Test Area	Test Number	Deflection Ratios		Load Reduction Factors	
		WES 16-kip	FWD	WES 16-kip	FWD
1	TJ-1	.79	.80	1.00	1.00
	TJ-2	.61	.91	.94	1.00
	TJ-3	.69	.72	.98	1.00
	TJ-4	.46	.67	.86	.97
	TJ-5	.83	.89	1.00	1.00
	TJ-6	.83	.90	1.00	1.00
	TJ-7	.39	.20	.84	.79
	TJ-8	.74	.43	1.00	.85
	TJ-9	.39	.26	.84	.80
	TJ-10	.60	.34	.93	.82
	LJ-11	.47	.75	.87	1.00
	LJ-12	.60	.44	.93	.85
	LJ-13	.43	.32	.85	.82
	LJ-14	.67	.59	.97	.93
	LJ-15	.35	.27	.83	.81
	LJ-16	.38	.29	.84	.81
	LJ-17	.33	.23	.82	.80
	LJ-18	.71	.62	1.00	.94
	LJ-19	.58	.82	.93	1.00
5	TJ-1	.84	.61	1.00	.93
	TJ-2	.66	.27	.96	.81
	TJ-3	.85	.88	1.00	1.00
	TJ-4	.59	.24	.93	.80
	TJ-5	.81	.62	1.00	.94
	TJ-6	.67	.22	.97	.79
	TJ-7	.83	.57	1.00	.91
	TJ-8	.77	.39	1.00	.83
	TJ-9	.59	.52	.93	.88
	TJ-10	.83	.73	1.00	1.00
	LJ-11	.50	.28	.88	.81
	LJ-12	.34	.18	.82	.78
	LJ-13	.71	.31	1.00	.82
	LJ-14	.62	.27	.94	.81
	LJ-15	.47	.21	.86	.79
	LJ-16	.42	.25	.84	.80
	LJ-17	.60	.26	.93	.80
	LJ-18	.76	.28	1.00	.81
	LJ-19	.47	.18	.86	.78

Table 15

## OVERLAY THICKNESS REQUIREMENTS

Overlay Thickness for DC 10-30, 590 kips, 1000 Passes										
Test Area	DSM Method			Layered-Elastic Method WES 16-kip Vibrator			Layered-Elastic Method FWD			
	AC	PCC Partial Bond	PCC Unbonded	AC	PCC Partial Bond	PCC Unbonded	AC	PCC Partial Bond	PCC Unbonded	
	1	0	0	0	0	0	0	0	0	0
2	0	--	--	0	0	0	0	0	0	
3	0.6	--	--	0	0	0	0	0	0	
4	0	--	--	0	0	0	0	0	0	
5	0	0	0	0.8	1.1	2.6	4.5	3.9	6.4	

Overlay Thickness for B-747, 780 kips, 10,000 Passes										
Test Area	DSM Method			Layered-Elastic Method WES 16-kip Vibrator			Layered-Elastic Method FWD			
	AC	PCC Partial Bond	PCC Unbonded	AC	PCC Partial Bond	PCC Unbonded	AC	PCC Partial Bond	PCC Unbonded	
	1	0	0	0	0	0	0	0	0	0
2	0	--	--	0	0	0	0	0	0	
3	2.4	--	--	0	0	0	0	0	0	
4	0	--	--	0	0	0	0	0	0	
5	0	0	0	5.0	4.2	6.8	9.0	6.5	9.4	

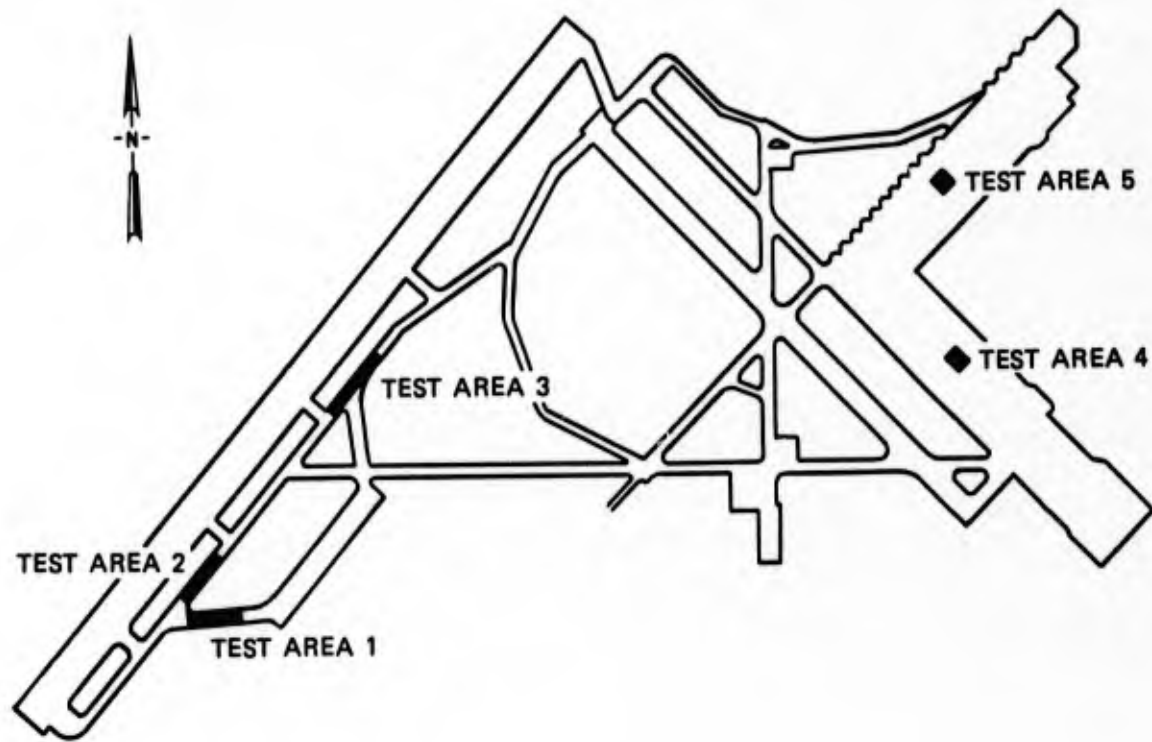


Figure 1. Airfield layout at MacDill AFB showing location of test areas

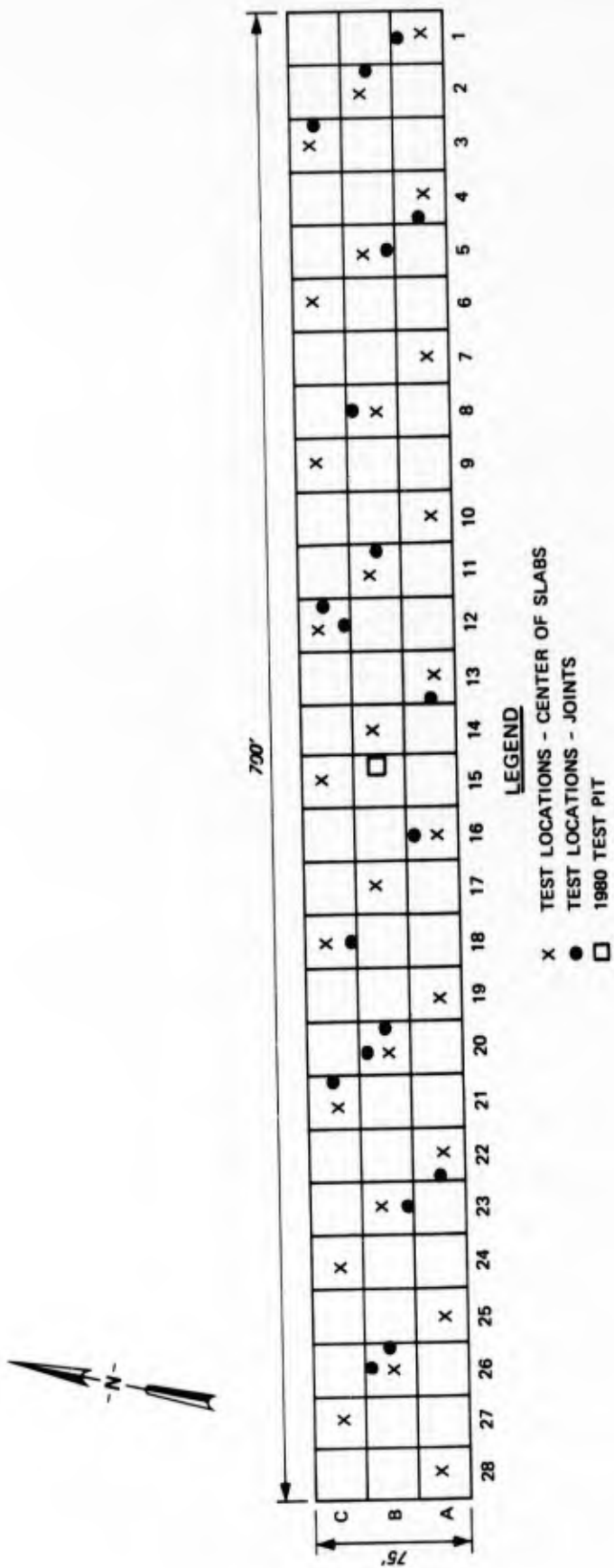


Figure 2. Test Area 1 showing test locations

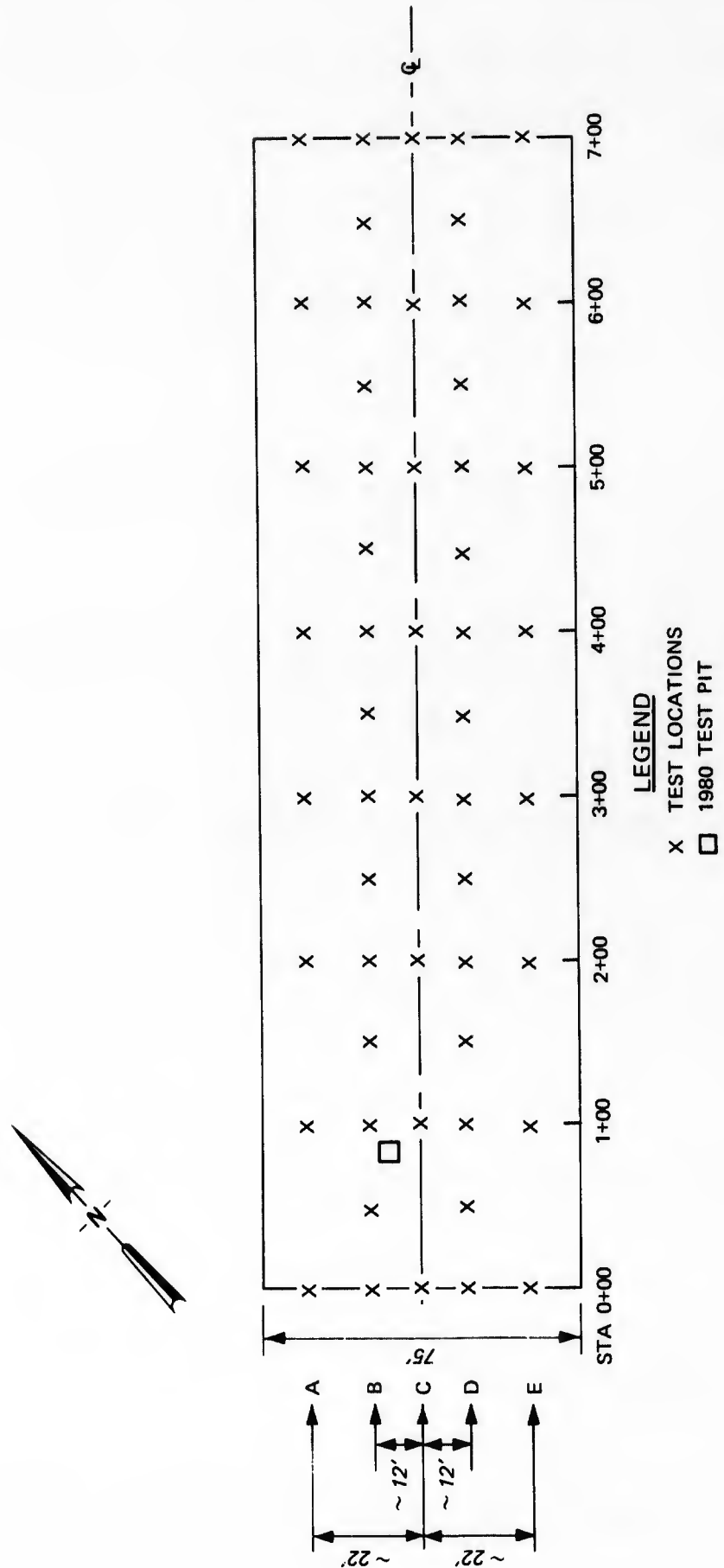


Figure 3. Test Area 2 showing test locations

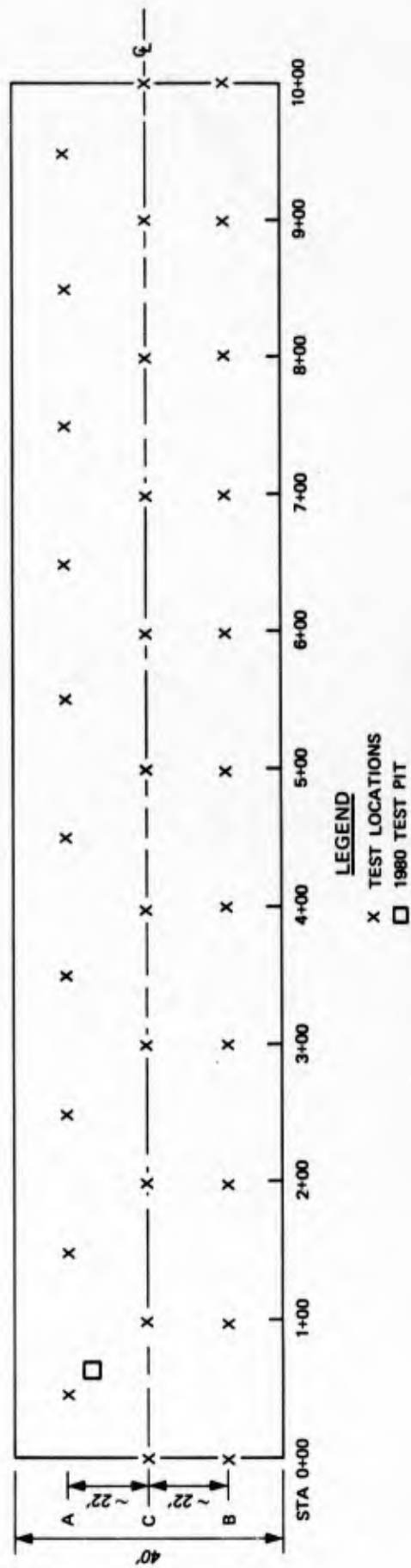
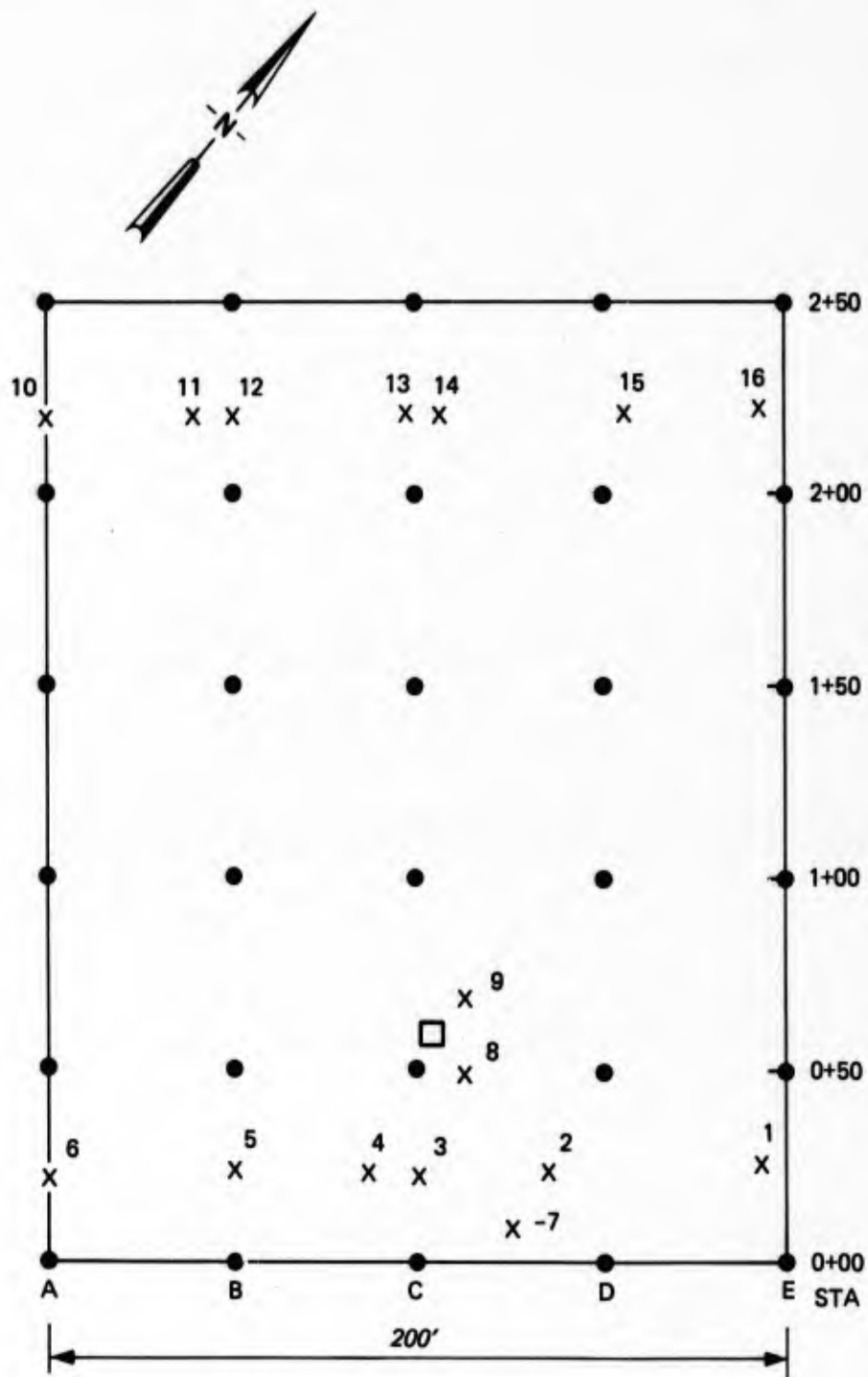


Figure 4. Test Area 3 showing test locations



**LEGEND**

- X TEST LOCATIONS
- 1980 TEST PIT

Figure 5. Test Area 4 showing test locations

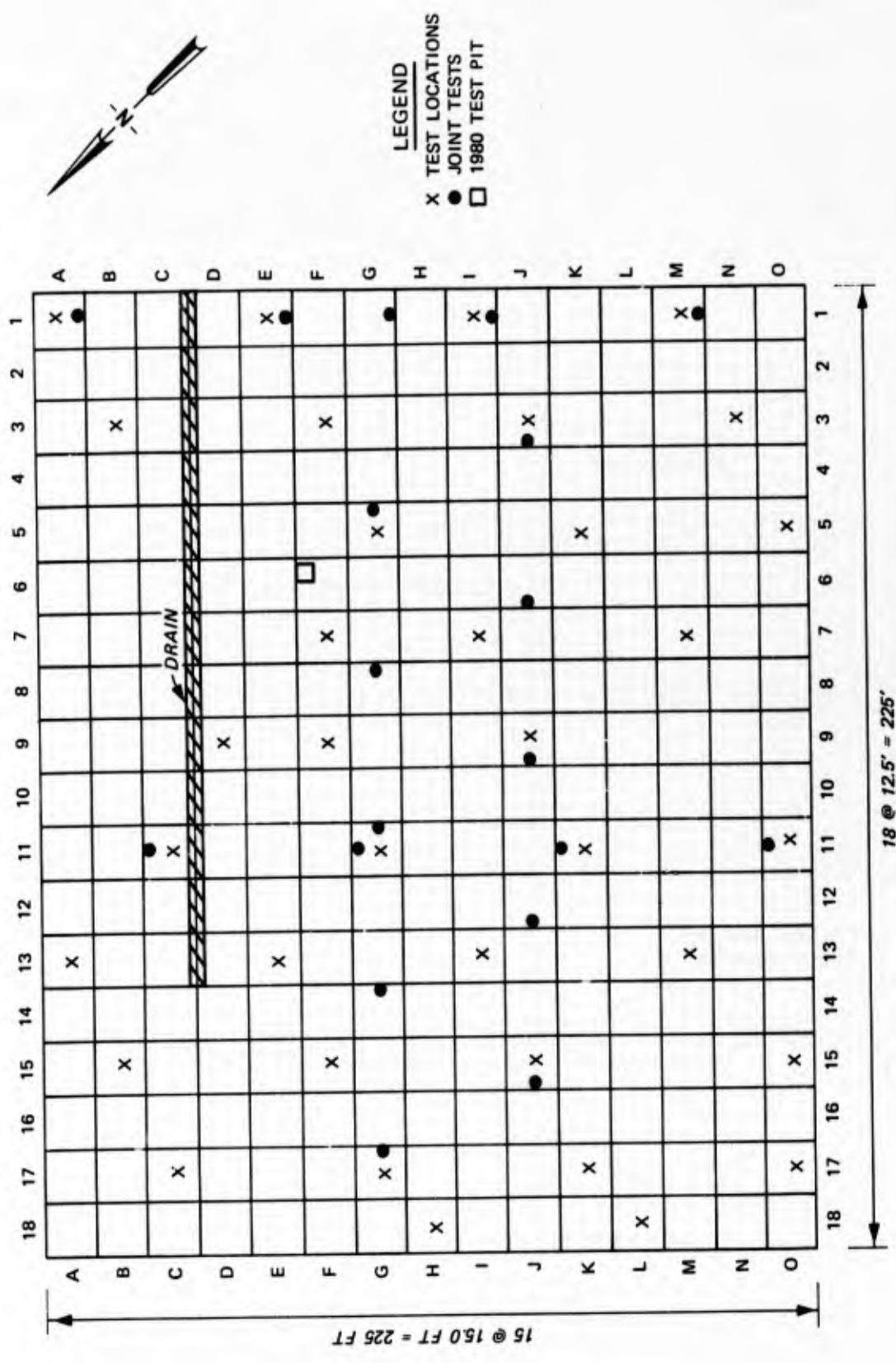


Figure 6. Test Area 5 showing test locations

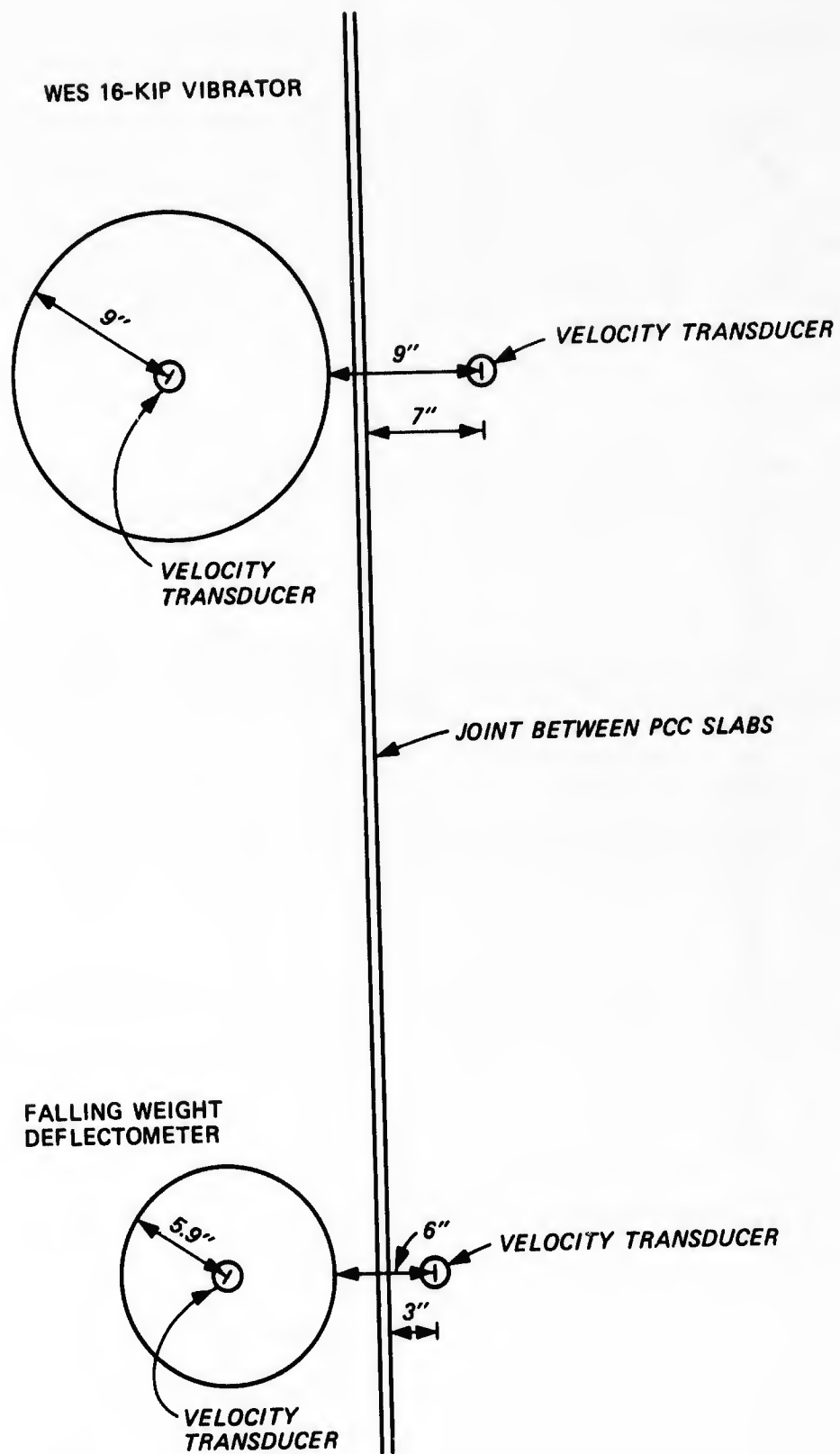


Figure 7. Set-up for joint deflection tests

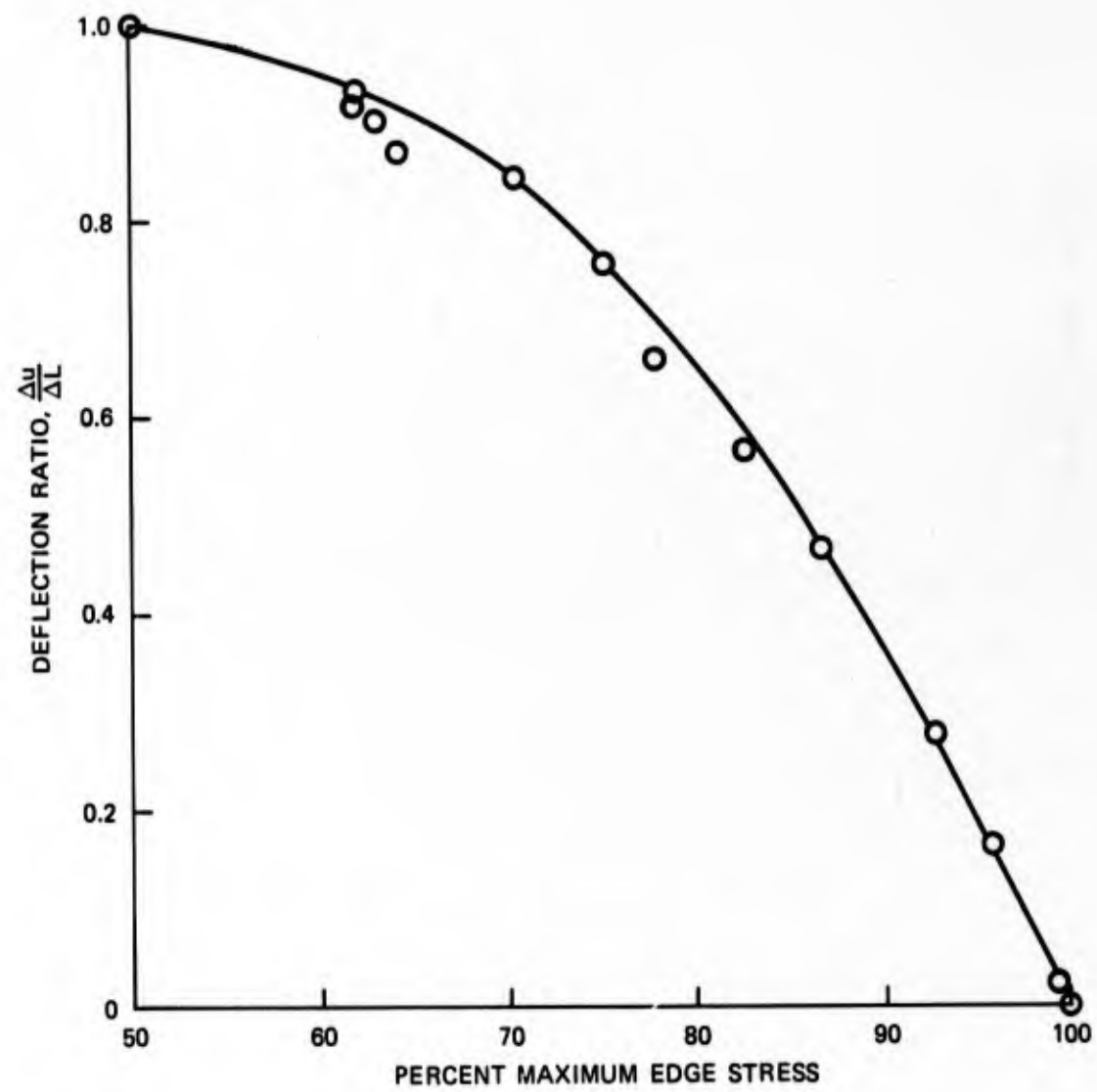


Figure 8. Relationship of deflection ratio and percent maximum edge stress

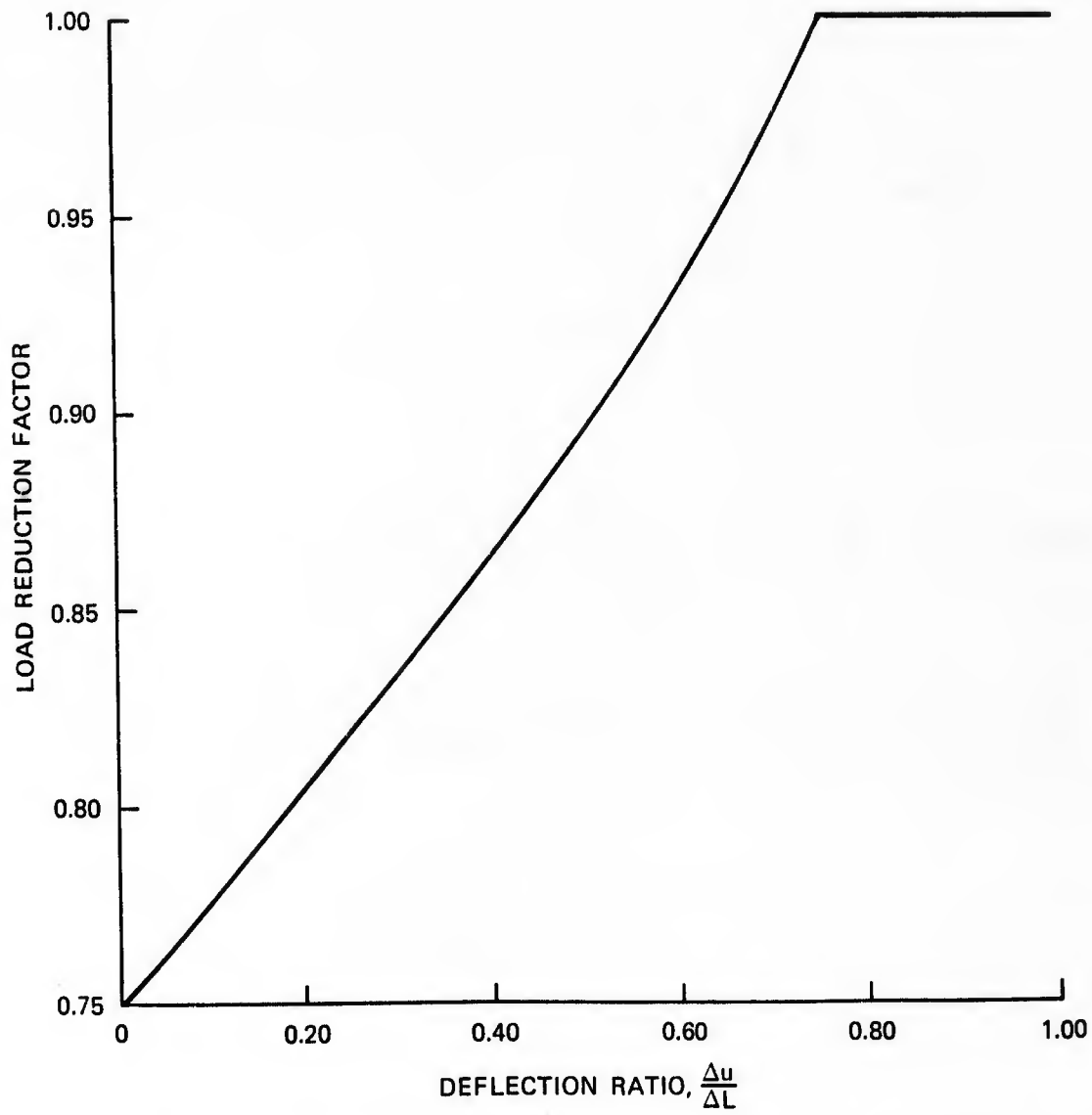


Figure 9. Load reduction factors for load transfer analysis