LATERAL LOAD BEHAVIOR OF DRILLED SHAFTS

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Soil Properties as Related to Load Transfer
Characteristics in Drilled Shafts

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PREFACE

This report is the tenth in a series of reports presenting results of Research Project 3-5-65-89, Soil Properties as Related to Load Transfer Characteristics in Drilled Shafts. It presents results of a study undertaken to find a method for predicting soil response for laterally loaded drilled shafts, especially in stiff clay. The response to short-term static loading and to repeated applications of load was studied. The results of an experimental program in stiff clays and a survey of the state-of-the-art for predicting response to lateral loads for other soils are given.

Acknowledgement of their efforts in completing this project is due to the staff of the Center for Highway Research, notably Hap Dalrymple, Olen Hudson, Fred Koch, and Jim Anagnos for their assistance in the field tests; Mark Toth for his careful and painstaking laboratory work; and Miss Cheryl Johnson and Mrs. Sue Penn for their work in keypunching and guiding the data reduction process. The project contact representatives from the Texas Highway Department, H. D. Butler and Horace Hoy, were helpful in coordinating and expediting the work. The financial assistance rendered by the Texas Highway Department and the U.S. Bureau of Public Roads is gratefully acknowledged.

Data obtained during the field tests is on file at the Center for Highway Research and available to interested parties.

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LIST OF REPORTS

Report No. 89-1, "Field Testing of Drilled Shafts to Develop Design Methods," by Lymon C. Reese and W. Ronald Hudson, describes the overall approach to the design of drilled shafts based on a series of field and laboratory investigations.

Report No. 89-2, "Measurements of Lateral Earth Pressure in Drilled Shafts," by Lymon C. Reese, J. Crozier Brown, and H. H. Dalrymple, describes the development and evaluation of pressure gages to measure lateral-earth pressures on the drilled shaft.

Report 89-3, "Studies of Shearing Resistance Between Cement Mortar and Soil," by John W. Chuang and Lymon C. Reese, describes the overall approach to the design of drilled shafts based on field and laboratory investigations.

Report No. 89-4, "The Nuclear Method of Soil-Moisture Determination at Depth," by Clarence J. Ehlers, Lymon C. Reese, and James N. Anagnos, describes the use of nuclear equipment for measuring the variations of moisture content at the drilled shaft test sites.

Report No. 89-5, "Load Distribution for a Drilled Shaft in Clay Shale," by Vasant N. Vijayvergiya, W. Ronald Hudson, and Lymon C. Reese, describes the development of instrumentation capable of measuring axial load distribution along a drilled shaft, the development, with the aid of full-scale load testing, of a technique of analysis of observed data, and the correlation of observed data with the Texas Highway Department cone penetration test.

Report No. 89-6, "Instrumentation for Measurement of Axial Load in Drilled Shafts," by Walter R. Barker and Lymon C. Reese, describes the development and performance of various instrumentation systems used to measure the axial load distribution in field tests of full-scale drilled shafts.

Report No. 89-7, "The Determination of Soil Properties In Situ," by David B. Campbell and W. Ronald Hudson, describes the use of the Menard Pressuremeter, the Texas Highway Department cone penetrometer, and The University of Texas in situ device in estimating soil properties in situ and estimating load transfer values obtained from drilled shaft tests.

Report No. 89-8, "Behavior of Axially Loaded Drilled Shafts in Beaumont Clay," by Michael W. O'Neill and Lymon C. Reese, describes the results of axial load tests of instrumented drilled shafts having varying geometry and differing methods of installation and presents a tentative design procedure for drilled shafts in Beaumont Clay.

Report No. 89-9, "Load Carrying Characteristics of Drilled Shafts Constructed with the Aid of Drilling Fluids," by Walter R. Barker and Lymon C. Reese, describes the construction, instrumentation, and testing of a drilled shaft constructed with the use of drilling mud.

Report No. 89-10, "Lateral Load Behavior of Drilled Shafts," by Robert C. Welch and Lymon C. Reese, describes the test procedures and results for lateral loading of an instrumented drilled shaft and presents criteria for developing design curves for drilled shafts in stiff clay.

ABSTRACT

Drilled shaft foundations, used extensively to support highway structures, are often subjected to both axial and lateral loads. To obtain a safe and economical design, the response of the soil to the applied loads must be known. In this study, currently available criteria for predicting the response of soft clays and sands to lateral loads are summarized and new criteria are developed for the lateral load response of stiff clays.

A full-scale instrumented shaft was subjected to repeated applications of lateral loads and the soil response was observed. Undisturbed samples of the soil at the test site were subjected to repetitive loading in laboratory triaxial compression tests. The results of the field test and the laboratory tests were correlated and a procedure for predicting the response of a stiff clay to short-term static loading or repeated loading was developed.

KEY WORDS: piles, bored piles, drilled shafts, soil mechanics, undrained shear tests, instrumentation, field tests, design criteria, lateral loading, p-y curves, cyclic loading.

SUMMARY

Research Report No. 89-10, the tenth in a series of reports issued for Research Project 3-5-65-89, describes methods for predicting the lateral deflection versus soil reaction relationship for laterally loaded drilled shafts in the most commonly encountered soil types. For clay soils, the methods cover short-term static loading and repeated loading, while only short-term static loading is considered for sands.

Emphasis is placed upon the behavior of laterally loaded drilled shafts in stiff clay. The methods presented for predicting the response of stiff clay are based upon a correlation of the results of a full-scale field test with the results of a laboratory testing program. For other soils the best methods currently available are summarized.

IMPLEMENTATION STATEMENT

The methods of predicting soil response to lateral loads presented in this report are believed to be the best currently available. These methods may be used to determine soil support data required as input for the various computer programs developed by Project 3-5-63-56 and Project 3-5-68-117.

The soil parameters required for the methods presented may be readily determined by standard testing procedures or, in the case of repeated loading, by modifications of standard procedures requiring no special apparatus. It is recommended that the methods presented for determining soil response to lateral loads be used whenever assessment of the lateral load capacity of a drilled shaft or pile foundation is required.

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CHAPTER I

INTRODUCTION

Recent years have seen the development and wide-spread acceptance of a foundation element commonly called a drilled shaft, bored pile, drilled-in pile, or other equally descriptive term. In this study, the term drilled shaft will be used. The feature which distinguishes drilled shafts from piles is the construction procedure. A drilled shaft is a reinforced concrete foundation element cast in a previously drilled hole in the ground while piles are driven and displace the soil as they penetrate. Drilled shafts may be constructed with enlarged bases with the view that most of the axial load will be carried in end-bearing, or they may be constructed with straight sides with the view that most of the axial load will be carried by "skin-friction." The construction sequence usually consists of drilling the hole, placing the reinforcement in the hole, and depositing the concrete. With construction equipment and methods currently in use, drilled shafts as small as 12 to 18 inches in diameter and as large as 10 to 15 feet in diameter may be successfully installed. The most commonly encountered sizes of drilled shafts have diameters in the range of 24 to 48 inches.

In highway construction, drilled shafts are used extensively for foundations of bridges, highway interchanges, and retaining structures. Large highway sign structures are often supported on drilled shafts.

In addition to the vertical loads resulting from the weight of the structure and the live load imposed by vehicles, most highway structures must resist some horizontal loading. These horizontal loads are derived from the action of wind, and in the case of bridges, from water current acting upon the structure and upon any debris which may have accumulated against the structure. Vehicle braking forces and centrifugal forces generated by vehicles traveling at speed on a curved section of an elevated structure are other sources of horizontal loading. Lateral earth pressures create horizontal loads on drilled shafts used to support retaining structures.

In order to design a structure that is both adequate and economical, the designer must have knowledge of the load-deformation properties of the supports. The stresses which the structure will generate in the foundation elements must also be determined. The behavior of drilled shaft foundations under axial load has been investigated by O'Neill and Reese (1971). The purpose of the study reported herein is to define the behavior of drilled shaft foundation elements under lateral load. The stresses occurring in the shaft as well as the load-deformation characteristics of the shaft are to be determined.

The method selected to accomplish the desired objective was to construct and test a full-scale foundation and to correlate the observed behavior with the available theory and with soil properties obtained from laboratory tests on undisturbed soil samples. A summary of the theory involved in the analysis of laterally loaded foundation elements is presented in the following chapter. The results of the laboratory tests and the field test are given in later chapters.

CHAPTER II

MECHANICS OF BEHAVIOR UNDER LATERAL LOAD

The analysis of a foundation element such as a drilled shaft or a pile under lateral load falls into the general category of beams-on-foundation. The problem of elastic beams on elastic foundations has been studied for many years with the result that solutions are available for many cases. A complete solution of a beam-on-foundation problem would yield values of deflection, slope, moment, shear, and soil reaction at all points along the beam.

Winkler Assumption

Usually the problem is approached by considering the foundation soil as a continuous, isotropic, elastic continuum or by making the assumption attributed to Winkler (1867) that:

1. The soil acts as a series of closely spaced discrete springs.

Use of the Winkler assumption implies:

2. There is no coupling of adjacent soil elements,

3. The soil deforms only under the loaded area.

Hetenyi (1946) states that Winkler's assumption often represents actual conditions better than more complicated analyses based upon the treatment of the foundation as a continuous isotropic continuum. Vesic (1961) compared solutions using the Winkler assumption with those obtained for an isotropic elastic solid. His study shows that the difference is quite small (on the order of five per cent or less) except for short relatively rigid foundation elements. For an infinitely rigid element, the difference is slightly less than 15 per cent. In the discussion which follows, the solution using Winkler springs will be assumed valid.

Basic Equations

In considering a beam-on-foundation problem, the solution is obtained by using the basic differential equation describing the deflection curve of a bent beam. This equation,

$$\frac{d^2y}{dx^2} = \frac{M}{EI} \quad \text{(2.1)}$$

and its derivation may be found in practically any text on strength of materials. Other relationships, derived from this basic differential equation, which are applicable to beam-on-foundation problems are given below.

$$\theta = \frac{dy}{dx} \quad \text{(2.2)}$$

$$M = EI\,\frac{d\theta}{dx} = EI\,\frac{d^2y}{dx^2} \quad \text{(2.3)}$$

$$V = \frac{dM}{dx} \quad \text{(2.4)}$$

$$p = \frac{dV}{dx} = \frac{d^2M}{dx^2} \quad \text{(2.5)}$$

$$E_s = -\frac{p}{y} \quad \text{(2.6)}$$

$$\phi = \frac{d^2y}{dx^2} = \frac{M}{EI} \quad \text{(2.7)}$$

The notation (with typical units shown) used in these equations is as follows:

E = modulus of elasticity of the beam (lb/in.^{2}).

I = moment of inertia of the beam (in.^{4}).

k = modulus of subgrade reaction (lb/in.^{3}).

b = width of the beam (in.).

x = distance along the axis of the beam (in.).

y = deflection of the beam perpendicular to the axis (in.).

θ = slope of the beam (radians).

M = moment in the beam (in-lb.).

V = shear in the beam (lbs).

p = reaction against the beam (lb/in.).

E_s = modulus of soil reaction (lb/in.^{2}).

ϕ = curvature of the beam (1/in.).

Modulus of Soil Reaction

The modulus of soil reaction, E_s, as defined by Eq. 2.6, represents the stiffness of the support springs. It would be the spring constant if the springs were spaced a unit distance apart. That is, if the units of E_s were lb/in.^{2}, E_s would be the stiffness of springs spaced one inch apart along the beam. If the modulus of subgrade reaction, k, is known, E_s can be determined from the following relationship:

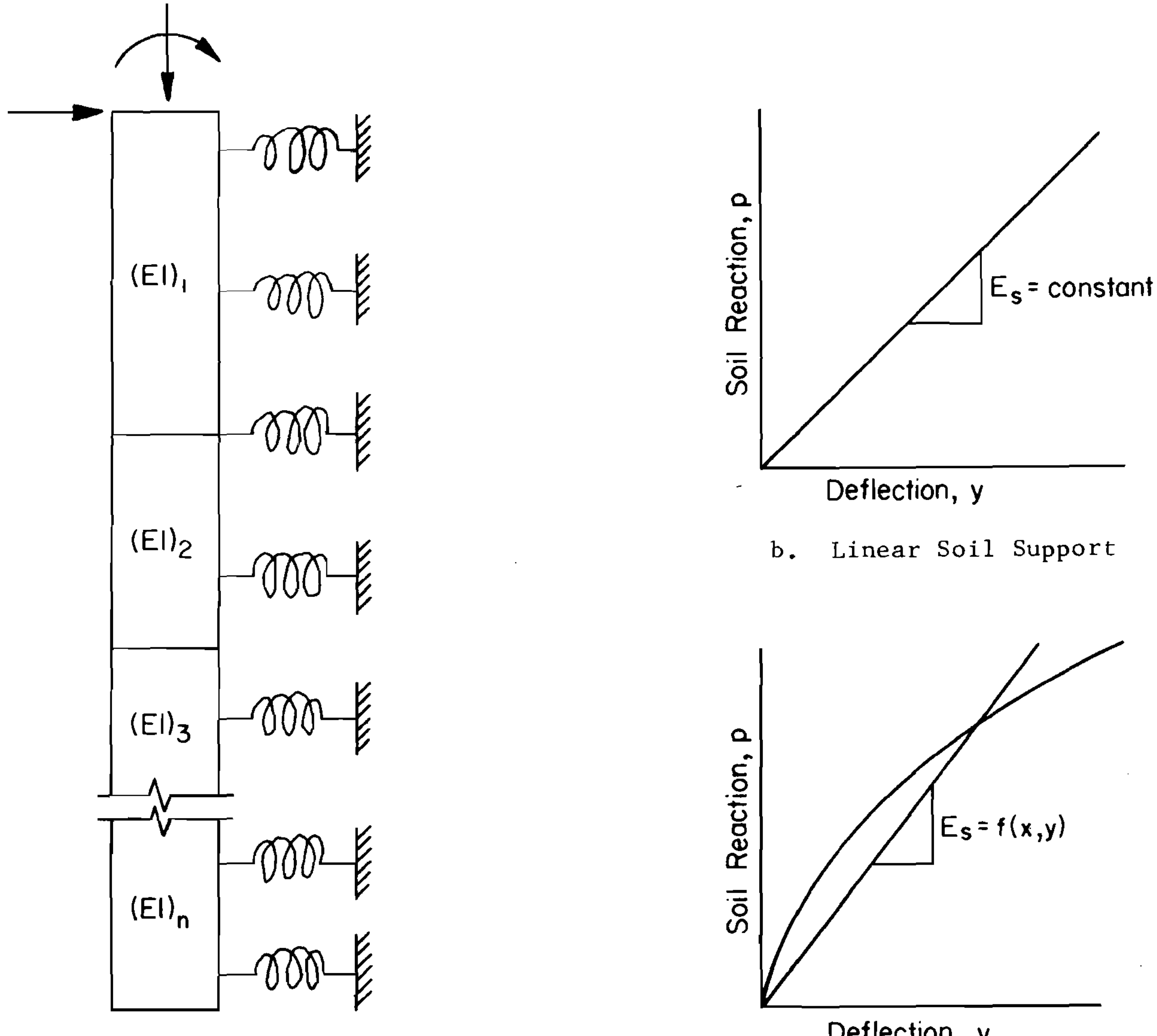
$$E_s = kb \quad \ldots\ldots\ldots (2.8)$$

Solution of Elastic Systems

For elastic beams on elastic supports, several solutions are presented by Hetenyi (1946). The solutions consider various loading conditions, variation of beam stiffness along the axis, variation of support stiffness along the beam axis, and a varied series of support conditions. Most of the solutions, other than those with a constant beam stiffness and a constant or linear variation of E_s along the beam, are rather complicated and tedious. Approximate solutions, using finite difference techniques such as those given by Palmer and Thompson (1948) and Gleser (1953), are easily handled by electronic computers and can be refined to any degree of accuracy that may be required. Such methods are in general use for the solution of beam-on-foundation problems.

Nonlinear Systems

In the actual case of a beam on soil or a laterally loaded drilled shaft or pile, the soil response is usually nonlinear. The value of the modulus of soil reaction, E_s , may vary with deflection as well as with distance along the axis of the foundation element. Reese and Matlock (1960) extended the finite difference solution technique to solve the problem of a laterally loaded pile with any arbitrary variation with depth of pile stiffness or modulus of soil reaction. Their solution requires repeated application of elastic theory with values of the modulus of soil reaction, E_s , adjusted until the values of soil reaction, p , and deflection, y , obtained in the solution are compatible with the actual pressure-deflection properties of the soil. A sketch of a laterally loaded foundation element and a typical p-y curve are shown in Fig. 2.1.



a. Laterally Loaded Pile

c. Nonlinear Soil Support

Fig. 2.1 Representation of a Laterally Loaded Foundation Element

Combined Axial and Lateral Loading

In most cases the primary loading on drilled shafts or piles is an axial load. There is, of course, an interaction between the effects of horizontal and vertical loading on the drilled shaft. The application of a horizontal load or a moment reduces the axial stiffness of the element. The flexural stiffness is reduced by axial compression and increased by axial tension. The basic fourth-order differential equation, extended to include the effects of a constant axial force, P , is:

$$EI \frac{d^4y}{dx^4} + P \frac{d^2y}{dx^2} - p = 0 \quad \text{. (2.9)}$$

The derivation and solution of this equation are given by Hetenyi (1946). Except for the case of a shaft or pile penetrating a very soft stratum and deriving all of its capacity from an underlying dense sand or rock stratum, the axial force will not be constant along the length of the shaft. If the distribution of axial load along the shaft is known, a solution can be obtained by considering the shaft as a series of segments, each with a constant axial load.

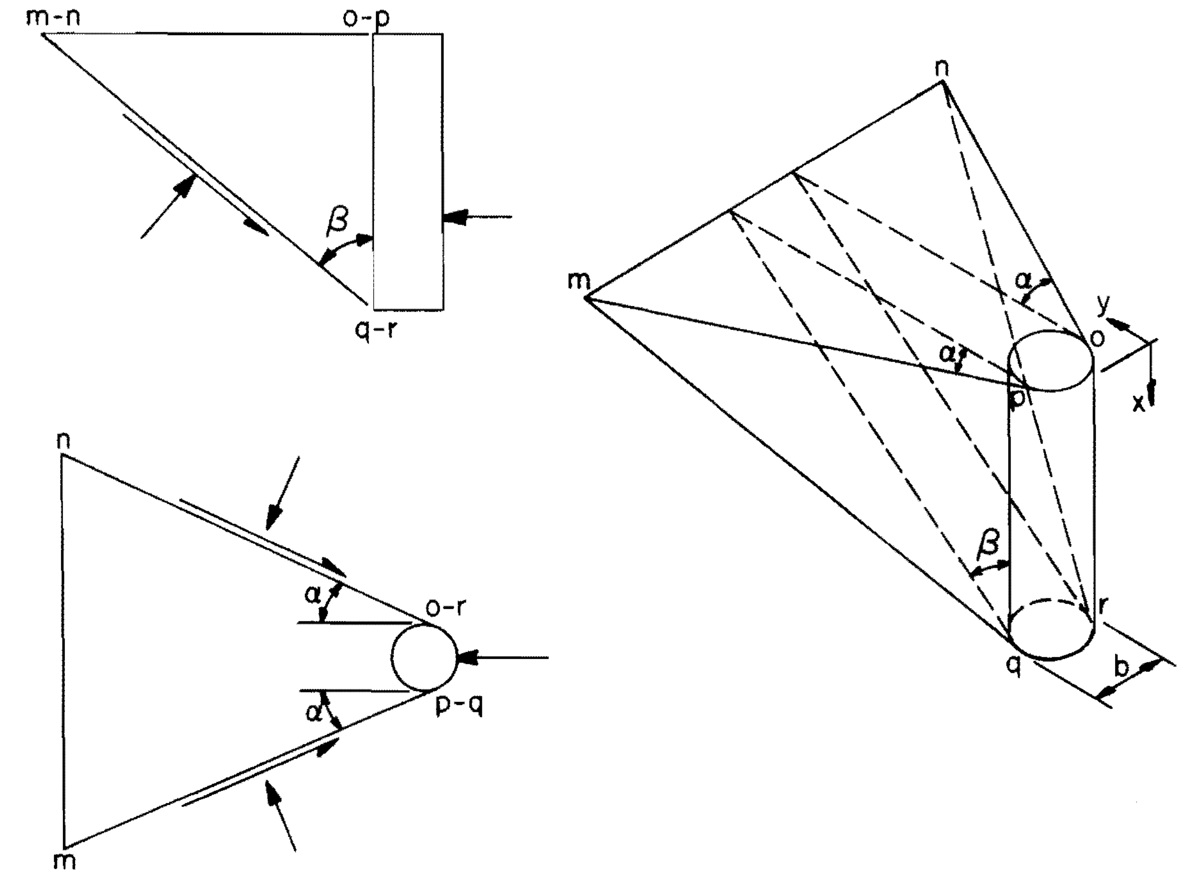
The p-y Relationship

It should be emphasized at this point that the soil response to lateral load, defined by the p-y relationship, is dependent upon many variables such as soil type, shear strength parameters, moisture conditions, effective stress, stress history, and loading conditions. The p-y curves will be different for short term static loading, sustained loading, cyclic loading, and dynamic loading. One of the purposes of this study is to present a method of determining p-y curves for repeated application of short-term static loads in stiff clay. Other investigators have dealt with soft clay and sand. Their results will be discussed in later chapters.

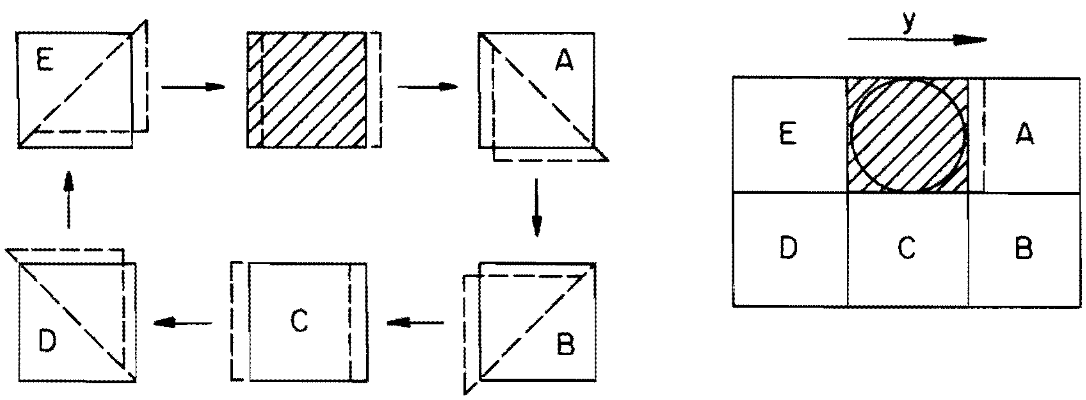
The difference between the analyses of a horizontal beam-on-foundation and a laterally loaded drilled shaft or pile lies primarily in the determination of the maximum resistance of the soil. The maximum resistance of horizontal beams-on-foundation may be determined by applying conventional bearing capacity theory. To determine the maximum soil resistance for the laterally loaded pile or drilled shaft, the mode of failure must first be considered. Near the surface, the mode of failure will be that of a passive wedge of soil moving upward and outward, while at greater depths the soil will fail by flowing around the shaft. Reese (1958, 1962) has described the modes of failure shown in Fig. 2.2 for both cohesive and cohesionless soils. Since the actual modes of failure may not correspond to those assumed, the resulting expressions should be considered as approximations to be modified by the results of experiments.

The depth of transition from the wedge to the flow-around failure is determined by the effective unit weight and shear strength of the soil and by the shaft width. Reese (1958) developed the expression given below for the maximum resistance of a passive wedge in cohesive soil. (For cohesive soil it is assumed that $\alpha = 0°$ and $\beta = 45°$.)

$$p_u = \left[3 + \frac{\gamma x}{c} + 2.83 \frac{x}{b} \right] cb \quad \ldots\ldots\ldots (2.10)$$



a. Wedge Failure (After Reese, 1962).



b. Flow-Around Failure (after Reese, 1958).

Fig. 2.2 Modes of Soil Failure

Matlock (1970) reports some field tests which indicate that the factor 2.83 in the above expression should be on the order of 0.25 to 0.5 for soft clays. He recommends a value of 0.5 for use with offshore clays in the Gulf of Mexico. No values have been reported for stiff clays.

At great depths, the bearing capacity factor for deep footings in clay developed by Skempton (1951) is applicable. The expression for maximum resistance in the flow-around mode is as follows:

$$p_u = 9\ cb \quad \ldots\ldots (2.11)$$

By equating the values of p_u in equations 2.10 and 2.11 and solving for x , the depth of transition from the passive wedge to the flow-around mode may be found.

In cohesionless soils, the maximum resistance of the passive wedge has been given by Reese (1962) as:

$$p_u = \gamma\ x \left[b\ (K_P - K_A) + x\ K_P\ (\tan \alpha \tan \beta) + x\ K \tan \beta\ (\tan \phi - \tan \alpha) \right] \ldots (2.12)$$

where

K_P = passive earth pressure coefficient,

K_A = active earth pressure coefficient, and

K = earth pressure coefficient for sides of wedge.

From Mohr-Coulomb theory the angle $\beta = 45° + \phi/2$ is known. Values of K and α are suggested by Bowman (1958) and Parker and Reese (1971).

The ultimate resistance at depths where flow-around failure occurs is given by Parker and Reese (1971).

$$p_u = \gamma b x (K_P^3 + 2 K_P^2 K \tan \phi + 2 K \tan \phi - K_A) \quad \ldots\ldots \quad (2.13)$$

The transition from wedge failure to flow-around will occur when the resistance to flow-around is less than the force required to move the wedge.

The problem which now remains is to define the pressure-deflection or p-y relationship. This can be done by (1) measuring or calculating values of soil pressure and deflection from the results of instrumented field tests, (2) assuming a correlation with stress-strain properties measured in the laboratory, or (3) assuming a characteristic shape for the pressure-deflection curve. McClelland and Focht (1958) developed a method for predicting p-y curves from the results of laboratory compression tests. Matlock (1970) and Parker and Reese (1971) assume a characteristic shape and present criteria for determining p-y curves. Detailed procedures for determining p-y curves, representing the current state-of-the-art, will be presented in a later chapter.

Difference in Behavior of Drilled Shafts and Driven Piles

Any difference in behavior between drilled shafts and driven piles will be due primarily to the influence of the method of construction. The driving of displacement piles in cohesive soils is accompanied by a disturbance of the surrounding soil and a subsequent consolidation under the pressures created by the displacement of the adjacent soil. The amount of disturbance and displacement are sometimes reduced by drilling a pilot hole slightly smaller than the pile and a few feet shorter than the proposed tip depth. The net effect of pile-driving operations upon the soil properties of the clay. In highly sensitive clays, the net effect may be a loss of strength whereas in relatively insensitive clays a slight strength gain may be experienced.

During the construction of drilled shafts the soil adjacent to the shaft experiences a release of stress during the excavation and reapplication of stress as the wet concrete is placed. The drilling of the hole produces some disturbance of the soil adjacent to the shaft. The effect of the release of stress upon soil strength will depend upon the length of time the hole is allowed to stand open before the concrete is deposited. After the concrete is placed, there may be some migration of cement or cement paste into the soil immediately adjacent to the shaft which would tend to increase the strength in this area. This migration is believed to be quite limited and would probably have no effect upon the lateral response of a drilled shaft.

Intuitively, it seems that the behavior of drilled shafts and driven piling in most clay soils would be essentially the same. In sand, however, the densification of the sand caused by vibration and displacement during pile driving would probably result in a stiffer response for driven piles than for drilled shafts.

CHAPTER III

DESIGN OR ANALYSIS METHODS CURRENTLY AVAILABLE

Traditionally, horizontal loads on pile-supported structures have been resisted by the horizontal component of the axial resistance of batter piles. In some cases, however, it is not possible or practical to use batter piles, thus requiring that the lateral resistance of vertical piles be estimated. Some of the methods used to determine lateral resistance will be briefly presented in this chapter.

Prescription Values

Feagin (1937), McNulty (1956), Teng (1962), and various building codes give allowable lateral loads on vertical piles. Some of these values are shown in Table 3.1.

Load Tests

Most building codes provide for greater allowable lateral loads than the prescription values if load tests are performed. The New York City Building Code specifies a maximum lateral displacement of 3/8 in. under the design lateral load. The Los Angeles code will allow one-half of the lateral load which causes 1/2 in. displacement with 75 percent recovery. Other authorities have essentially similar requirements.

Point-of-Fixity Method

A long flexible pile subjected to lateral load will at some point below the ground surface remain essentially straight. The pile could

TABLE 3.1 ALLOWABLE LATERAL LOADS ON VERTICAL PILES

Pile Type	Allowable Lateral Load per Pile, tons			Reference
All	2.0			New York City Building Code (1968)
Timber	Max. Displacement = 1/4" 4.0 (cyclic) 4.5 (sustained) Max. Displacement = 1/2" 6.5 (cyclic) 7.0 (sustained)			Feagin (1937)
All	0.5 (Soft Silts or Clays)			Teng (1962)
	Med. Sand	Fine Sand	Med. Clay	McNulty (1956)
Timber (12" dia., free-end)	0.75	0.75	0.75	
Timber (12" dia., fixed-end)	2.50	2.25	2.00	
Concrete (16" dia., free-end)	3.50	2.75	2.50	
Concrete (16" dia., fixed-end)	3.50	2.75	2.50	

be considered fixed at this point. If the pile and soil support are assumed to be elastic, the depth to this point, called the point-of-fixity, is dependent upon soil stiffness, pile stiffness, rotational restraint at the top of the pile, and type of loading, whether shear or moment. Cummings (1937) gives an equation for determining the point-of-fixity for a pile with zero slope at the top, i.e., a fixed head pile. Kocsis (1968) has summarized the relationships for determining the depths to fixity for three boundary conditions and two modes of soil modulus variation. The soil modulus is assumed to vary linearly with depth (sand) or to be constant with depth (stiff clay). For these cases, Kocsis has considered the boundary conditions of fixed-head, applied shear; free-head, applied shear; and free-head, applied moment. The principle of superposition is applied to determine the final values of deflection, rotation, moment, shear, and soil pressure.

Elastic Beam-on-Foundation Solution

Hetenyi (1946) has published a very comprehensive treatment of closed-form solutions for elastic beams on elastic foundations. He considers the cases of constant soil modulus and linear variation of soil modulus. Solutions are presented for constant beam stiffness, and also for step-wise variation, and continuous variation of beam stiffness. Many different end support and loading conditions are considered. The Winkler assumption is used for the great majority of solutions given.

Difference Equation Solution

To obtain a solution by the use of difference equations, the member is divided into a finite number of equally spaced intervals. The basic differential equation, expressed in difference form, may be written for each point. Known boundary conditions, also expressed in difference form, allow the resulting system of simultaneous equations to be solved. Palmer and Thompson (1948) and Palmer and Brown (1954) have presented this method in detail. The recursive solution method proposed by Gleser (1953) is an efficient means of obtaining a solution of the difference equations. Focht and McClelland (1955) have proposed a modification of the Gleser method and have presented examples of its application to laterally loaded pile problems.

Non-Dimensional Coefficients

Matlock and Reese (1960) have developed a procedure which will give a quick and easy solution if the variation of soil modulus with depth is known or can be estimated. Several sets of influence coefficients are given for a soil modulus variation described by a power function ($E_x = kx^n$) and for a polynomial variation ($E_x = k_o + k_1x + k_2x^2 \ldots$). The influence coefficients may be used to obtain a complete solution of a laterally loaded pile. These coefficients could be used to solve a problem with nonlinear soil response by adjusting the constant(s) describing the soil modulus variation or by changing the form of the variation until the solution obtained is compatible with the actual soil response.

Discrete Element Solution

The discrete element formulation of a solution of the beam-column problem, as developed by Matlock and others, is somewhat different from the conventional approach to the problem. The conventional approach is usually to state the problem as exactly as possible, and obtain approximate answers when an exact solution is not possible or practical. The discrete element approach is to construct a model, using mechanisms that can be exactly described, which will approximate, as closely as possible, the actual problem. Thus an exact solution of an approximate model is obtained rather than the conventional approximate solution of an exact model. A large number of simultaneous equations are usually generated in a discrete element solution and a digital computer is required for solution of most practical problems.

A discrete element solution of the beam-column problem has been developed by Matlock, Abdel-Raouf, and Panak (in progress) which will handle nonlinear soil response to both axial and lateral loads and nonlinear bending of the beam-column. The soil properties and the beam-column properties may vary in any arbitrary manner along the axis of the member.

CHAPTER IV

PREVIOUS FIELD STUDIES

The most reliable means of developing information on soil-structure interaction is a full-scale instrumented test. The expense and time consumed in performing such tests make them relatively rare. Some of the tests previsouly performed are categorized by general soil type and listed below.

Soft Clay

McCammon and Ascherman (1953) tested concrete encased hollow steel cylinders with a 54-inch outside diameter and a 5-inch wall thickness in a very soft clay. A two pile bent and a single pile were tested under lateral load only. Index properties of the soil and penetration of the piles under static vertical loads were also given.

McClelland and Focht (1958) report the results of static and dynamic lateral load tests of an instrumented 24-inch diameter steel pipe pile in the very soft offshore clays of the Gulf of Mexico. Using these field test results and the results of laboratory compression tests of undisturbed soil samples, they developed a procedure for predicting p-y curves using laboratory test results.

The results of two field tests in soft clay are reported by Matlock (1970). He presents methods for predicting p-y curves for static loading, cyclic loading, and reloading with a force less than the previous maximum force. The variation of shear strength with depth and the strain at one-half of the ultimate principal stress difference (in a laboratory compression test) must be known or assumed.

Stiff Clay

Two pile groups each consisting of three vertical timber piles were tested by McNulty (1956). These piles were not instrumented and the reported soil data consisted of standard penetration resistance values and driving records of the piles.

Osterberg (1958) reported tests on instrumented poles placed in predrilled holes in a stiff to very stiff clay. The poles were very rigid and the space between the pole and the side of the predrilled hole was filled with compacted sand.

Sand

The lateral load tests of timber and precast concrete piles reported by Feagin (1937) are among the earliest tests found in the literature. Tests of free-head single piles and of groups of 4, 12, and 20 piles (fixed-head) driven in Mississippi River sand were performed. Soil data consisted of sieve analyses and driving records of the piles. Based upon an analysis of these test results, Feagin gives prescription values of allowable lateral load.

Lateral load tests of cast-in-place concrete piles in a medium dense silty sand are reported by McNulty (1956). The piles were not instrumented and the reported soil data consisted of standard penetration resistance data and driving records of the piles.

Davisson and Salley (1968) report a series of static and cyclic loading tests on four-foot diameter drilled shafts extending through a medium dense sand to rock. Strains in the reinforcing steel were measured and soil data in the form of standard penetration resistance are given.

A comprehensive series of tests of several types of piles under lateral load are reported by Alizadeh and Davisson (1970). Six of the piles were instrumented to measure bending strains. The effects of batter, repetitive loading, and method of installation are considered. A relatively complete description of soil conditions at the test site is given by Mansur and Hunter (1970).

Parker and Reese (1971) report test results for two-inch diameter instrumented steel pipe piles in a dense sand. The test program included both vertical and batter piles. A complete description of soil properties is given. A procedure is presented for predicting p-y curves based upon a knowledge of soil properties.

Layered Systems

Alizadeh (1968) has presented results of tests on instrumented timber piles in a rather heterogeneous soil deposit consisting of layers of sand and gravel, clay, and silt. Most of the soils had relatively low values of shear strength.

CHAPTER V

SCOPE OF THIS STUDY

In view of the lack of published information on the response of stiff clays to lateral loading, the present study was initiated. The purposes of this study are listed below.

1. Develop an instrumentation system capable of producing reasonably accurate values of soil reaction and shaft deflection.

2. Determine the response of stiff clay to lateral load by constructing and testing a full-scale instrumented shaft.

3. Correlate the results of the field test with the results of laboratory tests on undisturbed soil samples.

4. Present workable methods of predicting soil response for use with currently available methods of analyzing drilled shafts or piles.

The objectives of this study were accomplished and each will be discussed in later chapters.

CHAPTER VI

FIELD TEST ARRANGEMENT

The site selected for the field test was located in Houston, Texas, near the intersection of State Highway 225 and Old South Loop East. The presence of a relatively deep uniform deposit of Beaumont Clay, a stiff, overconsolidated, fissured clay present throughout much of the Texas Gulf Coastal Plain, was a primary influence in the selection of this site. Also, this site was previously used by O'Neill and Reese (1971) for axial load transfer tests and the soil properties were well known.

Soil Conditions

The soil profile at the site consists of 28 feet of stiff to very stiff red clay, two feet of interspersed silt and clay layers and very stiff tan silty clay to a depth of 42 feet. At the time of the field test, the water table was at a depth of 18 feet. The soil profile showing the variation of shear strength and moisture content with depth is given in Fig. 6.1. The average shear strength in the upper 20 feet is approximately 2,200 pounds per square foot.

Beaumont Clay is an active clay, the principal clay mineral being calcium montmorillonite. Typical values of Atterberg limits are a liquid limit of 70 and a plastic limit of 20. The clay has been preconsolidated primarily by desiccation. The fissures in the clay occur in a random manner and many are slickensided but there is a tendency for the slickensided surfaces to occur at an angle of 45 degrees with the horizontal and to be spaced about six to eight inches apart vertically.

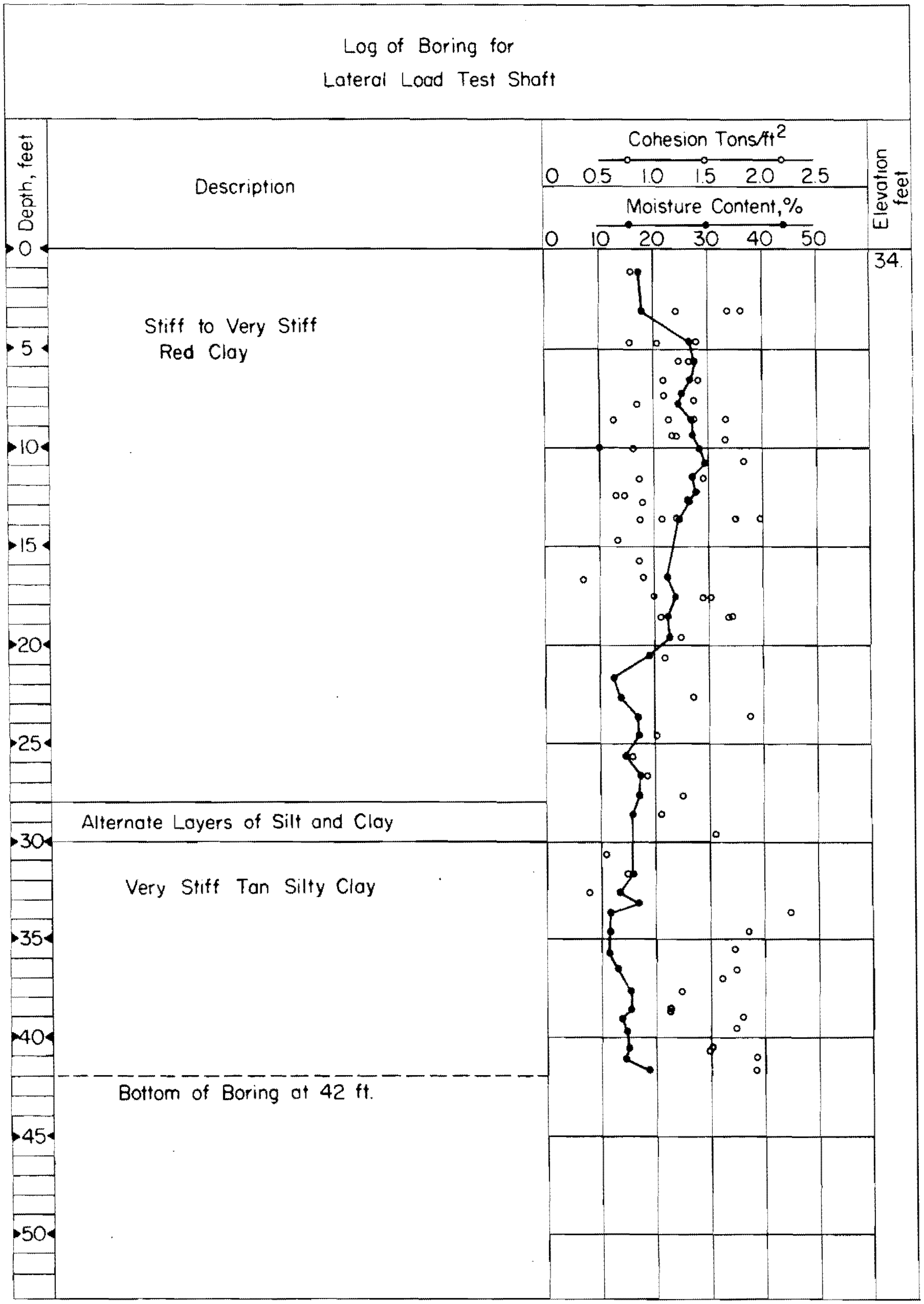


Fig. 6.1 Log of Boring

The soil properties will be presented in greater detail in the chapter on laboratory test results.

Shaft Configuration

It was considered desirable to test a full-sized shaft so that there would be no question regarding the effect of scale on the results. Most drilled shafts have a diameter in the range of 24 to 48 inches; a diameter of 30 inches was selected for the test shaft. Because the soil was a stiff clay, a large lateral load would be required to approach the failure stress in the near surface soil. To resist the bending stresses created by such a large lateral load, heavy reinforcing would be required. To determine the amount of reinforcing required and to estimate the range of deflection and slope, the soil response was estimated and a solution was obtained using the discrete element program developed by Matlock, Abdel-Raouf, and Panak (in progress). The estimated maximum moment would require approximately six percent steel if the AASHO criteria were used. Twenty 14-S deformed bars on a 24-inch diameter circle (through the center of the bars) restrained by one-half inch smooth spiral reinforcing spaced at six inches comprised the reinforcing selected for the test shaft.

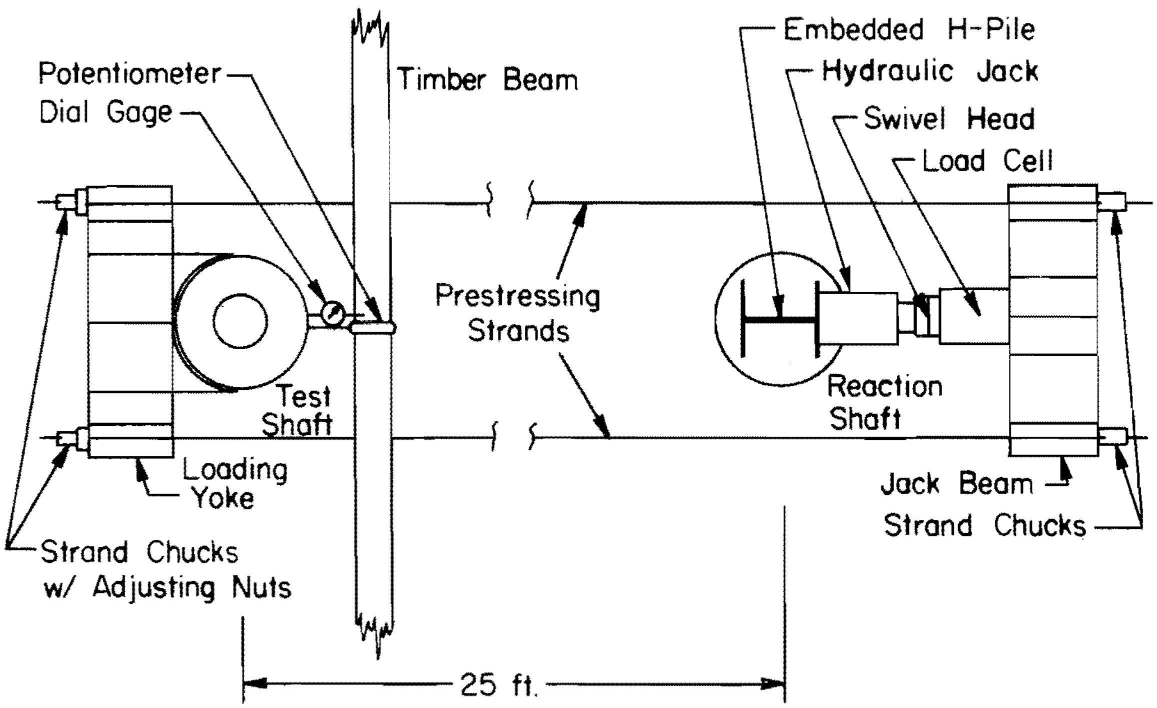
A design depth of 42 feet was selected so that the shaft would behave as a flexible member rather than as a rigid body. To facilitate the application of load, the shaft was extended two feet above the ground surface making the total length 44 feet.

Instrumentation

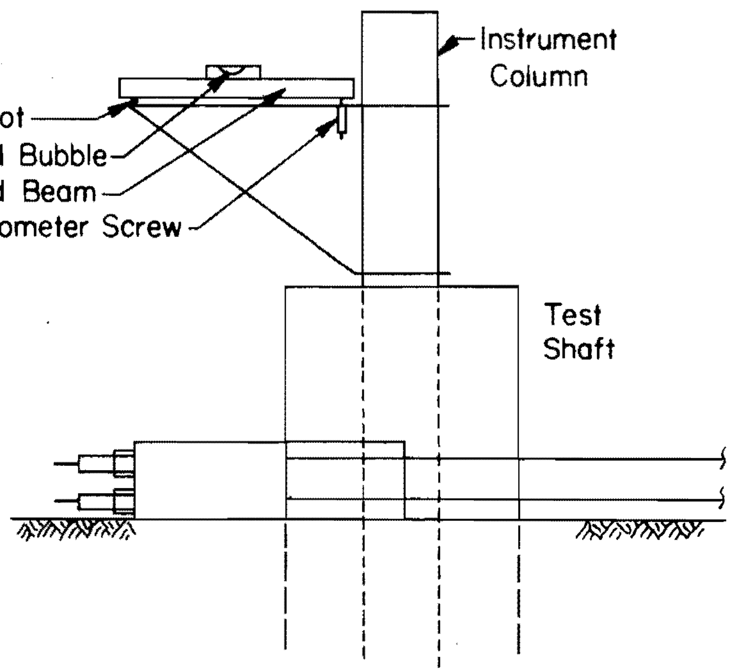
The quantities to be measured during the test were applied load, top deflection, top slope, and bending strains throughout the length of the shaft. The methods used for obtaining the measurements are discussed in this section. The overall test arrangement is shown in Fig. 6.2.

Two systems were provided to measure applied load. Since the load was to be applied with a hydraulic jack, a pressure transducer measuring the fluid pressure in the hydraulic system would indicate the applied load. The friction of the ram passing through the packing in the head of the jack is unknown and the applied load versus hydraulic pressure relationship must be determined by calibration tests. The logistical arrangements for the test did not permit laboratory calibration of the jack. For this reason, a strain-gage load cell was included in the loading system. The load cell provided the primary indication of applied load and during the progress of the test provided calibration data for the jack. The pressure transducer proved to be more sensitive to small changes in load than the load cell. The pressure transducer readings were correlated with strain gage load cell readings by means of a linear least-squares curve fit and were used as the best measure of applied load.

To measure the deflection of the top of the shaft, a dial gage (two inch travel), a linear potentiometer (six-inch travel) and a piano wire and machinist scale were provided. The wire and scale served only as a redundant system and since there was no trouble with the other systems it was not used. The dial gage and potentiometer were mounted on a wooden beam which was supported on stakes placed ten feet either side of the centerline of the shaft. Both devices had essentially the same sensitivity, and the deflection was taken as the average of the two readings.



a. Plan View



b. Side View

Fig. 6.2 Test Arrangement

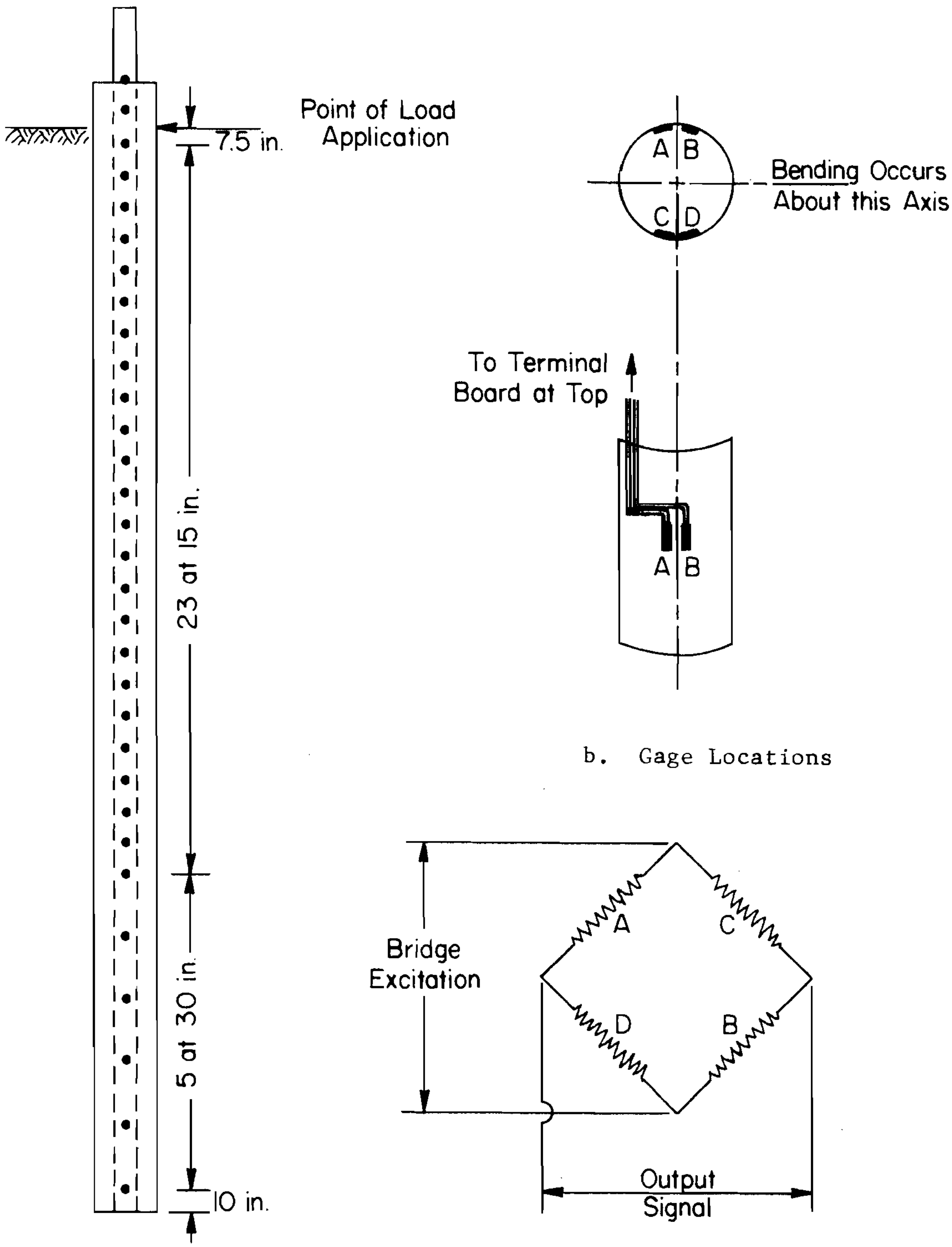
The slope of the top of the shaft was measured by a specially constructed slope-measuring device. The essential features of this device are a sensitive level bubble, a rigid beam 30 inches long, a micrometer screw, and a frame to support the beam and micrometer screw. The beam is supported by a pivot point on one end and by the micrometer screw on the other. The beam carries the level bubble and is adjusted to be level prior to load application. As the shaft deflects, the beam is maintained in a level position by adjusting the micrometer screw. The slope can be easily calculated by knowing the travel of the micrometer screw and the length of the beam.

To measure bending strains, two methods were considered, both involving the use of electrical strain gages. The first scheme involved the application of strain gages to the reinforcing bars. The difficulty in waterproofing the gages, protecting them from mechanical damage during the deposition of concrete and in interpreting the results when gages were in the vicinity of a flexural crack in the concrete led to the abandonment of this scheme. The second scheme, which was adopted, used an instrument column located in the center of the shaft to carry the strain gages for measurement of bending strains. The instrument column was a steel pipe 10 3/4 inches in outside diameter with a wall thickness of 1/4 inch. The outside diameter was the maximum that could be placed inside the reinforcing cage with enough room left for a tremie. The wall thickness was selected such that the flexural stiffness of the instrument column would be essentially equivalent to the flexural stiffness of the concrete it replaced. It was believed that, although some stress concentration would undoubtedly occur in the vicinity of flexural cracks, the increase in strain would not be nearly as great as the increase in strain shown by gages mounted on the reinforcing bars.

The spacing of the strain gages was arbitrarily set at 15 inches (one-half the shaft diameter) for the top two-thirds of the shaft and at 30 inches in the bottom one-third. (The gages were Micro-Measurements Type EA-06-250BG-120, Option B76, 120 vhm, gage length = .250 in., gage factor = 2.095.) To install the gages, the instrument column was split longitudinally by a trolley-mounted, self-propelled oxy-acetylene cutting torch. A very smooth cut was obtained and no more than one-sixteenth of an inch of metal was lost for each cut. The gage locations were marked and the inside surface of the pipe was thoroughly cleaned at each location. Two strain gages, with their axes parallel to the axis of the pipe, were mounted on each half of the pipe at each gage level. Lead wires were attached and the gages were waterproofed and covered with a neoprene pad for mechanical protection. The lead wires from each gage were carried to a terminal board at the top end of the pipe. The two halves of the pipe were welded back together and the bottom closed by welding on a steel plate. Provision was made for bolting on a steel plate and gasket at the top thus providing an airtight chamber containing the strain gages and terminal board. At the terminal board, the four gages at each level were connected in a full-bridge circuit arranged to give the maximum sensitivity to bending. The gage locations and arrangement are shown in Fig. 6.3.

Construction of the Test Shaft

Except for the inclusion of the instrument column, the construction procedure was the same procedure generally used for drilled shafts in



a. Gage Levels

b. Gage Locations

c. Bridge Circuit

Fig. 6.3 Gage Locations and Circuits

stiff clay. The steps in the construction of the shaft were (1) excavating the hole, (2) placing the instrument column, (3) placing the reinforcing cage, and (4) depositing the concrete.

The excavation procedure started with the augering of a 30-inch diameter hole down to the ground water level. Water was added to the hole and drilling continued, accompanied by a mixing of the soil and water in the hole to form a slurry. When the depth of the hole was about 38 feet, a 30-inch diameter casing was lowered into the hole and seated 4 feet into the clay at the bottom of the hole. The water and mud slurry were removed from the hole by bailing and the drilling to the design depth was completed with an auger slightly smaller than the inside diameter of the casing.

There was some concern over the tendency of the closed instrument column to float in the wet concrete. To counteract this tendency, a 28-inch diameter steel plate was welded to the bottom of the column so that the reinforcing cage would rest on the plate and add enough weight to prevent floating. The instrument column was placed in the cleaned hole and aligned with the reaction shaft.

The reinforcing cage was assembled in the contractor's yard. After the bars were tied to the spiral and braced to prevent racking, each intersection of bar and spiral was welded in a ten-foot interval at each end of the cage. Spacers were added inside the cage to insure that the instrument column would be centered in the cage and to the outside of the cage to insure that the cage would be centered in the casing. After the instrument column was placed, the reinforcing cage was carefully lowered into position.

Concrete was deposited through an eight-inch diameter rubber tremie. As the level of the concrete rose, sections of the tremie were cut off. When the level of the concrete was near the ground surface, the casing was lifted approximately 15 feet and filled with concrete to a height of about eight feet above ground level. The casing was then slowly removed from the hole assuming that the head of wet concrete in the casing would be sufficient to force any water or mud present between the outside of the casing and the side of the hole upward and out of the hole. After the casing was removed, the form for the two feet of shaft above the surface was placed and filled with concrete.

After construction was complete, the instrument column was cleaned and opened so that the gages could be checked. All gages responded properly. After the instrument column was closed, it was pressurized to 20 psi with dry nitrogen to insure that no moisture could enter. The concrete was cured for 40 days prior to loading.

Loading Procedure

The load was applied to the shaft as near to the ground surface as possible. A yoke, constructed to fit the shaft, was connected by 8 one-half inch diameter prestressing strands to a short beam section (see Fig. 6.2). The jack was placed between this short beam and the reaction shaft to apply the load. Adjusting nuts were added to the strand chucks at one end of each strand so that equal tension could be obtained in all strands. The tension was adjusted until all strands had had an equal midspan sag under a light load.

The shaft was subjected to repeated loadings of 10, 20, 30, 40, and 50 tons. The sequence of load application is described below.

1. The 10-ton load was applied and readings of deflection, slope, and bending strains were taken. The load was removed and readings of deflection, slope, and bending strains were taken again.

2. Data were taken as soon as possible after the load was applied or removed. The recording of the strain gage readings (by a Honeywell Model 620 Data-Logger) was completed within two minutes after the load was reached. The deflection and slope readings were taken simultaneously with the strain readings.

3. The 10-ton load was reapplied, data were taken, the load was removed, and data were taken. This procedure was repeated until the top deflection did not increase with additional repetitions of load or until the load had been applied 20 times.

4. The load was increased by 10 tons and the loading procedure was repeated. After the top deflection had stabilized or 20 cycles of load had been applied, the load was increased by an additional 10 tons. This process was followed until the shaft had been loaded with the maximum test load of 50 tons.

5. The top deflection stabilized during 10 cycles of the 10-ton load and during 15 cycles of the 20-ton load. Loading at all other values of load was carried through 20 cycles.

6. During certain selected cycles, (i.e., cycles 1, 2, 3, 5, 10, 15, 20) data were taken at loads intermediate between zero load and maximum load. For example, during some of the 10-ton load cycles (cycles 1, 2,

3, 5, 10) data were taken at loads of 0, 2.5, 5, 7.5, and 10 tons. The interval for intermediate readings during the 20-ton and 30-ton load cycle was 5 tons (data taken at 0, 5, 10, 15, 20, 25, 30 tons) and the interval for intermediate readings during the 40-ton and 50-ton load cycles was 10 tons (data taken at 0, 10, 20, 30, 40, and 50 tons).

7. After the 50-ton load cycles were completed, the instrument column was closed and pressurized to 10 psi. The shaft was allowed to rest for about one month and then subjected to an additional ten cycles of 50-ton maximum load.

Calibration

The diameter and properties of a drilled shaft are not precisely known because of the construction procedure. The stiffness of the shaft must be accurately known before the bending moment can be determined from the measured bending strains. Direct measurement of the relationship between bending moment and bending strains was considered the most feasible method of determining the stiffness, especially since nonlinear response was anticipated from the reinforced concrete shaft.

To facilitate the calibration, the soil around the perimeter of the shaft was excavated to a depth of 20 feet. After excavation, the shaft was cleaned and examined for defects. The most important defects noted were void spaces on the surface of the shaft (outside the spiral reinforcing) at a depth of approximately eight feet on the compression side of the shaft and at a depth of approximately eleven feet on the tension side of the shaft. At the eight foot depth, the spiral reinforcing was exposed in an area about two feet in length and one foot in width. The exposed area at the eleven foot depth was about one foot square. In both locations, the concrete within the spiral appeared to be sound. Other defects observed were minor irregularities which would have no significant effect on the behavior of the shaft.

To measure the stiffness of the shaft, it was loaded as a cantilever, and bending strain readings were taken at various load levels. Four sets of readings were taken and the average values were assumed to define the stiffness. The measured stiffness varied with both depth and applied moment. The variation of initial stiffness with depth is shown in Fig. 7.5 in the next chapter.

Accuracy of Measurements

To determine the deflected shape of the shaft, the M/EI diagram was integrated twice. To determine soil reaction the moment diagram was differentiated twice. The measured values of deflection and slope provided boundary conditions necessary in the integration process and the measured load provided a check of the accuracy of the data smoothing technique.

The bending strains are a direct measure of the curvature, ϕ , of the shaft at the level of the strain gages. The accuracy of the values of curvature is influenced only by errors in strain measurement. The slope, obtained by the first integration, is affected by errors in top slope measurement (used to define the constant of integration), strain readings, and gage spacing. The accuracy of the deflection, obtained by the second integration, is influenced by all of the errors in the slope determination plus the error in top deflection measurement.

The differentiation process, if done by numerical methods, is very sensitive to small errors in measurement, especially if the differences between measured values are small. The presence of significant errors is inevitable considering that the shaft is reinforced concrete and stress concentrations will occur in the vicinity of cracks. Smoothing of the data obtained in this study was done by fitting a high-order polynomial by least squares to all the moment values along the shaft. The accuracy of the moment values of the smooth curve is dependent upon the accuracy of measured strains, the M-ϕ relationship, and the curve-fitting technique. For the derivatives, the accuracy depends primarily on the accuracy of the curve-fitting technique. The measured value of applied load provides a check upon the accuracy of the first derivative at the ground surface.

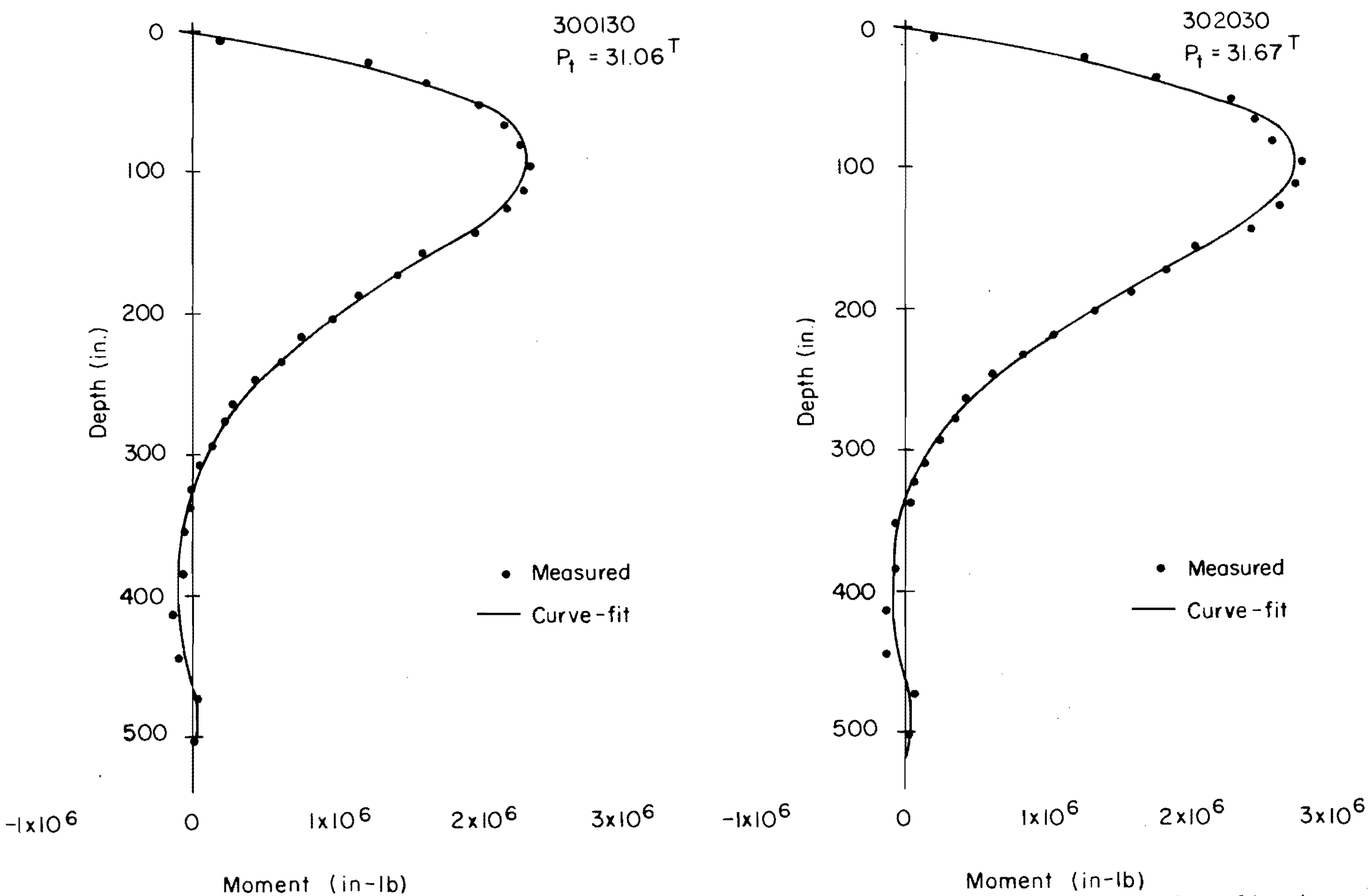
The sensitivity of reading and the estimated accuracy of measurement are shown in Table 6.1.

TABLE 6.1. ACCURACY OF MEASUREMENTS

Measurement	Sensitivity	Accuracy
Deflection		
Dial Gage	.001 in.	.001 in.
Linear Potentiometer	.001 in.	.001 in.
Slope	3×10^{-6} rad.	1×10^{-4} rad.
Strain	1×10^{-7} in/in	2×10^{-6} in/in
Applied Load		
Pressure Transducer	.01 ton	0.5 ton
Load Cell	0.1 ton	1.0 ton

The most important factor, by far, influencing the accuracy of the interpretation of data is the behavior of the reinforced concrete. During the first portion of the test, flexural cracks had not yet formed and the stiffness of the shaft was probably greater than indicated by the calibration test. Stress concentrations near cracks are undoubtedly the source of some of the scatter in the test data.

The data, considered in their entirety, appear to be very consistent, requiring no special compensation or adjustment for unusual errors. The curve-fit shown in Fig. 6.4 is typical.



a. 30-ton Load, First Application

b. 30-Ton Load, Twentieth Application

Fig. 6.4 Typical Curve-Fit

CHAPTER VII

RESULTS OF FIELD TEST

The results of the calibration test, the repeated loading tests, and the analysis of the data will be presented in this chapter. The results of the laboratory tests and the correlation between field and laboratory results will be presented in following chapters.

Top Deflection

The deflection of the top of the shaft was found to be a nonlinear function of load. An applied load of 10 tons produced a deflection of .020 inches while 1.165 inches deflection was observed with the first application of 50 tons. The increase in deflection for each successive application of the same load was observed to be dependent on the load level. For the lighter loads, the increase was very small, and for the maximum load the increase was significant. The response of the shaft, as measured by top deflection is shown in Fig. 7.1. The deflection under repeated loading is plotted on semi-log paper in Fig. 7.2. This plot illustrates the decrease in additional deflection as the number of cycles increase. That is, there was generally a greater increase in deflection with the second application of load than there was for the third, or tenth, or twentieth application of load. The change in slope of the lines (in Fig. 7.2) as the load increases clearly shows the effect of stress level upon deflection under repeated loading.

Top Slope

The slope measurements at the top of the shaft reflect the same nonlinear behavior shown by the deflection measurements. Figure 7.3 shows

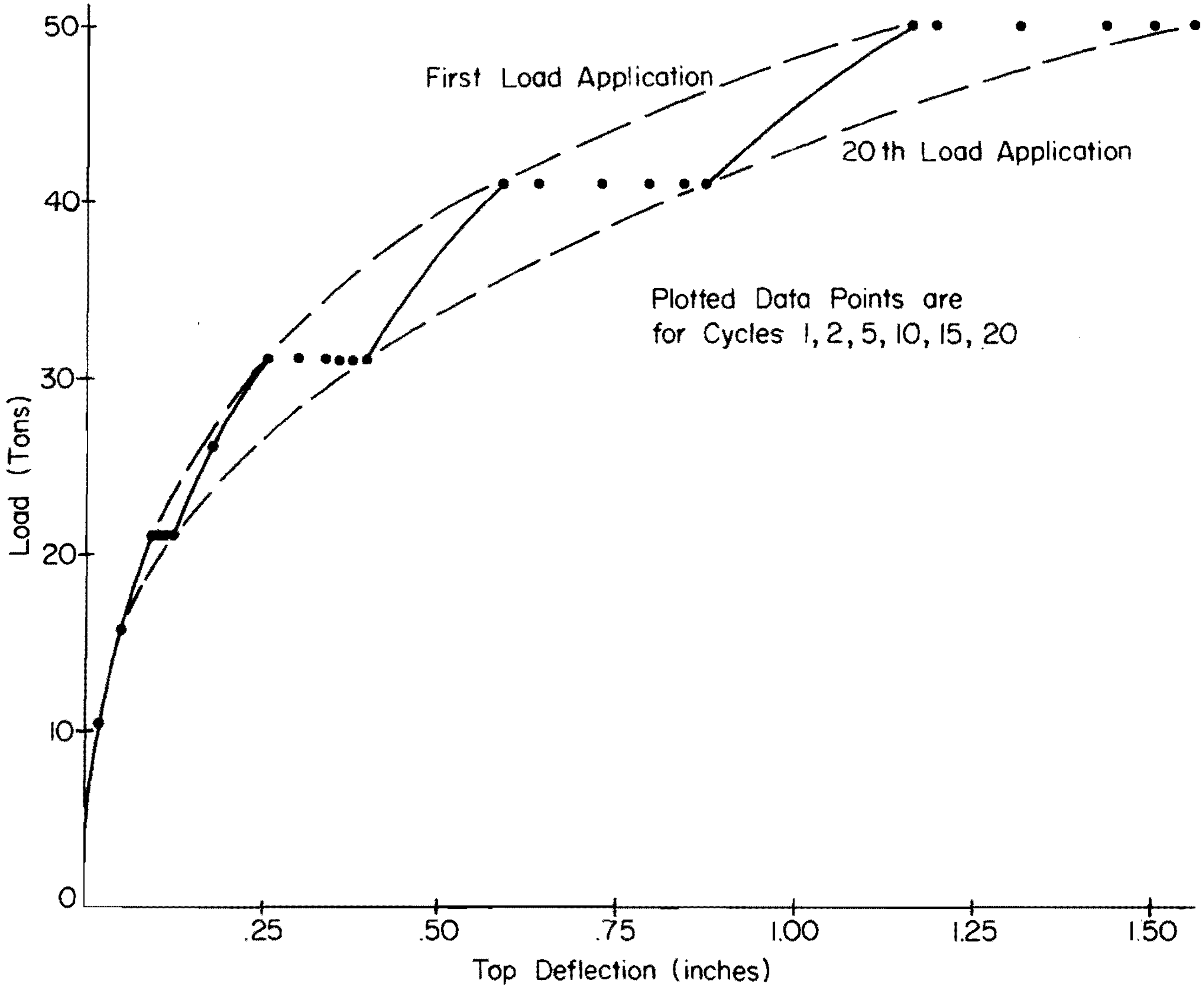


Fig. 7.1 Top Deflection

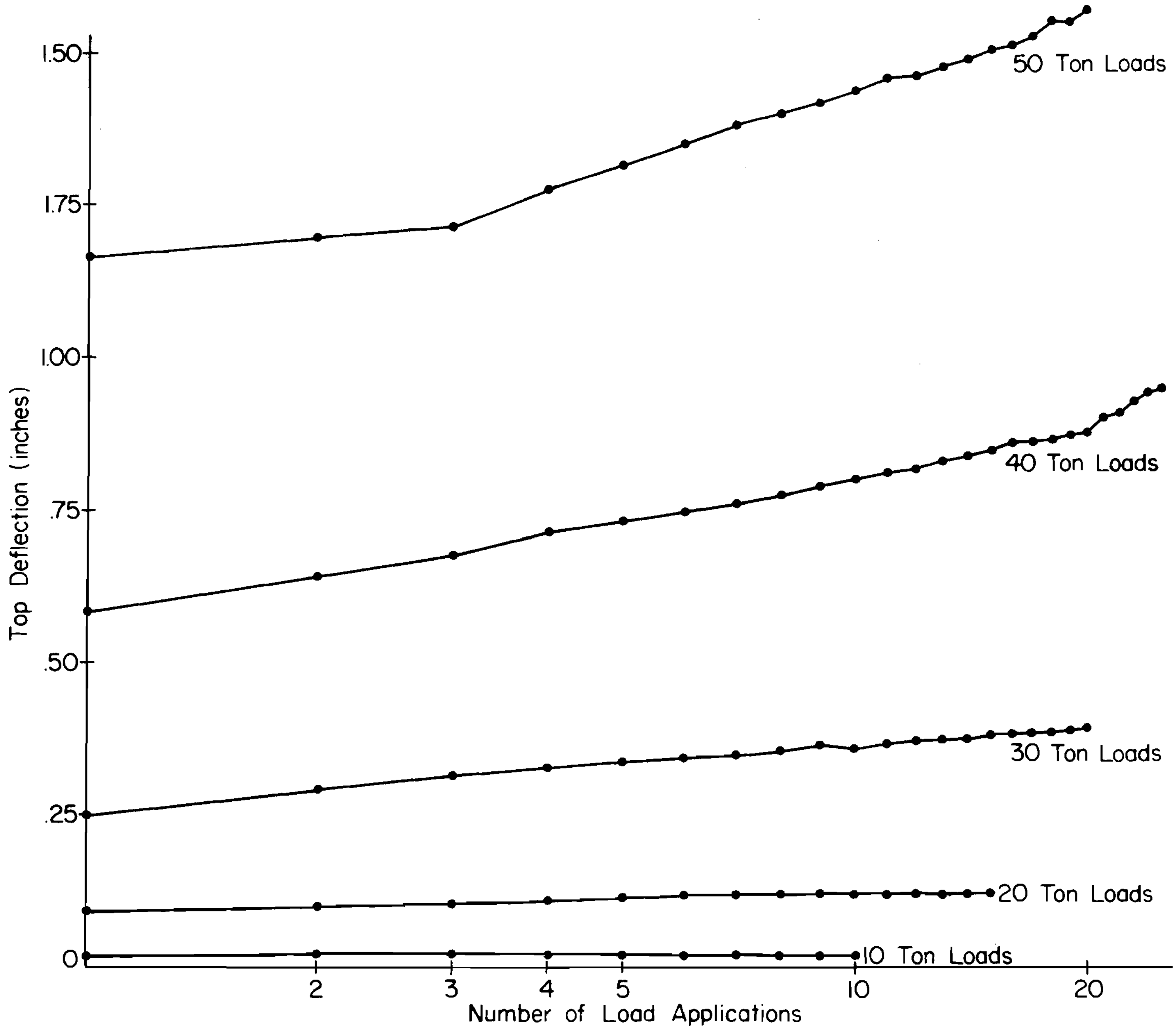


Fig. 7.2 Effect of Repeated Loading on Top Deflection

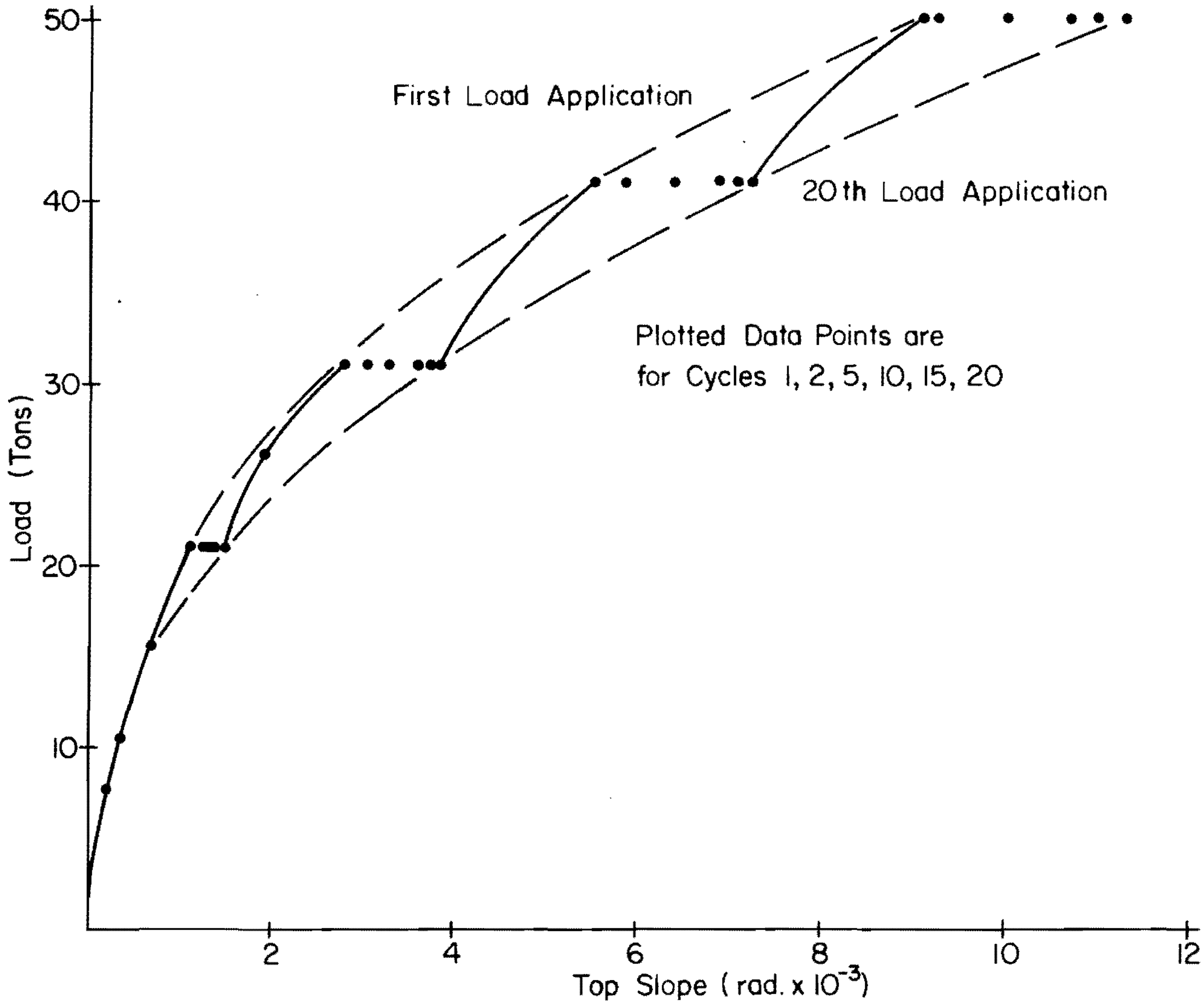


Fig. 7.3 Top Slope

the slope measurements for the various load levels. The effect of repeated loading upon the top slope is shown in Fig. 7.4.

Flexural Stiffness

The calibration test was performed to determine the flexural stiffness of the shaft as a function of depth and as a function of stress level. The most convenient way to define flexural stiffness as a function of stress level is by the moment-curvature or M-ϕ relationships. As previously defined,

$$\phi = \frac{M}{EI} \quad \text{. . . . . (2.7)}$$

and the flexural stiffness, represented by a secant of the M-ϕ curve, is equal to moment divided by curvature.

$$EI = \frac{M}{\phi} \quad \text{. . . . . (7.1)}$$

In the calibration test, the moment was determined at each exposed gage level in the cantilever portion of the shaft by multiplying the applied load by the distance from the point of load application to each gage level. The curvature was determined by measuring bending strains. The assumption of linear strain distribution on a cross-section perpendicular to the axis, which has been proven to be reasonable, was used. The relation between curvature and bending strains is as follows:

$$\phi = \frac{\epsilon_t - \epsilon_c}{t} \quad \text{. . . . .(7.2)}$$

where

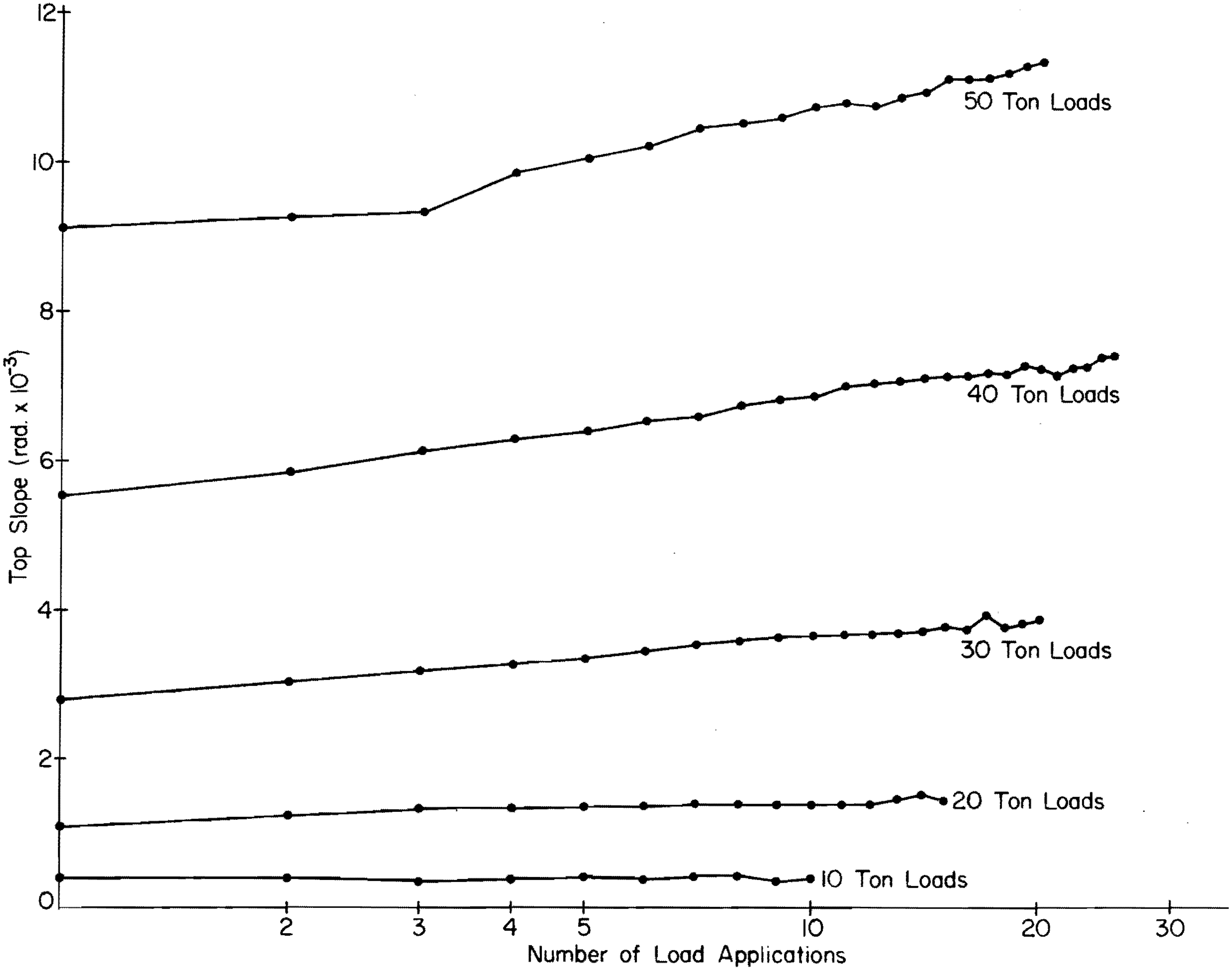


Fig. 7.4 Effect of Repeated Loading on Top Slope

ϵ_t = the tensile strain at the outside fiber,

ϵ_c = the compressive strain at the outside fiber,

t = the depth of the section (distance between the points where ϵ_t and ϵ_c are measured).

The strains were measured at each gage level on the instrument column and assumed to represent the curvature of the shaft at the level of the gages. The moment-curvature relationship was found to be slightly nonlinear at each gage level. There was a significant variation os stiffness with depth, due in part to the defects described in the section on calibration of the shaft of the previous chapter. The measured M-ϕ curves are shown in the appendix, and the variation of stiffness with depth (determined from the initial slope of the M-ϕ curves) is shown in Fig. 7.5.

A theoretical M-ϕ curve was generated, using Hognestad's stress-strain relationships for the concrete and considering the tensile strength of the concrete. The average 28-day concrete cylinder strength was 3600 psi, and the yield point of the reinforcing steel was taken from mill reports as 40,000 psi. The value of Young's modulus for the concrete was measured during the cylinder tests and a representative value of 4.8×10^6 psi was selected. The peak compressive stress for the Hognestad stress-strain diagram was taken as 85 per cent of the cylinder strength or 3060 psi. The maximum tensile stress was assumed to be 450 psi. A maximum compressive strain of .003 in/in was used. The theoretical M-ϕ curve is shown in Fig. 7.6 along with the measured M-ϕ values. The agreement is remarkable, considering the variation of the shaft diameter throughout the upper part of the shaft.

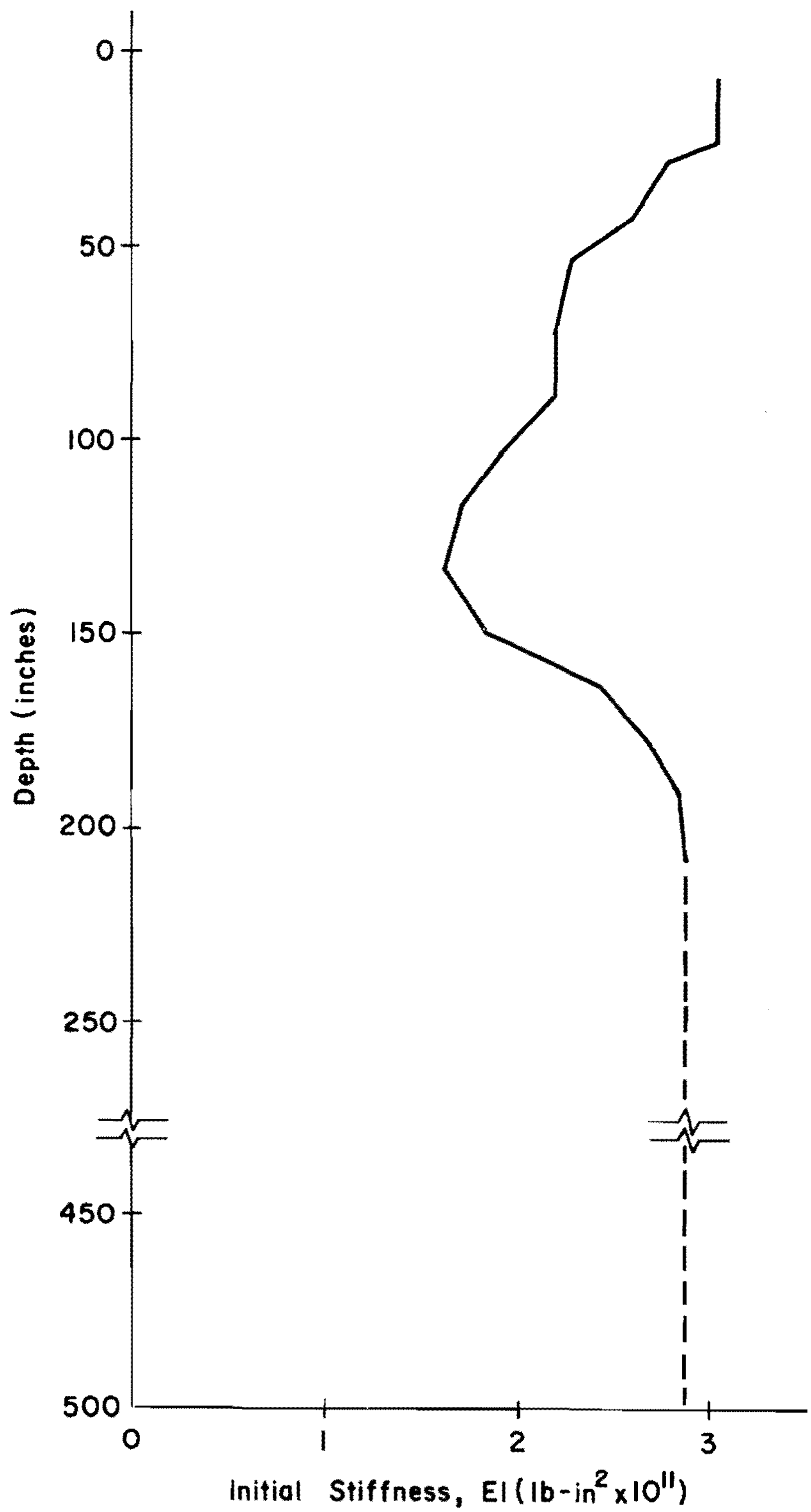


Fig. 7.5 Variation of Shaft Stiffness with Depth

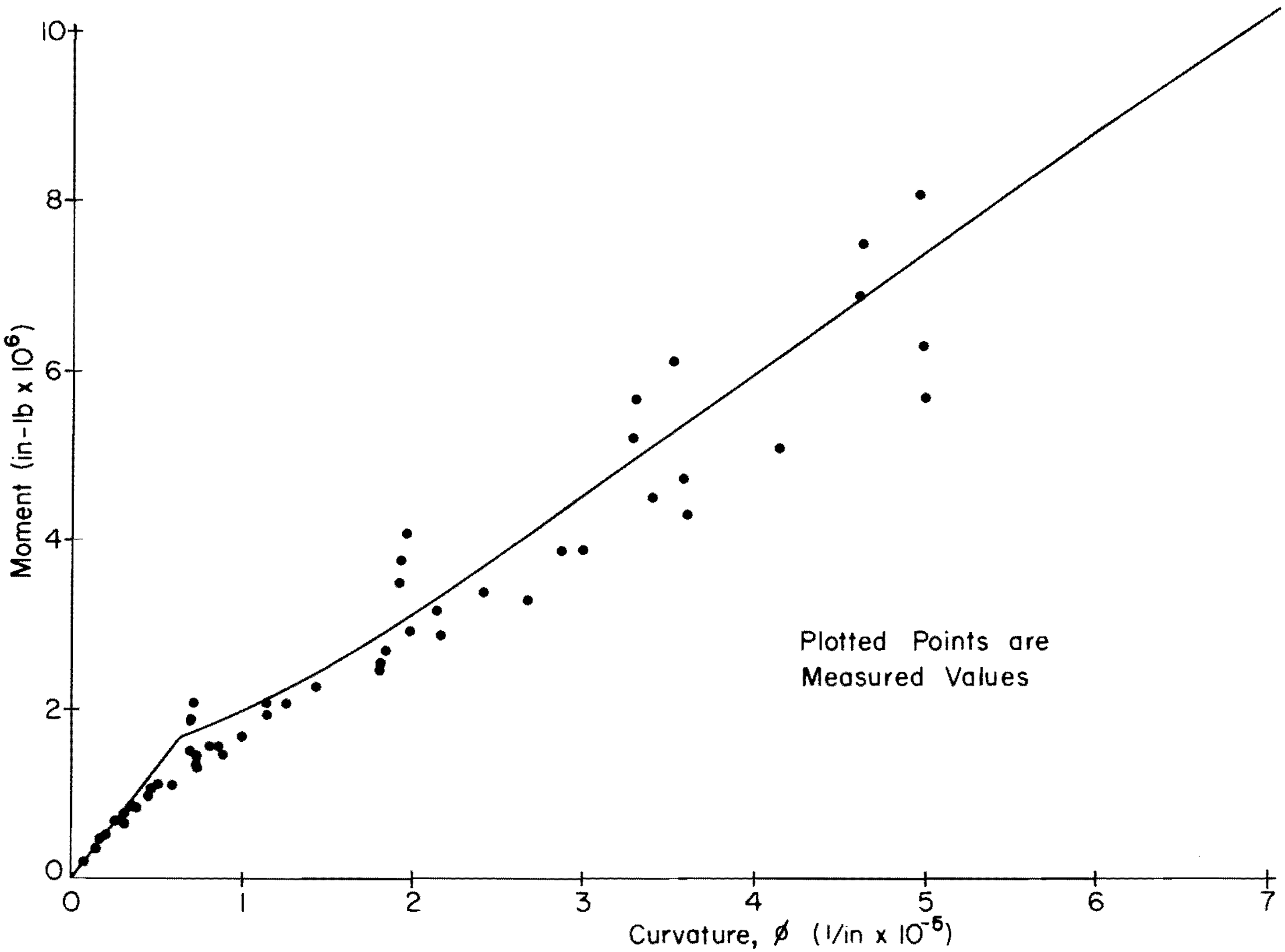


Fig. 7.6 Theoretical Moment-Curvature Relationship

Moment

The moment along the shaft was determined for each load application by using the M-ϕ curves from the calibration tests and the measured bending strains. A typical curve of moment with depth is shown in Fig. 7.7. The depth to the point of maximum moment increases with an increase in applied load. Under repeated loading, the maximum moment increases with each load application (10 to 20 per cent increase over 20 cycles) but the depth to the point of maximum moment increases very little. Moment curves illustrating the effect of repeated loading are shown in Fig. 7.8. The change in the distribution and magnitude of moment with an increase in load is illustrated in Fig. 7.9.

Curve-Fitting Procedure

It was recognized at the outset that some smoothing of the data would have to be done before the double differentiation process would give reasonable values of soil reaction. The most obvious way of smoothing the data would be to find a continuous mathematical function which would adequately describe the variation of moment with depth. This function could be a truncated power series, trigonometric series or a spline function. An alternate procedure would be to fit a function over a selected interval and then operate on the function within the interval, successively changing the interval until all data points had been operated upon. The most convenient function to use, from the standpoint of simple differentiation and integration, would be the polynomial describing a truncated power series. A least-squares curve-fitting technique was used to fit the selected function to the data.

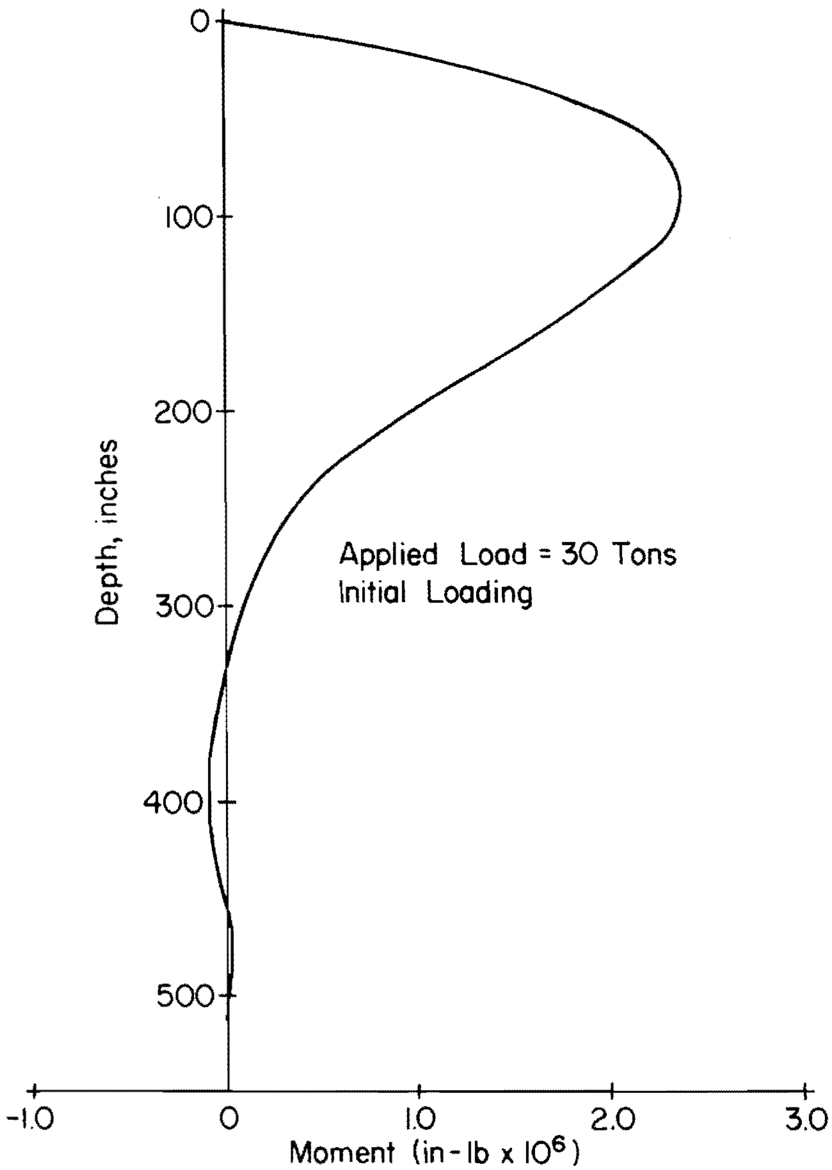


Fig. 7.7 Typical Variation of Moment with Depth

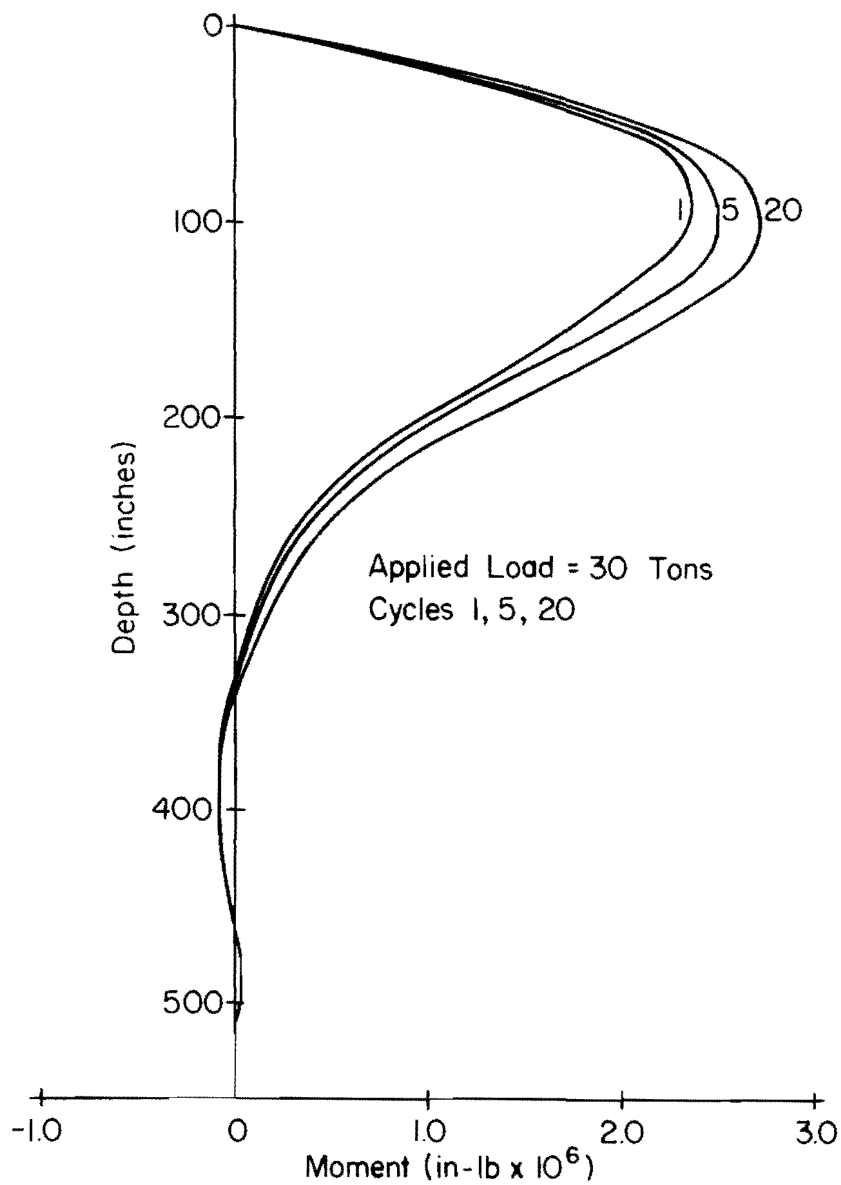


Fig. 7.8 Effect of Repeated Loading on Moment

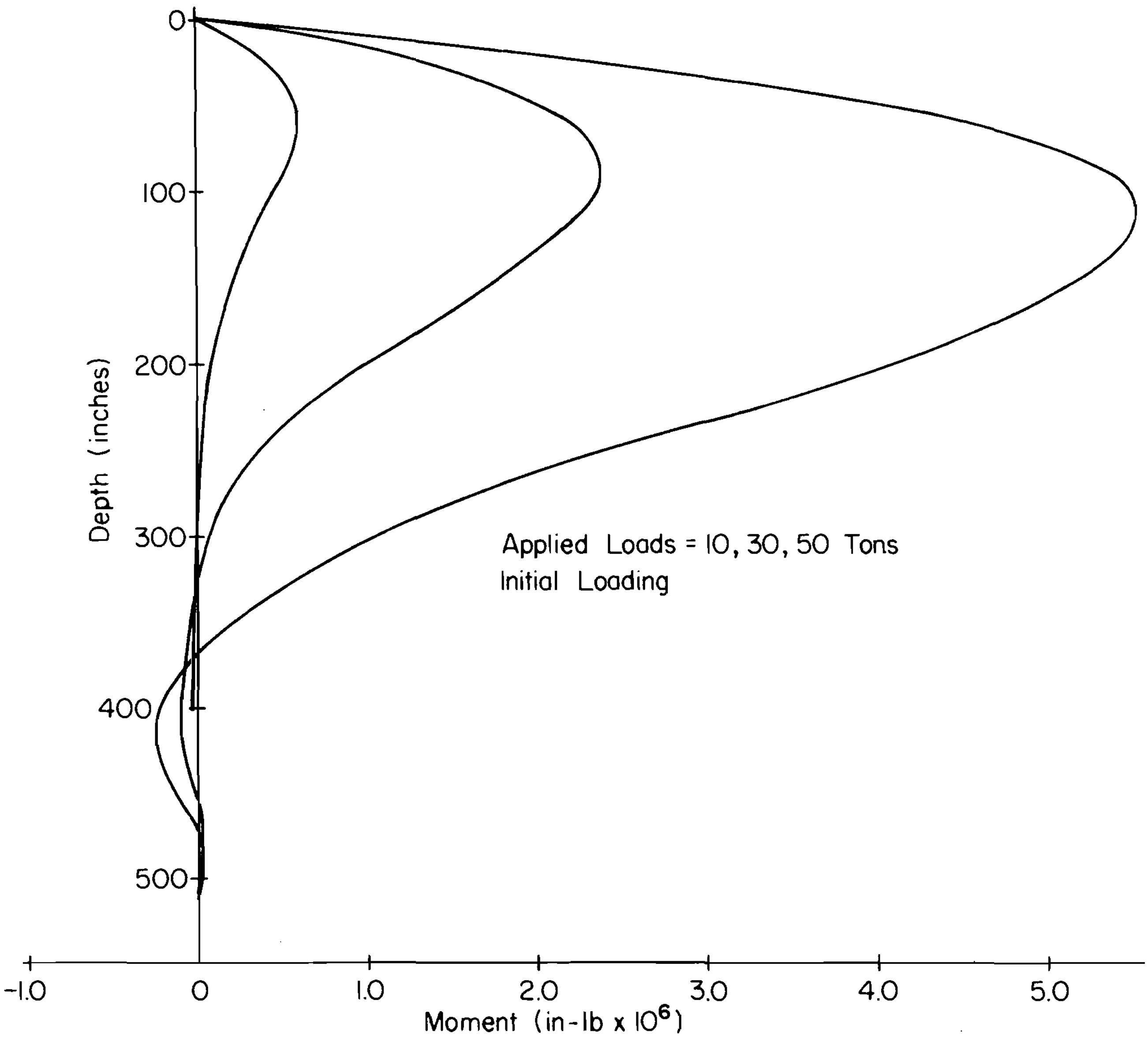


Fig. 7.9 Effect of Increasing Loads on Moment

In fitting a polynomial to the data, the question of the degree of polynomial to use required some analysis. Obviously, the polynomial would have to be of degree three or greater, since soil reaction is determined by differentiating twice. Also, the greater the degree of the polynomial, the better it would fit the data points but with a greater possibility of erratic behavior between points. To investigate the effect of the degree of the polynomial upon the reduction of the field test data, polynomials of degrees 4 through 20 were fitted to the moment curves obtained from the initial application of 20, 30, and 40 tons. The resulting polynomials were differentiated twice, the first derivative compared to the applied shear and the second derivative examined for variation with change in degree of the polynomial. As a result of this polynomial study, whose results are summarized in Figures 7.10 and 7.11, it was concluded that the moment curve could be satisfactorily described by a polynomial and that a polynomial of degree 7 would provide the best curve fit without erratic behavior. A polynomial of this order would describe the soil reaction as a fifth order function of depth.

Deflected Shape

The deflection of the shaft as a function of depth was determined by twice integrating the observed curvature data and by twice integrating curvatures obtained from the fitted moment curve using Simpson's rule. The boundary conditions used were the measured deflection at the top of the shaft and an assumed zero deflection at the bottom of the shaft. There was no appreciable difference in the deflections computed by the two methods.

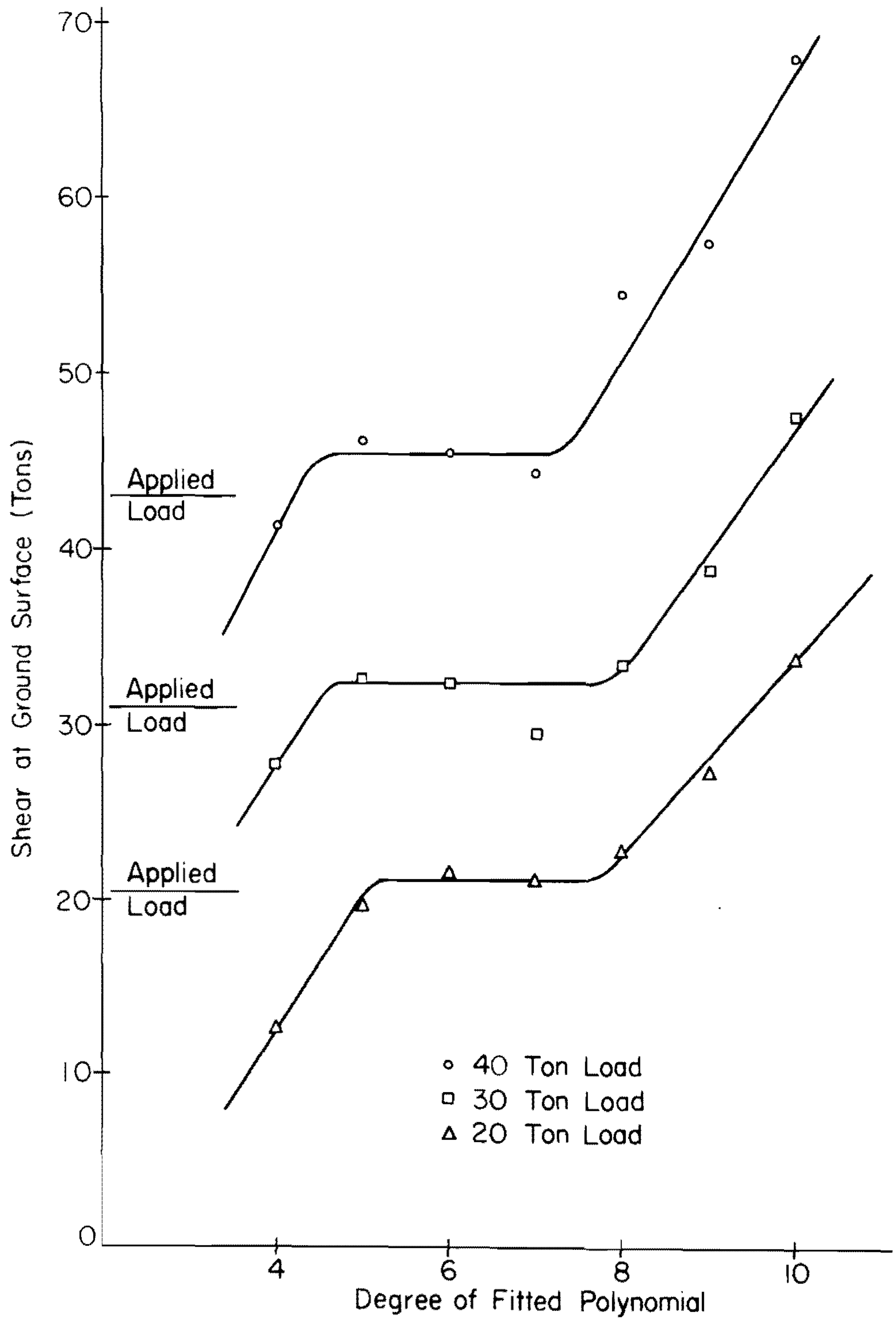


Fig. 7.10 Polynomial Study--Indicated Shear

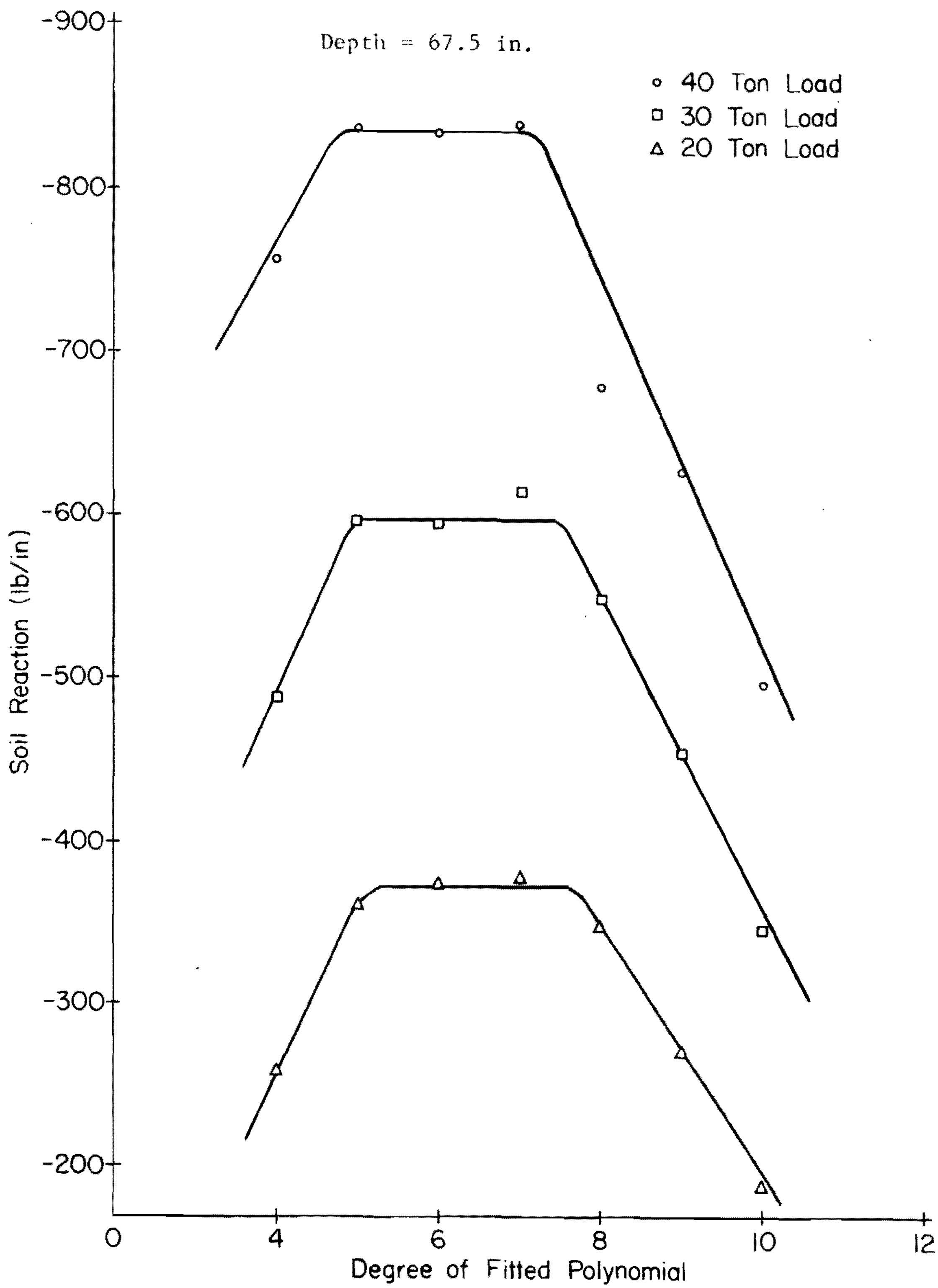


Fig. 7.11 Polynomial Study--Indicated Soil Reaction

Soil Reaction and Shear

The shear resisted by the shaft was determined by differentiating the polynomial describing the moment curve. The second differentiation yielded values of soil reaction. A typical complete solution showing deflection, slope, moment, shear, and soil reaction as a function of depth is presented in Fig. 7.12.

p-y Curves

The p-y relationship for the soil at the test site can be described by plotting the soil reaction and deflection at a selected depth for several values of applied load. In this test, the data taken was sufficient to allow the determination of p-y curves for the initial loading and for each of the cycles of repeated loading. Typical p-y curves showing the effect of repeated loading are given in Fig. 7.13.

The p-y relationship was determined for depths of 0, 7.5, 22.5, 37.5, 52.5, 67.5, 82.5, and 97.5 inches. These depths represent all the gage levels within the zone of significant deflection plus the ground surface. The shape of the p-y curves was similar for all gage levels and a nondimensional curve was constructed by dividing all y values by the deflection at one-half the ultimate soil reaction (y_{50}) and dividing all p values by the ultimate soil reaction (p_u). Skempton (1951) suggests a relationship, based on elastic theory, between load and settlement for various footing shapes. The data he presents appear to justify the use of his method for computing immediate settlements for all foundation depths and thus should be applicable to the case of a laterally loaded shaft of pile. Using the value he suggests for a long strip footing (L/B = 10), the deflection at one-half the ultimate load is:

$$y_{50} = 2.5\ b\varepsilon_{50} \quad \ldots\ldots\ldots\ldots (7.3)$$

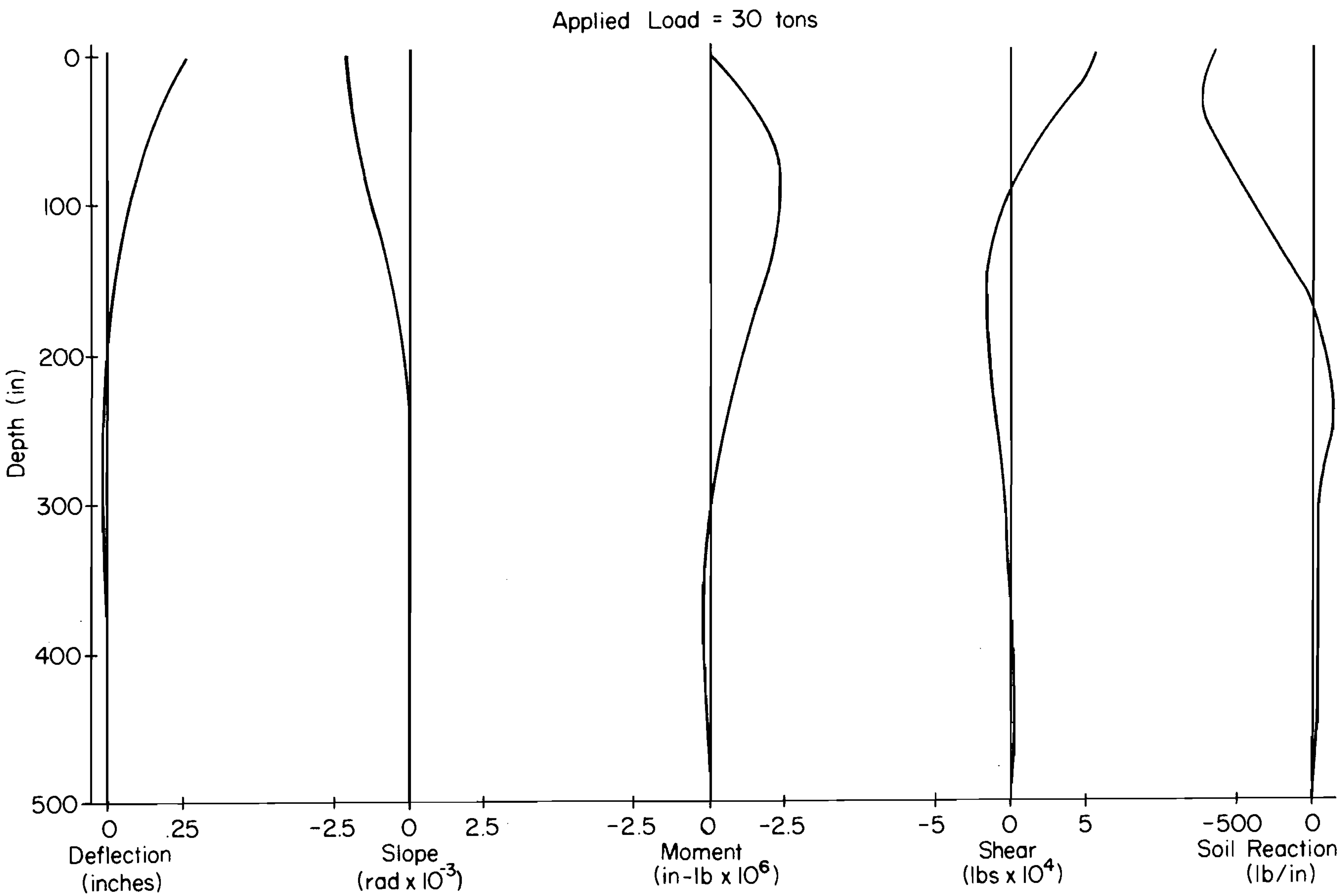


Fig. 7.12 Complete Solution of Laterally Loaded Drilled Shaft

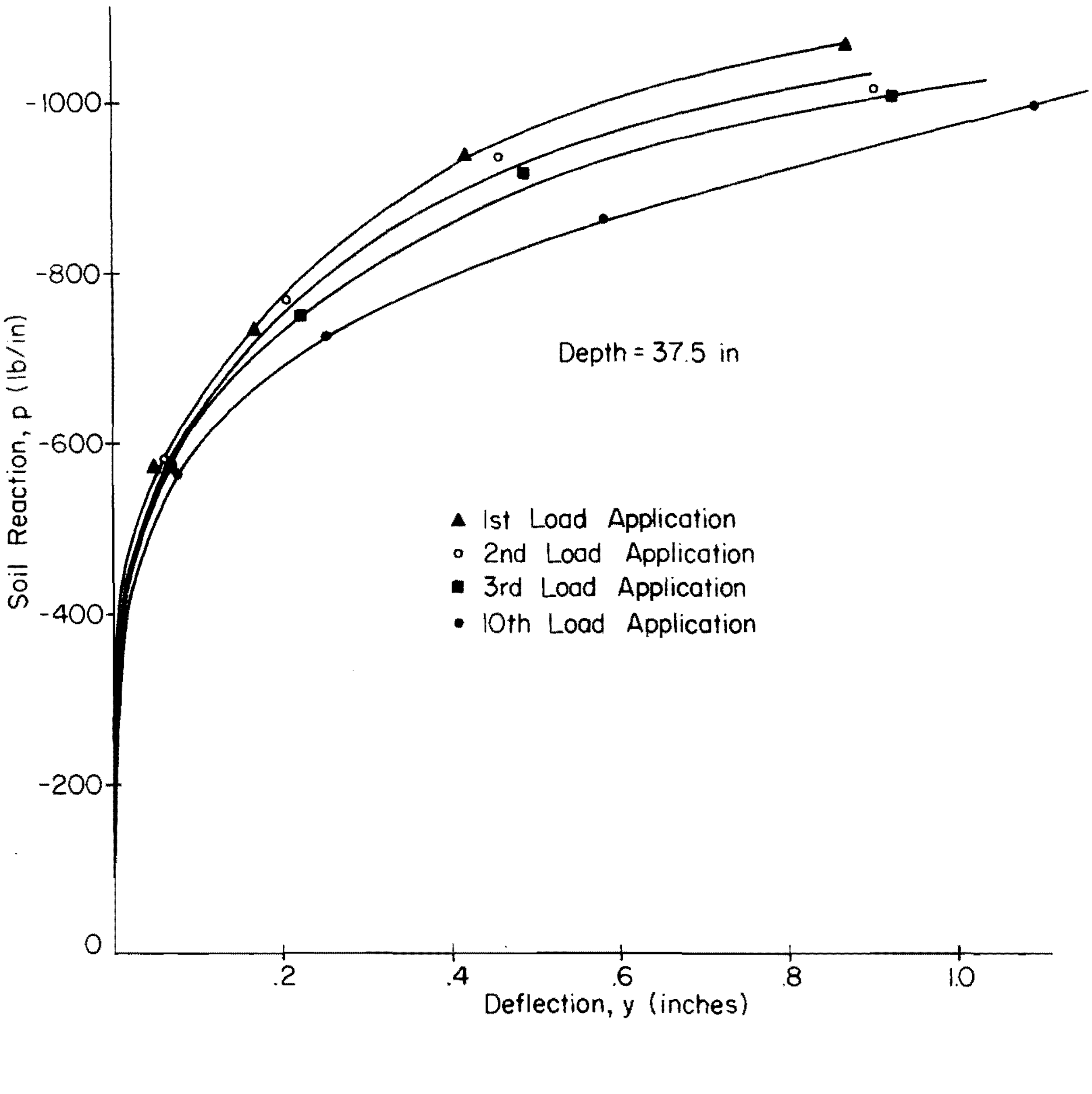


Fig. 7.13 Effect of Repeated Loading on p-y Curves

where

ϵ_{50} = strain at one-half the maximum principal stress difference in a laboratory triaxial test.

In the laboratory tests of samples taken at the test site, the average value of ϵ_{50} was 0.005 in/in. Using Eq. 7.3, the average value of y_{50} for the 30-inch diameter test shaft was computed to be 0.375 inches. The ultimate soil reaction was not reached during the test because the shaft was not strong enough to resist the bending stresses which would have been generated. Since y_{50} is the deflection at one-half the ultimate resistance, an estimate of the ultimate resistance can be obtained by doubling the value of soil reaction corresponding to y_{50}. The values of ultimate soil reaction were taken to be twice the values of soil reaction at a deflection of 0.375 inches for all gage levels. The values of p/p_u and y/y_{50} for all p-y data (initial loading) were plotted on log-log paper as shown in Fig. 7.14 and the equation of the curve was found to be:

$$\frac{p}{p_u} = 0.5 \left[\frac{y}{y_{50}} \right]^{\frac{1}{4}} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (7.4)$$

Matlock's (1970) criteria for soft clays has the same form but the exponent is one-third rather than one-fourth. His relationship is also shown in Fig. 7.14.

The effect of repeated loading on the p-y relationship is shown in Figures 7.15a - h where y/y_{50} is plotted versus the number of load applications. Each figure represents a set of p-y curves. The value of y_{50}

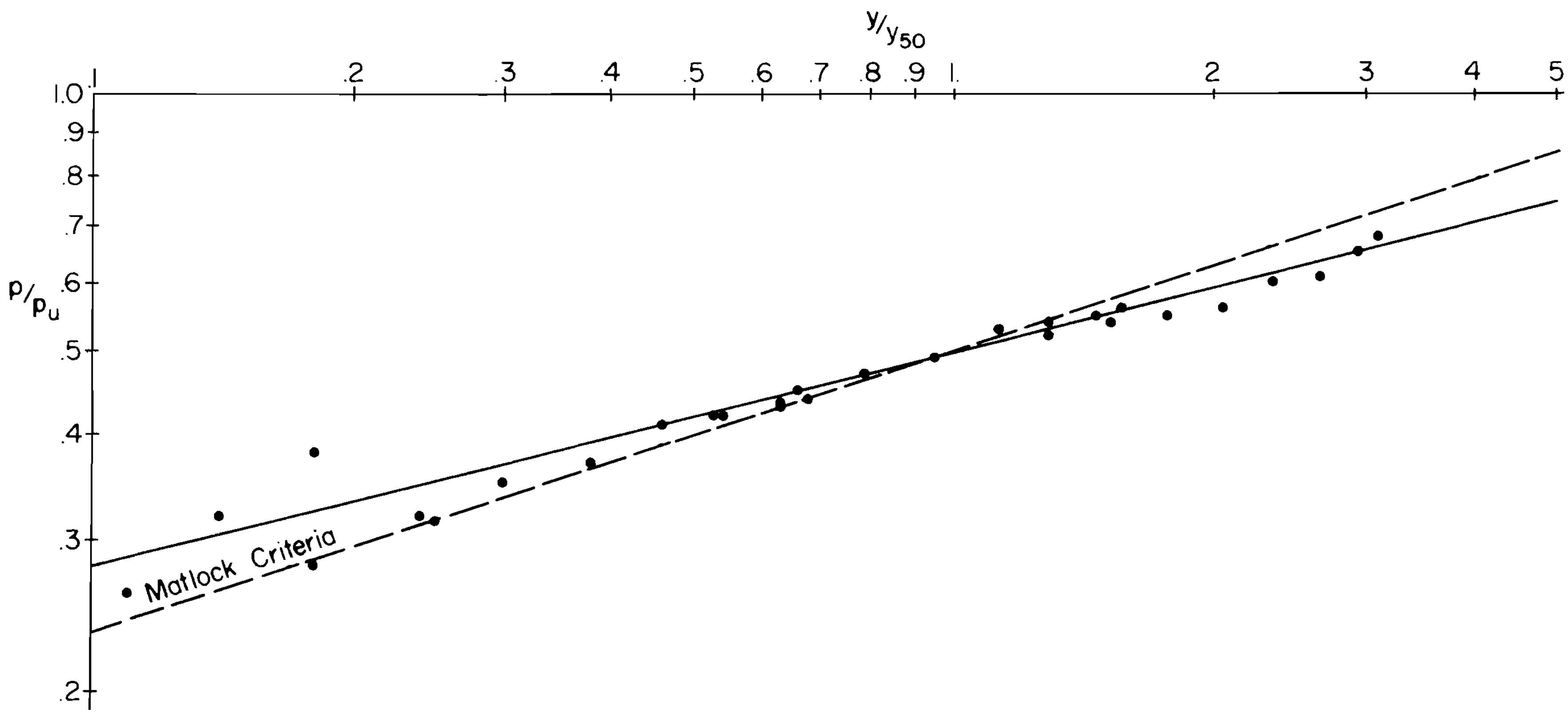


Fig. 7.14 Graphical Determination of Nondimensional p-y Curve

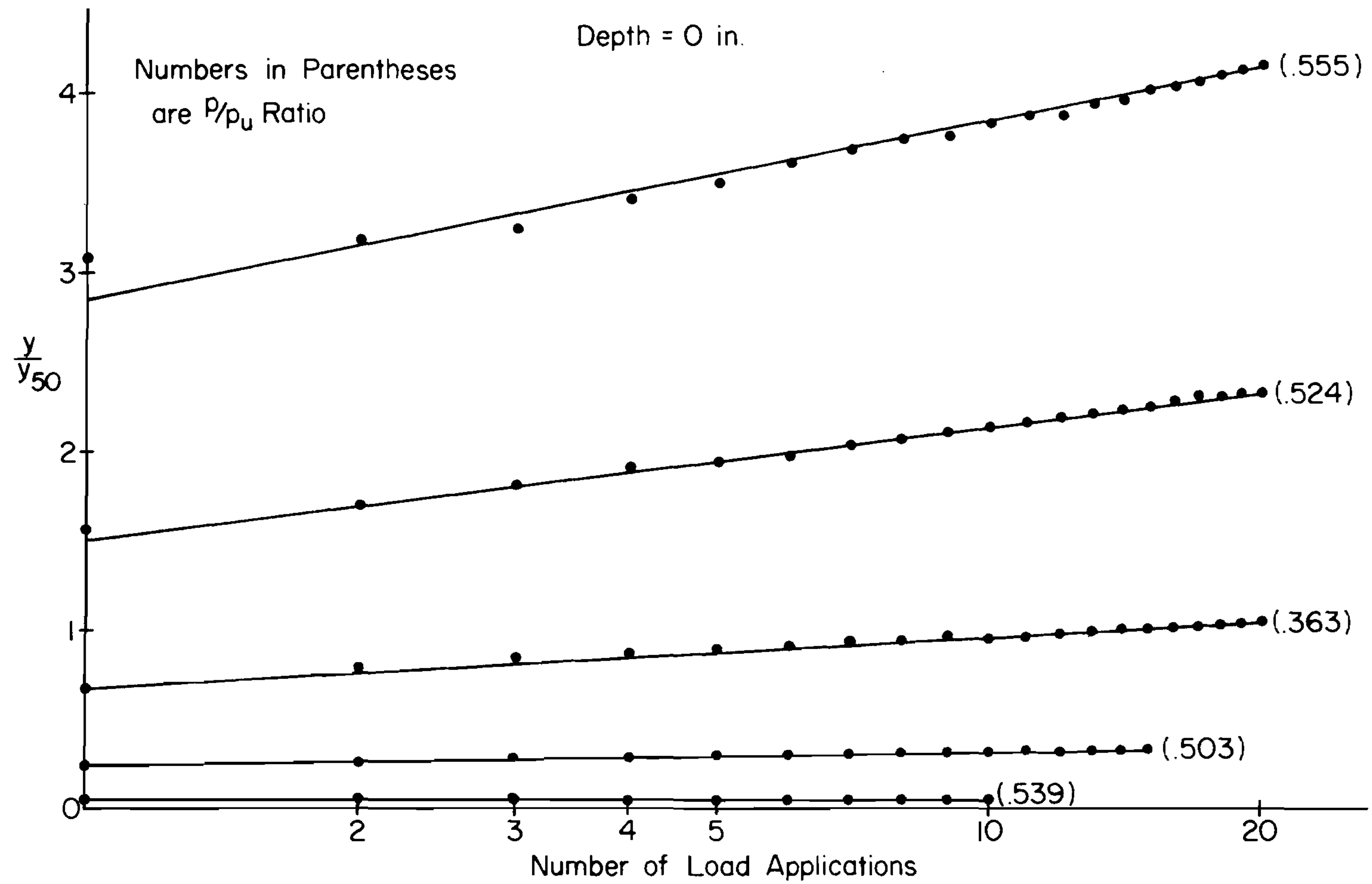


Fig. 7.15a Effect of Stress Level on Deformation Under Repeated Loading, Depth = 0 in.

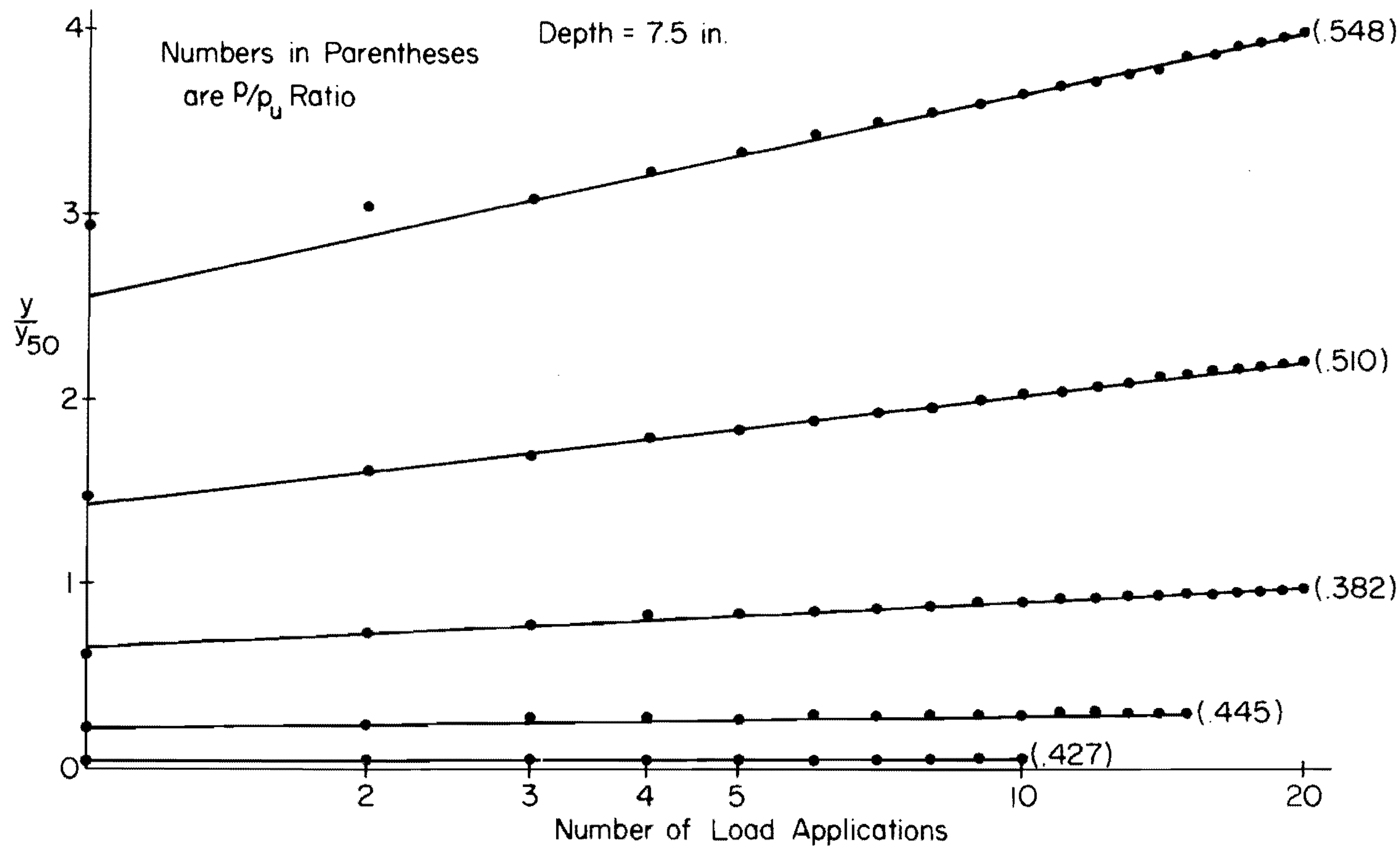


Fig. 7.15b Effect of Stress Level on Deformation Under Repeated Loading, Depth = 7.5 in.

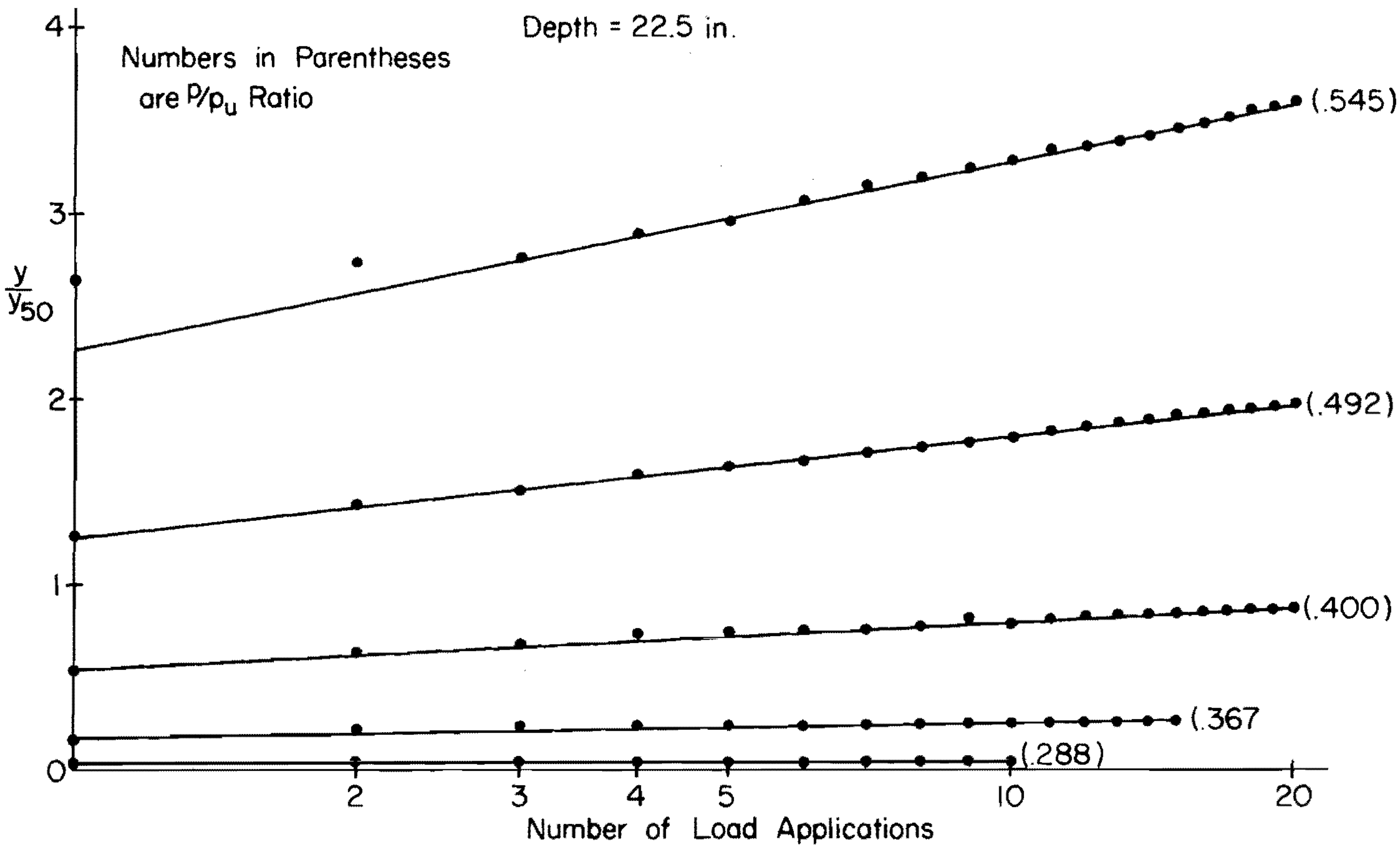


Fig. 7.15c Effect of Stress Level on Deformation Under Repeated Loading, Depth = 22.5 in.

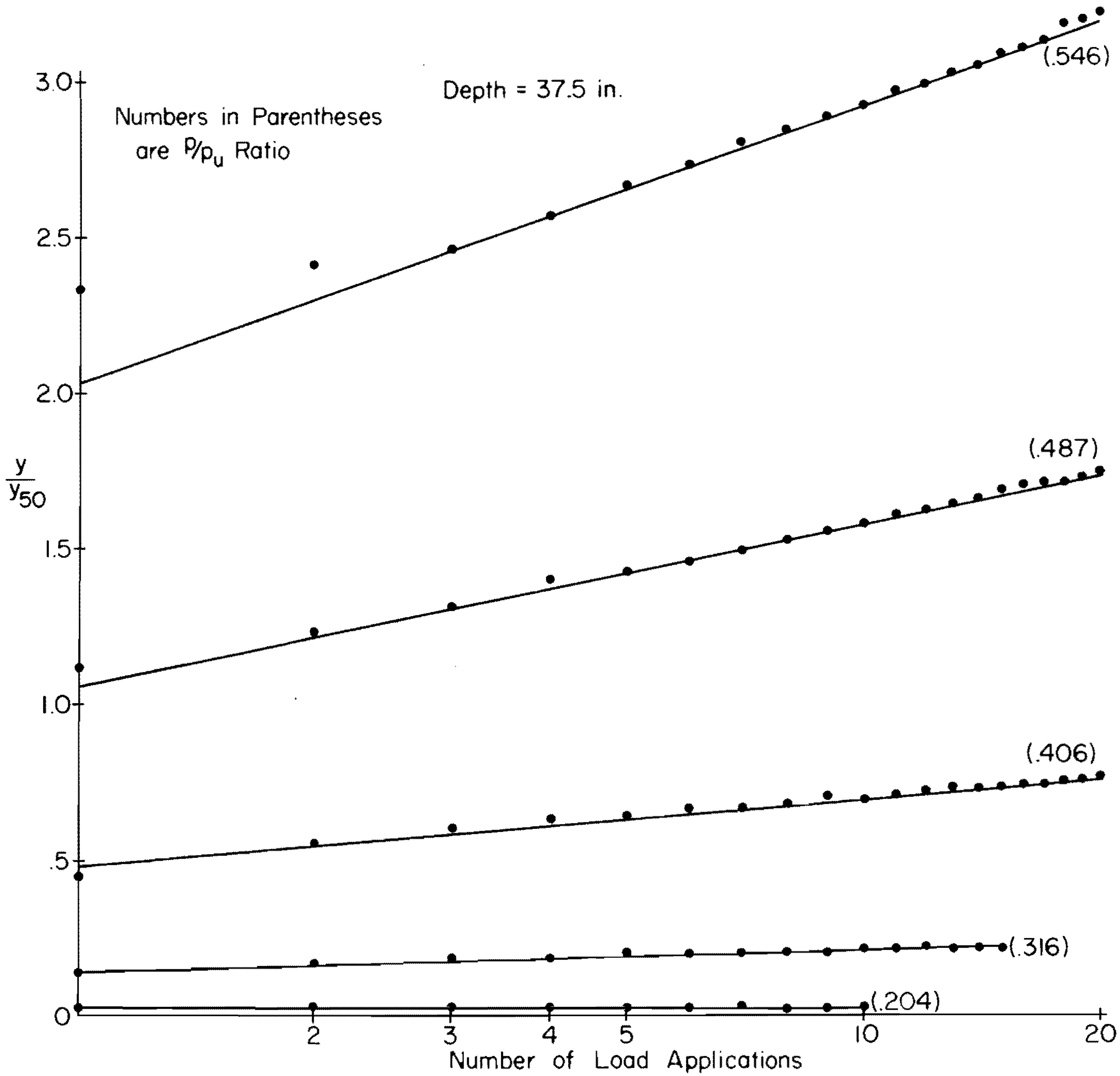


Fig. 7.15d Effect of Stress on Deformation Under Repeated Loading, Depth = 37.5 in.

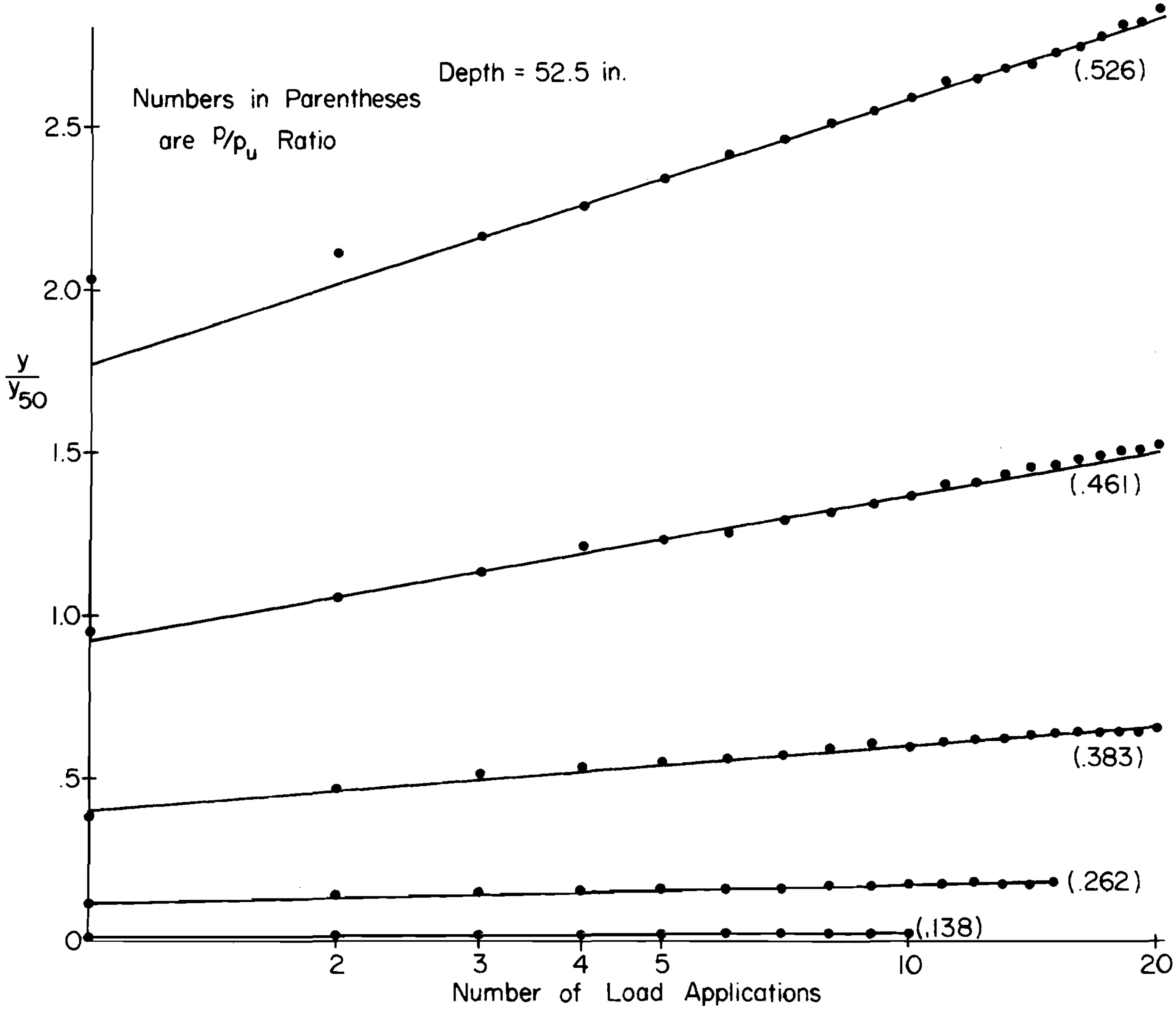


Fig. 7.15e Effect of Stress Level on Deformation Under Repeated Loading, Depth = 52.5 in.

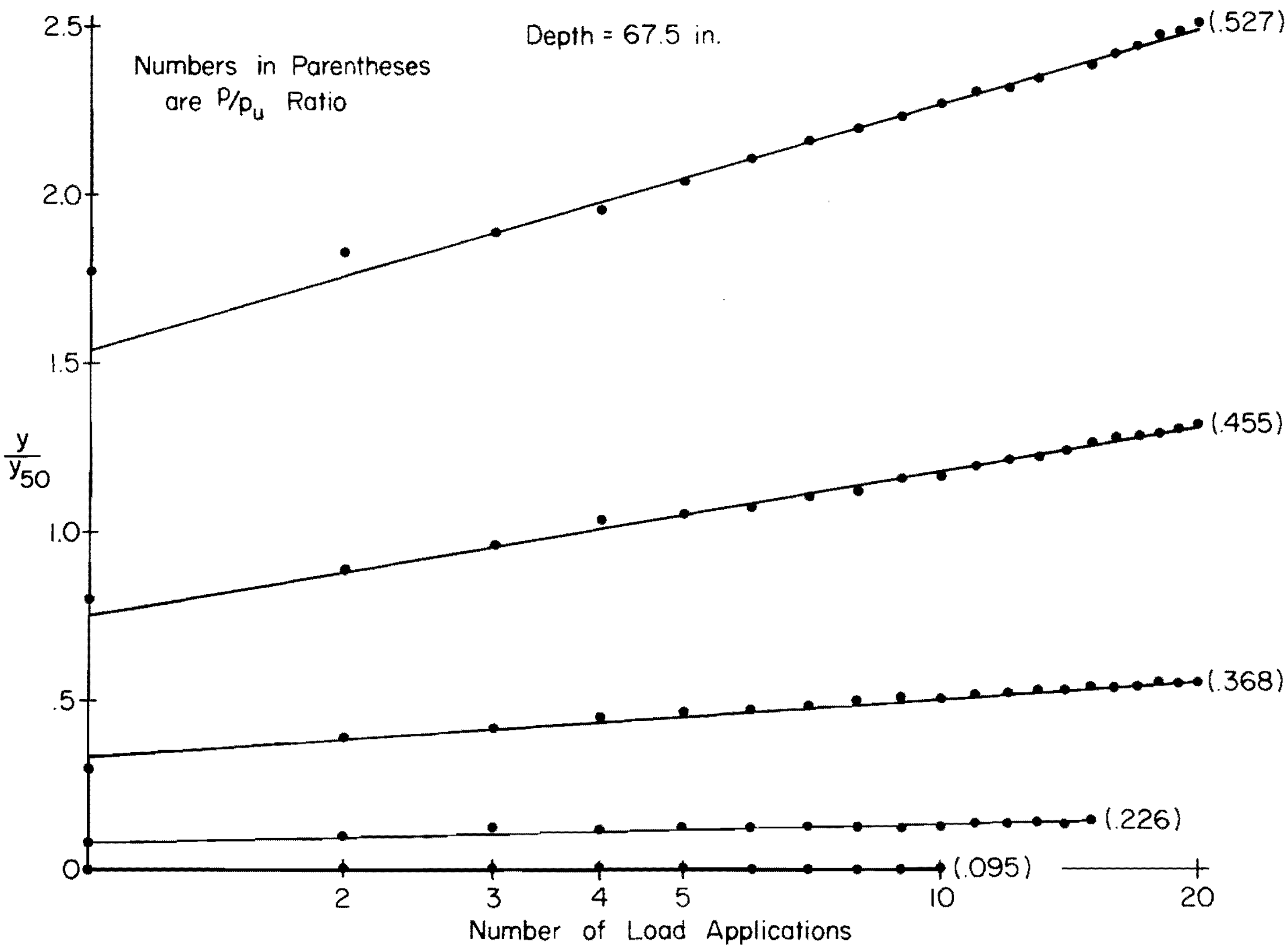


Fig. 7.15f Effect of Stress Level on Deformation Under Repeated Loading, Depth = 67.5 in.

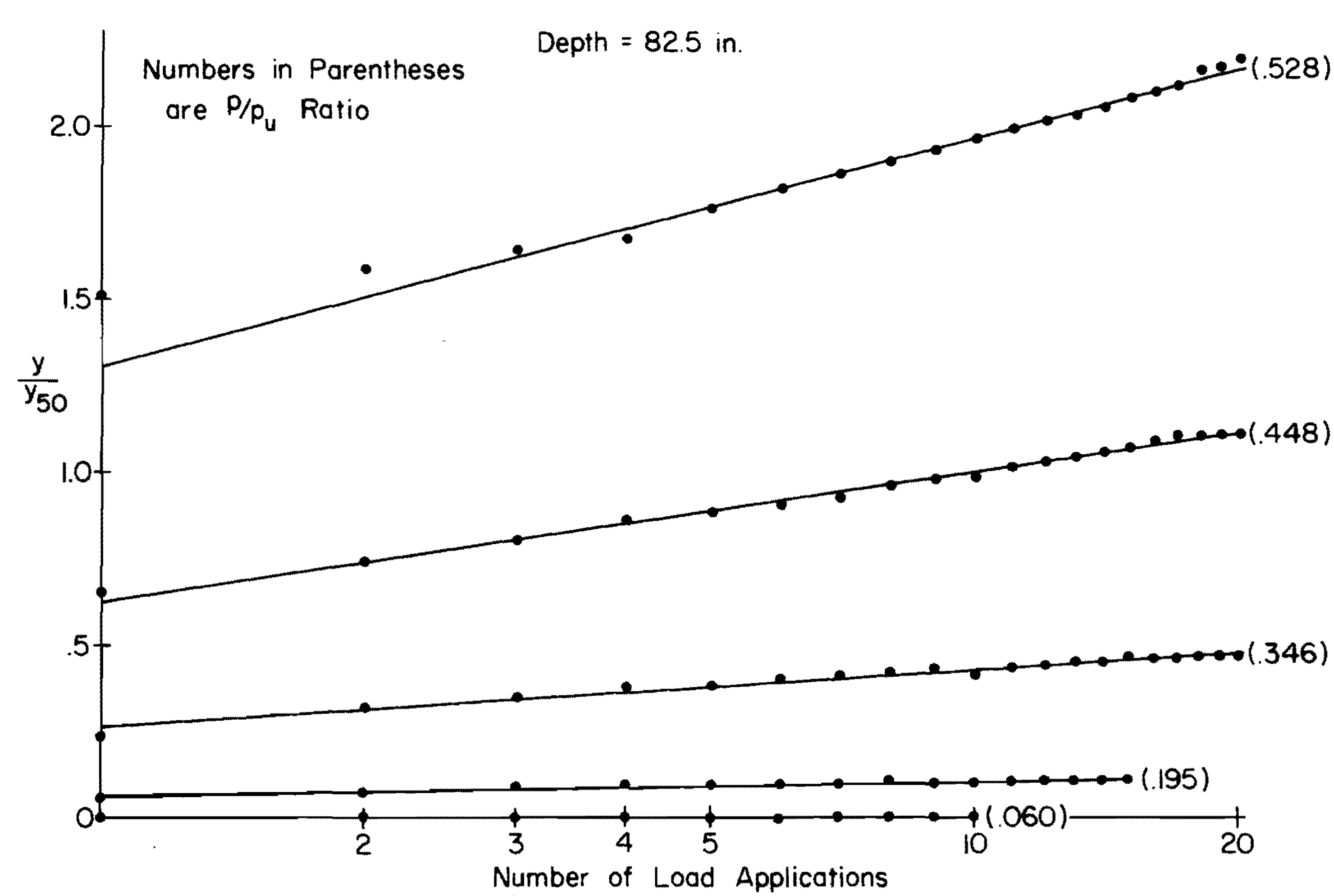


Fig. 7.15g Effect of Stress Level on Deformation Under Repeated Loading, Depth = 82.5 in.

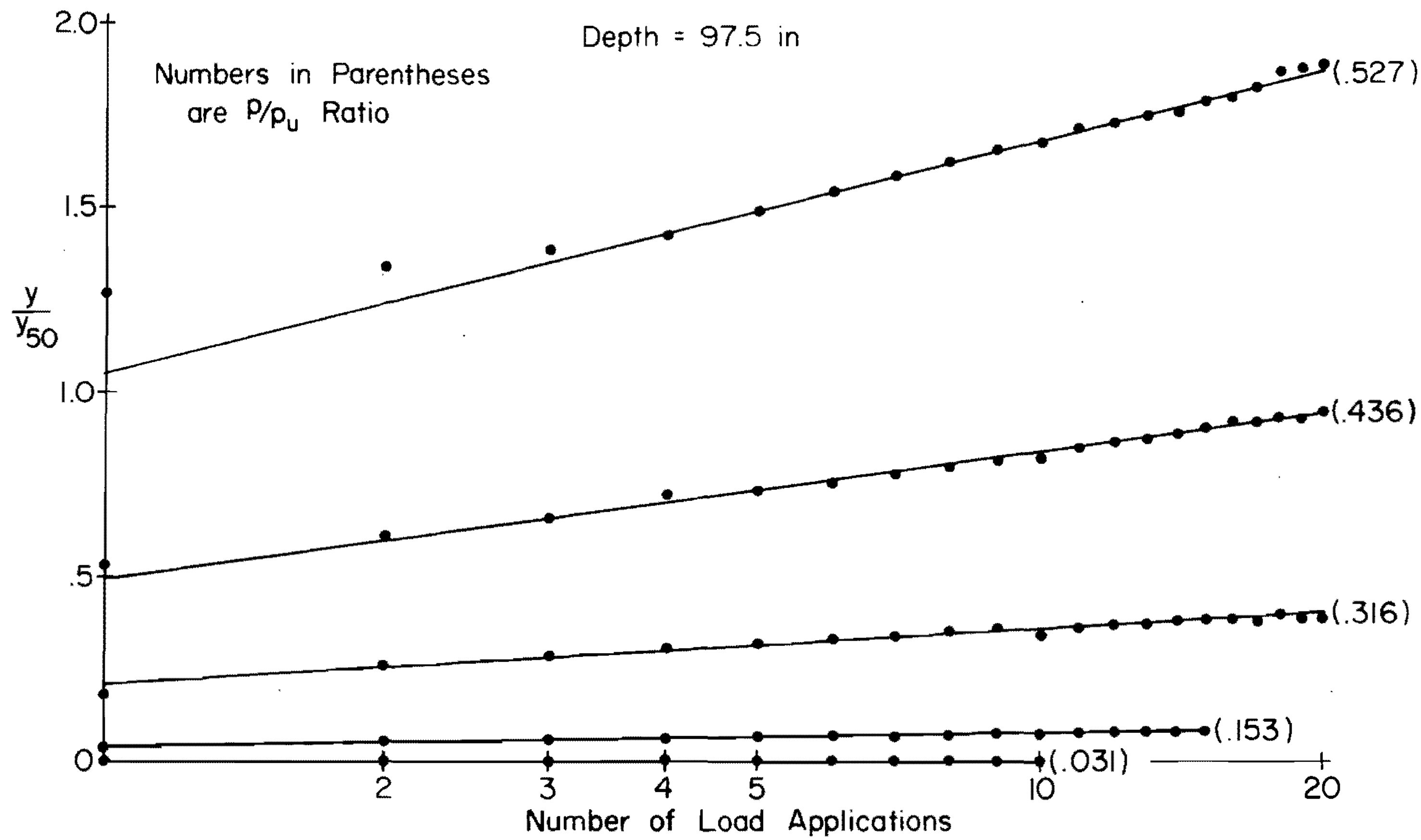


Fig. 7.15h Effect of Stress Level on Deformation Under Repeated Loading, Depth = 97.5 in.

used for computing the plotted points is the value for the initial application of load or 0.375 inches. It can be seen from these plots that the additional deflection for each application of load increases with an increase in stress level. It was noticed, however, that if the increase in deflection after a specific number of cycles is expressed as a percentage of the first cycle deflection, a fairly constant value is obtained. For example, the increase in deflection after 10 cycles of loading is approximately 60 percent of the first cycle deflection. This relationship appears to be independent of stress level.

The deflection of the shaft during the test was not large enough to develop the ultimate soil reaction, and it is felt that the estimated values of p_u are not sufficiently accurate to determine the variation of p_u with depth to an acceptable degree of certainty. It is of interest, however, to compare the estimated values with values predicted by Reese's wedge equation and Matlock's modification of that equation. This comparison is shown in Fig. 7.16. A shear strength of 2200 pounds per square foot (constant with depth) was used for the predicted values.

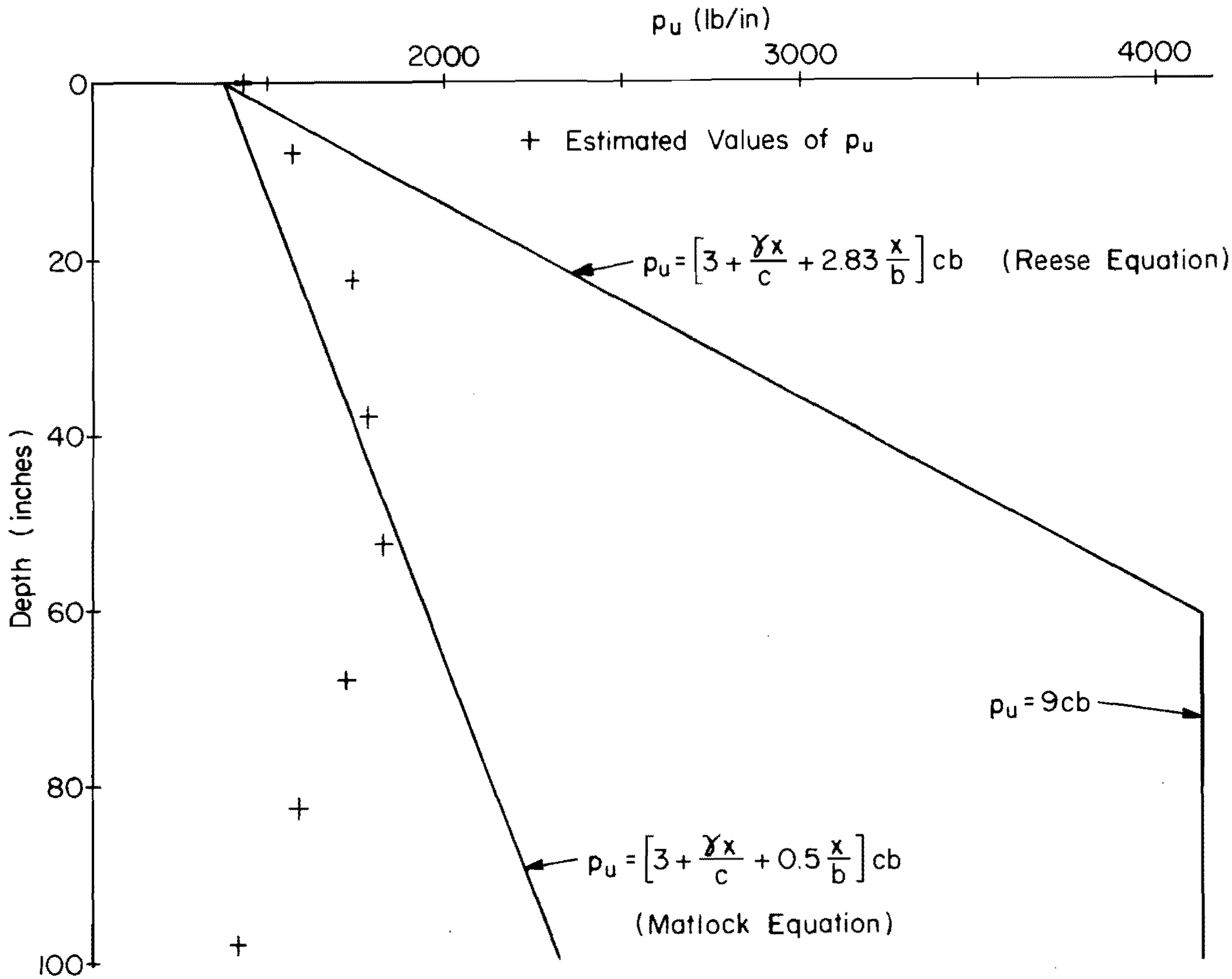


Fig. 7.16 Variation of Ultimate Soil Resistance with Depth

CHAPTER VIII

RESULTS OF LABORATORY TESTS

Unconsolidated-undrained triaxial compression tests were performed on undisturbed samples taken at the test site. The information obtained from these tests consisted of the undrained shear strength and the stress-strain properties of the soil. Several samples were subjected to repeated loading, and the effect on the stress-strain relationship was observed.

Triaxial Compression Tests

In all of the triaxial compression tests performed in this study, the samples were subjected to a confining pressure equal to the effective overburden pressure and tested in the unconsolidated-undrained condition. A controlled-strain loading procedure was used with the strain rate adjusted to 0.005 in/in. per minute.

Anisotropy

The effect of orientation upon soil properties was investigated by testing samples 1.4 inches in diameter by 2.8 inches in length whose axes were both horizontal and vertical. These samples were trimmed from four-inch diameter thin-walled tube samples. Moisture and density were determined from the larger sample before trimming since the measurement of volume would be more accurate for the larger sample. Contrary to expectations, no significant difference was found in sample properties because of orientation. Average values of strength and stiffness differed by only five and two percent, respectively. The stress-strain curves exhibited the same characteristic shape for both orientations. For this study, it was assumed that there was no anisotropy and that tests of vertically oriented samples would measure the properties of the soil under horizontal loading.

Undrained Shear Strength

The values of undrained shear strength were plotted versus depth on the boring log of Fig. 6.1. The strengths in the upper 20 feet, representing the zone most important in lateral behavior, are replotted in Fig. 8.1 with the sample orientation indicated. As can be seen from this plot, there is a wide variation in shear strength, due in part to the slickensided structure, but no discernable pattern of strength variation with depth. The average undrained shear strength in the upper 20 feet is approximately 15.3 pounds per square inch or 2200 pounds per square foot.

Stiffness

A secant modulus intersecting the stress-strain curve at one-half the maximum principal stress difference was used to describe the stiffness of the soil, E_c . These values of E_c are plotted versus depth in Fig. 8.2. The scatter in the data obscures any trend in the top 20 feet but the overall pattern shows a decreasing soil stiffness with depth.

Stress-Strain Relationship

To define the stress-strain relationship in nondimensional terms, the applied principal stress difference (deviator stress) was divided by the maximum principal stress difference and the strain was divided by the strain at one-half the maximum stress difference (ε_{50}). The values of $\varepsilon/\varepsilon_{50}$ were determined at 25 percent, 50 percent, 75 percent, and 100 percent of the maximum principal stress difference for all tests. The values

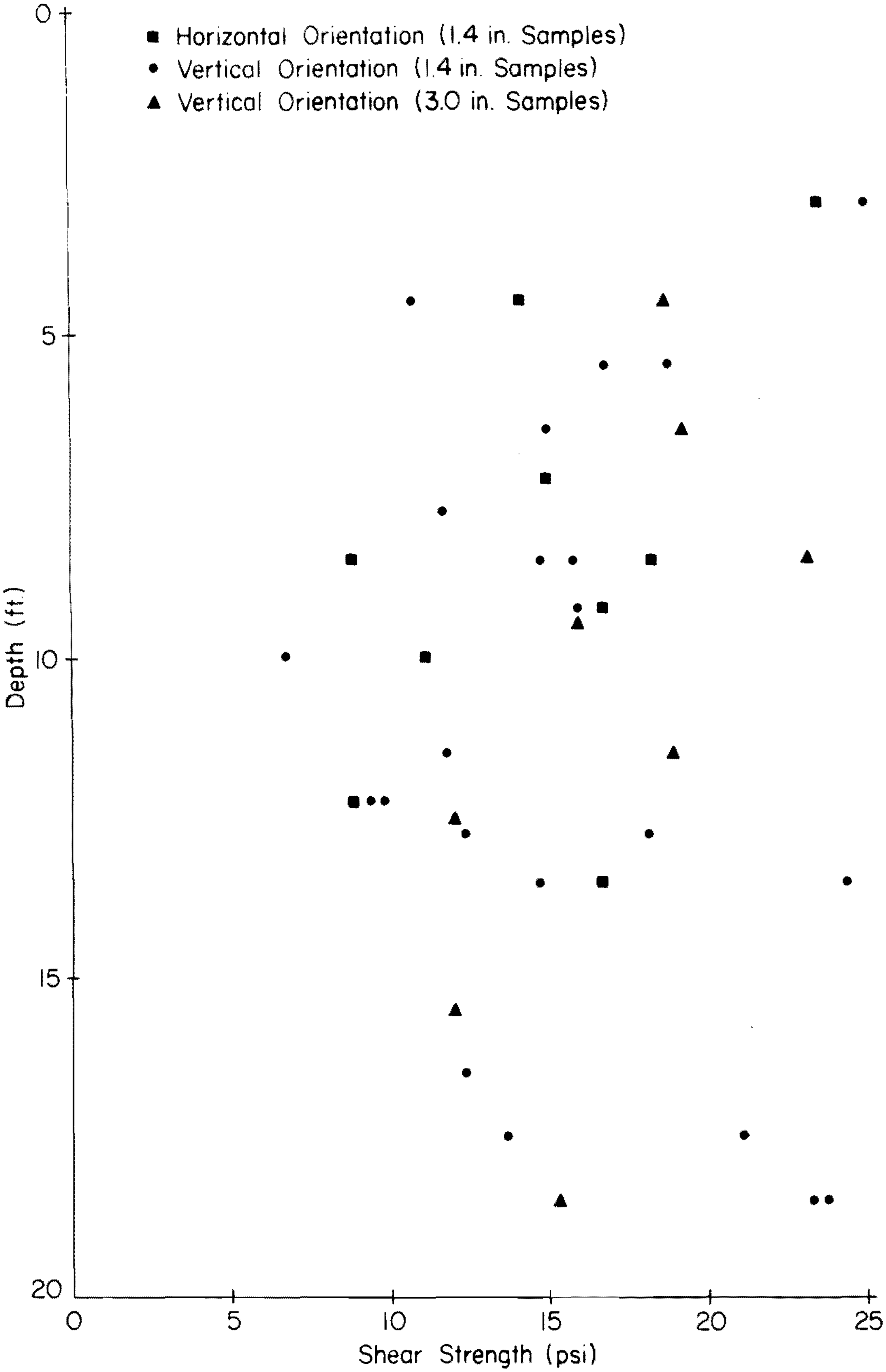


Fig. 8.1 Distribution of Undrained Shear Strength with Depth

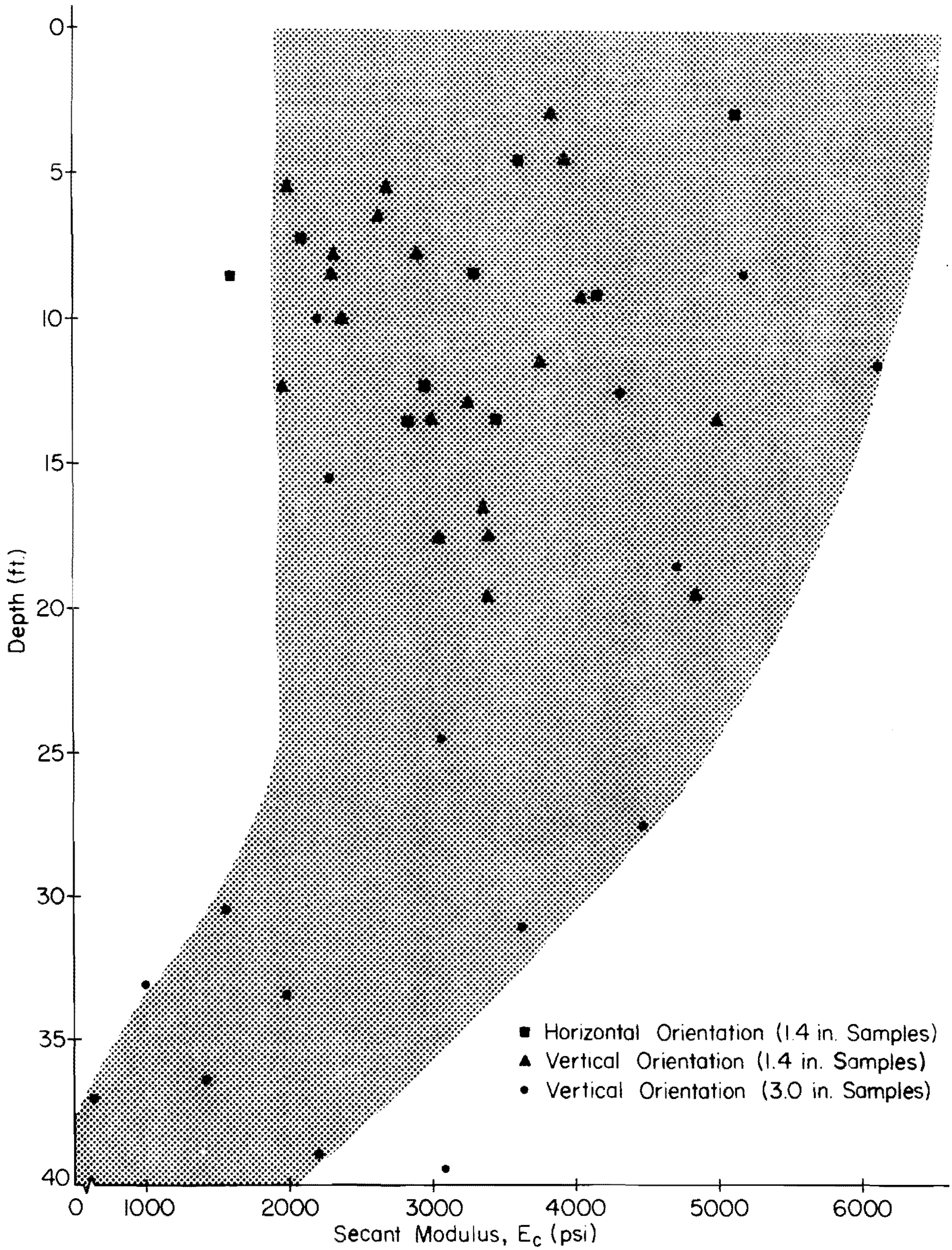


Fig. 8.2 Soil Stiffness Variation with Depth

from tests on 1.4-inch diameter horizontal samples were averaged, as were test values from 1.4-inch diameter vertical samples and 3-inch diameter vertical samples. These average values were plotted on log-log paper as shown in Fig. 8.3 and the equation of the curve was found to be:

$$\frac{(\sigma_1 - \sigma_3)}{(\sigma_1 - \sigma_3)_{max}} = 0.5 \left[\frac{\varepsilon}{\varepsilon_{50}} \right]^{\frac{1}{2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (8.1)$$

The average value of ε_{50} was 0.005 in/in.

Repeated Loading

Several of the samples were subjected to repeated loading. Various stress levels were used and the results are presented in Figures 8.4a - b. It can be seen that the additional deformation under repeated loading is dependent upon the stress level.

At high stress levels, repeated loading will probably reduce the shear strength of the sample, thus giving an erroneous value of the stress ratio. Errors in making deformation measurements at low stress levels will produce scatter in the data, thus leading to the conclusion that the most reliable estimates of behavior under repeated loading can be obtained for stress ratios between, say, 30 percent and 70 percent or perhaps 25 percent and 75 percent.

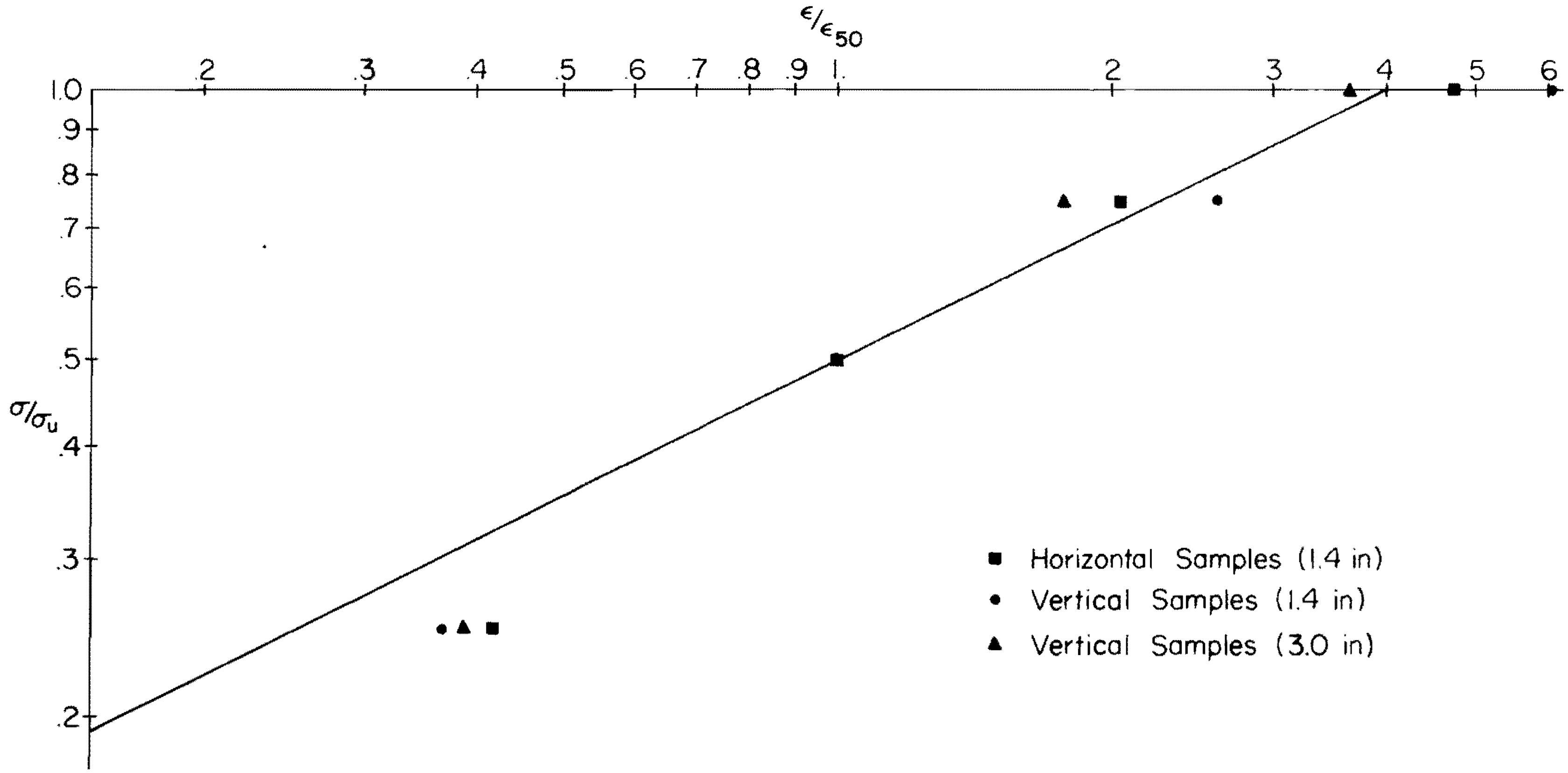


Fig. 8.3 Graphical Determination of Nondimensional Stress-Strain Curve

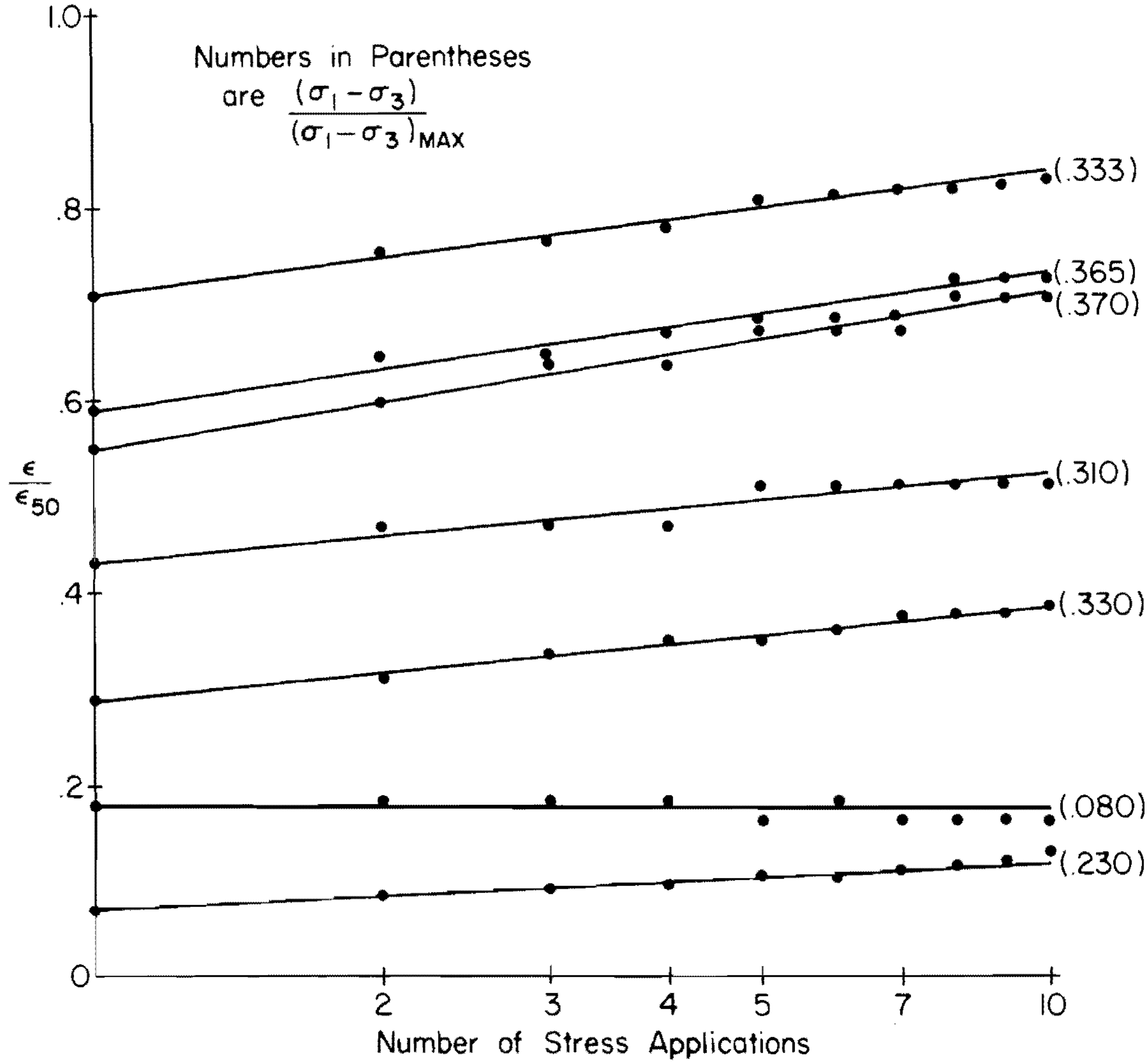


Fig. 8.4a Effect of Stress Level on Deformation Under Repeated Loading

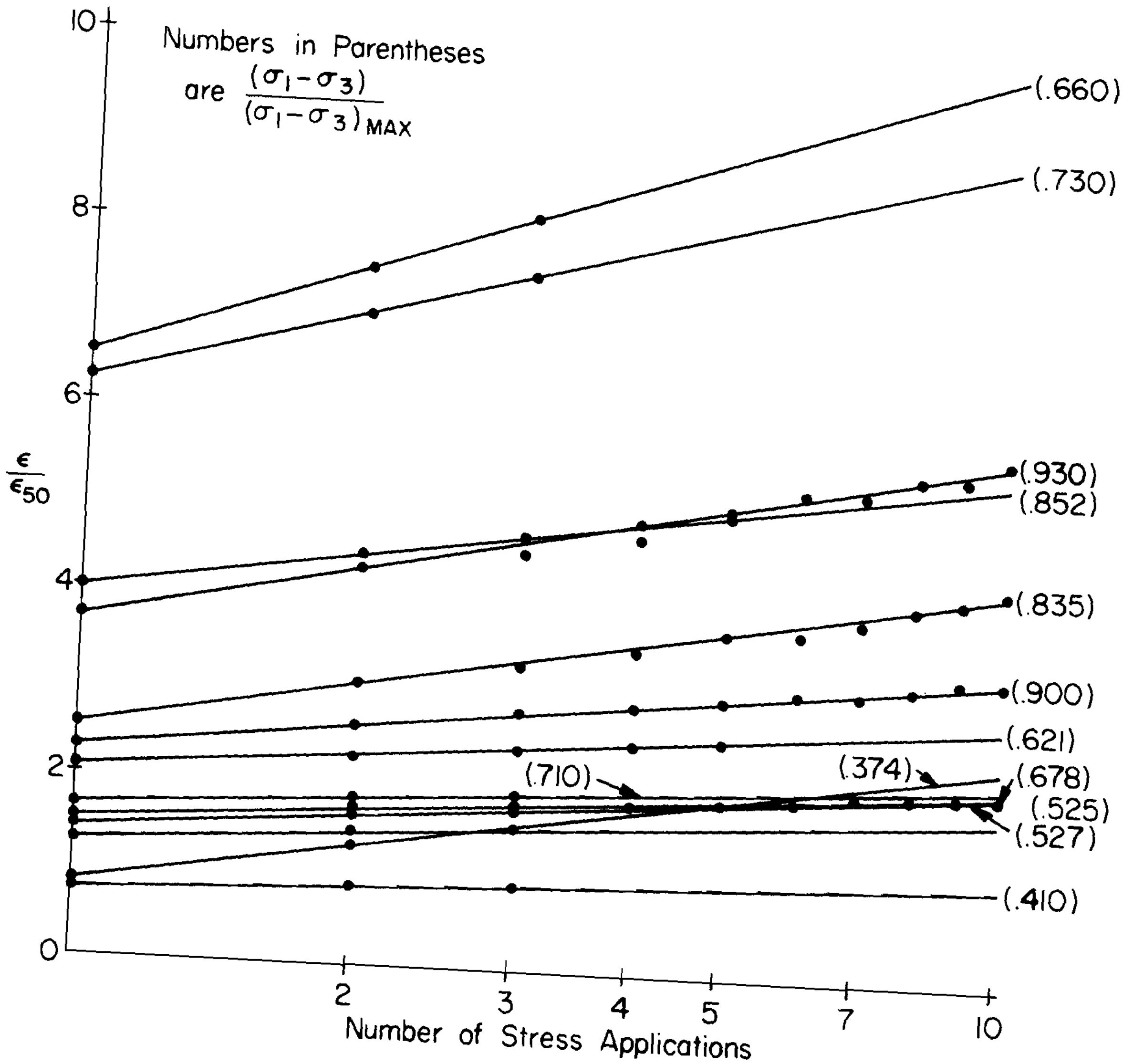


Fig. 8.4b Effect of Stress Level on Deformation Under Repeated Loading

CHAPTER IX

CORRELATION OF FIELD AND LABORATORY TESTS

The soil response observed in the field tests and in the laboratory test was similar in many respects. These similarities will be examined in this section and the field and laboratory results will be correlated.

Load-Deformation Relationships

The analysis of the p-y curves as described in Chapter VII yielded the following nondimensional p-y curves:

$$\frac{p}{p_u} = 0.5 \left[\frac{y}{y_{50}} \right]^{\frac{1}{4}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (7.4)$$

The value of y_{50} was found by Skempton's relationship:

$$y_{50} = 2.5\ b\varepsilon_{50} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (7.3)$$

The nondimensional stress-strain curve obtained from the triaxial compression tests in the laboratory is:

$$\frac{(\sigma_1 - \sigma_3)}{(\sigma_1 - \sigma_3)_{max}} = 0.5 \left[\frac{\varepsilon}{\varepsilon_{50}} \right]^{\frac{1}{2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots (8.1)$$

At a particular stress ratio, or percentage of ultimate resistance, the relationship between field and laboratory deformations is:

$$\left[\frac{y}{y_{50}}\right]^{1/4} = \left[\frac{\varepsilon}{\varepsilon_{50}}\right]^{1/2} \quad \text{. . . . .} (9.1)$$

or

$$\frac{y}{y_{50}} = \left[\frac{\varepsilon}{\varepsilon_{50}}\right]^{2} \quad \text{. . . . .} (9.2)$$

and, since

$$y_{50} = 2.5\ b\varepsilon_{50} \quad \text{. . . . .} (7.3)$$

then

$$y = \left[\frac{2.5\ b}{\varepsilon_{50}}\right] \varepsilon^{2} \quad \text{. . . . .} (9.3)$$

The values of b and ε_{50} will be constant for a specific set of conditions, thus showing (empirically) that the field deflection is proportional to the square of the strain in a laboratory compression test when the stress ratios are equal. The nondimensional stress-strain and p-y curves are shown in Fig. 9.1.

Effect of Repeated Loading

The effect of repeated loading on p-y curves was illustrated in Figures 7.15a - h by plotting y/y_{50} versus the log of the number of load cycles for various stress levels. The same type of relationship between $\varepsilon/\varepsilon_{50}$ and the number of cycles for the laboratory tests was shown in Figures 8.4a - b. The plotted data can be represented by straight lines on these semi-log

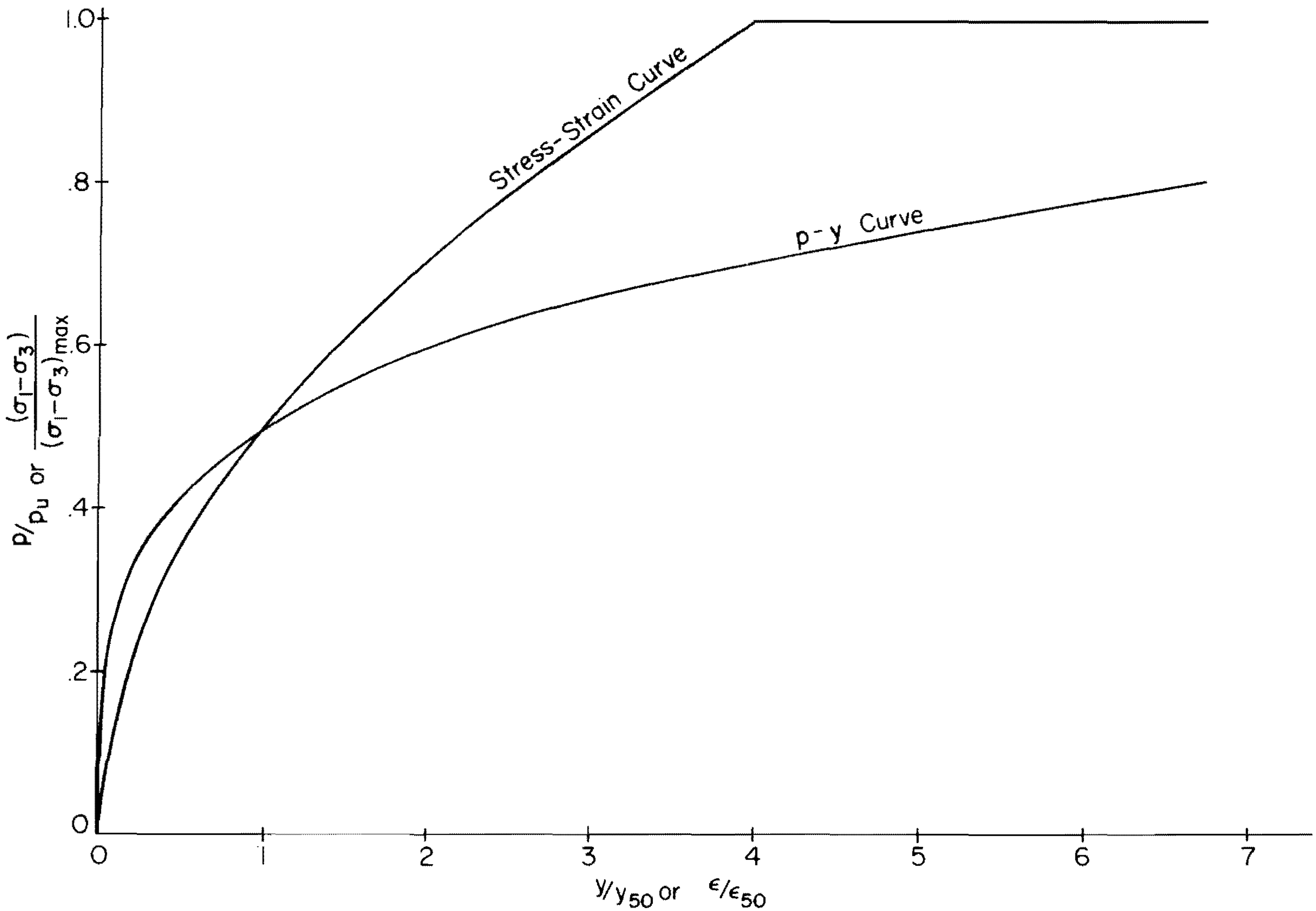


Fig. 9.1 Nondimensional Curves

plots and the relationships can be described by equations of the form:

$$y_c = y_s + y_{50} \cdot C_1 \cdot \log N \quad \text{. . . . . (9.4)}$$

where

y_c = deflection after N cycles of repeated loading,

y_s = deflection upon initial loading,

C_1 = a parameter describing the effect of repeated loading upon deflection, and

N = number of cycles of repeated loading.

or, for the laboratory tests

$$\varepsilon_c = \varepsilon_i + \varepsilon_{50} \cdot C_2 \cdot \log N \quad \text{. . . . . (9.5)}$$

where

ε_c = strain after N cycles of repeated loading,

ε_i = strain upon initial loading, and

C_2 = a parameter describing the effect of repeated loading on strain.

The parameters C_1 and C_2 are functions of the stress ratio and can be determined from the slope of the lines on the semi-log plots. To determine whether or not the values of C_1 and C_2 could be expressed as a relatively simple function of the stress ratio, log-log plots were made (see Fig. 9.2a - b). Although there is some scatter in the data, it appears that C_1 and C_2 are the same function of the stress ratio and can be described by the following expression:

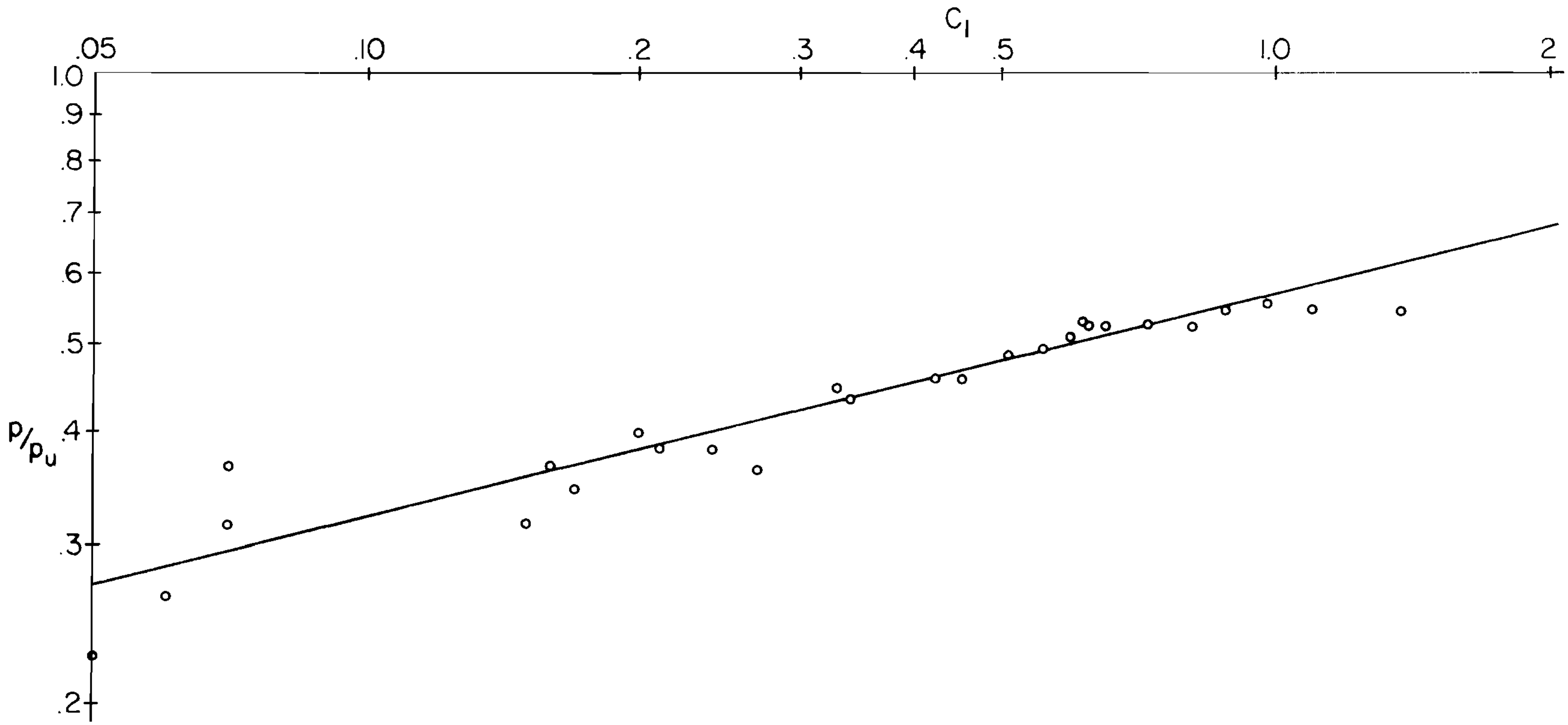


Fig. 9.2a Graphical Determination of Repeated Loading

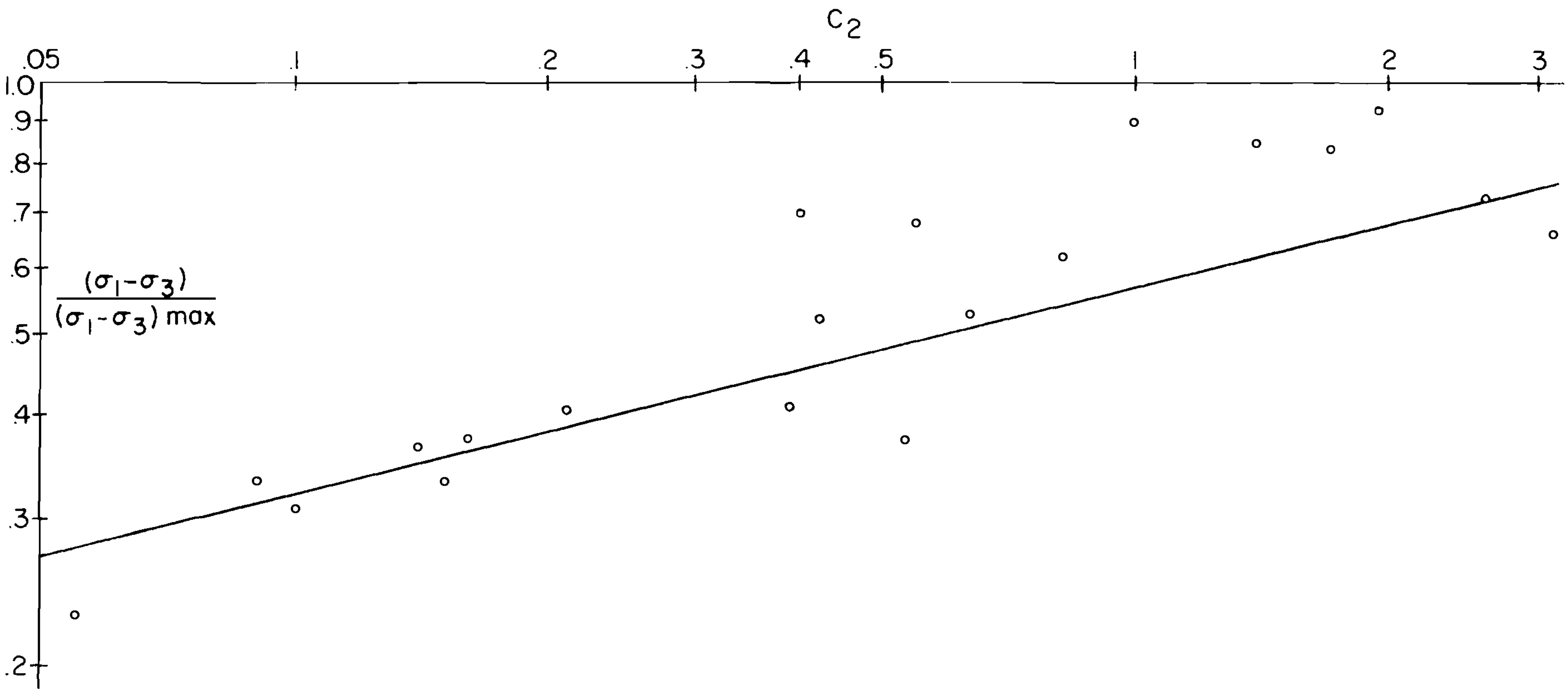


Fig. 9.2b Graphical Determination of Repeated Loading

$$C = 9.6\ R^4 \quad \ldots\ldots \quad (9.6)$$

where

$C = C_1 = C_2 =$ a parameter describing the effect of repeated loading upon deformation,

and

$$R = \frac{p}{p_u} = \frac{(\sigma_1 - \sigma_3)}{(\sigma_1 - \sigma_3)_{max}} = \text{stress ratio}$$

The effect of the stress level upon deformation under repeated loading is illustrated graphically in Fig. 9.3 by a plot of Eq. 9.6.

The p-y curves for short-term static loading and for repeated loading can be predicted using the empirical relationships developed. The necessary laboratory tests would consist of (1) conventional compression tests to define the short-term static stress-strain relationships and (2) enough repeated-loading compression tests at various stress levels to define the parameter C as a function of the stress ratio.

In this study, the relationships described by Equations 7.4 and 9.6 can be expressed in terms of the fourth power of p/p_u. It is interesting to do so and evaluate the resulting expressions. The following equations result:

$$C = 0.60 \left[\frac{y}{y_{50}} \right] \quad \ldots\ldots \quad (9.7)$$

or, substituting in Eq. 9.4

$$y_c = y_s\ (1 + 0.6 \log N) \quad \ldots\ldots \quad (9.8)$$

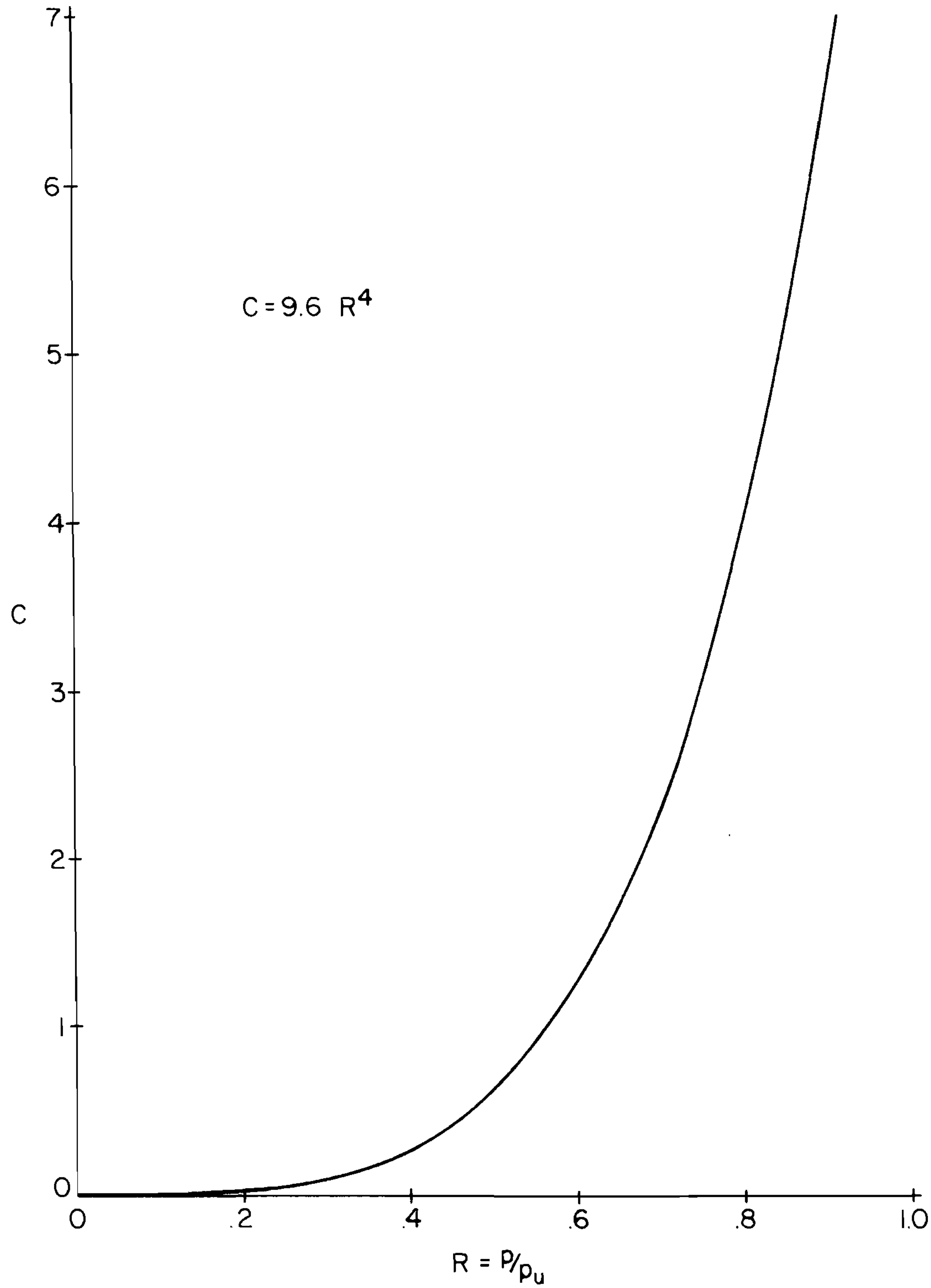


Fig. 9.3 Stress Ratio - Parameter C Relationship

which shows an increase of 60 percent over the initial cycle deflection for 10 repetitions of load.

The correlations made in this chapter are based upon 20 cycles of loading in the field test with a maximum stress ratio of slightly less than 60 percent, and 10 cycles of loading in the laboratory tests with a fairly wide range of values of stress ratio. Although these correlations are believed to be valid for the test conditions, caution should be used in extrapolating the results, especially to higher stress ratios.

Verification of Proposed Criteria

To verify the criteria proposed for determining the response of the foundation system to repetitive loading, the criteria were applied to the test shaft and the computed values of moment and deflection were compared to the measured values. Table 9.1 shows a comparison of maximum moments and deflection of the shaft at the groundline for several different loads and cycles of load application. Moment versus depth curves are compared in Fig. 9.4 for the initial application of 10 tons, 30 tons, and 50 tons, and for the twentieth application of 50 tons.

The greatest difference in computed and measured moments occurs for the 30-ton loadings and illustrates the difficulty in determining the flexural stiffness during the transition from an uncracked section to a cracked section. The overall agreement between measured and computed values is reasonably good.

A detailed procedure for the application of the proposed criteria is given in Chapter X. Computer program LLP, developed by Awoshika and Reese (1971) was used to compute the values used for comparison with the measured values.

TABLE 9.1 COMPARISON OF COMPUTED AND MEASURED VALUES OF DEFLECTION AND MOMENT

LOAD (Tons)	CYCLE	TOP DEFLECTION (inches)		MAXIMUM MOMENT (in-lb x 10^6)	
		Measured	Computed	Measured	Computed
10	1	.020	.027	.583	.539
10	10	.020	.037	.580	.595
20	1	.090	.114	1.33	1.62
20	10	.118	.139	1.43	1.71
30	1	.254	.292	2.39	2.81
30	10	.358	.368	2.65	3.11
30	20	.390	.406	2.77	3.27
40	1	.586	.540	3.88	4.04
40	10	.794	.668	4.35	4.44
40	20	.870	.748	4.47	4.72
50	1	1.16	.875	5.55	5.53
50	10	1.43	1.05	6.04	5.98
50	20	1.56	1.14	6.23	6.23

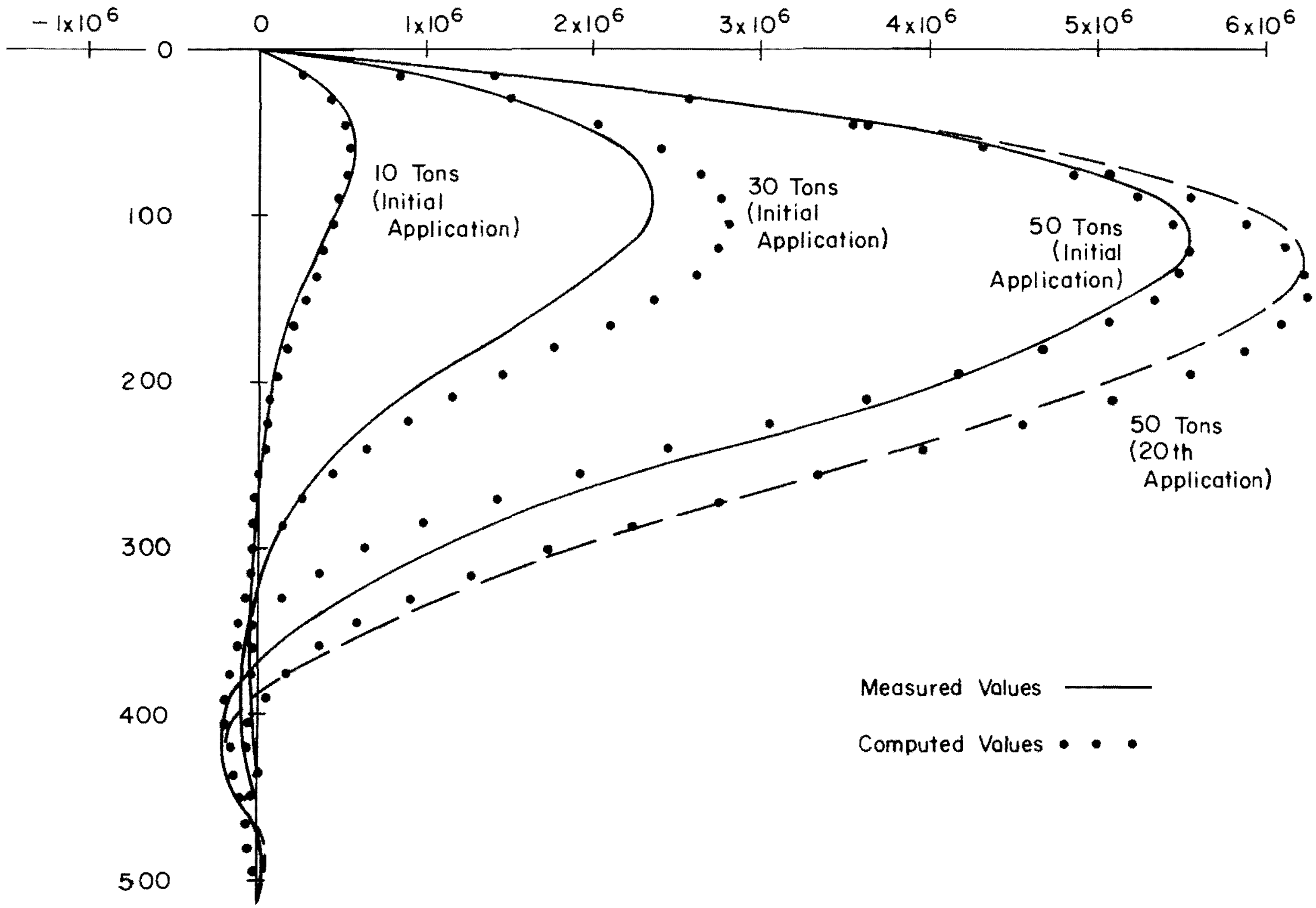


Fig. 9.4 Computed and Measured Values of Moment vs. Depth

Comparison With Other Criteria

Other criteria have been suggested for predicting p-y curves. The correlation for short-term static loading will be compared to some of these criteria. The predicted p-y curves are plotted in Fig. 9.5.

McClelland and Focht (1958) present criteria based upon a direct correlation with a laboratory stress-strain curve. Their equations for ultimate resistance, soil reaction, and deflection are:

$$p_u = 11\ cb \quad (9.9)$$

$$p = 5.5\ (\sigma_1 - \sigma_3)\ b \quad (9.10)$$

$$y = 0.5\ \varepsilon b \quad (9.11)$$

where

p	=	soil reaction,
y	=	deflection corresponding to p,
$(\sigma_1 - \sigma_3)$	=	principal stress difference in a laboratory compression test,
ε	=	strain corresponding to $(\sigma_1 - \sigma_3)$, and
b	=	diameter of shaft or pile.

Matlock (1970) suggests a characteristic shape for the p-y curves with the shear strength and the strain at one-half the maximum principal stress difference determining the magnitude of the values. The equations he presents are:

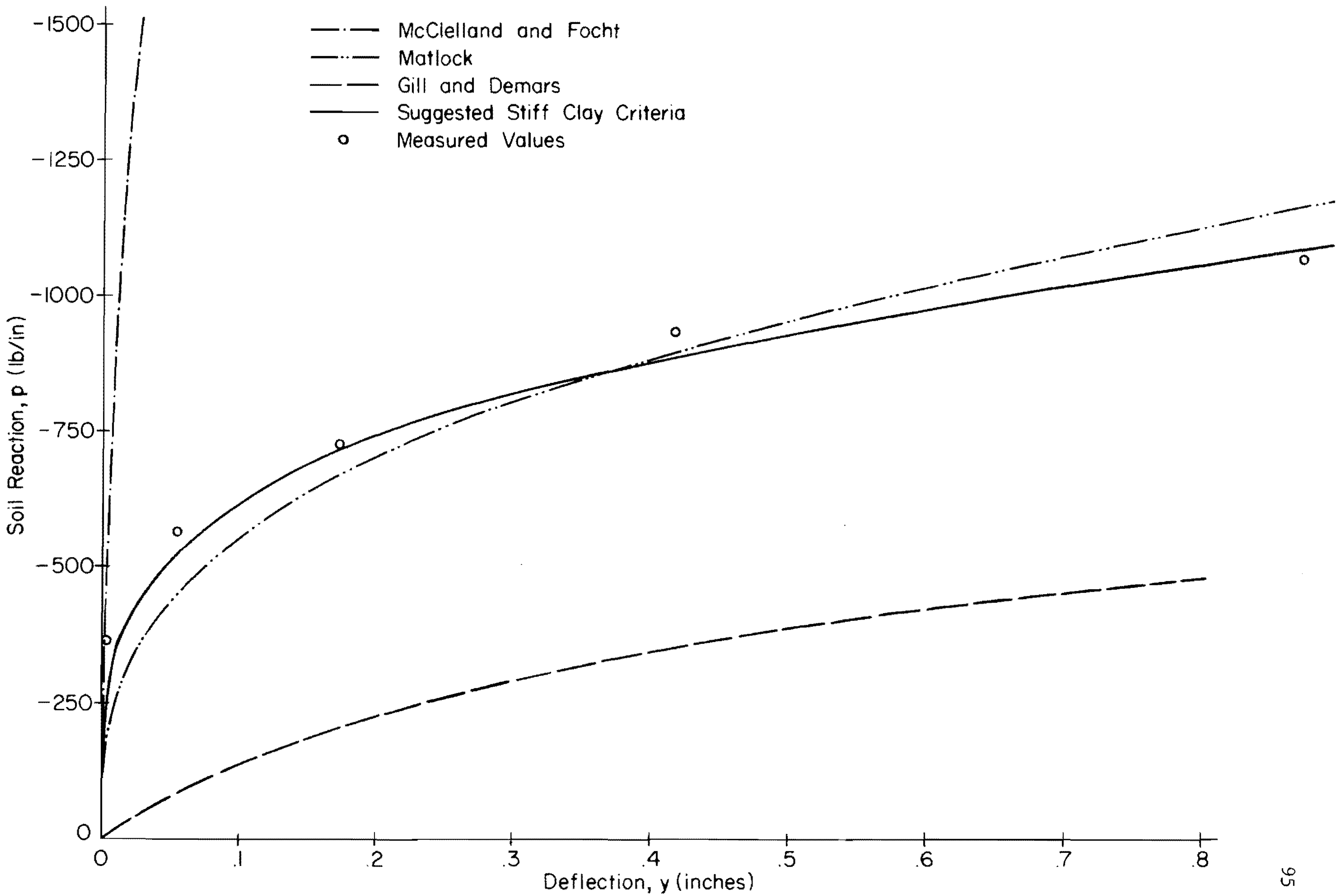


Fig. 9.5 Comparison of Various Criteria

$$p_u = \left[3 + \frac{\gamma}{c} x + \frac{0.5}{b} x\right] cb \quad \ldots \quad (9.12)$$

$$y_{50} = 2.5\ \varepsilon_{50} b \quad \ldots \quad (9.13)$$

$$\frac{p}{p_u} = 0.5 \left[\frac{y}{y_{50}}\right]^{\frac{1}{3}} \quad \ldots \quad (9.14)$$

Gill and Demars (1970) present equations describing a hyberbolic relationship between p and y. The equations for cohesive soil are:

$$p_u = 0.25 \left(\frac{x}{\sqrt{b}}\right) b \quad \ldots \quad (9.15)$$

$$E_{si} = 100c \quad \ldots \quad (9.16)$$

$$\frac{y}{p} = \frac{1}{E_{si}} + \frac{y}{p_u} \quad \ldots \quad (9.17)$$

where

E_{si} = the slope of the p-y curve at the origin.

The soil properties used in calculating the curves shown in Fig. 9.5 are given below.

Unit weight , γ = 110 lbs/cu. ft.

Shear strength, c = 2200 lbs/sq. ft.

Strain at one-half the maximum principal stress difference, ε_{50} = 0.005 in/in.

It was assumed that the laboratory stress strain curve could be represented by the equation:

$$\frac{(\sigma_1 - \sigma_3)}{(\sigma_1 - \sigma_3)_{max}} = 0.5 \left[\frac{\varepsilon}{\varepsilon_{50}} \right]^{\frac{1}{2}} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (8.1)$$

The width of the shaft used in the calculations was 30 inches. A depth of 37.5 inches was used and, for comparison, the measured values of p and y are shown on the plot.

CHAPTER X

PROCEDURES FOR PREDICTING SOIL RESPONSE

In this chapter, detailed procedures will be presented for predicting p-y curves for soft clay, stiff clay, and sand. These methods are believed to be the best now available, representing the current state-of-the-art.

Soft Clay-Short-Term Static Loads

Matlock's (1970) criteria are believed to be the best available for soft clays. For short-term static loading, the step-by-step procedure for calculating p-y curves is given below.

1. Obtain the best possible estimate of the variation of shear strength and effective unit weight with depth, and the value of ε_{50}, the strain corresponding to one-half the maximum principal stress difference (the principal stress difference is sometimes called the deviator stress). If no values of ε_{50} are available, typical values suggested by Skempton (1951) are given below.

Consistency of Clay	ε_{50}	E/c
Soft	0.020	50
Medium	0.010	100
Stiff	0.005	200

2. Calculate the ultimate soil resistance per unit length of shaft, p_u, using the smaller of the values given by the equations below.

$$p_u = \left[3 + \frac{\gamma}{c} x + \frac{0.5}{b} x\right] cb \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (10.1)$$

$$p_u = 9 \text{ cb} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (10.2)$$

where

γ = average effective unit weight from ground surface to p-y curve,

x = depth from ground surface to p-y curve,

c = average shear strength from ground surface to depth x,

b = width of shaft.

3. Calculate the deflection, y_{50}, at one-half the ultimate soil resistance from the following equation:

$$y_{50} = 2.5\ \varepsilon_{50}\ b \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (10.3)$$

4. Points describing the p-y curve are now calculated from the relationship below.

$$\frac{p}{p_u} = 0.5 \left(\frac{y}{y_{50}}\right)^{\frac{1}{3}} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (10.4)$$

<u>Soft Clay-Cylic Loads</u>

The effect of cyclic loading as presented by Matlock (1970) will be described in this section since the criteria developed in this study for stiff clays have not been verified for soft clays.

1. Construct the p-y curve in the same manner as for short-term static loading for values of p less than 0.72 p_u.
2. Solve Equations 10.1 and 10.2 simultaneously to find the depth, x_r, where the transition from wedge failure to flow-around failure is assumed to occur. If the unit weight and shear strength are constant in the upper zone, then

$$x_r = \frac{6cb}{(\gamma b + 0.5c)} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (10.5)$$

3. If the depth to the p-y curve is greater than or equal to x_r, then p is equal to 0.72 p_u for all values of y greater than $3 \cdot y_{50}$.
4. If the depth to the p-y curve is less than x_r, then the value of p decreases from 0.72 p_u at y = 3 y_{50} to the value given by the expression below at y = 15 y_{50}.

$$p = 0.72\, p_u \left(\frac{x}{x_r} \right) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (10.6)$$

The value of p remains constant beyond y = 15 y_{50}.

Stiff Clay-Short-Term Static Loads

The correlations developed in this study will provide the basis for the methods for predicting behavior in stiff clay.

1. Obtain the best possible estimate of the variation of shear strength and effective unit weight with depth, and the value of ε_{50}, the strain corresponding to one-half the maximum

principal stress difference. If no value of ϵ_{50} is available, use a value of 0.005 or 0.010, the larger value being more conservative.

2. Calculate the ultimate soil resistance per unit length of shaft, p_u, using the smaller of the values given by the equations below.

$$p_u = \left[3 + \frac{\gamma}{c} x + \frac{0.5}{b} x\right] c\ b \quad \text{. . . . . (10.1)}$$

$$p_u = 9\ c\ b \quad \text{. . . . . (10.2)}$$

where

γ = average effective unit weight from ground surface to p-y curve,

c = average shear strength from ground surface to depth x,

b = width of shaft.

3. Calculate the deflection, y_{50}, at one-half the ultimate soil resistance from the following equation.

$$y_{50} = 2.5\ \epsilon_{50} b \quad \text{. . . . . (10.3)}$$

4. Points describing the p-y curve are now calculated from the relationship below.

$$\frac{p}{p_u} = 0.5 \left(\frac{y}{y_{50}} \right)^{\frac{1}{4}} \quad \text{. (10.7)}$$

5. Beyond $y = 16\ y_{50}$, p is equal to p_u for all values of y.

Stiff Clay-Cyclic Loads

The effect of repeated loading is predicted by the following procedure.

1. Determine the p-y curve for short-term static loading by the procedure previsouly given.
2. Determine the number of times the design lateral load will be applied to the shaft.
3. For several values of p/p_u obtain the value of C, the parameter describing the effect of repeated loading on deformation, from a relationship developed by laboratory test, or in the absence of tests, from Fig. 9.3.
4. At the values of p corresponding to the values of p/p_u selected in Step 3, calculate new values of y for cyclic loading from the following equation.

$$y_c = y_s + y_{50} \cdot C \cdot \log N \quad \ldots\ldots\ldots\ldots\ldots (10.8)$$

where

y_c = deflection under N cycles of load,

y_s = deflection under short-term static load,

y_{50} = deflection under short-term static load at one-half the ultimate resistance,

N = number of cycles of load application.

5. The $p\text{-}y_c$ curve defines the soil response after N cycles of load.

Sand-Short-Term Static Loads

The criteria for sand presented by Parker and Reese (1970) are the most current. Their procedure is given below.

1. Obtain the best possible estimate of the variation of effective unit weight and angle of internal friction with depth. If compression tests are performed, determine Young's modulus.

2. Calculate the values of the earth pressure coefficients from the following equations.

$$K_A = \tan^2 (45° - \phi/2) \quad \text{. . . . .(10.9)}$$

$$K_P = \tan^2 (45° + \phi/2) \quad \text{. . . . . (10.10)}$$

$$K_O = 0.5 \text{ (for dense or medium sand)}$$

$$= 0.4 \text{ (for loose sand)}$$

where

K_A = active earth pressure coefficient,

K_P = passive earth pressure coefficient,

K_O = earth pressure coefficient at rest,

ϕ = angle of internal friction.

3. Determine the ultimate soil resistance by the two equations below. Use the smaller value.

$$p_u = \gamma x \left[b \, (K_P - K_A) + xK_P \, (\tan\alpha \tan\beta) \right.$$

$$\left. + \, xK_O \tan \beta \, (\tan\phi - \tan\alpha) \right] \quad \text{. . . . . (10.11)}$$

$$p_u = \gamma x\ b\ (K_P^3 + 2K_P^2 K_O \tan\phi - K_A) \quad (10.12)$$

where

γ = average effective unit weight from the ground surface to depth x,

x = depth to p-y curve,

b = width of shaft,

α = angle defining the shape of the wedge. Use $\alpha = \phi/2$ for dense or medium sand and $\alpha = \phi/3$ for loose sand.

β = angle from bottom of wedge to vertical. Use $\beta = 45° + \phi/2$.

4. If values of Young's modulus were not obtained from laboratory tests, Terzaghi (1955) suggests that a reasonable value can be obtained from the expression below.

$$E_m = J\gamma x \quad (10.13)$$

where

E_m = Young's modulus for the soil,

γ = average effective unit weight,

x = depth to p-y curve,

J = empirical factor. Use J = 200 for loose sand, J = 600 for medium sand, and J = 1500 for dense sand.

5. Define the initial slope of the p-y curve, E_{si}, by using the following equation.

$$E_{si} = \frac{E_m}{1.35} \quad \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \quad (10.14)$$

6. Determine p and y values defining the curve from the hyperbolic relationship below.

$$p = p_u \tanh \frac{\left(E_{si} y\right)}{p_u} \quad \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \quad (10.15)$$

Sand-Cyclic Loads

No criteria are available for predicting the response of sand to repeated loading. According to Davisson and Salley (1968), cyclic loading causes deflections to double and bending moments to increase 20 to 50 percent, approximately, compared to the values for the first cycle of load.

CHAPTER XI

CONCLUSIONS AND RECOMMENDATIONS

The conclusions reached during this study are presented in this chapter. Recommendations are given for adding to the information developed by the field and laboratory tests described in previous chapters.

Conclusions

1. The soil response to short-term static loading and repeated loading was successfully measured. Bending strains in the shaft were measured by the strain gages mounted on the embedded instrument column and load, deflection, and top slope were measured by transducers and other measuring devices at the ground surface. Calibration tests furnished data to convert bending strains into bending moments. A seventh-order polynomial fitted to the observed moment versus depth data by least squares satisfactorily describes the measured values. Integration and differentiation of the fitted polynomial, using known boundary conditions, yield values of soil reaction and deflection. The soil reaction-deflection relationships or p-y curves describe the soil response.

2. A correlation was observed between field and laboratory test results for both short-term static loading and for repeated loading. For short-term static loading, the deflection of the shaft was found to be proportional to

the square of the strain in a laboratory compression test when the ratio of applied stress to ultimate stress was the same for both field and laboratory test. It was found that the effect of repeated loading on deflection can be described by a soil parameter determined by repetitive loading in a laboratory compression test. The increase in deflection under repeated applications of a constant load was proportional to the logarithm of the number of load applications in both field and laboratory tests.

3. A procedure was developed to predict the response of stiff clay to short-term static loading and repeated loading. For short-term loading, stress-strain properties of the soil are determined by a laboratory compression test and are applied to field conditions by means of the correlations developed in this study. To determine the effect of repeated loading, the repeated loading soil parameter is determined by a series of repeated loading compression tests at various stress levels. This parameter, along with the predicted response under short-term static loading may be used to predict the soil response for any desired number of applications of load. Details of these procedures for predicting p-y curves along with a state-of-the-art presentation of procedures for other soil types are given in Chapter X.

4. The procedures and correlations developed in this study are believed to be valid for stiff clays. The extrapolation of these procedures to a significantly greater number of load applications than were used in the tests or to different soil conditions should be done with caution.

<u>Recommendations for Future Study</u>

The test conditions were necessarily limited in scope. To develop a full understanding of soil response under any loading condition more data and analyses are required. Some of the parameters which should be varied are given in the following recommendations.

1. Instrumented tests should be performed in many different soil types before adopting design procedures.
2. The tests should be carried through a greater number of load applications, or alternatively, an instrumented structure could be monitored in service.
3. Stress levels nearer the ultimate soil resistance should be applied, to examine possible effects of cyclic loading on ultimate resistance and deformations.
4. The permanent deformation of the soil adjacent to the shaft occurring with lateral loading will obviously have an effect on the axial load transfer. Tests combining axial and vertical loads could examine this effect.

REFERENCES

Alizadeh, M. (1968), "Lateral Load Tests on Instrumented Timber Piles," Special Technical Publication 444, American Society for Testing and Materials, 1968, pp. 379-384.

Alizadeh, M. and M. T. Davisson (1970), "Lateral Load Tests on Piles - Arkansas River Project," Journal of the Soil Mechanics and Foundations Division, American Society of Civil Engineers, September, 1970, pp. 1583-1627.

Biot, M. A. (1937), "Bending of an Infinite Beam on an Elastic Foundation," Journal of Applied Mechanics, American Society of Mechanical Engineers, Vol. 59, 1937, pp. A1-A7.

Bowman, Elliott R. (1958), "Investigation of the Lateral Resistance to Movement of a Plate in Cohesionless Soil," Thesis submitted to The University of Texas at Austin, 1985.

Coyle, H. M. and Lymon C. Reese (1966), "Load Transfer for Axially Loaded Piles in Clay," Journal of the Soil Mechanics and Foundations Division, American Society of Civil Engineers, November, 1967, pp. 261.

Cummings, A. E. (1937), "Discussion of Lateral Pile Loading Tests," Transactions, American Society of Civil Engineers, Vol. 63, No. 8, Part 2, 1937, pp. 255-264.

Davisson, M. T. (1960), "Behavior of Flexible Vertical Piles Subjected to Moment, Shear and Axial Load," Ph.D. Thesis, University of Illinois, Urbana, Illinois, 1960.

Davisson, M. T. and J. R. Salley (1968), "Lateral Load Tests on Drilled Piers," Special Technical Publication 444, American Society for Testing and Materials, 1968, pp. 68-84.

Feagin, L. B. (1937), "Lateral Pile Loading Tests," Transactions, American Society of Civil Engineers, Vol. 63, No. 8, Part 2, 1937, pp. 236-254.

Focht, John A. and Bramlette McClelland (1955), "Analysis of Laterally Loaded Piles by Difference Equation Solution," The Texas Engineer, Texas Section, American Society of Civil Engineers, September, October, November, 1955.

Gill, H. L. and K. R. Demars (1970), "Displacement of Laterally Loaded Structures in Nonlinearly Responsive Soil," Technical Report R670, Naval Civil Engineering Laboratory, Port Hueneme, California, 1970.

Gleser, Sol M. (1953), "Lateral Load Tests on Vertical Fixed-Head and Free-Head Piles," Special Technical Publication 154, American Society for Testing and Materials, 1953, pp. 75.

Hetenyi, M. (1946), Beams on Elastic Foundation, University of Michigan Press, Ann Arbor, Michigan, 1946.

Kocsis, Peter,(1968), Lateral Loads on Piles, Bureau of Engineering, Chicago, Illinois, 1968.

Mansur, Charles I. and Alfred H. Hunter (1970), "Pile Tests - Arkansas River Project," Journal of the Soil Mechanics and Foundations Division, American Society of Civil Engineers, September, 1970, pp. 1545-1582.

Mason, H. G. and J. A. Bishop (1954), "Measurement of Earth Pressure and Deflection along the Embedded Portion of a Forty-Foot Steel Pile," Special Technical Publication 154, American Society for Testing and Materials, 1954, pp. 1.

Matlock, Hudson (1970), "Correlations for Design of Laterally Loaded Piles in Soft Clay," presented at the Second Annual Offshore Technology Conference, Houston, Texas, 1970.

Matlock, Hudson, Rachid Abdel-Raoof, and John J. Panak (Research in Progress), "A Computer Program for Nonlinear Bending and Support Analysis for Beam-Columns," Center for Highway Research, The University of Texas at Austin.

Matlock, Hudson and Lymon C. Reese (1960), "Generalized Solutions for Laterally Loaded Piles," Journal of the Soil Mechanics and Foundations Division, American Society of Civil Engineers, October, 1960, pp. 63.

Matlock, Hudson and Lymon C. Reese (1961), "Foundations Analysis of Offshore Pile-Supported Structures," Proceedings of the Fifth International Conference, International Society of Soil Mechanics and Foundation Engineering, Paris, Vol. 2, 1961, pp. 91.

Matlock, Hudson and E. A. Ripperger (1956), "Procedures and Instrumentation for Tests on a Laterally Loaded Pile," Proceedings, Eighth Texas Conference on Soil Mechanics and Foundation Engineering, Austin, Texas, 1956.

Matlock, Hudson and E. A. Ripperger (1958), "Measurements of Soil Pressure on a Laterally Loaded Pile," Proceedings, American Society for Testing and Materials, 1958.

McCammon, G. A. and J. C. Ascherman (1953), "Resistance of Long Hollow Piles to Applied Lateral Loads," Special Technical Publication 154, American Society for Testing and Materials, 1953, pp. 3-11.

McClelland, B. and J. A. Focht (1958), "Soil Modulus for Laterally Loaded Piles," Transactions, American Society of Civil Engineers, Vol. 123, 1958, pp. 1071-1074.

McNulty, James F. (1956), "Thrust Loading on Piles," Journal of the Soil Mechanics and Foundations Division, American Society of Civil Engineers, April, 1956.

O'Neill, Michael W. and Lymon C. Reese (1971), "Behavior of Axially Loaded Drilled Shafts in Beaumont Clay," Research Report 89-8, Center for Highway Research, The University of Texas at Austin.

Osterberg, J. O. (1958), "Lateral Stability of Poles Embedded in a Clay Soil," Northwestern University Project 208, Bell Telephone Laboratories, Evanston, Illinois, December, 1958.

Palmer, L. A. and P. P. Brown (1954), "Piles Subjected to Lateral Thrust," Special Technical Publication 154-A, American Society for Testing and Materials, 1954, pp. 22-31.

Parker, Frazier Jr. and Lymon C. Reese (1971), "Experimental and Analytical Studies of Behavior of Single Piles in Sand Under Lateral and Axial Loading," Research Report 117-2, Center for Highway Research, The University of Texas at Austin, 1971.

Reese, Lymon C. (1958), Discussion of "Soil Modulus for Laterally Loaded Piles," by McClelland and Focht, Transactions, American Society of Civil Engineers, Vol. 123, 1958, pp. 1071.

Reese, Lymon C. (1962), "Ultimate Resistance Against a Rigid Cylinder Moving Laterally in a Cohesionless Soil," Journal, Society of Petroleum Engineers, December, 1962, pp. 355.

Reese, Lymon C. and William R. Cox (1969), "Soil Behavior from Analysis of Tests of Uninstrumented Piles Under Lateral Loading," Special Technical Publication 444, American Society for Testing and Materials, 1969, pp. 160.

Reese, Lymon C. and Hudson Matlock (1956), "Non-Dimensional Solutions for Laterally Loaded Piles with Soil Modulus Assumed Proportional to Depth," Proceedings, Eighth Texas Conference on Soil Mechanics and Foundation Engineering, Austin, Texas, 1956.

Reese, Lymon C. and Hudson Matlock (1960), "Numerical Analysis of Laterally Loaded Piles," Proceedings, Second Structural Division Conference on Electronic Computation, American Society of Civil Engineers, Pittsburg, Pennsylvania, 1960, pp. 657.

Skempton, A. W. (1951), "The Bearing Capacity of Clays," Proceedings, Building Research Congress, Division I, London, 1951.

Teng, Wayne C. (1962), Foundation Design, Prentice Hall, Englewood Cliffs, New Jersey, 1962.

Terzaghi, Karl (1955), "Evaluation of Coefficient of Subgrade Reaction," Geotechnique, Vol. 5 No. 4, December, 1955, pp. 297.

Vesic, Aleksander S. (1961), "Bending of Beams Resting on Isotropic Elastic Solid," Journal of the Engineering Mechanics Division, American Society of Civil Engineers, 1961.

Winkler, E. (1867), Die Lehre von Elastizitat und Festigkeit (On Elasticity and Fixity), Prague, 1967.

APPENDIX

FIELD TEST DATA

In this appendix the significant data from the field tests are given. Figures A.1 through A.8 show the measured moment-curvature relationship. The load deflection and strain data follow these figures.

The identification numbers for each set of data may be read as follows. The first two digits indicate the value of the maximum load for a series of load cycles. The second two digits represent the cycle number. The third two digits show the value of the load when the set of data was taken. For example, 100110 would indicate 10 ton load cycles, first cycle, and an applied load of 10 tons.

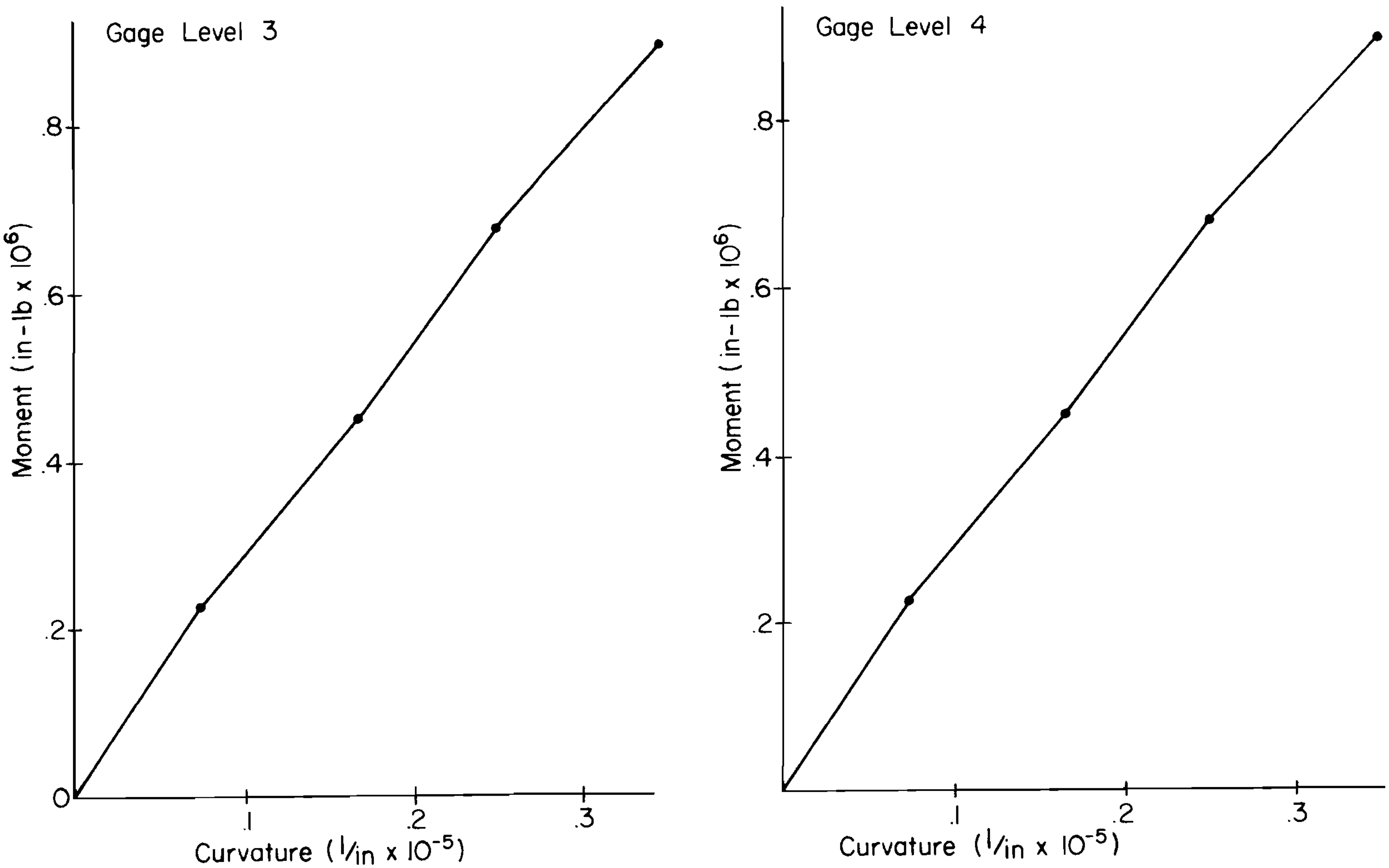


Fig. A.1 Measured Moment-Curvature Relationships

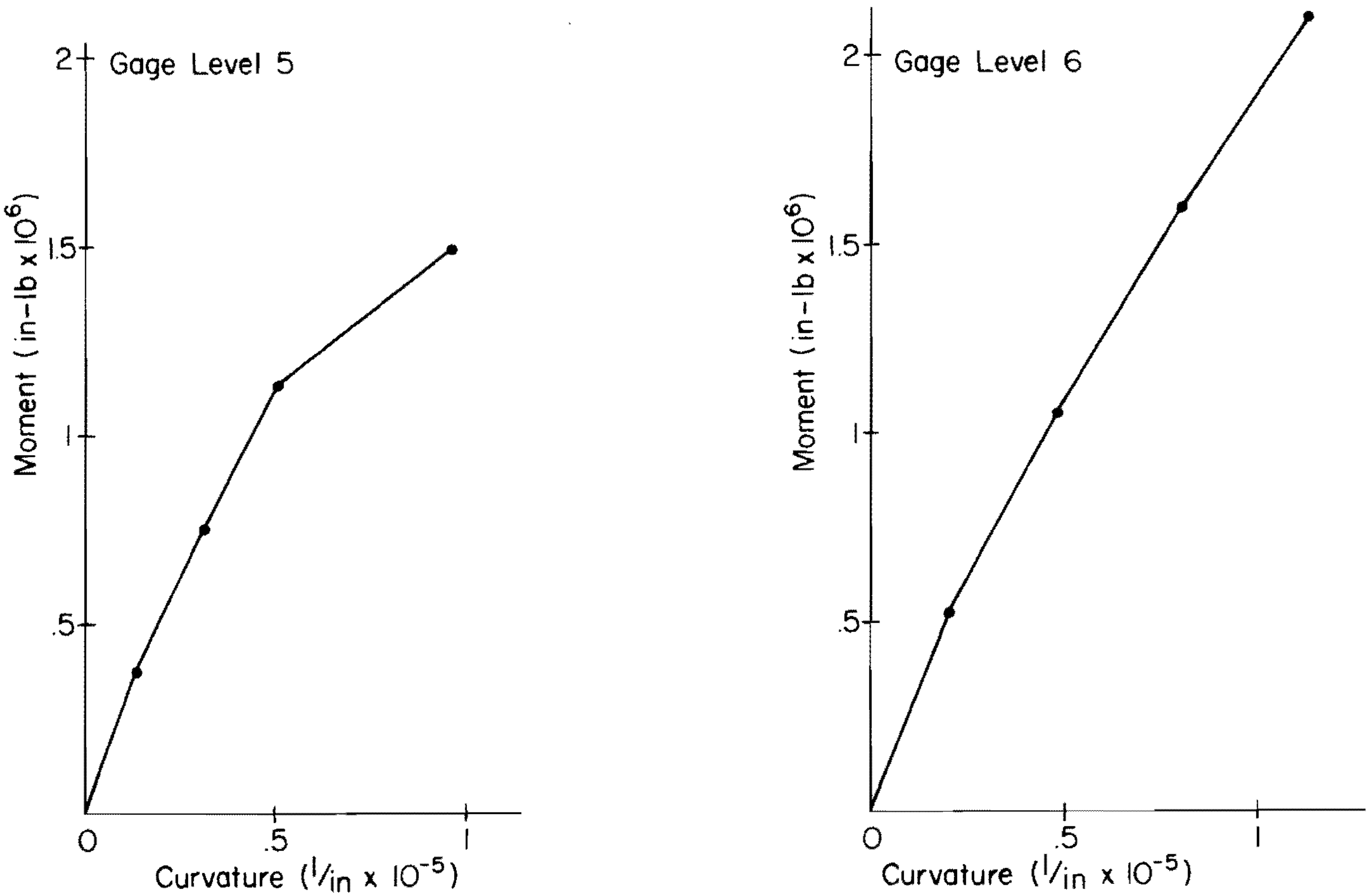


Fig. A.2 Measured Moment-Curvature Relationships

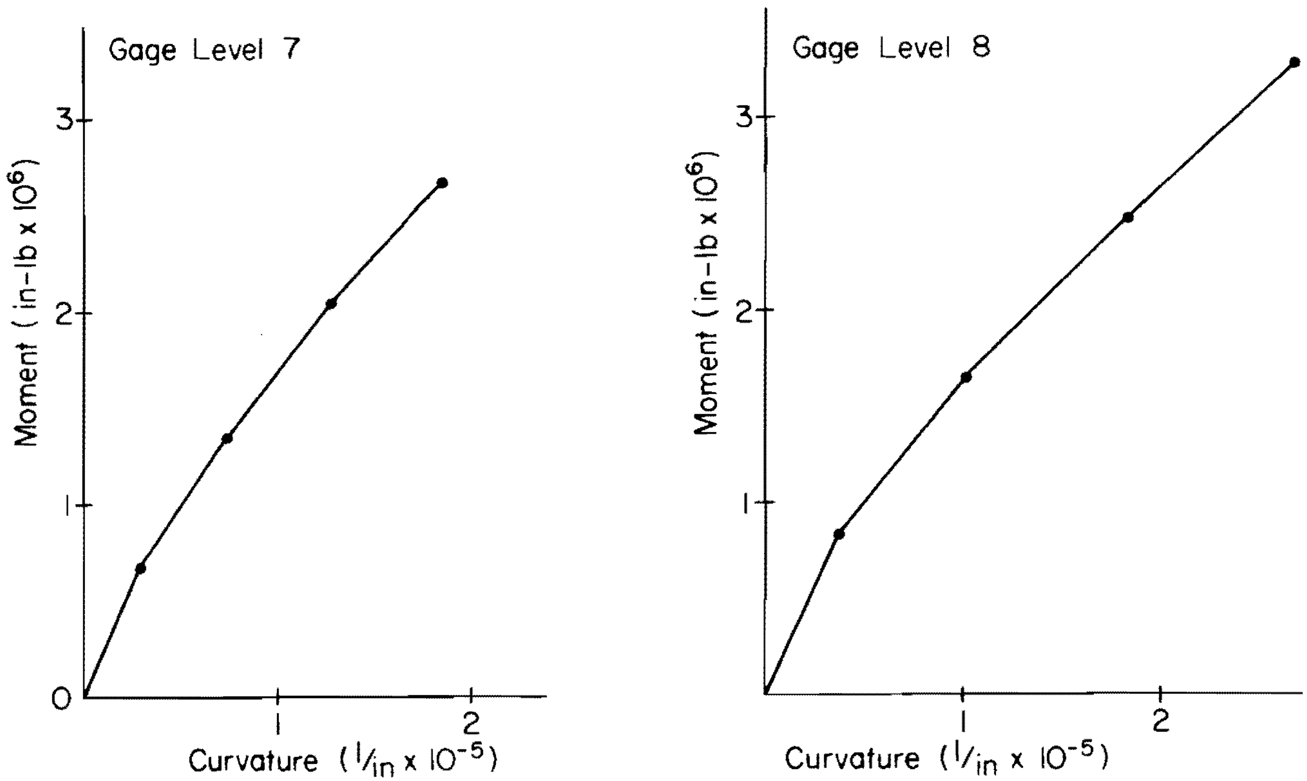


Fig. A.3 Measured Moment-Curvature Relationships

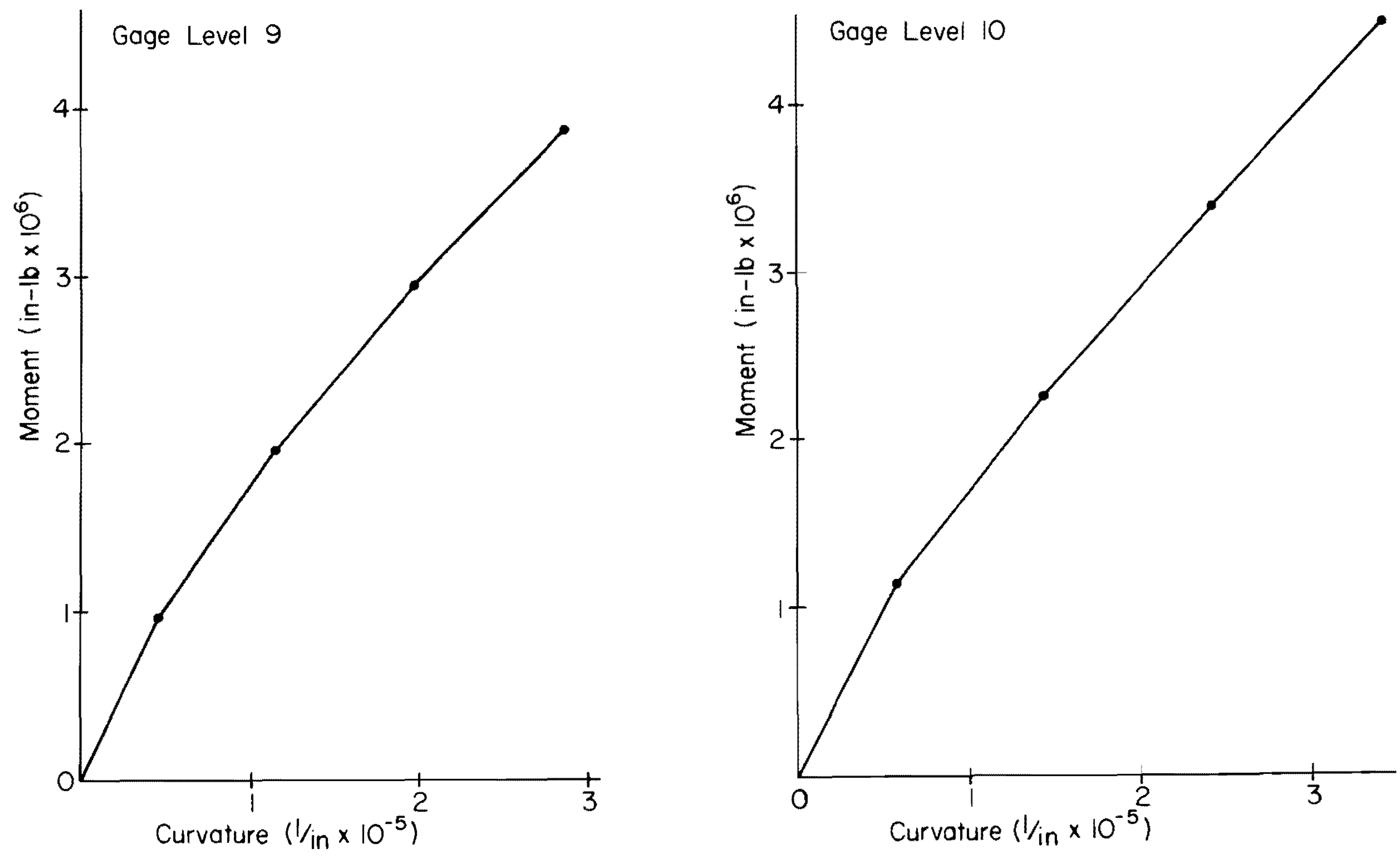


Fig. A.4 Measured Moment-Curvature Relationships

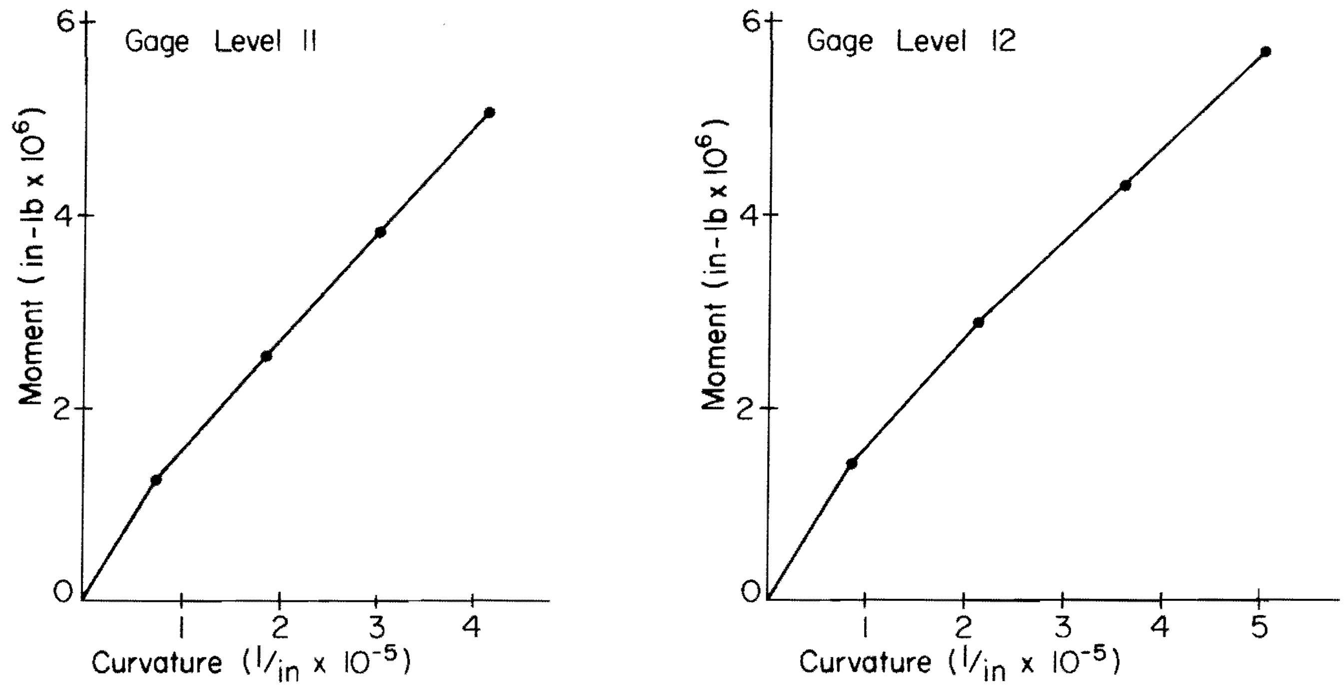


Fig. A.5 Measured Moment-Curvature Relationships

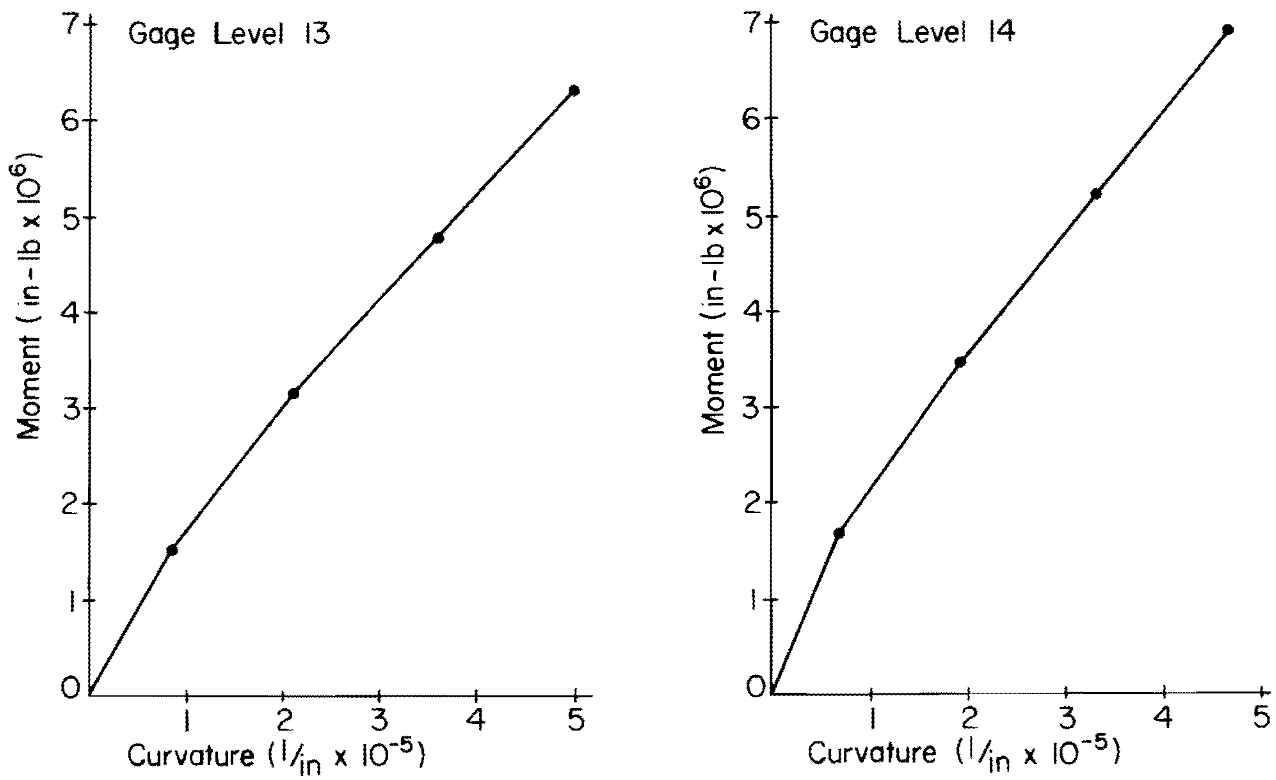


Fig. A.6 Measured Moment-Curvature Relationships

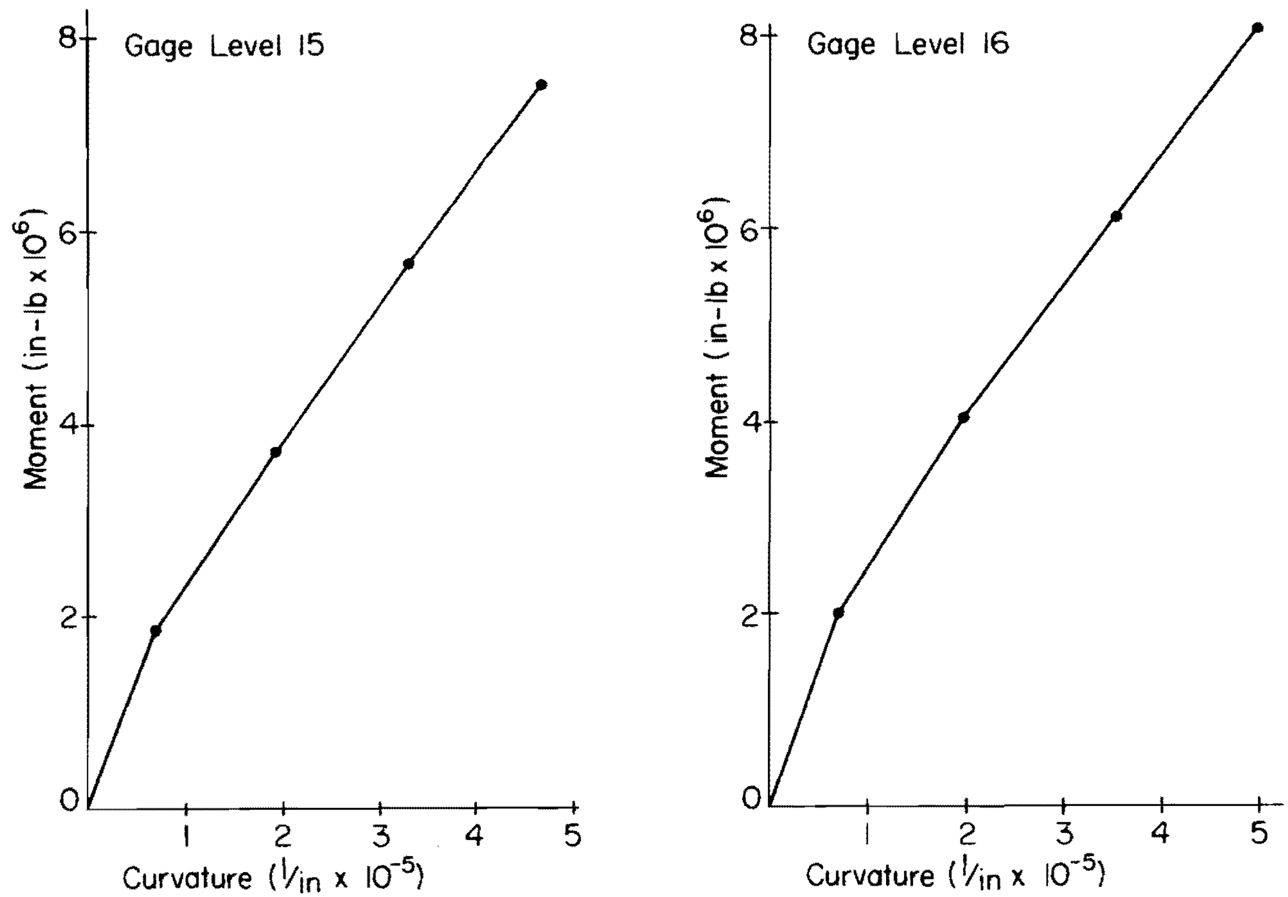


Fig. A.7 Measured Moment-Curvature Relationships

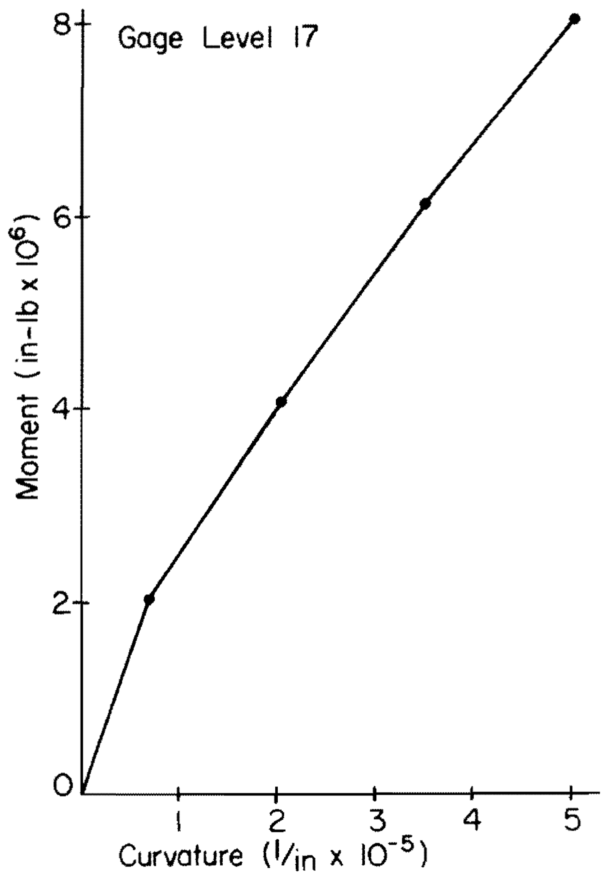


Fig. A.8 Measured Moment-Curvature Relationships

IDENTIFICATION 100110 TIME 1057.

APPLIED LOAD 10.44 TONS

TOP DEFLECTION
POTENTIOMETER 0.019 INCHES
DIAL GAGE 0.021 INCHES

TOP SLOPE 4.10000E-04 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	15.	2.32842E-07
4	22.5	93.	1.44362E-06
5	37.5	127.	1.97140E-06
6	52.5	155.	2.41380E-06
7	67.5	169.	2.61560E-06
8	82.5	165.	2.55351E-06
9	97.5	144.	2.22753E-06
10	112.5	135.	2.10334E-06
11	127.5	126.	1.95588E-06
12	142.5	106.	1.64542E-06
13	157.5	60.	9.39131E-07
14	172.5	42.	6.59720E-07
15	187.5	32.	4.96731E-07
16	202.5	23.	3.64786E-07
17	217.5	16.	2.48365E-07
18	232.5	13.	2.01797E-07
19	247.5	6.	1.00398E-07
20	262.5	1.	1.55228E-08
21	277.5	3.	4.65685E-08
22	292.5	-1.	-1.55228E-08
23	307.5	-2.	-3.10457E-08
24	322.5	-1.	-2.32842E-08
25	337.5	-1.	-2.32842E-08
26	352.5	-3.	-3.88071E-08
27	382.5	-2.	-3.10457E-08
28	412.5	-3.	-3.88071E-08
29	442.5	-3.	-3.88071E-08
30	472.5	1.	1.55228E-08
31	502.5	1.	2.32842E-08

IDENTIFICATION 100210 TIME 1109.

APPLIED LOAD 10.49 TONS

TOP DEFLECTION
POTENTIOMETER 0.019 INCHES
DIAL GAGE 0.020 INCHES

TOP SLOPE 3.93333E-04 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	12.	1.94035E-07
4	22.5	92.	1.42310E-06
5	37.5	124.	1.93259E-06
6	52.5	153.	2.37499E-06
7	67.5	166.	2.56903E-06
8	82.5	163.	2.52246E-06
9	97.5	142.	2.21200E-06
10	112.5	134.	2.08782E-06
11	127.5	127.	1.97916E-06
12	142.5	105.	1.62990E-06
13	157.5	63.	9.77938E-07
14	172.5	43.	6.75243E-07
15	187.5	31.	4.81208E-07
16	202.5	24.	3.80309E-07
17	217.5	17.	2.71549E-07
18	232.5	12.	1.78513E-07
19	247.5	5.	7.76141E-08
20	262.5	4.	6.20913E-08
21	277.5	1.	2.32842E-08
22	292.5	-1.	-1.55228E-08
23	307.5	-1.	-1.55228E-08
24	322.5	1.	1.55228E-08
25	337.5	1.	2.32842E-08
26	352.5	0.	7.76141E-09
27	382.5	-2.	-3.10457E-08
28	412.5	-3.	-4.65685E-08
29	442.5	-2.	-3.10457E-08
30	472.5	-1.	-2.32842E-08
31	502.5	-1.	-1.55228E-08

IDENTIFICATION 100310 TIME 1118.

APPLIED LOAD 10.45 TONS

TOP DEFLECTION
POTENTIOMETER 0.021 INCHES
DIAL GAGE 0.021 INCHES

TOP SLOPE 3.33333E-04 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	17.	2.56127E-07
4	22.5	93.	1.44362E-06
5	37.5	124.	1.93259E-06
6	52.5	151.	2.34395E-06
7	67.5	165.	2.55351E-06
8	82.5	163.	2.53798E-06
9	97.5	143.	2.21976E-06
10	112.5	134.	2.08006E-06
11	127.5	128.	1.99468E-06
12	142.5	106.	1.64542E-06
13	157.5	60.	9.39131E-07
14	172.5	44.	6.83004E-07
15	187.5	34.	5.20015E-07
16	202.5	26.	4.03594E-07
17	217.5	18.	2.87172E-07
18	232.5	14.	2.25081E-07
19	247.5	8.	1.24183E-07
20	262.5	4.	6.20913E-08
21	277.5	1.	1.55228E-08
22	292.5	1.	1.55228E-08
23	307.5	-1.	-2.32842E-08
24	322.5	-3.	-5.43299E-08
25	337.5	-4.	-6.20913E-08
26	352.5	-1.	-1.55228E-08
27	382.5	-4.	-6.20913E-08
28	412.5	-4.	-6.98527E-08
29	442.5	-3.	-3.88071E-08
30	472.5	-1.	-2.32842E-08
31	502.5	-2.	-3.10457E-08

IDENTIFICATION 100410 TIME 1125.

APPLIED LOAD 10.69 TONS

TOP DEFLECTION
POTENTIOMETER 0.019 INCHES
DIAL GAGE 0.020 INCHES

TOP SLOPE 3.76667E-04 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	15.	2.32842E-07
4	22.5	91.	1.41258E-06
5	37.5	123.	1.90155E-06
6	52.5	150.	2.32842E-06
7	67.5	162.	2.51470E-06
8	82.5	160.	2.49141E-06
9	97.5	138.	2.14991E-06
10	112.5	130.	2.01021E-06
11	127.5	123.	1.90931E-06
12	142.5	102.	1.59109E-06
13	157.5	59.	9.23508E-07
14	172.5	42.	6.51959E-07
15	187.5	31.	4.88969E-07
16	202.5	24.	3.80309E-07
17	217.5	17.	2.63888E-07
18	232.5	13.	2.09558E-07
19	247.5	8.	1.24183E-07
20	262.5	3.	5.43299E-08
21	277.5	3.	3.88071E-08
22	292.5	1.	2.32842E-08
23	307.5	-1.	-1.55228E-08
24	322.5	-0.	-7.76141E-09
25	337.5	-1.	-1.55228E-08
26	352.5	-2.	-3.10457E-08
27	382.5	-3.	-3.88071E-08
28	412.5	-2.	-3.10457E-08
29	442.5	-1.	-1.55228E-08
30	472.5	0.	7.76141E-09
31	502.5	2.	3.10457E-08

IDENTIFICATION 100510 TIME 1130.

APPLIED LOAD 10.74 TONS

TOP DEFLECTION
POTENTIOMETER 0.020 INCHES
DIAL GAGE 0.020 INCHES

TOP SLOPE 3.90000E-04 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	15.	2.32842E-07
4	22.5	95.	1.46591E-06
5	37.5	129.	2.00244E-06
6	52.5	157.	2.43708E-06
7	67.5	173.	2.67769E-06
8	82.5	170.	2.64664E-06
9	97.5	146.	2.27409E-06
10	112.5	139.	2.15767E-06
11	127.5	132.	2.05677E-06
12	142.5	109.	1.69975E-06
13	157.5	64.	9.93460E-07
14	172.5	45.	6.98527E-07
15	187.5	34.	5.27776E-07
16	202.5	24.	3.80309E-07
17	217.5	19.	3.02695E-07
18	232.5	13.	2.09558E-07
19	247.5	7.	1.08660E-07
20	262.5	4.	6.98527E-08
21	277.5	2.	3.10457E-08
22	292.5	0.	7.76141E-09
23	307.5	-2.	-3.10457E-08
24	322.5	-3.	-3.88071E-08
25	337.5	-3.	-4.65685E-08
26	352.5	-2.	-3.10457E-08
27	382.5	-3.	-3.88071E-08
28	412.5	-4.	-6.20913E-08
29	442.5	-2.	-3.10457E-08
30	472.5	-0.	-7.76141E-09
31	502.5	-1.	-1.55228E-08

IDENTIFICATION 100610 TIME 1135.

APPLIED LOAD 10.39 TONS

TOP DEFLECTION
POTENTIOMETER 0.018 INCHES
DIAL GAGE 0.020 INCHES

TOP SLOPE 3.66667E-04 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	14.	2.17320E-07
4	22.5	91.	1.41258E-06
5	37.5	123.	1.91707E-06
6	52.5	151.	2.34395E-06
7	67.5	163.	2.53798E-06
8	82.5	162.	2.51470E-06
9	97.5	138.	2.14991E-06
10	112.5	128.	1.99468E-06
11	127.5	121.	1.88602E-06
12	142.5	105.	1.62214E-06
13	157.5	59.	9.23608E-07
14	172.5	43.	6.75243E-07
15	187.5	29.	4.50162E-07
16	202.5	22.	3.33741E-07
17	217.5	17.	2.56127E-07
18	232.5	11.	1.70751E-07
19	247.5	6.	1.00898E-07
20	262.5	4.	6.20913E-08
21	277.5	3.	5.43299E-08
22	292.5	1.	2.32842E-08
23	307.5	0.	7.76141E-09
24	322.5	-0.	-7.76141E-09
25	337.5	-1.	-1.55228E-08
26	352.5	-3.	-3.88071E-08
27	382.5	-1.	-2.32842E-08
28	412.5	-1.	-2.32842E-08
29	442.5	-2.	-3.10457E-08
30	472.5	1.	1.55228E-08
31	502.5	1.	2.32842E-08

IDENTIFICATION 100710 TIME 1138.

APPLIED LOAD 10.43 TONS

TOP DEFLECTION
POTENTIOMETER 0.021 INCHES
DIAL GAGE 0.022 INCHES

TOP SLOPE 3.90000E-04 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	14.	2.25081E-07
4	22.5	94.	1.45915E-06
5	37.5	124.	1.93259E-06
6	52.5	151.	2.34395E-06
7	67.5	165.	2.56127E-06
8	82.5	165.	2.56127E-06
9	97.5	144.	2.23529E-06
10	112.5	135.	2.09558E-06
11	127.5	130.	2.01797E-06
12	142.5	109.	1.69975E-06
13	157.5	63.	9.77938E-07
14	172.5	46.	7.14050E-07
15	187.5	34.	5.27776E-07
16	202.5	25.	3.95832E-07
17	217.5	18.	2.87172E-07
18	232.5	13.	2.01797E-07
19	247.5	8.	1.24183E-07
20	262.5	3.	3.88071E-08
21	277.5	3.	3.88071E-08
22	292.5	1.	2.32842E-08
23	307.5	0.	7.76141E-09
24	322.5	-2.	-3.10457E-08
25	337.5	-3.	-5.43299E-08
26	352.5	-0.	-7.76141E-09
27	382.5	-3.	-3.88071E-08
28	412.5	-3.	-4.65685E-08
29	442.5	-0.	-7.76141E-09
30	472.5	1.	2.32842E-08
31	502.5	1.	1.55228E-08

IDENTIFICATION 100810 TIME 1142.

APPLIED LOAD 10.45 TONS

TOP DEFLECTION
  POTENTIOMETER 0.019 INCHES
  DIAL GAGE 0.021 INCHES

TOP SLOPE 4.10000E-04 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	15.	2.32842E-07
4	22.5	92.	1.43586E-06
5	37.5	130.	2.01021E-06
6	52.5	158.	2.44485E-06
7	67.5	172.	2.66993E-06
8	82.5	168.	2.60784E-06
9	97.5	146.	2.27409E-06
10	112.5	137.	2.12663E-06
11	127.5	131.	2.03349E-06
12	142.5	109.	1.69975E-06
13	157.5	63.	9.77938E-07
14	172.5	43.	6.75243E-07
15	187.5	32.	4.96731E-07
16	202.5	24.	3.80309E-07
17	217.5	18.	2.79411E-07
18	232.5	12.	1.86274E-07
19	247.5	7.	1.08660E-07
20	262.5	3.	4.65685E-08
21	277.5	2.	3.10457E-08
22	292.5	1.	2.32842E-08
23	307.5	-0.	-7.76141E-09
24	322.5	-2.	-3.10457E-08
25	337.5	-3.	-4.65685E-08
26	352.5	-3.	-3.88071E-08
27	382.5	-4.	-6.20913E-08
28	412.5	-3.	-5.43299E-08
29	442.5	-3.	-3.88071E-08
30	472.5	0.	7.76141E-09
31	502.5	-1.	-1.55228E-08

IDENTIFICATION 100910 TIME 1144.

APPLIED LOAD 10.71 TONS

TOP DEFLECTION
POTENTIOMETER 0.020 INCHES
DIAL GAGE 0.021 INCHES

TOP SLOPE 3.76667E-04 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	15.	2.32842E-07
4	22.5	98.	1.51348E-06
5	37.5	132.	2.04901E-06
6	52.5	160.	2.48365E-06
7	67.5	176.	2.72426E-06
8	82.5	173.	2.68545E-06
9	97.5	149.	2.31290E-06
10	112.5	139.	2.16543E-06
11	127.5	132.	2.04901E-06
12	142.5	113.	1.75408E-06
13	157.5	63.	9.85599E-07
14	172.5	46.	7.06289E-07
15	187.5	31.	4.88969E-07
16	202.5	24.	3.72548E-07
17	217.5	16.	2.48365E-07
18	232.5	12.	1.94035E-07
19	247.5	6.	1.00898E-07
20	262.5	3.	4.65685E-08
21	277.5	3.	4.65685E-08
22	292.5	0.	7.76141E-09
23	307.5	-0.	-7.76141E-09
24	322.5	-1.	-1.55228E-08
25	337.5	-3.	-3.88071E-08
26	352.5	-4.	-6.20913E-08
27	382.5	-3.	-3.88071E-08
28	412.5	-3.	-3.88071E-08
29	442.5	-3.	-3.88071E-08
30	472.5	3.	4.65685E-08
31	502.5	0.	7.76141E-09

IDENTIFICATION 101010 TIME 1149.

APPLIED LOAD 10.51 TONS

TOP DEFLECTION
POTENTIOMETER 0.018 INCHES
DIAL GAGE 0.020 INCHES

TOP SLOPE 3.93333E-04 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	14.	2.25081E-07
4	22.5	92.	1.43586E-06
5	37.5	125.	1.94811E-06
6	52.5	155.	2.41380E-06
7	67.5	167.	2.59231E-06
8	82.5	165.	2.55351E-06
9	97.5	143.	2.21976E-06
10	112.5	133.	2.06454E-06
11	127.5	125.	1.94811E-06
12	142.5	109.	1.68423E-06
13	157.5	61.	9.54654E-07
14	172.5	43.	6.67482E-07
15	187.5	30.	4.73446E-07
16	202.5	22.	3.41502E-07
17	217.5	16.	2.48365E-07
18	232.5	12.	1.78513E-07
19	247.5	7.	1.16421E-07
20	262.5	5.	7.76141E-08
21	277.5	3.	5.43299E-08
22	292.5	2.	3.10457E-08
23	307.5	0.	0.0
24	322.5	0.	0.0
25	337.5	0.	7.76141E-09
26	352.5	-3.	-4.65685E-08
27	382.5	-0.	-7.76141E-09
28	412.5	-1.	-2.32842E-08
29	442.5	-0.	-7.76141E-09
30	472.5	2.	3.10457E-08
31	502.5	0.	7.76141E-09

IDENTIFICATION 200120 TIME 1159.

APPLIED LOAD 20.64 TONS

TOP DEFLECTION
POTENTIOMETER 0.083 INCHES
DIAL GAGE 0.096 INCHES

TOP SLOPE 1.09667E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	28.	4.26878E-07
4	22.5	203.	3.15113E-06
5	37.5	298.	4.62580E-06
6	52.5	377.	5.85211E-06
7	67.5	442.	6.85333E-06
8	82.5	465.	7.21812E-06
9	97.5	424.	6.57392E-06
10	112.5	427.	6.62825E-06
11	127.5	424.	6.57392E-06
12	142.5	374.	5.79778E-06
13	157.5	230.	3.57801E-06
14	172.5	155.	2.41380E-06
15	187.5	115.	1.78513E-06
16	202.5	89.	1.38153E-06
17	217.5	67.	1.04003E-06
18	232.5	49.	7.68380E-07
19	247.5	32.	4.96731E-07
20	262.5	18.	2.87172E-07
21	277.5	16.	2.40604E-07
22	292.5	6.	9.31370E-08
23	307.5	-0.	-7.76141E-09
24	322.5	-3.	-5.43299E-08
25	337.5	-6.	-1.00898E-07
26	352.5	-11.	-1.62990E-07
27	382.5	-11.	-1.62990E-07
28	412.5	-11.	-1.62990E-07
29	442.5	-7.	-1.16421E-07
30	472.5	4.	6.20913E-08
31	502.5	3.	3.88071E-08

IDENTIFICATION 200220 TIME 1209.

APPLIED LOAD 20.99 TONS

TOP DEFLECTION
POTENTIOMETER 0.098 INCHES
DIAL GAGE 0.104 INCHES

TOP SLOPE 1.23667E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	26.	4.11355E-07
4	22.5	207.	3.21323E-06
5	37.5	304.	4.72670E-06
6	52.5	389.	6.04514E-06
7	67.5	464.	7.21035E-06
8	82.5	489.	7.59066E-06
9	97.5	442.	6.85333E-06
10	112.5	443.	6.87661E-06
11	127.5	439.	6.81452E-06
12	142.5	385.	5.96853E-06
13	157.5	236.	3.65563E-06
14	172.5	160.	2.48365E-06
15	187.5	120.	1.87050E-06
16	202.5	93.	1.45138E-06
17	217.5	70.	1.07884E-06
18	232.5	52.	8.14948E-07
19	247.5	35.	5.51060E-07
20	262.5	17.	2.71649E-07
21	277.5	16.	2.48365E-07
22	292.5	7.	1.16421E-07
23	307.5	1.	2.32842E-08
24	322.5	-4.	-6.20913E-08
25	337.5	-6.	-9.31370E-08
26	352.5	-10.	-1.47467E-07
27	382.5	-9.	-1.39705E-07
28	412.5	-10.	-1.55228E-07
29	442.5	-7.	-1.16421E-07
30	472.5	3.	4.65685E-08
31	502.5	-0.	-7.76141E-09

IDENTIFICATION 200320 TIME 1217.

APPLIED LOAD 21.04 TONS

TOP DEFLECTION
POTENTIOMETER 0.104 INCHES
DIAL GAGE 0.111 INCHES

TOP SLOPE 1.31667E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	25.	3.88071E-07
4	22.5	207.	3.21323E-06
5	37.5	304.	4.72570E-06
6	52.5	392.	6.07719E-06
7	67.5	469.	7.27245E-06
8	82.5	495.	7.68380E-06
9	97.5	446.	6.92318E-06
10	112.5	448.	6.94647E-06
11	127.5	444.	6.89214E-06
12	142.5	394.	6.11599E-06
13	157.5	235.	3.64786E-06
14	172.5	162.	2.51470E-06
15	187.5	120.	1.86274E-06
16	202.5	91.	1.41258E-06
17	217.5	70.	1.08660E-06
18	232.5	52.	8.07187E-07
19	247.5	34.	5.20315E-07
20	262.5	23.	3.49264E-07
21	277.5	18.	2.79411E-07
22	292.5	9.	1.39705E-07
23	307.5	3.	3.88071E-08
24	322.5	-4.	-6.20913E-08
25	337.5	-5.	-7.76141E-08
26	352.5	-6.	-1.00898E-07
27	382.5	-9.	-1.39705E-07
28	412.5	-8.	-1.31944E-07
29	442.5	-6.	-9.31370E-08
30	472.5	3.	5.43299E-08
31	502.5	0.	7.76141E-09

IDENTIFICATION 200420 TIME 1222.

APPLIED LOAD 21.01 TONS

TOP DEFLECTION
POTENTIOMETER 0.106 INCHES
DIAL GAGE 0.112 INCHES

TOP SLOPE 1.32000E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	25.	3.95832E-07
4	22.5	205.	3.18218E-06
5	37.5	303.	4.70342E-06
6	52.5	390.	6.05390E-06
7	67.5	470.	7.28797E-06
8	82.5	496.	7.69932E-06
9	97.5	447.	6.93870E-06
10	112.5	452.	7.00856E-06
11	127.5	449.	6.96199E-06
12	142.5	396.	6.13928E-06
13	157.5	238.	3.70219E-06
14	172.5	165.	2.55351E-06
15	187.5	123.	1.90155E-06
16	202.5	94.	1.45915E-06
17	217.5	71.	1.10212E-06
18	232.5	54.	8.45994E-07
19	247.5	35.	5.43299E-07
20	262.5	20.	3.18218E-07
21	277.5	17.	2.56127E-07
22	292.5	7.	1.08660E-07
23	307.5	2.	3.10457E-08
24	322.5	-6.	-8.53756E-08
25	337.5	-6.	-8.53756E-08
26	352.5	-8.	-1.24183E-07
27	382.5	-10.	-1.55228E-07
28	412.5	-9.	-1.39705E-07
29	442.5	-8.	-1.24183E-07
30	472.5	3.	5.43299E-08
31	502.5	2.	3.10457E-08

IDENTIFICATION 200520 TIME 1228.

APPLIED LOAD 21.14 TONS

TOP DEFLECTION
POTENTIOMETER 0.110 INCHES
DIAL GAGE 0.114 INCHES

TOP SLOPE 1.35000E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	26.	4.11355E-07
4	22.5	206.	3.19770E-06
5	37.5	308.	4.78103E-06
6	52.5	395.	6.12376E-06
7	67.5	476.	7.38887E-06
8	82.5	504.	7.82351E-06
9	97.5	455.	7.05513E-06
10	112.5	460.	7.14826E-06
11	127.5	457.	7.09393E-06
12	142.5	403.	6.26346E-06
13	157.5	245.	3.81085E-06
14	172.5	166.	2.56903E-06
15	187.5	125.	1.94811E-06
16	202.5	96.	1.49795E-06
17	217.5	74.	1.14869E-06
18	232.5	54.	8.45994E-07
19	247.5	36.	5.66583E-07
20	262.5	21.	3.25979E-07
21	277.5	17.	2.63888E-07
22	292.5	10.	1.47467E-07
23	307.5	2.	3.10457E-08
24	322.5	-4.	-6.20913E-08
25	337.5	-6.	-9.31370E-08
26	352.5	-9.	-1.39705E-07
27	382.5	-11.	-1.62990E-07
28	412.5	-11.	-1.62990E-07
29	442.5	-8.	-1.31944E-07
30	472.5	3.	4.65685E-08
31	502.5	0.	0.0

IDENTIFICATION 200620 TIME 1234.

APPLIED LOAD 20.78 TONS

TOP DEFLECTION
POTENTIOMETER 0.109 INCHES
DIAL GAGE 0.114 INCHES

TOP SLOPE 1.36000E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	25.	3.88071E-07
4	22.5	202.	3.13561E-06
5	37.5	302.	4.68789E-06
6	52.5	387.	6.00733E-06
7	67.5	468.	7.26468E-06
8	82.5	496.	7.69932E-06
9	97.5	448.	6.95423E-06
10	112.5	453.	7.03184E-06
11	127.5	450.	6.98527E-06
12	142.5	402.	6.24018E-06
13	157.5	240.	3.73324E-06
14	172.5	166.	2.56903E-06
15	187.5	123.	1.90155E-06
16	202.5	95.	1.47467E-06
17	217.5	71.	1.10212E-06
18	232.5	53.	8.30471E-07
19	247.5	35.	5.35538E-07
20	262.5	22.	3.33741E-07
21	277.5	18.	2.79411E-07
22	292.5	10.	1.47467E-07
23	307.5	3.	3.88071E-08
24	322.5	-3.	-3.88071E-08
25	337.5	-4.	-6.98527E-08
26	352.5	-6.	-8.53756E-08
27	382.5	-9.	-1.39705E-07
28	412.5	-9.	-1.39705E-07
29	442.5	-5.	-7.76141E-08
30	472.5	4.	6.98527E-08
31	502.5	1.	2.32842E-08

IDENTIFICATION 200720 TIME 1236.

APPLIED LOAD 21.12 TONS

TOP DEFLECTION
POTENTIOMETER 0.112 INCHES
DIAL GAGE 0.117 INCHES

TOP SLOPE 1.39333E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	25.	3.95832E-07
4	22.5	206.	3.19770E-06
5	37.5	310.	4.80432E-06
6	52.5	397.	6.16256E-06
7	67.5	481.	7.45872E-06
8	82.5	509.	7.90112E-06
9	97.5	461.	7.15502E-06
10	112.5	466.	7.23364E-06
11	127.5	466.	7.22588E-06
12	142.5	411.	6.38764E-06
13	157.5	251.	3.88847E-06
14	172.5	170.	2.64664E-06
15	187.5	127.	1.97140E-06
16	202.5	99.	1.52900E-06
17	217.5	74.	1.14093E-06
18	232.5	54.	8.45994E-07
19	247.5	34.	5.27776E-07
20	262.5	20.	3.10457E-07
21	277.5	18.	2.79411E-07
22	292.5	7.	1.08660E-07
23	307.5	0.	7.76141E-09
24	322.5	-4.	-6.20913E-08
25	337.5	-7.	-1.08660E-07
26	352.5	-7.	-1.16421E-07
27	382.5	-10.	-1.55228E-07
28	412.5	-12.	-1.86274E-07
29	442.5	-7.	-1.16421E-07
30	472.5	4.	6.20913E-08
31	502.5	1.	2.32842E-08

IDENTIFICATION 200820 TIME 1239.

APPLIED LOAD 20.99 TONS

TOP DEFLECTION
POTENTIOMETER 0.114 INCHES
DIAL GAGE 0.119 INCHES

TOP SLOPE 1.39333E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	27.	4.19116E-07
4	22.5	205.	3.18994E-06
5	37.5	307.	4.76551E-06
6	52.5	397.	6.17032E-06
7	67.5	481.	7.46648E-06
8	82.5	512.	7.94769E-06
9	97.5	464.	7.20259E-06
10	112.5	470.	7.29573E-06
11	127.5	470.	7.29573E-06
12	142.5	416.	6.45750E-06
13	157.5	253.	3.92728E-06
14	172.5	173.	2.67769E-06
15	187.5	130.	2.01797E-06
16	202.5	101.	1.56781E-06
17	217.5	75.	1.17197E-06
18	232.5	58.	8.92563E-07
19	247.5	37.	5.82106E-07
20	262.5	20.	3.10457E-07
21	277.5	16.	2.48365E-07
22	292.5	7.	1.16421E-07
23	307.5	1.	1.55228E-08
24	322.5	-6.	-9.31370E-08
25	337.5	-9.	-1.39705E-07
26	352.5	-7.	-1.08660E-07
27	382.5	-11.	-1.62990E-07
28	412.5	-13.	-2.01797E-07
29	442.5	-8.	-1.31944E-07
30	472.5	2.	3.10457E-08
31	502.5	0.	0.0

IDENTIFICATION 200920 TIME 1242.

APPLIED LOAD 20.86 TONS

TOP DEFLECTION
POTENTIOMETER 0.114 INCHES
DIAL GAGE 0.120 INCHES

TOP SLOPE 1.35667E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	26.	4.11355E-07
4	22.5	205.	3.17442E-06
5	37.5	305.	4.74222E-06
6	52.5	396.	6.14704E-06
7	67.5	481.	7.45872E-06
8	82.5	510.	7.92440E-06
9	97.5	462.	7.17155E-06
10	112.5	467.	7.25692E-06
11	127.5	467.	7.25592E-06
12	142.5	416.	6.44974E-06
13	157.5	251.	3.89623E-06
14	172.5	173.	2.67769E-06
15	187.5	129.	2.00244E-06
16	202.5	100.	1.55228E-06
17	217.5	77.	1.18750E-06
18	232.5	57.	8.84801E-07
19	247.5	37.	5.74345E-07
20	262.5	21.	3.25979E-07
21	277.5	17.	2.71649E-07
22	292.5	8.	1.24183E-07
23	307.5	1.	2.32842E-08
24	322.5	-5.	-7.76141E-08
25	337.5	-6.	-9.31370E-08
26	352.5	-9.	-1.39705E-07
27	382.5	-11.	-1.62990E-07
28	412.5	-11.	-1.70751E-07
29	442.5	-9.	-1.39705E-07
30	472.5	3.	3.88071E-08
31	502.5	0.	0.0

IDENTIFICATION 201020 TIME 1247.

APPLIED LOAD 21.08 TONS

TOP DEFLECTION
POTENTIOMETER 0.115 INCHES
DIAL GAGE 0.121 INCHES

TOP SLOPE 1.36000E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	26.	4.11355E-07
4	22.5	208.	3.22099E-06
5	37.5	308.	4.78879E-06
6	52.5	399.	6.20137E-06
7	67.5	484.	7.51305E-06
8	82.5	515.	7.98650E-06
9	97.5	466.	7.24140E-06
10	112.5	472.	7.32677E-06
11	127.5	472.	7.32677E-06
12	142.5	419.	6.50407E-06
13	157.5	254.	3.94280E-06
14	172.5	174.	2.70373E-06
15	187.5	129.	2.00244E-06
16	202.5	100.	1.56004E-06
17	217.5	75.	1.16421E-06
18	232.5	58.	8.92563E-07
19	247.5	38.	5.89867E-07
20	262.5	24.	3.72548E-07
21	277.5	20.	3.10457E-07
22	292.5	11.	1.70751E-07
23	307.5	3.	3.88071E-08
24	322.5	-3.	-3.88071E-08
25	337.5	-4.	-6.20913E-08
26	352.5	-6.	-9.31370E-08
27	382.5	-8.	-1.31944E-07
28	412.5	-10.	-1.47467E-07
29	442.5	-8.	-1.24183E-07
30	472.5	3.	5.43299E-08
31	502.5	1.	1.55228E-08

IDENTIFICATION 201120 TIME 1253.

APPLIED LOAD 21.11 TONS

TOP DEFLECTION
POTENTIOMETER 0.117 INCHES
DIAL GAGE 0.123 INCHES

TOP SLOPE 1.37667E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	26.	4.11355E-07
4	22.5	208.	3.23651E-06
5	37.5	311.	4.82760E-06
6	52.5	400.	6.20913E-06
7	67.5	488.	7.56738E-06
8	82.5	520.	8.07187E-06
9	97.5	472.	7.32677E-06
10	112.5	477.	7.40439E-06
11	127.5	479.	7.43543E-06
12	142.5	424.	6.57392E-06
13	157.5	258.	4.00489E-06
14	172.5	176.	2.72426E-06
15	187.5	132.	2.04901E-06
16	202.5	103.	1.60661E-06
17	217.5	78.	1.20302E-06
18	232.5	59.	9.15847E-07
19	247.5	38.	5.89867E-07
20	262.5	22.	3.41502E-07
21	277.5	18.	2.87172E-07
22	292.5	10.	1.47467E-07
23	307.5	1.	1.55228E-08
24	322.5	-3.	-4.65685E-08
25	337.5	-6.	-9.31370E-08
26	352.5	-6.	-1.00898E-07
27	382.5	-11.	-1.62990E-07
28	412.5	-12.	-1.94035E-07
29	442.5	-8.	-1.31944E-07
30	472.5	2.	3.10457E-08
31	502.5	0.	0.0

IDENTIFICATION 201220 TIME 1256.

APPLIED LOAD 21.00 TONS

TOP DEFLECTION
POTENTIOMETER 0.118 INCHES
DIAL GAGE 0.125 INCHES

TOP SLOPE 1.37333E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	26.	4.03594E-07
4	22.5	205.	3.18994E-06
5	37.5	308.	4.78879E-06
6	52.5	399.	6.20137E-06
7	67.5	485.	7.53633E-06
8	82.5	519.	8.04859E-06
9	97.5	473.	7.33454E-06
10	112.5	477.	7.39663E-06
11	127.5	477.	7.40439E-06
12	142.5	427.	6.62825E-06
13	157.5	255.	3.96608E-06
14	172.5	176.	2.72426E-06
15	187.5	131.	2.02573E-06
16	202.5	102.	1.58333E-06
17	217.5	77.	1.18750E-06
18	232.5	58.	9.00324E-07
19	247.5	37.	5.82106E-07
20	262.5	23.	3.49264E-07
21	277.5	19.	2.94934E-07
22	292.5	10.	1.47467E-07
23	307.5	3.	3.88071E-08
24	322.5	-4.	-6.20913E-08
25	337.5	-6.	-9.31370E-08
26	352.5	-7.	-1.16421E-07
27	382.5	-9.	-1.39705E-07
28	412.5	-11.	-1.62990E-07
29	442.5	-8.	-1.24183E-07
30	472.5	3.	5.43299E-08
31	502.5	0.	7.76141E-09

IDENTIFICATION 201320 TIME 1258.

APPLIED LOAD 20.78 TONS

TOP DEFLECTION
POTENTIOMETER 0.117 INCHES
DIAL GAGE 0.123 INCHES

TOP SLOPE 1.44333E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	26.	4.11355E-07
4	22.5	203.	3.15113E-06
5	37.5	304.	4.72670E-06
6	52.5	396.	6.13928E-06
7	67.5	481.	7.45872E-06
8	82.5	514.	7.97873E-06
9	97.5	469.	7.28021E-06
10	112.5	472.	7.32677E-06
11	127.5	474.	7.36558E-06
12	142.5	422.	6.55839E-06
13	157.5	255.	3.95832E-06
14	172.5	176.	2.73202E-06
15	187.5	131.	2.02573E-06
16	202.5	102.	1.57557E-06
17	217.5	77.	1.18750E-06
18	232.5	59.	9.15847E-07
19	247.5	39.	6.05390E-07
20	262.5	23.	3.57025E-07
21	277.5	18.	2.87172E-07
22	292.5	9.	1.39705E-07
23	307.5	3.	3.88071E-08
24	322.5	-3.	-5.43299E-08
25	337.5	-6.	-9.31370E-08
26	352.5	-7.	-1.08660E-07
27	382.5	-10.	-1.55228E-07
28	412.5	-10.	-1.55228E-07
29	442.5	-7.	-1.08660E-07
30	472.5	4.	6.98527E-08
31	502.5	3.	3.88071E-08

IDENTIFICATION 201420 TIME 1300.

APPLIED LOAD 21.10 TONS

TOP DEFLECTION
POTENTIOMETER 0.116 INCHES
DIAL GAGE 0.123 INCHES

TOP SLOPE 1.51000E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	29.	4.57923E-07
4	22.5	208.	3.22875E-06
5	37.5	310.	4.81208E-06
6	52.5	400.	6.20913E-06
7	67.5	488.	7.56738E-06
8	82.5	522.	8.10292E-06
9	97.5	476.	7.38887E-06
10	112.5	481.	7.46648E-06
11	127.5	482.	7.48200E-06
12	142.5	426.	6.61272E-06
13	157.5	260.	4.03594E-06
14	172.5	178.	2.76306E-06
15	187.5	134.	2.08006E-06
16	202.5	105.	1.62214E-06
17	217.5	81.	1.24959E-06
18	232.5	60.	9.31370E-07
19	247.5	40.	6.13152E-07
20	262.5	24.	3.80309E-07
21	277.5	19.	3.02695E-07
22	292.5	10.	1.55228E-07
23	307.5	3.	3.88071E-08
24	322.5	-2.	-3.10457E-08
25	337.5	-4.	-6.20913E-08
26	352.5	-7.	-1.16421E-07
27	382.5	-10.	-1.47467E-07
28	412.5	-10.	-1.47467E-07
29	442.5	-8.	-1.24183E-07
30	472.5	2.	3.10457E-08
31	502.5	0.	0.0

IDENTIFICATION 201520 TIME 1306.

APPLIED LOAD 20.81 TONS

TOP DEFLECTION
POTENTIOMETER 0.117 INCHES
DIAL GAGE 0.125 INCHES

TOP SLOPE 1.43000E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	29.	4.42401E-07
4	22.5	205.	3.18994E-06
5	37.5	307.	4.77327E-06
6	52.5	397.	6.17032E-06
7	67.5	484.	7.50529E-06
8	82.5	518.	8.04083E-06
9	97.5	474.	7.36558E-06
10	112.5	477.	7.40439E-06
11	127.5	476.	7.38887E-06
12	142.5	422.	6.55839E-06
13	157.5	258.	3.99713E-06
14	172.5	176.	2.72426E-06
15	187.5	131.	2.02573E-06
16	202.5	102.	1.57557E-06
17	217.5	78.	1.21078E-06
18	232.5	58.	9.00324E-07
19	247.5	40.	6.13152E-07
20	262.5	23.	3.64786E-07
21	277.5	19.	3.02695E-07
22	292.5	12.	1.78513E-07
23	307.5	3.	5.43299E-08
24	322.5	-3.	-3.88071E-08
25	337.5	-3.	-5.43299E-08
26	352.5	-8.	-1.31944E-07
27	382.5	-11.	-1.70751E-07
28	412.5	-11.	-1.62990E-07
29	442.5	-9.	-1.39705E-07
30	472.5	4.	6.20913E-08
31	502.5	0.	0.0

IDENTIFICATION 300130 TIME 1317.

APPLIED LOAD 31.06 TONS

TOP DEFLECTION
POTENTIOMETER 0.243 INCHES
DIAL GAGE 0.264 INCHES

TOP SLOPE 2.79333E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	45.	6.98527E-07
4	22.5	321.	4.98283E-06
5	37.5	508.	7.88560E-06
6	52.5	724.	1.12308E-05
7	67.5	910.	1.41335E-05
8	82.5	1054.	1.63688E-05
9	97.5	984.	1.52822E-05
10	112.5	968.	1.50261E-05
11	127.5	982.	1.52434E-05
12	142.5	892.	1.38541E-05
13	157.5	570.	8.84801E-06
14	172.5	374.	5.79778E-06
15	187.5	282.	4.36968E-06
16	202.5	223.	3.46159E-06
17	217.5	177.	2.74754E-06
18	232.5	138.	2.14215E-06
19	247.5	100.	1.56004E-06
20	262.5	65.	1.00898E-06
21	277.5	54.	8.45994E-07
22	292.5	31.	4.81208E-07
23	307.5	16.	2.40604E-07
24	322.5	-1.	-2.32842E-08
25	337.5	-6.	-1.00898E-07
26	352.5	-14.	-2.17320E-07
27	382.5	-19.	-3.02695E-07
28	412.5	-26.	-4.03594E-07
29	442.5	-22.	-3.41502E-07
30	472.5	10.	1.55228E-07
31	502.5	0.	7.76141E-09

IDENTIFICATION 300230 TIME 1328.

APPLIED LOAD 31.34 TONS

TOP DEFLECTION
POTENTIOMETER 0.290 INCHES
DIAL GAGE 0.301 INCHES

TOP SLOPE 3.03333E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	45.	6.90766E-07
4	22.5	329.	5.10701E-06
5	37.5	531.	8.24262E-06
6	52.5	760.	1.17973E-05
7	67.5	968.	1.50261E-05
8	82.5	1097.	1.70363E-05
9	97.5	1023.	1.58799E-05
10	112.5	1002.	1.55539E-05
11	127.5	1011.	1.56936E-05
12	142.5	924.	1.43431E-05
13	157.5	597.	9.27489E-06
14	172.5	388.	6.02286E-06
15	187.5	289.	4.47834E-06
16	202.5	229.	3.55473E-06
17	217.5	179.	2.77859E-06
18	232.5	139.	2.16543E-06
19	247.5	99.	1.53676E-06
20	262.5	67.	1.04003E-06
21	277.5	57.	8.77040E-07
22	292.5	34.	5.27776E-07
23	307.5	17.	2.63888E-07
24	322.5	1.	2.32842E-08
25	337.5	-4.	-6.98527E-08
26	352.5	-10.	-1.55228E-07
27	382.5	-19.	-3.02695E-07
28	412.5	-25.	-3.88071E-07
29	442.5	-19.	-3.02695E-07
30	472.5	11.	1.62990E-07
31	502.5	3.	3.88071E-08

IDENTIFICATION 300330 TIME 1333.

APPLIED LOAD 31.21 TONS

TOP DEFLECTION
POTENTIOMETER 0.308 INCHES
DIAL GAGE 0.319 INCHES

TOP SLOPE 3.19333E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	43.	6.75243E-07
4	22.5	329.	5.09925E-06
5	37.5	533.	8.27367E-06
6	52.5	766.	1.18982E-05
7	67.5	981.	1.52279E-05
8	82.5	1114.	1.72847E-05
9	97.5	1045.	1.62291E-05
10	112.5	1023.	1.58799E-05
11	127.5	1030.	1.59885E-05
12	142.5	945.	1.46768E-05
13	157.5	615.	9.54654E-06
14	172.5	399.	6.18585E-06
15	187.5	294.	4.57147E-06
16	202.5	233.	3.62458E-06
17	217.5	182.	2.82515E-06
18	232.5	142.	2.21200E-06
19	247.5	102.	1.57557E-06
20	262.5	68.	1.05555E-06
21	277.5	58.	9.08085E-07
22	292.5	35.	5.51060E-07
23	307.5	18.	2.87172E-07
24	322.5	4.	6.98527E-08
25	337.5	-3.	-3.88071E-08
26	352.5	-12.	-1.86274E-07
27	382.5	-17.	-2.71649E-07
28	412.5	-25.	-3.88071E-07
29	442.5	-20.	-3.18218E-07
30	472.5	12.	1.78513E-07
31	502.5	3.	3.88071E-08

IDENTIFICATION 300430 TIME 1338.

APPLIED LOAD 31.31 TONS

TOP DEFLECTION
POTENTIOMETER 0.323 INCHES
DIAL GAGE 0.335 INCHES

TOP SLOPE 3.25000E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	43.	6.67482E-07
4	22.5	330.	5.13029E-06
5	37.5	539.	8.36680E-06
6	52.5	779.	1.21000E-05
7	67.5	1000.	1.55306E-05
8	82.5	1140.	1.76883E-05
9	97.5	1075.	1.66870E-05
10	112.5	1052.	1.63300E-05
11	127.5	1059.	1.64464E-05
12	142.5	974.	1.51192E-05
13	157.5	642.	9.96566E-06
14	172.5	414.	6.42645E-06
15	187.5	307.	4.75775E-06
16	202.5	240.	3.73324E-06
17	217.5	187.	2.90277E-06
18	232.5	146.	2.26633E-06
19	247.5	103.	1.60661E-06
20	262.5	71.	1.09436E-06
21	277.5	60.	9.39131E-07
22	292.5	37.	5.74345E-07
23	307.5	19.	2.94934E-07
24	322.5	5.	7.76141E-08
25	337.5	-3.	-5.43299E-08
26	352.5	-10.	-1.55228E-07
27	382.5	-17.	-2.63888E-07
28	412.5	-25.	-3.95832E-07
29	442.5	-19.	-2.94934E-07
30	472.5	13.	2.09558E-07
31	502.5	4.	6.98527E-08

IDENTIFICATION 300530 TIME 1347.

APPLIED LOAD 31.11 TONS

TOP DEFLECTION
POTENTIOMETER 0.327 INCHES
DIAL GAGE 0.339 INCHES

TOP SLOPE 3.33000E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	44.	6.83004E-07
4	22.5	330.	5.13029E-06
5	37.5	537.	8.33576E-06
6	52.5	780.	1.21078E-05
7	67.5	998.	1.54995E-05
8	82.5	1141.	1.77193E-05
9	97.5	1080.	1.67569E-05
10	112.5	1056.	1.63921E-05
11	127.5	1064.	1.65163E-05
12	142.5	980.	1.52124E-05
13	157.5	650.	1.00821E-05
14	172.5	417.	6.47302E-06
15	187.5	312.	4.84312E-06
16	202.5	244.	3.79533E-06
17	217.5	191.	2.97262E-06
18	232.5	149.	2.32066E-06
19	247.5	108.	1.67547E-06
20	262.5	75.	1.16421E-06
21	277.5	62.	9.62415E-07
22	292.5	40.	6.13152E-07
23	307.5	22.	3.41502E-07
24	322.5	6.	1.00398E-07
25	337.5	0.	7.76141E-09
26	352.5	-9.	-1.39705E-07
27	382.5	-14.	-2.25081E-07
28	412.5	-23.	-3.49264E-07
29	442.5	-19.	-3.02595E-07
30	472.5	12.	1.94035E-07
31	502.5	2.	3.10457E-08

IDENTIFICATION 300630 TIME 1350.

APPLIED LOAD 31.18 TONS

TOP DEFLECTION
POTENTIOMETER 0.336 INCHES
DIAL GAGE 0.347 INCHES

TOP SLOPE 3.42000E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	44.	6.83004E-07
4	22.5	332.	5.15358E-06
5	37.5	544.	8.43666E-06
6	52.5	787.	1.22165E-05
7	67.5	1015.	1.57634E-05
8	82.5	1160.	1.80142E-05
9	97.5	1101.	1.70906E-05
10	112.5	1079.	1.67414E-05
11	127.5	1089.	1.69044E-05
12	142.5	1003.	1.55594E-05
13	157.5	674.	1.04701E-05
14	172.5	430.	6.67482E-06
15	187.5	320.	4.96731E-06
16	202.5	251.	3.89623E-06
17	217.5	195.	3.02695E-06
18	232.5	153.	2.37499E-06
19	247.5	109.	1.69199E-06
20	262.5	73.	1.12541E-06
21	277.5	62.	9.70176E-07
22	292.5	39.	5.97529E-07
23	307.5	20.	3.18218E-07
24	322.5	4.	6.98527E-08
25	337.5	-3.	-3.88071E-08
26	352.5	-10.	-1.47467E-07
27	382.5	-18.	-2.87172E-07
28	412.5	-26.	-4.11355E-07
29	442.5	-21.	-3.25979E-07
30	472.5	13.	2.09558E-07
31	502.5	3.	5.43299E-08

IDENTIFICATION 300730 TIME 1352.

APPLIED LOAD 31.33 TONS

TOP DEFLECTION
POTENTIOMETER 0.342 INCHES
DIAL GAGE 0.354 INCHES

TOP SLOPE 3.50667E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	45.	6.90766E-07
4	22.5	334.	5.18462E-06
5	37.5	545.	8.46770E-06
6	52.5	794.	1.23251E-05
7	67.5	1023.	1.58799E-05
8	82.5	1171.	1.81695E-05
9	97.5	1113.	1.72769E-05
10	112.5	1090.	1.69199E-05
11	127.5	1101.	1.70906E-05
12	142.5	1014.	1.57479E-05
13	157.5	686.	1.06487E-05
14	172.5	435.	6.74467E-06
15	187.5	323.	5.01387E-06
16	202.5	254.	3.94280E-06
17	217.5	198.	3.07352E-06
18	232.5	154.	2.39052E-06
19	247.5	109.	1.69199E-06
20	262.5	73.	1.13317E-06
21	277.5	62.	9.62415E-07
22	292.5	36.	5.58822E-07
23	307.5	18.	2.87172E-07
24	322.5	3.	3.88071E-08
25	337.5	-5.	-7.76141E-08
26	352.5	-11.	-1.70751E-07
27	382.5	-21.	-3.25979E-07
28	412.5	-27.	-4.19116E-07
29	442.5	-23.	-3.57025E-07
30	472.5	11.	1.62990E-07
31	502.5	0.	7.76141E-09

IDENTIFICATION 300830 TIME 1356.

APPLIED LOAD 31.14 TONS

TOP DEFLECTION
POTENTIOMETER 0.348 INCHES
DIAL GAGE 0.360 INCHES

TOP SLOPE 3.56333E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	46.	7.06289E-07
4	22.5	332.	5.14582E-06
5	37.5	544.	8.44442E-06
6	52.5	791.	1.22863E-05
7	67.5	1023.	1.58876E-05
8	82.5	1173.	1.82083E-05
9	97.5	1117.	1.73390E-05
10	112.5	1093.	1.69665E-05
11	127.5	1104.	1.71372E-05
12	142.5	1023.	1.58721E-05
13	157.5	693.	1.07496E-05
14	172.5	438.	6.79900E-06
15	187.5	325.	5.03716E-06
16	202.5	256.	3.97384E-06
17	217.5	198.	3.08128E-06
18	232.5	154.	2.39052E-06
19	247.5	109.	1.69975E-06
20	262.5	74.	1.14093E-06
21	277.5	61.	9.54654E-07
22	292.5	36.	5.66583E-07
23	307.5	19.	2.94934E-07
24	322.5	3.	3.88071E-08
25	337.5	-4.	-6.20913E-08
26	352.5	-12.	-1.94035E-07
27	382.5	-20.	-3.10457E-07
28	412.5	-26.	-4.11355E-07
29	442.5	-22.	-3.41502E-07
30	472.5	12.	1.86274E-07
31	502.5	1.	1.55228E-08

IDENTIFICATION 300930 TIME 1359.

APPLIED LOAD 31.44 TONS

TOP DEFLECTION
POTENTIOMETER 0.357 INCHES
DIAL GAGE 0.370 INCHES

TOP SLOPE 3.63000E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	44.	6.83004E-07
4	22.5	334.	5.18462E-06
5	37.5	551.	8.54532E-06
6	52.5	801.	1.24415E-05
7	67.5	1037.	1.60972E-05
8	82.5	1191.	1.84954E-05
9	97.5	1134.	1.76106E-05
10	112.5	1111.	1.72459E-05
11	127.5	1126.	1.74787E-05
12	142.5	1045.	1.62291E-05
13	157.5	710.	1.10212E-05
14	172.5	450.	6.98527E-06
15	187.5	333.	5.17586E-06
16	202.5	262.	4.06698E-06
17	217.5	204.	3.15890E-06
18	232.5	158.	2.45261E-06
19	247.5	113.	1.75408E-06
20	262.5	78.	1.20302E-06
21	277.5	64.	1.00122E-06
22	292.5	40.	6.13152E-07
23	307.5	22.	3.41502E-07
24	322.5	4.	6.98527E-08
25	337.5	-1.	-1.55228E-08
26	352.5	-10.	-1.47467E-07
27	382.5	-19.	-2.94934E-07
28	412.5	-25.	-3.95832E-07
29	442.5	-22.	-3.33741E-07
30	472.5	13.	2.09558E-07
31	502.5	3.	3.88071E-08

IDENTIFICATION 301030 TIME 1427.

APPLIED LOAD 31.13 TONS

TOP DEFLECTION
POTENTIOMETER 0.351 INCHES
DIAL GAGE 0.364 INCHES

TOP SLOPE 3.63000E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	45.	6.98527E-07
4	22.5	335.	5.19239E-06
5	37.5	552.	8.56860E-06
6	52.5	800.	1.24183E-05
7	67.5	1031.	1.60118E-05
8	82.5	1186.	1.84178E-05
9	97.5	1136.	1.76339E-05
10	112.5	1116.	1.73235E-05
11	127.5	1133.	1.75951E-05
12	142.5	1057.	1.64154E-05
13	157.5	721.	1.11842E-05
14	172.5	458.	7.10946E-06
15	187.5	343.	5.31657E-06
16	202.5	271.	4.20569E-06
17	217.5	215.	3.32965E-06
18	232.5	169.	2.62336E-06
19	247.5	124.	1.93259E-06
20	262.5	88.	1.37377E-06
21	277.5	74.	1.14869E-06
22	292.5	49.	7.60619E-07
23	307.5	30.	4.65685E-07
24	322.5	14.	2.25081E-07
25	337.5	6.	8.53756E-08
26	352.5	-7.	-1.16421E-07
27	382.5	-17.	-2.63888E-07
28	412.5	-26.	-4.11355E-07
29	442.5	-24.	-3.72548E-07
30	472.5	14.	2.17320E-07
31	502.5	4.	6.20913E-08

IDENTIFICATION 301130 TIME 1433.

APPLIED LOAD 31.27 TONS

TOP DEFLECTION
POTENTIOMETER 0.357 INCHES
DIAL GAGE 0.373 INCHES

TOP SLOPE 3.63333E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	46.	7.06289E-07
4	22.5	332.	5.16134E-06
5	37.5	548.	8.49875E-06
6	52.5	797.	1.23717E-05
7	67.5	1028.	1.59575E-05
8	82.5	1183.	1.83635E-05
9	97.5	1132.	1.75796E-05
10	112.5	1112.	1.72614E-05
11	127.5	1129.	1.75330E-05
12	142.5	1051.	1.63145E-05
13	157.5	717.	1.11299E-05
14	172.5	456.	7.07841E-06
15	187.5	340.	5.27776E-06
16	202.5	267.	4.14460E-06
17	217.5	209.	3.25203E-06
18	232.5	163.	2.53798E-06
19	247.5	119.	1.83946E-06
20	262.5	83.	1.28839E-06
21	277.5	71.	1.10212E-06
22	292.5	46.	7.06289E-07
23	307.5	25.	3.95832E-07
24	322.5	10.	1.47467E-07
25	337.5	1.	1.55228E-08
26	352.5	-9.	-1.39705E-07
27	382.5	-17.	-2.63888E-07
28	412.5	-25.	-3.95832E-07
29	442.5	-24.	-3.72548E-07
30	472.5	14.	2.17320E-07
31	502.5	4.	6.20913E-08

IDENTIFICATION 301230 TIME 1435.

APPLIED LOAD 31.34 TONS

TOP DEFLECTION
POTENTIOMETER 0.361 INCHES
DIAL GAGE 0.378 INCHES

TOP SLOPE 3.68333E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	45.	6.98527E-07
4	22.5	332.	5.16134E-06
5	37.5	549.	8.52203E-06
6	52.5	800.	1.24260E-05
7	67.5	1033.	1.60428E-05
8	82.5	1193.	1.85110E-05
9	97.5	1142.	1.77271E-05
10	112.5	1121.	1.74011E-05
11	127.5	1141.	1.77193E-05
12	142.5	1063.	1.65008E-05
13	157.5	726.	1.12773E-05
14	172.5	463.	7.17931E-06
15	187.5	346.	5.37090E-06
16	202.5	272.	4.22997E-06
17	217.5	212.	3.29860E-06
18	232.5	166.	2.57679E-06
19	247.5	121.	1.87826E-06
20	262.5	85.	1.31944E-06
21	277.5	71.	1.10988E-06
22	292.5	47.	7.21812E-07
23	307.5	29.	4.42401E-07
24	322.5	12.	1.78513E-07
25	337.5	3.	5.43299E-08
26	352.5	-8.	-1.24183E-07
27	382.5	-16.	-2.48365E-07
28	412.5	-24.	-3.72548E-07
29	442.5	-23.	-3.49264E-07
30	472.5	13.	2.09558E-07
31	502.5	1.	2.32842E-08

IDENTIFICATION 301330 TIME 1438.

APPLIED LOAD 31.20 TONS

TOP DEFLECTION
POTENTIOMETER 0.364 INCHES
DIAL GAGE 0.381 INCHES

TOP SLOPE 3.69333E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	45.	6.90766E-07
4	22.5	331.	5.13806E-06
5	37.5	548.	8.49875E-06
6	52.5	798.	1.23872E-05
7	67.5	1033.	1.60351E-05
8	82.5	1191.	1.84954E-05
9	97.5	1144.	1.77581E-05
10	112.5	1122.	1.74166E-05
11	127.5	1142.	1.77348E-05
12	142.5	1067.	1.65706E-05
13	157.5	730.	1.13317E-05
14	172.5	464.	7.21035E-06
15	187.5	347.	5.38642E-06
16	202.5	275.	4.26102E-06
17	217.5	212.	3.29860E-06
18	232.5	166.	2.57679E-06
19	247.5	120.	1.85498E-06
20	262.5	85.	1.31944E-06
21	277.5	72.	1.11764E-06
22	292.5	47.	7.29573E-07
23	307.5	27.	4.19116E-07
24	322.5	11.	1.62990E-07
25	337.5	3.	4.65685E-08
26	352.5	-8.	-1.24183E-07
27	382.5	-17.	-2.71649E-07
28	412.5	-26.	-4.11355E-07
29	442.5	-22.	-3.41502E-07
30	472.5	15.	2.32842E-07
31	502.5	3.	4.65685E-08

IDENTIFICATION 301430 TIME 1440.

APPLIED LOAD 30.94 TONS

TOP DEFLECTION
  POTENTIOMETER 0.365 INCHES
  DIAL GAGE 0.382 INCHES

TOP SLOPE 3.69333E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	45.	6.98527E-07
4	22.5	329.	5.11477E-06
5	37.5	545.	8.46770E-06
6	52.5	795.	1.23406E-05
7	67.5	1028.	1.59652E-05
8	82.5	1188.	1.84334E-05
9	97.5	1141.	1.77193E-05
10	112.5	1123.	1.74244E-05
11	127.5	1143.	1.77426E-05
12	142.5	1066.	1.65396E-05
13	157.5	734.	1.13860E-05
14	172.5	467.	7.25692E-06
15	187.5	350.	5.44075E-06
16	202.5	276.	4.27654E-06
17	217.5	214.	3.32189E-06
18	232.5	169.	2.61560E-06
19	247.5	121.	1.87826E-06
20	262.5	84.	1.30392E-06
21	277.5	71.	1.10988E-06
22	292.5	47.	7.29573E-07
23	307.5	27.	4.19116E-07
24	322.5	10.	1.47467E-07
25	337.5	1.	2.32842E-08
26	352.5	-8.	-1.24183E-07
27	382.5	-6.	-9.31370E-08
28	412.5	-14.	-2.17320E-07
29	442.5	-11.	-1.62990E-07
30	472.5	23.	3.57025E-07
31	502.5	13.	2.09558E-07

IDENTIFICATION 301530 TIME 1447.

APPLIED LOAD 31.33 TONS

TOP DEFLECTION
POTENTIOMETER 0.371 INCHES
DIAL GAGE 0.386 INCHES

TOP SLOPE 3.76667E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	45.	6.90766E-07
4	22.5	335.	5.20015E-06
5	37.5	551.	8.55308E-06
6	52.5	803.	1.24648E-05
7	67.5	1037.	1.60972E-05
8	82.5	1197.	1.85886E-05
9	97.5	1153.	1.78978E-05
10	112.5	1131.	1.75563E-05
11	127.5	1154.	1.79211E-05
12	142.5	1079.	1.67414E-05
13	157.5	739.	1.14714E-05
14	172.5	474.	7.35006E-06
15	187.5	353.	5.47956E-06
16	202.5	280.	4.35415E-06
17	217.5	219.	3.39174E-06
18	232.5	172.	2.66993E-06
19	247.5	126.	1.95588E-06
20	262.5	89.	1.38929E-06
21	277.5	77.	1.18750E-06
22	292.5	51.	7.91664E-07
23	307.5	30.	4.73446E-07
24	322.5	13.	2.01797E-07
25	337.5	4.	6.98527E-08
26	352.5	-4.	-6.98527E-08
27	382.5	-5.	-7.76141E-08
28	412.5	-13.	-2.09558E-07
29	442.5	-11.	-1.62990E-07
30	472.5	22.	3.33741E-07
31	502.5	14.	2.17320E-07

IDENTIFICATION 301630 TIME 1454.

APPLIED LOAD 31.02 TONS

TOP DEFLECTION
  POTENTIOMETER 0.370 INCHES
  DIAL GAGE 0.387 INCHES

TOP SLOPE 3.73000E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	46.	7.06289E-07
4	22.5	329.	5.11477E-06
5	37.5	547.	8.48323E-06
6	52.5	795.	1.23406E-05
7	67.5	1030.	1.59885E-05
8	82.5	1189.	1.84566E-05
9	97.5	1144.	1.77581E-05
10	112.5	1128.	1.75098E-05
11	127.5	1149.	1.78435E-05
12	142.5	1074.	1.66715E-05
13	157.5	739.	1.14791E-05
14	172.5	471.	7.31125E-06
15	187.5	353.	5.47956E-06
16	202.5	280.	4.34639E-06
17	217.5	218.	3.38398E-06
18	232.5	170.	2.63888E-06
19	247.5	123.	1.90931E-06
20	262.5	88.	1.35825E-06
21	277.5	74.	1.14869E-06
22	292.5	49.	7.68380E-07
23	307.5	28.	4.34639E-07
24	322.5	11.	1.62990E-07
25	337.5	3.	4.65685E-08
26	352.5	-8.	-1.31944E-07
27	382.5	-18.	-2.87172E-07
28	412.5	-26.	-4.11355E-07
29	442.5	-23.	-3.49264E-07
30	472.5	14.	2.25081E-07
31	502.5	3.	3.88071E-08

IDENTIFICATION 301730 TIME 1456.

APPLIED LOAD 31.01 TONS

TOP DEFLECTION
POTENTIOMETER 0.371 INCHES
DIAL GAGE 0.389 INCHES

TOP SLOPE 3.92667E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	45.	6.98527E-07
4	22.5	329.	5.10701E-06
5	37.5	546.	8.47546E-06
6	52.5	798.	1.23872E-05
7	67.5	1035.	1.60739E-05
8	82.5	1199.	1.86119E-05
9	97.5	1155.	1.79366E-05
10	112.5	1140.	1.76883E-05
11	127.5	1163.	1.80453E-05
12	142.5	1089.	1.69044E-05
13	157.5	751.	1.16576E-05
14	172.5	479.	7.43543E-06
15	187.5	359.	5.57270E-06
16	202.5	284.	4.41624E-06
17	217.5	220.	3.42278E-06
18	232.5	173.	2.68545E-06
19	247.5	125.	1.94811E-06
20	262.5	88.	1.37377E-06
21	277.5	74.	1.14869E-06
22	292.5	48.	7.52357E-07
23	307.5	29.	4.50162E-07
24	322.5	12.	1.78513E-07
25	337.5	1.	2.32342E-08
26	352.5	-8.	-1.24183E-07
27	382.5	-17.	-2.63888E-07
28	412.5	-26.	-4.03594E-07
29	442.5	-24.	-3.72548E-07
30	472.5	14.	2.25081E-07
31	502.5	3.	5.43299E-08

IDENTIFICATION 301830 TIME 1458.

APPLIED LOAD 30.87 TONS

TOP DEFLECTION
POTENTIOMETER 0.375 INCHES
DIAL GAGE 0.392 INCHES

TOP SLOPE 3.75667E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	45.	6.98527E-07
4	22.5	329.	5.09925E-06
5	37.5	547.	8.48323E-06
6	52.5	801.	1.24338E-05
7	67.5	1040.	1.61360E-05
8	82.5	1204.	1.86972E-05
9	97.5	1164.	1.80586E-05
10	112.5	1149.	1.78357E-05
11	127.5	1176.	1.82626E-05
12	142.5	1106.	1.71605E-05
13	157.5	765.	1.18827E-05
14	172.5	489.	7.59842E-06
15	187.5	367.	5.68912E-06
16	202.5	290.	4.50162E-06
17	217.5	227.	3.52368E-06
18	232.5	177.	2.74754E-06
19	247.5	130.	2.01797E-06
20	262.5	93.	1.44362E-06
21	277.5	81.	1.24959E-06
22	292.5	53.	8.22710E-07
23	307.5	33.	5.04492E-07
24	322.5	13.	2.09558E-07
25	337.5	5.	7.76141E-08
26	352.5	-6.	-8.53756E-08
27	382.5	-16.	-2.48365E-07
28	412.5	-26.	-4.03594E-07
29	442.5	-23.	-3.49264E-07
30	472.5	17.	2.63888E-07
31	502.5	4.	6.98527E-08

IDENTIFICATION 301930 TIME 1519.

APPLIED LOAD 31.25 TONS

TOP DEFLECTION
POTENTIOMETER 0.378 INCHES
DIAL GAGE 0.395 INCHES

TOP SLOPE 3.79333E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	46.	7.06289E-07
4	22.5	332.	5.14582E-06
5	37.5	552.	8.57636E-06
6	52.5	809.	1.25580E-05
7	67.5	1055.	1.63766E-05
8	82.5	1233.	1.91396E-05
9	97.5	1195.	1.85575E-05
10	112.5	1182.	1.83557E-05
11	127.5	1214.	1.88447E-05
12	142.5	1145.	1.77659E-05
13	157.5	792.	1.23018E-05
14	172.5	509.	7.90112E-06
15	187.5	382.	5.92972E-06
16	202.5	304.	4.72670E-06
17	217.5	237.	3.67891E-06
18	232.5	188.	2.91829E-06
19	247.5	138.	2.13439E-06
20	262.5	100.	1.56004E-06
21	277.5	87.	1.35049E-06
22	292.5	59.	9.15847E-07
23	307.5	36.	5.66583E-07
24	322.5	18.	2.79411E-07
25	337.5	10.	1.55228E-07
26	352.5	-3.	-3.88071E-08
27	382.5	-15.	-2.32842E-07
28	412.5	-26.	-4.11355E-07
29	442.5	-24.	-3.80309E-07
30	472.5	17.	2.56127E-07
31	502.5	6.	9.31370E-08

IDENTIFICATION 302030 TIME 1528.

APPLIED LOAD 31.67 TONS

TOP DEFLECTION
POTENTIOMETER 0.382 INCHES
DIAL GAGE 0.399 INCHES

TOP SLOPE 3.84000E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	47.	7.21812E-07
4	22.5	337.	5.23895E-06
5	37.5	562.	8.73159E-06
6	52.5	822.	1.27675E-05
7	67.5	1067.	1.65706E-05
8	82.5	1239.	1.92405E-05
9	97.5	1203.	1.86740E-05
10	112.5	1191.	1.84877E-05
11	127.5	1222.	1.89689E-05
12	142.5	1150.	1.78513E-05
13	157.5	799.	1.24027E-05
14	172.5	512.	7.93993E-06
15	187.5	383.	5.94524E-06
16	202.5	304.	4.72670E-06
17	217.5	237.	3.68667E-06
18	232.5	187.	2.90277E-06
19	247.5	139.	2.16543E-06
20	262.5	100.	1.55228E-06
21	277.5	86.	1.34272E-06
22	292.5	58.	8.92563E-07
23	307.5	35.	5.51060E-07
24	322.5	17.	2.63888E-07
25	337.5	9.	1.39705E-07
26	352.5	-9.	-1.39705E-07
27	382.5	-17.	-2.63888E-07
28	412.5	-27.	-4.19116E-07
29	442.5	-26.	-4.03594E-07
30	472.5	17.	2.71649E-07
31	502.5	4.	6.20913E-08

IDENTIFICATION 400140 TIME 1547.

APPLIED LOAD 43.06 TONS

TOP DEFLECTION
POTENTIOMETER 0.575 INCHES
DIAL GAGE 0.596 INCHES

TOP SLOPE 5.53667E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	55.	8.61517E-07
4	22.5	462.	7.16379E-06
5	37.5	803.	1.24648E-05
6	52.5	1212.	1.88214E-05
7	67.5	1606.	2.49374E-05
8	82.5	1874.	2.90898E-05
9	97.5	1868.	2.89889E-05
10	112.5	1890.	2.93381E-05
11	127.5	1900.	2.95011E-05
12	142.5	1843.	2.86086E-05
13	157.5	1371.	2.12818E-05
14	172.5	917.	1.42267E-05
15	187.5	711.	1.10367E-05
16	202.5	565.	8.76264E-06
17	217.5	436.	6.76795E-06
18	232.5	333.	5.17686E-06
19	247.5	246.	3.81862E-06
20	262.5	197.	3.05800E-06
21	277.5	172.	2.66993E-06
22	292.5	116.	1.80065E-06
23	307.5	75.	1.17197E-06
24	322.5	43.	6.67482E-07
25	337.5	25.	3.95832E-07
26	352.5	6.	8.53756E-08
27	382.5	-20.	-3.18218E-07
28	412.5	-41.	-6.36436E-07
29	442.5	-43.	-6.67482E-07
30	472.5	33.	5.04492E-07
31	502.5	13.	2.09558E-07

IDENTIFICATION 400240 TIME 1606.

APPLIED LOAD 41.26 TONS

TOP DEFLECTION
POTENTIOMETER 0.626 INCHES
DIAL GAGE 0.651 INCHES

TOP SLOPE 5.86333E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	66.	1.02451E-06
4	22.5	475.	7.38110E-06
5	37.5	823.	1.27830E-05
6	52.5	1241.	1.92638E-05
7	67.5	1644.	2.55118E-05
8	82.5	1937.	3.00677E-05
9	97.5	1942.	3.01376E-05
10	112.5	1960.	3.04170E-05
11	127.5	2006.	3.11388E-05
12	142.5	1952.	3.03006E-05
13	157.5	1478.	2.29427E-05
14	172.5	994.	1.54297E-05
15	187.5	770.	1.19603E-05
16	202.5	628.	9.74834E-06
17	217.5	492.	7.63723E-06
18	232.5	375.	5.82882E-06
19	247.5	282.	4.37744E-06
20	262.5	210.	3.25979E-06
21	277.5	181.	2.80963E-06
22	292.5	127.	1.97916E-06
23	307.5	87.	1.35049E-06
24	322.5	49.	7.60519E-07
25	337.5	31.	4.88969E-07
26	352.5	6.	8.53756E-08
27	382.5	-19.	-2.94934E-07
28	412.5	-48.	-7.52857E-07
29	442.5	-48.	-7.45096E-07
30	472.5	30.	4.73446E-07
31	502.5	7.	1.16421E-07

IDENTIFICATION 400340 TIME 1616.

APPLIED LOAD 41.41 TONS

TOP DEFLECTION
POTENTIOMETER 0.660 INCHES
DIAL GAGE 0.687 INCHES

TOP SLOPE 6.13000E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	68.	1.06331E-06
4	22.5	477.	7.41215E-06
5	37.5	826.	1.28219E-05
6	52.5	1251.	1.94191E-05
7	67.5	1663.	2.58222E-05
8	82.5	1968.	3.05489E-05
9	97.5	1978.	3.07119E-05
10	112.5	2009.	3.11931E-05
11	127.5	2060.	3.19770E-05
12	142.5	2010.	3.12086E-05
13	157.5	1536.	2.38431E-05
14	172.5	1031.	1.60040E-05
15	187.5	799.	1.24027E-05
16	202.5	655.	1.01675E-05
17	217.5	515.	7.98650E-06
18	232.5	396.	6.13928E-06
19	247.5	288.	4.47057E-06
20	262.5	212.	3.29084E-06
21	277.5	183.	2.83292E-06
22	292.5	125.	1.94035E-06
23	307.5	84.	1.30392E-06
24	322.5	46.	7.14050E-07
25	337.5	27.	4.19116E-07
26	352.5	3.	3.88071E-08
27	382.5	-24.	-3.72548E-07
28	412.5	-49.	-7.60619E-07
29	442.5	-49.	-7.60619E-07
30	472.5	30.	4.73446E-07
31	502.5	6.	1.00898E-07

IDENTIFICATION 400440 TIME 1623.

APPLIED LOAD 41.46 TONS

TOP DEFLECTION
POTENTIOMETER 0.702 INCHES
DIAL GAGE 0.722 INCHES

TOP SLOPE 6.29333E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	67.	1.04003E-06
4	22.5	480.	7.45096E-06
5	37.5	832.	1.29150E-05
6	52.5	1265.	1.96364E-05
7	67.5	1690.	2.62413E-05
8	82.5	2007.	3.11466E-05
9	97.5	2022.	3.13949E-05
10	112.5	2060.	3.19770E-05
11	127.5	2121.	3.29162E-05
12	142.5	2077.	3.22409E-05
13	157.5	1605.	2.49064E-05
14	172.5	1083.	1.68035E-05
15	187.5	839.	1.30159E-05
16	202.5	691.	1.07340E-05
17	217.5	546.	8.47546E-06
18	232.5	418.	6.49630E-06
19	247.5	307.	4.76551E-06
20	262.5	224.	3.47711E-06
21	277.5	191.	2.96486E-06
22	292.5	131.	2.03349E-06
23	307.5	88.	1.36601E-06
24	322.5	49.	7.60619E-07
25	337.5	29.	4.42401E-07
26	352.5	3.	4.65685E-08
27	382.5	-25.	-3.95832E-07
28	412.5	-49.	-7.68380E-07
29	442.5	-51.	-7.91664E-07
30	472.5	32.	4.96731E-07
31	502.5	7.	1.16421E-07

IDENTIFICATION 400540 TIME 1629.

APPLIED LOAD 41.41 TONS

TOP DEFLECTION
POTENTIOMETER 0.713 INCHES
DIAL GAGE 0.738 INCHES

TOP SLOPE 6.39333E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	67.	1.03227E-06
4	22.5	481.	7.47424E-06
5	37.5	837.	1.29926E-05
6	52.5	1276.	1.97994E-05
7	67.5	1702.	2.64276E-05
8	82.5	2023.	3.14104E-05
9	97.5	2044.	3.17364E-05
10	112.5	2087.	3.24039E-05
11	127.5	2157.	3.34827E-05
12	142.5	2128.	3.30326E-05
13	157.5	1654.	2.56748E-05
14	172.5	1123.	1.74244E-05
15	187.5	873.	1.35514E-05
16	202.5	728.	1.12929E-05
17	217.5	581.	9.02552E-06
18	232.5	452.	7.02408E-06
19	247.5	339.	5.26224E-06
20	262.5	254.	3.94280E-06
21	277.5	217.	3.36845E-06
22	292.5	155.	2.41380E-06
23	307.5	109.	1.69975E-06
24	322.5	66.	1.02451E-06
25	337.5	45.	6.90766E-07
26	352.5	15.	2.32842E-07
27	382.5	-17.	-2.63888E-07
28	412.5	-50.	-7.76141E-07
29	442.5	-52.	-7.99426E-07
30	472.5	37.	5.82106E-07
31	502.5	11.	1.62990E-07

IDENTIFICATION 400640 TIME 1640.

APPLIED LOAD 41.36 TONS

TOP DEFLECTION
POTENTIOMETER 0.723 INCHES
DIAL GAGE 0.760 INCHES

TOP SLOPE 6.51667E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	68.	1.06331E-06
4	22.5	486.	7.54409E-06
5	37.5	842.	1.30625E-05
6	52.5	1284.	1.99236E-05
7	67.5	1719.	2.66837E-05
8	82.5	2050.	3.18218E-05
9	97.5	2073.	3.21788E-05
10	112.5	2124.	3.29782E-05
11	127.5	2203.	3.41968E-05
12	142.5	2176.	3.37854E-05
13	157.5	1707.	2.65052E-05
14	172.5	1164.	1.80763E-05
15	187.5	908.	1.40870E-05
16	202.5	756.	1.17430E-05
17	217.5	605.	9.39131E-06
18	232.5	471.	7.31125E-06
19	247.5	350.	5.44075E-06
20	262.5	259.	4.02041E-06
21	277.5	222.	3.43831E-06
22	292.5	156.	2.42156E-06
23	307.5	109.	1.68423E-06
24	322.5	63.	9.85599E-07
25	337.5	42.	6.59720E-07
26	352.5	13.	2.09558E-07
27	382.5	-19.	-2.94934E-07
28	412.5	-54.	-8.38233E-07
29	442.5	-55.	-8.61517E-07
30	472.5	35.	5.43299E-07
31	502.5	8.	1.24183E-07

IDENTIFICATION 400740 TIME 1648.

APPLIED LOAD 41.43 TONS

TOP DEFLECTION
POTENTIOMETER 0.743 INCHES
DIAL GAGE 0.772 INCHES

TOP SLOPE 6.56667E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	66.	1.02451E-06
4	22.5	484.	7.52081E-06
5	37.5	842.	1.30702E-05
6	52.5	1289.	2.00089E-05
7	67.5	1728.	2.68234E-05
8	82.5	2064.	3.20391E-05
9	97.5	2092.	3.24738E-05
10	112.5	2149.	3.33586E-05
11	127.5	2233.	3.46625E-05
12	142.5	2215.	3.43908E-05
13	157.5	1746.	2.70951E-05
14	172.5	1195.	1.85498E-05
15	187.5	932.	1.44573E-05
16	202.5	779.	1.21000E-05
17	217.5	626.	9.71729E-06
18	232.5	488.	7.57514E-06
19	247.5	364.	5.65031E-06
20	262.5	271.	4.19893E-06
21	277.5	230.	3.57801E-06
22	292.5	163.	2.53022E-06
23	307.5	113.	1.76184E-06
24	322.5	68.	1.06331E-06
25	337.5	46.	7.14050E-07
26	352.5	15.	2.32842E-07
27	382.5	-18.	-2.79411E-07
28	412.5	-53.	-8.22710E-07
29	442.5	-55.	-8.53756E-07
30	472.5	37.	5.82106E-07
31	502.5	9.	1.39705E-07

IDENTIFICATION 400840 TIME 1651.

APPLIED LOAD 41.28 TONS

TOP DEFLECTION
POTENTIOMETER 0.756 INCHES
DIAL GAGE 0.785 INCHES

TOP SLOPE 6.70667E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	67.	1.03227E-06
4	22.5	481.	7.47424E-06
5	37.5	839.	1.30314E-05
6	52.5	1287.	1.99856E-05
7	67.5	1729.	2.68390E-05
8	82.5	2067.	3.20857E-05
9	97.5	2096.	3.25358E-05
10	112.5	2156.	3.34672E-05
11	127.5	2244.	3.48332E-05
12	142.5	2227.	3.45616E-05
13	157.5	1762.	2.73435E-05
14	172.5	1207.	1.87361E-05
15	187.5	941.	1.46147E-05
16	202.5	788.	1.22320E-05
17	217.5	632.	9.81043E-06
18	232.5	492.	7.64499E-06
19	247.5	365.	5.67359E-06
20	262.5	269.	4.17564E-06
21	277.5	227.	3.52368E-06
22	292.5	159.	2.46813E-06
23	307.5	110.	1.71527E-06
24	322.5	64.	1.00122E-06
25	337.5	42.	6.51959E-07
26	352.5	10.	1.47467E-07
27	382.5	-22.	-3.33741E-07
28	412.5	-55.	-8.61517E-07
29	442.5	-55.	-8.53756E-07
30	472.5	37.	5.74345E-07
31	502.5	9.	1.39705E-07

IDENTIFICATION 400940 TIME 1654.

APPLIED LOAD 41.42 TONS

TOP DEFLECTION
POTENTIOMETER 0.774 INCHES
DIAL GAGE 0.798 INCHES

TOP SLOPE 6.80667E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	67.	1.04779E-06
4	22.5	483.	7.49753E-06
5	37.5	845.	1.31168E-05
6	52.5	1298.	2.01486E-05
7	67.5	1741.	2.70330E-05
8	82.5	2085.	3.23651E-05
9	97.5	2117.	3.28618E-05
10	112.5	2179.	3.38242E-05
11	127.5	2272.	3.52679E-05
12	142.5	2261.	3.50971E-05
13	157.5	1793.	2.78402E-05
14	172.5	1235.	1.91707E-05
15	187.5	963.	1.49485E-05
16	202.5	808.	1.25424E-05
17	217.5	651.	1.01054E-05
18	232.5	509.	7.90888E-06
19	247.5	379.	5.88315E-06
20	262.5	280.	4.35415E-06
21	277.5	236.	3.66339E-06
22	292.5	166.	2.57579E-06
23	307.5	117.	1.82393E-06
24	322.5	70.	1.08660E-06
25	337.5	47.	7.21812E-07
26	352.5	14.	2.25081E-07
27	382.5	-20.	-3.10457E-07
28	412.5	-55.	-8.61517E-07
29	442.5	-57.	-8.77040E-07
30	472.5	40.	6.20913E-07
31	502.5	11.	1.70751E-07

IDENTIFICATION 401040 TIME 1659.

APPLIED LOAD 41.20 TONS

TOP DEFLECTION
POTENTIOMETER 0.780 INCHES
DIAL GAGE 0.807 INCHES

TOP SLOPE 6.86333E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	65.	1.00898E-06
4	22.5	483.	7.49753E-06
5	37.5	843.	1.30935E-05
6	52.5	1294.	2.00943E-05
7	67.5	1736.	2.69476E-05
8	82.5	2082.	3.23185E-05
9	97.5	2117.	3.28618E-05
10	112.5	2184.	3.39019E-05
11	127.5	2279.	3.53688E-05
12	142.5	2273.	3.52834E-05
13	157.5	1807.	2.80575E-05
14	172.5	1246.	1.93492E-05
15	187.5	976.	1.51503E-05
16	202.5	820.	1.27287E-05
17	217.5	664.	1.03072E-05
18	232.5	523.	8.11844E-06
19	247.5	392.	6.09271E-06
20	262.5	294.	4.56371E-06
21	277.5	248.	3.85742E-06
22	292.5	178.	2.76306E-06
23	307.5	124.	1.93259E-06
24	322.5	77.	1.18750E-06
25	337.5	52.	8.14948E-07
26	352.5	17.	2.71649E-07
27	382.5	-16.	-2.48365E-07
28	412.5	-57.	-8.77040E-07
29	442.5	-58.	-9.08085E-07
30	472.5	39.	6.05390E-07
31	502.5	8.	1.24183E-07

IDENTIFICATION 401140 TIME 1738.

APPLIED LOAD 41.47 TONS

TOP DEFLECTION
POTENTIOMETER 0.797 INCHES
DIAL GAGE 0.823 INCHES

TOP SLOPE 6.96333E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	66.	1.02451E-06
4	22.5	485.	7.53633E-06
5	37.5	847.	1.31478E-05
6	52.5	1301.	2.01952E-05
7	67.5	1750.	2.71572E-05
8	82.5	2099.	3.25747E-05
9	97.5	2135.	3.31490E-05
10	112.5	2205.	3.42201E-05
11	127.5	2306.	3.57956E-05
12	142.5	2303.	3.57491E-05
13	157.5	1838.	2.85310E-05
14	172.5	1273.	1.97506E-05
15	187.5	995.	1.54452E-05
16	202.5	835.	1.29693E-05
17	217.5	675.	1.04779E-05
18	232.5	531.	8.25038E-06
19	247.5	398.	6.17809E-06
20	262.5	297.	4.61028E-06
21	277.5	251.	3.89623E-06
22	292.5	178.	2.76306E-06
23	307.5	124.	1.93259E-06
24	322.5	76.	1.17973E-06
25	337.5	52.	7.99426E-07
26	352.5	18.	2.87172E-07
27	382.5	-18.	-2.79411E-07
28	412.5	-55.	-8.61517E-07
29	442.5	-57.	-8.84801E-07
30	472.5	41.	6.28675E-07
31	502.5	10.	1.55228E-07

IDENTIFICATION 401240 TIME 1712.

APPLIED LOAD 41.44 TONS

TOP DEFLECTION
POTENTIOMETER 0.803 INCHES
DIAL GAGE 0.833 INCHES

TOP SLOPE 7.00333E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	67.	1.03227E-06
4	22.5	485.	7.52857E-06
5	37.5	849.	1.31789E-05
6	52.5	1303.	2.02340E-05
7	67.5	1753.	2.72038E-05
8	82.5	2104.	3.26523E-05
9	97.5	2143.	3.32554E-05
10	112.5	2214.	3.43598E-05
11	127.5	2319.	3.59897E-05
12	142.5	2315.	3.59431E-05
13	157.5	1855.	2.88026E-05
14	172.5	1285.	1.99391E-05
15	187.5	1007.	1.56315E-05
16	202.5	846.	1.31323E-05
17	217.5	684.	1.06099E-05
18	232.5	538.	8.35128E-06
19	247.5	404.	6.27122E-06
20	262.5	299.	4.64133E-06
21	277.5	251.	3.89623E-06
22	292.5	177.	2.75530E-06
23	307.5	123.	1.91707E-06
24	322.5	76.	1.17973E-06
25	337.5	51.	7.83903E-07
26	352.5	17.	2.71649E-07
27	382.5	-19.	-2.94934E-07
28	412.5	-57.	-8.77040E-07
29	442.5	-58.	-9.00324E-07
30	472.5	41.	6.44197E-07
31	502.5	12.	1.78513E-07

IDENTIFICATION 401340 TIME 1715.

APPLIED LOAD 41.45 TONS

TOP DEFLECTION
POTENTIOMETER 0.812 INCHES
DIAL GAGE 0.841 INCHES

TOP SLOPE 7.05000E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	67.	1.03227E-06
4	22.5	484.	7.50529E-06
5	37.5	851.	1.32022E-05
6	52.5	1304.	2.02495E-05
7	67.5	1755.	2.72503E-05
8	82.5	2110.	3.27532E-05
9	97.5	2150.	3.33741E-05
10	112.5	2220.	3.44607E-05
11	127.5	2329.	3.61504E-05
12	142.5	2335.	3.62458E-05
13	157.5	1872.	2.90510E-05
14	172.5	1299.	2.01719E-05
15	187.5	1018.	1.58100E-05
16	202.5	856.	1.32875E-05
17	217.5	694.	1.07651E-05
18	232.5	548.	8.49875E-06
19	247.5	411.	6.38764E-06
20	262.5	307.	4.75775E-06
21	277.5	258.	3.99713E-06
22	292.5	182.	2.82515E-06
23	307.5	128.	1.98592E-06
24	322.5	78.	1.21078E-06
25	337.5	52.	8.14948E-07
26	352.5	18.	2.87172E-07
27	382.5	-19.	-2.94934E-07
28	412.5	-58.	-9.08085E-07
29	442.5	-59.	-9.15847E-07
30	472.5	40.	6.13152E-07
31	502.5	10.	1.55228E-07

IDENTIFICATION 401440 TIME 1718.

APPLIED LOAD 41.42 TONS

TOP DEFLECTION
POTENTIOMETER 0.819 INCHES
DIAL GAGE 0.853 INCHES

TOP SLOPE 7.09000E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	67.	1.03227E-06
4	22.5	481.	7.46648E-06
5	37.5	848.	1.31556E-05
6	52.5	1298.	2.01409E-05
7	67.5	1757.	2.72736E-05
8	82.5	2118.	3.28851E-05
9	97.5	2160.	3.35293E-05
10	112.5	2232.	3.46470E-05
11	127.5	2354.	3.65485E-05
12	142.5	2354.	3.65407E-05
13	157.5	1894.	2.93925E-05
14	172.5	1318.	2.04668E-05
15	187.5	1035.	1.60584E-05
16	202.5	871.	1.35281E-05
17	217.5	708.	1.09902E-05
18	232.5	560.	8.69278E-06
19	247.5	422.	6.55839E-06
20	262.5	315.	4.88969E-06
21	277.5	265.	4.10579E-06
22	292.5	187.	2.90277E-06
23	307.5	131.	2.04125E-06
24	322.5	81.	1.24959E-06
25	337.5	55.	8.53756E-07
26	352.5	20.	3.18218E-07
27	382.5	-18.	-2.79411E-07
28	412.5	-58.	-9.00324E-07
29	442.5	-60.	-9.31370E-07
30	472.5	41.	6.44197E-07
31	502.5	10.	1.47467E-07

IDENTIFICATION 401540 TIME 1725.

APPLIED LOAD 41.10 TONS

TOP DEFLECTION
POTENTIOMETER 0.829 INCHES
DIAL GAGE 0.857 INCHES

TOP SLOPE 7.11000E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	66.	1.02451E-06
4	22.5	484.	7.51305E-06
5	37.5	849.	1.31866E-05
6	52.5	1299.	2.01642E-05
7	67.5	1746.	2.71106E-05
8	82.5	2102.	3.26367E-05
9	97.5	2144.	3.32809E-05
10	112.5	2219.	3.44529E-05
11	127.5	2349.	3.64631E-05
12	142.5	2345.	3.64010E-05
13	157.5	1892.	2.93692E-05
14	172.5	1317.	2.04436E-05
15	187.5	1038.	1.61127E-05
16	202.5	876.	1.35980E-05
17	217.5	713.	1.10678E-05
18	232.5	569.	8.82473E-06
19	247.5	431.	6.69034E-06
20	262.5	325.	5.04492E-06
21	277.5	272.	4.22997E-06
22	292.5	197.	3.05024E-06
23	307.5	139.	2.16543E-06
24	322.5	88.	1.35825E-06
25	337.5	62.	9.70176E-07
26	352.5	24.	3.80309E-07
27	382.5	-15.	-2.32842E-07
28	412.5	-57.	-8.77040E-07
29	442.5	-60.	-9.31370E-07
30	472.5	44.	6.83004E-07
31	502.5	12.	1.78513E-07

IDENTIFICATION 401640 TIME 1730.

APPLIED LOAD 41.15 TONS

TOP DEFLECTION
POTENTIOMETER 0.841 INCHES
DIAL GAGE 0.861 INCHES

TOP SLOPE 7.12333E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	66.	1.01675E-06
4	22.5	481.	7.45872E-06
5	37.5	848.	1.31711E-05
6	52.5	1296.	2.01253E-05
7	67.5	1747.	2.71261E-05
8	82.5	2105.	3.26833E-05
9	97.5	2147.	3.33275E-05
10	112.5	2222.	3.44917E-05
11	127.5	2357.	3.65873E-05
12	142.5	2358.	3.65951E-05
13	157.5	1899.	2.94856E-05
14	172.5	1325.	2.05755E-05
15	187.5	1041.	1.61593E-05
16	202.5	877.	1.36135E-05
17	217.5	715.	1.10911E-05
18	232.5	568.	8.80921E-06
19	247.5	431.	6.68258E-06
20	262.5	323.	5.01387E-06
21	277.5	271.	4.20669E-06
22	292.5	194.	3.01919E-06
23	307.5	138.	2.14215E-06
24	322.5	86.	1.33496E-06
25	337.5	60.	9.39131E-07
26	352.5	24.	3.80309E-07
27	382.5	-14.	-2.25081E-07
28	412.5	-57.	-8.77040E-07
29	442.5	-59.	-9.23608E-07
30	472.5	41.	6.44197E-07
31	502.5	10.	1.47467E-07

IDENTIFICATION 401740 TIME 1734.

APPLIED LOAD 41.33 TONS

TOP DEFLECTION
POTENTIOMETER 0.845 INCHES
DIAL GAGE 0.873 INCHES

TOP SLOPE 7.16000E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	67.	1.03227E-06
4	22.5	484.	7.52081E-06
5	37.5	855.	1.32643E-05
6	52.5	1303.	2.02185E-05
7	67.5	1756.	2.72658E-05
8	82.5	2115.	3.28385E-05
9	97.5	2159.	3.35138E-05
10	112.5	2237.	3.47323E-05
11	127.5	2376.	3.68900E-05
12	142.5	2376.	3.68900E-05
13	157.5	1922.	2.98426E-05
14	172.5	1342.	2.08394E-05
15	187.5	1057.	1.63999E-05
16	202.5	892.	1.38464E-05
17	217.5	728.	1.12929E-05
18	232.5	581.	9.01376E-06
19	247.5	442.	6.86885E-06
20	262.5	332.	5.16134E-06
21	277.5	279.	4.33087E-06
22	292.5	201.	3.11233E-06
23	307.5	144.	2.22753E-06
24	322.5	89.	1.38929E-06
25	337.5	63.	9.77938E-07
26	352.5	28.	4.26878E-07
27	382.5	-14.	-2.17320E-07
28	412.5	-58.	-8.92563E-07
29	442.5	-60.	-9.31370E-07
30	472.5	45.	6.90766E-07
31	502.5	11.	1.62990E-07

IDENTIFICATION 401840 TIME 1737.

APPLIED LOAD 41.04 TONS

TOP DEFLECTION
POTENTIOMETER 0.846 INCHES
DIAL GAGE 0.874 INCHES

TOP SLOPE 7.16000E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	66.	1.01675E-06
4	22.5	480.	7.45096E-06
5	37.5	848.	1.31556E-05
6	52.5	1296.	2.01253E-05
7	67.5	1746.	2.70951E-05
8	82.5	2105.	3.26678E-05
9	97.5	2151.	3.33896E-05
10	112.5	2231.	3.46237E-05
11	127.5	2373.	3.68434E-05
12	142.5	2375.	3.68590E-05
13	157.5	1925.	2.98892E-05
14	172.5	1344.	2.08704E-05
15	187.5	1061.	1.64620E-05
16	202.5	896.	1.39162E-05
17	217.5	732.	1.13627E-05
18	232.5	584.	9.06533E-06
19	247.5	446.	6.93094E-06
20	262.5	337.	5.23895E-06
21	277.5	283.	4.39296E-06
22	292.5	203.	3.15113E-06
23	307.5	146.	2.26633E-06
24	322.5	94.	1.45915E-06
25	337.5	66.	1.01675E-06
26	352.5	29.	4.50162E-07
27	382.5	-12.	-1.86274E-07
28	412.5	-57.	-8.84801E-07
29	442.5	-61.	-9.46893E-07
30	472.5	46.	7.06289E-07
31	502.5	13.	2.01797E-07

IDENTIFICATION 401940 TIME 1740.

APPLIED LOAD 41.59 TONS

TOP DEFLECTION
POTENTIOMETER 0.856 INCHES
DIAL GAGE 0.883 INCHES

TOP SLOPE 7.23667E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	66.	1.02451E-06
4	22.5	487.	7.55186E-06
5	37.5	858.	1.33263E-05
6	52.5	1312.	2.03660E-05
7	67.5	1767.	2.74366E-05
8	82.5	2129.	3.30481E-05
9	97.5	2175.	3.37699E-05
10	112.5	2254.	3.49962E-05
11	127.5	2401.	3.72703E-05
12	142.5	2406.	3.73402E-05
13	157.5	1951.	3.02773E-05
14	172.5	1365.	2.11887E-05
15	187.5	1076.	1.67103E-05
16	202.5	910.	1.41258E-05
17	217.5	746.	1.15723E-05
18	232.5	597.	9.26713E-06
19	247.5	456.	7.07841E-06
20	262.5	346.	5.37090E-06
21	277.5	290.	4.50938E-06
22	292.5	210.	3.25979E-06
23	307.5	150.	2.32842E-06
24	322.5	95.	1.47467E-06
25	337.5	68.	1.05555E-06
26	352.5	28.	4.34639E-07
27	382.5	-12.	-1.94035E-07
28	412.5	-59.	-9.15847E-07
29	442.5	-62.	-9.62415E-07
30	472.5	43.	6.67482E-07
31	502.5	12.	1.86274E-07

IDENTIFICATION 402040 TIME 1746.

APPLIED LOAD 41.27 TONS

TOP DEFLECTION
POTENTIOMETER 0.856 INCHES
DIAL GAGE 0.885 INCHES

TOP SLOPE 7.22000E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	66.	1.02451E-06
4	22.5	482.	7.48200E-06
5	37.5	854.	1.32565E-05
6	52.5	1300.	2.01797E-05
7	67.5	1751.	2.71805E-05
8	82.5	2112.	3.27765E-05
9	97.5	2159.	3.35138E-05
10	112.5	2241.	3.47867E-05
11	127.5	2389.	3.70840E-05
12	142.5	2394.	3.71617E-05
13	157.5	1944.	3.01764E-05
14	172.5	1360.	2.11188E-05
15	187.5	1074.	1.66715E-05
16	202.5	907.	1.40792E-05
17	217.5	743.	1.15412E-05
18	232.5	597.	9.25937E-06
19	247.5	457.	7.09393E-06
20	262.5	346.	5.37866E-06
21	277.5	291.	4.51714E-06
22	292.5	209.	3.25203E-06
23	307.5	151.	2.34395E-06
24	322.5	97.	1.50571E-06
25	337.5	68.	1.06331E-06
26	352.5	29.	4.57923E-07
27	382.5	-12.	-1.78513E-07
28	412.5	-59.	-9.23508E-07
29	442.5	-64.	-9.93460E-07
30	472.5	45.	6.98527E-07
31	502.5	11.	1.70751E-07

IDENTIFICATION 402140 TIME 911.

APPLIED LOAD 41.33 TONS

TOP DEFLECTION
POTENTIOMETER 0.909 INCHES
DIAL GAGE 0.904 INCHES

TOP SLOPE 7.13333E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	67.	1.04003E-06
4	22.5	485.	7.52857E-06
5	37.5	854.	1.32565E-05
6	52.5	1289.	2.00089E-05
7	67.5	1740.	2.70097E-05
8	82.5	2100.	3.25979E-05
9	97.5	2147.	3.33275E-05
10	112.5	2229.	3.46004E-05
11	127.5	2389.	3.70840E-05
12	142.5	2397.	3.72005E-05
13	157.5	1952.	3.03083E-05
14	172.5	1370.	2.12740E-05
15	187.5	1083.	1.68035E-05
16	202.5	913.	1.41723E-05
17	217.5	750.	1.16421E-05
18	232.5	603.	9.36027E-06
19	247.5	463.	7.19483E-06
20	262.5	353.	5.47956E-06
21	277.5	300.	4.65685E-06
22	292.5	223.	3.45383E-06
23	307.5	163.	2.53798E-06
24	322.5	107.	1.66094E-06
25	337.5	80.	1.24183E-06
26	352.5	41.	6.28675E-07
27	382.5	-2.	-3.10457E-08
28	412.5	-52.	-7.99426E-07
29	442.5	-59.	-9.15847E-07
30	472.5	43.	6.75243E-07
31	502.5	11.	1.62990E-07

IDENTIFICATION 402240 TIME 917.

APPLIED LOAD 41.26 TONS

TOP DEFLECTION
POTENTIOMETER 0.920 INCHES
DIAL GAGE 0.917 INCHES

TOP SLOPE 7.20667E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	64.	9.93460E-07
4	22.5	478.	7.41991E-06
5	37.5	848.	1.31711E-05
6	52.5	1285.	1.99468E-05
7	67.5	1738.	2.69864E-05
8	82.5	2101.	3.26135E-05
9	97.5	2148.	3.33508E-05
10	112.5	2239.	3.47556E-05
11	127.5	2398.	3.72160E-05
12	142.5	2412.	3.74488E-05
13	157.5	1956.	3.03704E-05
14	172.5	1372.	2.12973E-05
15	187.5	1077.	1.67181E-05
16	202.5	904.	1.40326E-05
17	217.5	737.	1.14403E-05
18	232.5	587.	9.10414E-06
19	247.5	445.	6.90766E-06
20	262.5	339.	5.25448E-06
21	277.5	286.	4.43177E-06
22	292.5	206.	3.19770E-06
23	307.5	148.	2.30514E-06
24	322.5	95.	1.48243E-06
25	337.5	67.	1.04779E-06
26	352.5	32.	4.96731E-07
27	382.5	-8.	-1.31944E-07
28	412.5	-53.	-8.30471E-07
29	442.5	-58.	-8.92563E-07
30	472.5	44.	6.83004E-07
31	502.5	12.	1.94035E-07

IDENTIFICATION 402340 TIME 920.

APPLIED LOAD 41.43 TONS

TOP DEFLECTION
POTENTIOMETER 0.929 INCHES
DIAL GAGE 0.929 INCHES

TOP SLOPE 7.25333E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	64.	1.00122E-06
4	22.5	482.	7.48200E-06
5	37.5	855.	1.32643E-05
6	52.5	1294.	2.00865E-05
7	67.5	1750.	2.71572E-05
8	82.5	2113.	3.28075E-05
9	97.5	2164.	3.35914E-05
10	112.5	2258.	3.50505E-05
11	127.5	2417.	3.75187E-05
12	142.5	2429.	3.77127E-05
13	157.5	1977.	3.06809E-05
14	172.5	1390.	2.15767E-05
15	187.5	1093.	1.69742E-05
16	202.5	918.	1.42500E-05
17	217.5	750.	1.16344E-05
18	232.5	598.	9.28265E-06
19	247.5	454.	7.04736E-06
20	262.5	345.	5.35538E-06
21	277.5	290.	4.50938E-06
22	292.5	209.	3.25203E-06
23	307.5	151.	2.33619E-06
24	322.5	95.	1.48243E-06
25	337.5	68.	1.06331E-06
26	352.5	31.	4.81208E-07
27	382.5	-11.	-1.70751E-07
28	412.5	-54.	-8.45994E-07
29	442.5	-58.	-9.08085E-07
30	472.5	42.	6.59720E-07
31	502.5	11.	1.62990E-07

IDENTIFICATION 402440 TIME 922.

APPLIED LOAD 41.85 TONS

TOP DEFLECTION
POTENTIOMETER 0.940 INCHES
DIAL GAGE 0.939 INCHES

TOP SLOPE 7.37333E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	68.	1.06331E-06
4	22.5	485.	7.52857E-06
5	37.5	862.	1.33884E-05
6	52.5	1307.	2.02806E-05
7	67.5	1764.	2.73823E-05
8	82.5	2132.	3.31024E-05
9	97.5	2181.	3.38553E-05
10	112.5	2278.	3.53610E-05
11	127.5	2442.	3.79145E-05
12	142.5	2455.	3.81008E-05
13	157.5	2003.	3.10922E-05
14	172.5	1409.	2.18717E-05
15	187.5	1112.	1.72614E-05
16	202.5	935.	1.45216E-05
17	217.5	766.	1.18982E-05
18	232.5	614.	9.53102E-06
19	247.5	467.	7.24916E-06
20	262.5	354.	5.49508E-06
21	277.5	297.	4.61804E-06
22	292.5	216.	3.35293E-06
23	307.5	155.	2.40604E-06
24	322.5	99.	1.54452E-06
25	337.5	71.	1.10988E-06
26	352.5	33.	5.12253E-07
27	382.5	-10.	-1.55228E-07
28	412.5	-57.	-8.84801E-07
29	442.5	-61.	-9.46893E-07
30	472.5	43.	6.67482E-07
31	502.5	11.	1.62990E-07

IDENTIFICATION 402540 TIME 928.

APPLIED LOAD 41.35 TONS

TOP DEFLECTION
POTENTIOMETER 0.944 INCHES
DIAL GAGE 0.942 INCHES

TOP SLOPE 7.39667E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	67.	1.04779E-06
4	22.5	481.	7.47424E-06
5	37.5	857.	1.33031E-05
6	52.5	1296.	2.01176E-05
7	67.5	1750.	2.71649E-05
8	82.5	2117.	3.28596E-05
9	97.5	2171.	3.37078E-05
10	112.5	2266.	3.51670E-05
11	127.5	2432.	3.77438E-05
12	142.5	2448.	3.80076E-05
13	157.5	1995.	3.09680E-05
14	172.5	1408.	2.18484E-05
15	187.5	1111.	1.72459E-05
16	202.5	935.	1.45138E-05
17	217.5	768.	1.19215E-05
18	232.5	615.	9.55430E-06
19	247.5	471.	7.31901E-06
20	262.5	360.	5.58822E-06
21	277.5	304.	4.71894E-06
22	292.5	223.	3.45383E-06
23	307.5	160.	2.49141E-06
24	322.5	105.	1.62214E-06
25	337.5	76.	1.17973E-06
26	352.5	36.	5.66583E-07
27	382.5	-7.	-1.16421E-07
28	412.5	-54.	-8.45994E-07
29	442.5	-61.	-9.46893E-07
30	472.5	46.	7.06289E-07
31	502.5	13.	2.09558E-07

IDENTIFICATION 500150 TIME 938.

APPLIED LOAD 55.06 TONS

TOP DEFLECTION
POTENTIOMETER 1.165 INCHES
DIAL GAGE 1.165 INCHES

TOP SLOPE 9.13333E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	86.	1.34272E-06
4	22.5	607.	9.41460E-06
5	37.5	1133.	1.75951E-05
6	52.5	1675.	2.60085E-05
7	67.5	2237.	3.47323E-05
8	82.5	2704.	4.19815E-05
9	97.5	2778.	4.31147E-05
10	112.5	2891.	4.48765E-05
11	127.5	3090.	4.79555E-05
12	142.5	3102.	4.81441E-05
13	157.5	2560.	3.97462E-05
14	172.5	1851.	2.87328E-05
15	187.5	1488.	2.31057E-05
16	202.5	1263.	1.96053E-05
17	217.5	1043.	1.61903E-05
18	232.5	847.	1.31478E-05
19	247.5	669.	1.03925E-05
20	262.5	515.	7.98650E-06
21	277.5	425.	6.59720E-06
22	292.5	306.	4.74999E-06
23	307.5	223.	3.45383E-06
24	322.5	145.	2.25081E-06
25	337.5	102.	1.59109E-06
26	352.5	49.	7.68380E-07
27	382.5	-6.	-1.00898E-07
28	412.5	-79.	-1.22630E-06
29	442.5	-83.	-1.28839E-06
30	472.5	62.	9.70176E-07
31	502.5	19.	2.94934E-07

IDENTIFICATION 500250 TIME 949.

APPLIED LOAD 54.79 TONS

TOP DEFLECTION
POTENTIOMETER 1.191 INCHES
DIAL GAGE 1.195 INCHES

TOP SLOPE 9.26333E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	84.	1.30392E-06
4	22.5	584.	9.06533E-06
5	37.5	1103.	1.71217E-05
6	52.5	1640.	2.54652E-05
7	67.5	2193.	3.40416E-05
8	82.5	2656.	4.12209E-05
9	97.5	2739.	4.25093E-05
10	112.5	2844.	4.41469E-05
11	127.5	3070.	4.76628E-05
12	142.5	3094.	4.80199E-05
13	157.5	2578.	4.00256E-05
14	172.5	1869.	2.90199E-05
15	187.5	1506.	2.33851E-05
16	202.5	1282.	1.99003E-05
17	217.5	1064.	1.65163E-05
18	232.5	869.	1.34816E-05
19	247.5	691.	1.07340E-05
20	262.5	535.	8.31247E-06
21	277.5	433.	6.72138E-06
22	292.5	318.	4.92850E-06
23	307.5	229.	3.54697E-06
24	322.5	150.	2.32842E-06
25	337.5	106.	1.65318E-06
26	352.5	52.	8.07187E-07
27	382.5	-4.	-6.20913E-08
28	412.5	-74.	-1.14869E-06
29	442.5	-81.	-1.26511E-06
30	472.5	62.	9.70176E-07
31	502.5	16.	2.40604E-07

IDENTIFICATION 500350 TIME 959.

APPLIED LOAD 58.18 TONS

TOP DEFLECTION
POTENTIOMETER 1.210 INCHES
DIAL GAGE 1.215 INCHES

TOP SLOPE 9.32667E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	85.	1.31944E-06
4	22.5	574.	8.91786E-06
5	37.5	1093.	1.69665E-05
6	52.5	1629.	2.52867E-05
7	67.5	2179.	3.38165E-05
8	82.5	2640.	4.09880E-05
9	97.5	2725.	4.22997E-05
10	112.5	2849.	4.42323E-05
11	127.5	3073.	4.77094E-05
12	142.5	3103.	4.81751E-05
13	157.5	2597.	4.03205E-05
14	172.5	1891.	2.93537E-05
15	187.5	1525.	2.36646E-05
16	202.5	1297.	2.01331E-05
17	217.5	1080.	1.67569E-05
18	232.5	882.	1.36911E-05
19	247.5	707.	1.09746E-05
20	262.5	553.	8.58412E-06
21	277.5	442.	6.85333E-06
22	292.5	328.	5.08373E-06
23	307.5	237.	3.67115E-06
24	322.5	156.	2.42156E-06
25	337.5	112.	1.73080E-06
26	352.5	57.	8.84801E-07
27	382.5	-3.	-4.65685E-08
28	412.5	-74.	-1.15645E-06
29	442.5	-82.	-1.27287E-06
30	472.5	61.	9.54654E-07
31	502.5	17.	2.63888E-07

IDENTIFICATION 500450 TIME 1016.

APPLIED LOAD 49.82 TONS

TOP DEFLECTION
POTENTIOMETER 1.264 INCHES
DIAL GAGE 1.278 INCHES

TOP SLOPE 9.86333E-03 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	92.	1.43586E-06
4	22.5	604.	9.37579E-06
5	37.5	1142.	1.77271E-05
6	52.5	1730.	2.68545E-05
7	67.5	2303.	3.57491E-05
8	82.5	2784.	4.32078E-05
9	97.5	2877.	4.46592E-05
10	112.5	2994.	4.64831E-05
11	127.5	3252.	5.04802E-05
12	142.5	3296.	5.11710E-05
13	157.5	2779.	4.31302E-05
14	172.5	2039.	3.16510E-05
15	187.5	1652.	2.56437E-05
16	202.5	1412.	2.19182E-05
17	217.5	1184.	1.83790E-05
18	232.5	975.	1.51270E-05
19	247.5	794.	1.23174E-05
20	262.5	636.	9.87252E-06
21	277.5	505.	7.83903E-06
22	292.5	378.	5.87539E-06
23	307.5	280.	4.34639E-06
24	322.5	191.	2.96486E-06
25	337.5	141.	2.18872E-06
26	352.5	78.	1.20302E-06
27	382.5	12.	1.78513E-07
28	412.5	-74.	-1.15645E-06
29	442.5	-88.	-1.35825E-06
30	472.5	68.	1.05555E-06
31	502.5	20.	3.10457E-07

IDENTIFICATION 500550 TIME 1022.

APPLIED LOAD 50.08 TONS

TOP DEFLECTION
POTENTIOMETER 1.306 INCHES
DIAL GAGE 1.317 INCHES

TOP SLOPE 1.00267E-02 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	93.	1.45138E-06
4	22.5	604.	9.36803E-06
5	37.5	1158.	1.79677E-05
6	52.5	1745.	2.70873E-05
7	67.5	2321.	3.60285E-05
8	82.5	2813.	4.36657E-05
9	97.5	2906.	4.51171E-05
10	112.5	3028.	4.70031E-05
11	127.5	3301.	5.12409E-05
12	142.5	3348.	5.19704E-05
13	157.5	2830.	4.39296E-05
14	172.5	2083.	3.23418E-05
15	187.5	1689.	2.62103E-05
16	202.5	1445.	2.24382E-05
17	217.5	1211.	1.88059E-05
18	232.5	998.	1.54995E-05
19	247.5	812.	1.25968E-05
20	262.5	651.	1.01054E-05
21	277.5	514.	7.97873E-06
22	292.5	384.	5.96077E-06
23	307.5	280.	4.34639E-06
24	322.5	188.	2.92605E-06
25	337.5	135.	2.09558E-06
26	352.5	72.	1.11764E-06
27	382.5	5.	7.76141E-08
28	412.5	-79.	-1.22630E-06
29	442.5	-90.	-1.39705E-06
30	472.5	71.	1.10212E-06
31	502.5	20.	3.10457E-07

IDENTIFICATION 500650 TIME 1029.

APPLIED LOAD 49.82 TONS

TOP DEFLECTION
POTENTIOMETER 1.343 INCHES
DIAL GAGE 1.351 INCHES

TOP SLOPE 1.02400E-02 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	93.	1.45138E-06
4	22.5	600.	9.30594E-06
5	37.5	1160.	1.80065E-05
6	52.5	1750.	2.71649E-05
7	67.5	2332.	3.61915E-05
8	82.5	2829.	4.39141E-05
9	97.5	2928.	4.54431E-05
10	112.5	3051.	4.73524E-05
11	127.5	3324.	5.15979E-05
12	142.5	3395.	5.27000E-05
13	157.5	2883.	4.47523E-05
14	172.5	2131.	3.30714E-05
15	187.5	1732.	2.68778E-05
16	202.5	1488.	2.30980E-05
17	217.5	1250.	1.94035E-05
18	232.5	1038.	1.61127E-05
19	247.5	847.	1.31478E-05
20	262.5	685.	1.06331E-05
21	277.5	540.	8.37457E-06
22	292.5	410.	6.36436E-06
23	307.5	300.	4.66461E-06
24	322.5	203.	3.15113E-06
25	337.5	146.	2.27409E-06
26	352.5	81.	1.25735E-06
27	382.5	11.	1.62990E-07
28	412.5	-78.	-1.21854E-06
29	442.5	-91.	-1.40482E-06
30	472.5	73.	1.12541E-06
31	502.5	22.	3.33741E-07

IDENTIFICATION 500750 TIME 1033.

APPLIED LOAD 50.49 TONS

TOP DEFLECTION
POTENTIOMETER 1.374 INCHES
DIAL GAGE 1.382 INCHES

TOP SLOPE 1.04600E-02 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	94.	1.45915E-06
4	22.5	604.	9.38355E-06
5	37.5	1177.	1.82781E-05
6	52.5	1775.	2.75530E-05
7	67.5	2371.	3.67969E-05
8	82.5	2871.	4.45660E-05
9	97.5	2972.	4.61338E-05
10	112.5	3100.	4.81208E-05
11	127.5	3382.	5.24982E-05
12	142.5	3458.	5.36857E-05
13	157.5	2951.	4.58156E-05
14	172.5	2189.	3.39795E-05
15	187.5	1780.	2.76384E-05
16	202.5	1532.	2.37810E-05
17	217.5	1289.	2.00089E-05
18	232.5	1072.	1.66482E-05
19	247.5	877.	1.36135E-05
20	262.5	710.	1.10212E-05
21	277.5	556.	8.63845E-06
22	292.5	420.	6.51183E-06
23	307.5	308.	4.78103E-06
24	322.5	208.	3.23651E-06
25	337.5	149.	2.31290E-06
26	352.5	81.	1.24959E-06
27	382.5	9.	1.39705E-07
28	412.5	-84.	-1.29616E-06
29	442.5	-95.	-1.46591E-06
30	472.5	73.	1.12541E-06
31	502.5	19.	3.02695E-07

IDENTIFICATION 500850 TIME 1036.

APPLIED LOAD 50.11 TONS

TOP DEFLECTION
POTENTIOMETER 1.391 INCHES
DIAL GAGE 1.404 INCHES

TOP SLOPE 1.05033E-02 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	95.	1.46691E-06
4	22.5	601.	9.32146E-06
5	37.5	1173.	1.82160E-05
6	52.5	1768.	2.74521E-05
7	67.5	2364.	3.66960E-05
8	82.5	2864.	4.44574E-05
9	97.5	2966.	4.60407E-05
10	112.5	3100.	4.81208E-05
11	127.5	3388.	5.25991E-05
12	142.5	3471.	5.38797E-05
13	157.5	2976.	4.61959E-05
14	172.5	2211.	3.43287E-05
15	187.5	1804.	2.80032E-05
16	202.5	1556.	2.41458E-05
17	217.5	1310.	2.03349E-05
18	232.5	1093.	1.69665E-05
19	247.5	897.	1.39317E-05
20	262.5	732.	1.13627E-05
21	277.5	575.	8.92563E-06
22	292.5	431.	6.69034E-06
23	307.5	319.	4.95954E-06
24	322.5	216.	3.36069E-06
25	337.5	154.	2.39052E-06
26	352.5	85.	1.31168E-06
27	382.5	10.	1.47467E-07
28	412.5	-85.	-1.31168E-06
29	442.5	-95.	-1.47467E-06
30	472.5	74.	1.15645E-06
31	502.5	21.	3.25979E-07

IDENTIFICATION 500950 TIME 1040.

APPLIED LOAD 49.89 TONS

TOP DEFLECTION
POTENTIOMETER 1.406 INCHES
DIAL GAGE 1.418 INCHES

TOP SLOPE 1.05800E-02 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	94.	1.45915E-06
4	22.5	597.	9.25937E-06
5	37.5	1171.	1.81772E-05
6	52.5	1763.	2.73590E-05
7	67.5	2355.	3.65640E-05
8	82.5	2858.	4.43565E-05
9	97.5	2960.	4.59553E-05
10	112.5	3094.	4.80354E-05
11	127.5	3387.	5.25758E-05
12	142.5	3479.	5.39962E-05
13	157.5	2987.	4.63667E-05
14	172.5	2226.	3.45538E-05
15	187.5	1816.	2.81972E-05
16	202.5	1570.	2.43786E-05
17	217.5	1326.	2.05910E-05
18	232.5	1110.	1.72303E-05
19	247.5	914.	1.41956E-05
20	262.5	753.	1.16887E-05
21	277.5	590.	9.16623E-06
22	292.5	446.	6.93094E-06
23	307.5	333.	5.16910E-06
24	322.5	227.	3.52368E-06
25	337.5	162.	2.51470E-06
26	352.5	91.	1.40482E-06
27	382.5	14.	2.25081E-07
28	412.5	-85.	-1.31944E-06
29	442.5	-98.	-1.51348E-06
30	472.5	75.	1.17197E-06
31	502.5	22.	3.33741E-07

IDENTIFICATION 501050 TIME 1047.

APPLIED LOAD 50.38 TONS

TOP DEFLECTION
POTENTIOMETER 1.426 INCHES
DIAL GAGE 1.439 INCHES

TOP SLOPE 1.07067E-02 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	95.	1.47467E-06
4	22.5	604.	9.36803E-06
5	37.5	1184.	1.83790E-05
6	52.5	1775.	2.75530E-05
7	67.5	2375.	3.68667E-05
8	82.5	2877.	4.46592E-05
9	97.5	2985.	4.63434E-05
10	112.5	3121.	4.84390E-05
11	127.5	3422.	5.31191E-05
12	142.5	3489.	5.41591E-05
13	157.5	3020.	4.68789E-05
14	172.5	2254.	3.49962E-05
15	187.5	1845.	2.86319E-05
16	202.5	1597.	2.47977E-05
17	217.5	1348.	2.09325E-05
18	232.5	1133.	1.75874E-05
19	247.5	938.	1.45504E-05
20	262.5	773.	1.20069E-05
21	277.5	607.	9.42236E-06
22	292.5	463.	7.19483E-06
23	307.5	344.	5.34761E-06
24	322.5	234.	3.64010E-06
25	337.5	170.	2.63112E-06
26	352.5	95.	1.47467E-06
27	382.5	17.	2.63888E-07
28	412.5	-85.	-1.32720E-06
29	442.5	-99.	-1.52900E-06
30	472.5	78.	1.20302E-06
31	502.5	22.	3.41502E-07

IDENTIFICATION 501150 TIME 1052.

APPLIED LOAD 50.11 TONS

TOP DEFLECTION
POTENTIOMETER 1.446 INCHES
DIAL GAGE 1.461 INCHES

TOP SLOPE 1.07967E-02 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	92.	1.43586E-06
4	22.5	598.	9.28265E-06
5	37.5	1177.	1.82781E-05
6	52.5	1766.	2.74133E-05
7	67.5	2373.	3.68357E-05
8	82.5	2871.	4.45660E-05
9	97.5	2978.	4.62347E-05
10	112.5	3116.	4.83691E-05
11	127.5	3406.	5.28785E-05
12	142.5	3546.	5.50439E-05
13	157.5	3037.	4.71506E-05
14	172.5	2268.	3.52135E-05
15	187.5	1856.	2.88181E-05
16	202.5	1610.	2.49840E-05
17	217.5	1361.	2.11343E-05
18	232.5	1145.	1.77736E-05
19	247.5	950.	1.47467E-05
20	262.5	785.	1.21854E-05
21	277.5	616.	9.56382E-06
22	292.5	475.	7.37334E-06
23	307.5	354.	5.50284E-06
24	322.5	243.	3.76429E-06
25	337.5	176.	2.73978E-06
26	352.5	102.	1.58333E-06
27	382.5	22.	3.41502E-07
28	412.5	-82.	-1.28063E-06
29	442.5	-97.	-1.50571E-06
30	472.5	78.	1.21078E-06
31	502.5	23.	3.57025E-07

IDENTIFICATION 501250 TIME 1056.

APPLIED LOAD 49.27 TONS

TOP DEFLECTION
POTENTIOMETER 1.448 INCHES
DIAL GAGE 1.462 INCHES

TOP SLOPE 1.07433E-02 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	91.	1.40482E-06
4	22.5	587.	9.11966E-06
5	37.5	1161.	1.80220E-05
6	52.5	1737.	2.69709E-05
7	67.5	2345.	3.64088E-05
8	82.5	2838.	4.40615E-05
9	97.5	2947.	4.57458E-05
10	112.5	3087.	4.79267E-05
11	127.5	3381.	5.24904E-05
12	142.5	3538.	5.49198E-05
13	157.5	3031.	4.70497E-05
14	172.5	2270.	3.52291E-05
15	187.5	1859.	2.88492E-05
16	202.5	1614.	2.50461E-05
17	217.5	1369.	2.12508E-05
18	232.5	1154.	1.79133E-05
19	247.5	959.	1.48864E-05
20	262.5	797.	1.23717E-05
21	277.5	628.	9.74834E-06
22	292.5	486.	7.54409E-06
23	307.5	364.	5.65807E-06
24	322.5	251.	3.88847E-06
25	337.5	181.	2.81739E-06
26	352.5	107.	1.66094E-06
27	382.5	26.	4.11355E-07
28	412.5	-81.	-1.24959E-06
29	442.5	-97.	-1.50571E-06
30	472.5	77.	1.18750E-06
31	502.5	22.	3.33741E-07

IDENTIFICATION 501350 TIME 1100.

APPLIED LOAD 50.00 TONS

TOP DEFLECTION
POTENTIOMETER 1.468 INCHES
DIAL GAGE 1.481 INCHES

TOP SLOPE 1.08467E-02 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	92.	1.43586E-06
4	22.5	597.	9.26713E-06
5	37.5	1180.	1.83169E-05
6	52.5	1766.	2.74056E-05
7	67.5	2377.	3.68978E-05
8	82.5	2877.	4.46592E-05
9	97.5	2985.	4.63279E-05
10	112.5	3127.	4.85476E-05
11	127.5	3427.	5.32045E-05
12	142.5	3585.	5.56571E-05
13	157.5	3081.	4.78258E-05
14	172.5	2308.	3.58344E-05
15	187.5	1895.	2.94235E-05
16	202.5	1649.	2.55894E-05
17	217.5	1401.	2.17475E-05
18	232.5	1185.	1.83946E-05
19	247.5	988.	1.53288E-05
20	262.5	821.	1.27520E-05
21	277.5	649.	1.00743E-05
22	292.5	508.	7.87784E-06
23	307.5	376.	5.84434E-06
24	322.5	262.	4.06698E-06
25	337.5	190.	2.94934E-06
26	352.5	114.	1.76960E-06
27	382.5	30.	4.65685E-07
28	412.5	-81.	-1.24959E-06
29	442.5	-99.	-1.53576E-06
30	472.5	78.	1.21854E-06
31	502.5	20.	3.18218E-07

IDENTIFICATION 501450 TIME 1103.

APPLIED LOAD 49.63 TONS

TOP DEFLECTION
POTENTIOMETER 1.477 INCHES
DIAL GAGE 1.491 INCHES

TOP SLOPE 1.09133E-02 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	92.	1.42034E-06
4	22.5	593.	9.20504E-06
5	37.5	1173.	1.82160E-05
6	52.5	1756.	2.72581E-05
7	67.5	2367.	3.67503E-05
8	82.5	2865.	4.44729E-05
9	97.5	2976.	4.61882E-05
10	112.5	3117.	4.83847E-05
11	127.5	3421.	5.31036E-05
12	142.5	3592.	5.57580E-05
13	157.5	3086.	4.79034E-05
14	172.5	2318.	3.59742E-05
15	187.5	1903.	2.95322E-05
16	202.5	1658.	2.57291E-05
17	217.5	1409.	2.18717E-05
18	232.5	1192.	1.85032E-05
19	247.5	999.	1.55073E-05
20	262.5	834.	1.29538E-05
21	277.5	661.	1.02606E-05
22	292.5	516.	8.00202E-06
23	307.5	386.	5.99357E-06
24	322.5	271.	4.19893E-06
25	337.5	197.	3.05024E-06
26	352.5	119.	1.83946E-06
27	382.5	35.	5.35538E-07
28	412.5	-79.	-1.22630E-06
29	442.5	-97.	-1.50571E-06
30	472.5	81.	1.24959E-06
31	502.5	23.	3.57025E-07

IDENTIFICATION 501550 TIME 1110.

APPLIED LOAD 50.16 TONS

TOP DEFLECTION
POTENTIOMETER 1.494 INCHES
DIAL GAGE 1.509 INCHES

TOP SLOPE 1.10167E-02 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	95.	1.46691E-06
4	22.5	599.	9.29817E-06
5	37.5	1184.	1.83790E-05
6	52.5	1769.	2.74676E-05
7	67.5	2385.	3.70142E-05
8	82.5	2884.	4.47756E-05
9	97.5	2994.	4.64831E-05
10	112.5	3139.	4.87262E-05
11	127.5	3445.	5.34684E-05
12	142.5	3621.	5.62082E-05
13	157.5	3112.	4.82993E-05
14	172.5	2339.	3.63079E-05
15	187.5	1924.	2.98582E-05
16	202.5	1674.	2.59775E-05
17	217.5	1423.	2.20967E-05
18	232.5	1204.	1.86972E-05
19	247.5	1006.	1.56237E-05
20	262.5	839.	1.30314E-05
21	277.5	664.	1.03149E-05
22	292.5	516.	8.00202E-06
23	307.5	388.	6.02286E-06
24	322.5	271.	4.19893E-06
25	337.5	194.	3.01919E-06
26	352.5	116.	1.80841E-06
27	382.5	33.	5.04492E-07
28	412.5	-82.	-1.27287E-06
29	442.5	-99.	-1.52900E-06
30	472.5	80.	1.24183E-06
31	502.5	23.	3.57025E-07

IDENTIFICATION 501650 TIME 1120.

APPLIED LOAD 49.71 TONS

TOP DEFLECTION
POTENTIOMETER 1.502 INCHES
DIAL GAGE 1.517 INCHES

TOP SLOPE 1.10100E-02 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	93.	1.45138E-06
4	22.5	595.	9.24384E-06
5	37.5	1177.	1.82704E-05
6	52.5	1759.	2.73124E-05
7	67.5	2374.	3.68512E-05
8	82.5	2875.	4.46281E-05
9	97.5	2985.	4.63434E-05
10	112.5	3134.	4.86563E-05
11	127.5	3445.	5.34839E-05
12	142.5	3625.	5.62780E-05
13	157.5	3127.	4.85476E-05
14	172.5	2354.	3.65407E-05
15	187.5	1938.	3.00910E-05
16	202.5	1690.	2.62413E-05
17	217.5	1441.	2.23584E-05
18	232.5	1223.	1.89767E-05
19	247.5	1026.	1.59264E-05
20	262.5	858.	1.33186E-05
21	277.5	682.	1.05866E-05
22	292.5	534.	8.28143E-06
23	307.5	405.	6.28675E-06
24	322.5	287.	4.45505E-06
25	337.5	210.	3.25979E-06
26	352.5	130.	2.01797E-06
27	382.5	42.	6.59720E-07
28	412.5	-75.	-1.16421E-06
29	442.5	-95.	-1.46691E-06
30	472.5	78.	1.21854E-06
31	502.5	23.	3.49264E-07

IDENTIFICATION 501750 TIME 1125.

APPLIED LOAD 49.62 TONS

TOP DEFLECTION
POTENTIOMETER 1.515 INCHES
DIAL GAGE 1.527 INCHES

TOP SLOPE 1.11267E-02 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	91.	1.40482E-06
4	22.5	591.	9.18175E-06
5	37.5	1172.	1.82005E-05
6	52.5	1756.	2.72581E-05
7	67.5	2371.	3.67969E-05
8	82.5	2871.	4.45583E-05
9	97.5	2984.	4.63124E-05
10	112.5	3129.	4.85709E-05
11	127.5	3444.	5.34606E-05
12	142.5	3633.	5.64022E-05
13	157.5	3131.	4.86020E-05
14	172.5	2362.	3.66649E-05
15	187.5	1943.	3.01531E-05
16	202.5	1693.	2.62724E-05
17	217.5	1442.	2.23839E-05
18	232.5	1223.	1.89844E-05
19	247.5	1026.	1.59187E-05
20	262.5	857.	1.33031E-05
21	277.5	680.	1.05555E-05
22	292.5	530.	8.21934E-06
23	307.5	400.	6.21689E-06
24	322.5	282.	4.37744E-06
25	337.5	205.	3.17442E-06
26	352.5	124.	1.93259E-06
27	382.5	39.	5.97629E-07
28	412.5	-78.	-1.21854E-06
29	442.5	-96.	-1.49019E-06
30	472.5	78.	1.21854E-06
31	502.5	23.	3.64786E-07

IDENTIFICATION 501850 TIME 1128.

APPLIED LOAD 50.15 TONS

TOP DEFLECTION
POTENTIOMETER 1.535 INCHES
DIAL GAGE 1.550 INCHES

TOP SLOPE 1.04133E-02 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	92.	1.43586E-06
4	22.5	597.	9.27489E-06
5	37.5	1185.	1.83946E-05
6	52.5	1773.	2.75220E-05
7	67.5	2394.	3.71694E-05
8	82.5	2899.	4.50007E-05
9	97.5	3010.	4.67160E-05
10	112.5	3161.	4.90754E-05
11	127.5	3479.	5.40039E-05
12	142.5	3683.	5.71783E-05
13	157.5	3160.	4.90444E-05
14	172.5	2392.	3.71306E-05
15	187.5	1969.	3.05644E-05
16	202.5	1717.	2.66527E-05
17	217.5	1464.	2.27177E-05
18	232.5	1243.	1.92949E-05
19	247.5	1044.	1.61981E-05
20	262.5	873.	1.35437E-05
21	277.5	691.	1.07340E-05
22	292.5	539.	8.36680E-06
23	307.5	409.	6.34884E-06
24	322.5	287.	4.45505E-06
25	337.5	208.	3.23651E-06
26	352.5	127.	1.97916E-06
27	382.5	39.	6.05390E-07
28	412.5	-80.	-1.24183E-06
29	442.5	-98.	-1.51348E-06
30	472.5	79.	1.23406E-06
31	502.5	23.	3.49264E-07

IDENTIFICATION 501950 TIME 1131.

APPLIED LOAD 49.01 TONS

TOP DEFLECTION
POTENTIOMETER 1.541 INCHES
DIAL GAGE 1.556 INCHES

TOP SLOPE 1.12767E-02 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	95.	1.48243E-06
4	22.5	597.	9.26713E-06
5	37.5	1183.	1.83635E-05
6	52.5	1773.	2.75220E-05
7	67.5	2393.	3.71461E-05
8	82.5	2898.	4.49852E-05
9	97.5	3010.	4.67160E-05
10	112.5	3162.	4.90832E-05
11	127.5	3484.	5.40893E-05
12	142.5	3691.	5.73025E-05
13	157.5	3171.	4.92306E-05
14	172.5	2404.	3.73246E-05
15	187.5	1981.	3.07507E-05
16	202.5	1728.	2.68312E-05
17	217.5	1473.	2.28574E-05
18	232.5	1250.	1.94113E-05
19	247.5	1050.	1.63067E-05
20	262.5	880.	1.36601E-05
21	277.5	695.	1.07884E-05
22	292.5	541.	8.39785E-06
23	307.5	411.	6.38764E-06
24	322.5	288.	4.47057E-06
25	337.5	209.	3.24427E-06
26	352.5	125.	1.94035E-06
27	382.5	39.	5.97629E-07
28	412.5	-82.	-1.27287E-06
29	442.5	-100.	-1.56004E-06
30	472.5	81.	1.26511E-06
31	502.5	23.	3.49264E-07

IDENTIFICATION 502050 TIME 1138.

APPLIED LOAD 48.94 TONS

TOP DEFLECTION
POTENTIOMETER 1.553 INCHES
DIAL GAGE 1.571 INCHES

TOP SLOPE 1.13267E-02 RADIANS

GAGE LEVEL	X-DISTANCE (INCHES)	STRAIN RDG. (MICROVOLTS)	M/EI (1/INCHES)
3	7.5	93.	1.45138E-06
4	22.5	601.	9.32922E-06
5	37.5	1191.	1.84877E-05
6	52.5	1780.	2.76229E-05
7	67.5	2402.	3.72858E-05
8	82.5	2907.	4.51249E-05
9	97.5	3019.	4.68634E-05
10	112.5	3173.	4.92617E-05
11	127.5	3499.	5.43144E-05
12	142.5	3710.	5.75897E-05
13	157.5	3188.	4.94868E-05
14	172.5	2419.	3.75420E-05
15	187.5	1995.	3.09758E-05
16	202.5	1742.	2.70485E-05
17	217.5	1487.	2.30747E-05
18	232.5	1263.	1.96131E-05
19	247.5	1061.	1.64620E-05
20	262.5	891.	1.38231E-05
21	277.5	706.	1.09591E-05
22	292.5	551.	8.55308E-06
23	307.5	419.	6.50407E-06
24	322.5	293.	4.55595E-06
25	337.5	213.	3.30636E-06
26	352.5	128.	1.99468E-06
27	382.5	41.	6.36436E-07
28	412.5	-82.	-1.27287E-06
29	442.5	-102.	-1.57557E-06
30	472.5	81.	1.24959E-06
31	502.5	23.	3.64786E-07