A NONLINEAR ANALYSIS OF PILE SUPPORTED PLANE FRAMES

By

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NOMENCLATURE

A	cross section area
b	width of the rectangle used to input cross section
c	soil shearing strength or wave speed
c_D	drag coefficient
c_M	inertia coefficient
d	depth of the cross section or diameter of pile
D	diameter
E	Young's modulus of elasticity
E_i	slope of stress-strain curve for ith sub-rectangle
f	wind and wave forces or element end forces
f_c	concrete stress
f_y	yield stress of reinforcing steel
F	axial force or applied forces at the joint in the structure coordinates
g	gravity acceleration
H	wave height
k	wave number
k_{ij}	increment of ith force corresponding to a unit increment in jth displacement in the element
L	length of element or wave length
m	number of rectangles input for a cross section
M	bending moment
n	parameter defining the moment-rotation, force-displacement curve

P	load
q	soil resistance per unit area
Q	soil resistance per unit length
R	radius or stiffness coefficient
t	time
T	axial thrust or wave period
u	displacement or velocity
U	strain energy
U(z)	wind velocity at elevation z above the storm mean water level
v	element end deformations or angle changes
V	shear force
V_n	variance
w	end displacements of an element
W	displacements at joint measured in structure coordinate
x, y, z	cartesian coordinate axes for frame structure coordinates
x', y', z'	cartesian coordinate axes for member
Δ	elongation of the element or pile movement
ε	strain
γ	unit weight of soil
ϕ	curvature
ρ	density of fluid or reinforcement ratio
σ	stress
θ	phase angle or rotation

CHAPTER I

INTRODUCTION

1.1 General

The general formulation and computation techniques for the analysis of linear elastic structures have been very thoroughly studied in recent years. The theory can be elegantly and concisely expressed in standard matrix form. Efficient solution procedures for both the force and displacement methods are well established. However, many of the structures that have been constructed recently are basically nonlinear in their behavior. Therefore the nonlinearity arising from material behavior should be included in the analysis in order that the load-displacement response can be predicted more accurately.

For structures in which the material behavior is linear, the displacements of the joints during loading may be assumed to be small in comparison with the overall dimensions. However, if the materials in a structure exhibit nonlinear behavior, large joint displacements may occur during loading. When large displacements occur, the entire geometry of the structure is changed. The length of moment arms may change significantly, and the axial force and shear may not be parallel and perpendicular to the member's original axis. This is an indication that changes in geometry are important and should be included in an analysis.

The analysis and design of the plane frame became more complex due to the presence of geometric and material nonlinearities. A linear analysis which is often assumed to be sufficiently accurate must be extended to include the nonlinearities of the frames. A load-displacement response of the frame is often required to estimate the ultimate load which this sturcture can support.

A frame is usually supported on piles which are driven into a non-homogeneous and highly nonlinear soil medium. The nonlinear response of the soil and structure must be taken into consideration.

The methods for analysis of systems having material, geometric and soil support nonlinearities are far more complex than those for linear systems. The development of a closed-form or "exact" analysis for such frames is not possible. The need for dependable and accurate methods for analyzing nonlinear structures is evident. A reliable approach must then resort to numerical methods. The numerical solution of the problem using finite element or finite difference techniques is possible due to advances in computer technology and matrix methods of structure analysis. The actual system is therefore replaced by a highly idealized mathematical model in order to formulate an analysis and obtain a solution. The application of a numerical method results in a large system of simultaneous equations which can be solved very efficiently on a digital computer.

1.2 Literature Review

The Ramberg-Osgood polynomial (39) for moment-curvature relationships has been widely used in frame analysis. Wilson (44) integrated the curvature given by the Ramberg-Osgood polynomial over the length of a member to obtain moment-rotation curves. He then used an approximation to the chord stiffness derived from the moment-rotation relationship in an incremental method to predict nonlinear frame response. Goldberg and Richard (14) assume that all the nonlinear curvatures are concentrated at the end of a member. The resulting nonlinear differential equations were solved by the Runge-Kutta method. Goel and Berg (13) used the Ramberg-Osgood polynomial in the dynamic analysis of steel frames. They assumed that nonlinear strains occured in the beams but that the columns remained linear. Kaldjan and Fan (25) proposed a similar analysis. Goel (13) extended the method of Goel and Berg to include the P-Δ effect and axial shortening of the columns.

Another approach to the treatment of structure nonlinearity due to material properties is described by Argyris (3). He used the concept of "initial strains" which could be descrived as the strains in a structural member in excess of linear strain. This term was also applied to strains in a structural member due to temperature changes or due to a prior loading.

For an ultimate strength study, the load-displacement response of the structure is required. Large displacements may occur at high load levels. The extreme change in geometry may cause an additional change in slope and should therefore be included in the analysis. One method for treating the problem of large displacements was described by Saafan and Brottan (42). They assumed that only the joints reflect changes in geometry, while member deflections remain "small." Jennings (22) proposed a method for accounting for large deformations of a member. He includes a second-order term in displacement transformation matrix to account for the effect of displacement on axial extension. He then assumed that the lateral deflection curve of a member was cubic, and modified the member stiffness matrix to account for the interaction of axial load with moment in the member. He provided equations for computing member forces from displacements, and developed a tangent stiffness matrix for use in nonlinear analysis by incremental loading.

Gunnin (17) developed a method of analysis for concrete and steel frameworks by considering both geometric and material nonlinearities. He combined Saafan's concept of restraint forces and Argyris's concept of initial strain to develop his iterative procedure. Lansing's (27) constant strain technique was also used in conjunction with Newton's method to obtain a better estimate of initial strain from current member forces and in solving the simultaneous equations for each member. His solution neglected the secondary effect of axial load acting through member deformations caused by primary moments in a member. The increase in moment due to thrust can be treated by subdividing a member into two or more segments. Since his program cannot handle the member forces, extra joints are required at the locations of concentrated loads in the member. An equivalent concentrated load must be specified to substitute for distributed loads. Kroenke (26) also presented an analysis of a reinforced-concrete frame by the finite element method. The analysis included inelastic moment-load-curvature curves and large displacements. The concrete stress-strain curves were automatically generated following Hognestad's stress-strain curve. In his frame interaction solution, the initial forces were assumed to remain constant during a load increment. Small load increments were required to reduce the errors in Kroenke's procedure.

A method of analysis of laterally loaded piles was given by Malter (29), who applied mathematical finite-difference techniques to the solution of the second-order differential equations of beam behavior. Gleser (11) suggested a recurring difference-equation form of beam solution that was utilized by Matlock and Reese (32,33) in the analysis of laterally loaded piles. Haliburton (19) developed a finite-difference solution for linearly elastic beam-columns on nonlinear supports. Jones (23) and Dawkins (7) presented their work on analysis of curved piles subjected to lateral loads in the plane of curvature. The pile properties are linear and can be modeled using straight elements.

Hays and Matlock (20) presented a method for the nonlinear analysis of plane frame structures. Geometric, material, and support nonlinearities are accommodated by a discrete element model of the frame members which is incorporated in a nonlinear frame solution.

1.3 Purpose and Scope of this Study

The purpose of this study is to develop a method of analysis for pile supported plane frames subjected to static loads in the plane of the structure. The plane frame is composed of either straight or curved members that lie in a single plane. A member is subdivided into a finite number of straight elements. A mathematical model is used to represent the actual behavior of the frame structure. The effects of material, geometric and soil supporting nonlinearities are included in the analysis by revising the stiffness matrix of the elements in the structure as deformations occur under the transient loads. The method of analysis is based on an iterative procedure in which unbalanced forces at the nodal points are applied to a temporary linear structure until an equilibrium position has been found.

The finite element method is chosen because the large deflections which characterize a structure at limit loads and the variation of rigidity which occurs along the frame member could be included in the solution. In addition, this method allowed the frame member to have varying load, support conditions and cross-section properties.

The main application of this study is to use the method, here developed, in the investigation of pile supported plane frames similar to those found in offshore construction. Loads due to wind and waves are considered in the analysis. Wind force components are assumed to be constant. Wave forces vary as the wave passes the structure. Changes in waves loads are treated as static increments as the wave progresses. Even though these wind and wave forces may induce dynamic responses of the structure, only static effects are investigated.

The second application of the method developed herein is the capability to investigate the influence of loads on the curved piles since the pile may deviate from the straight condition, particularly in the case of long, flexible piles used in offshore construction.

The method developed herein is similar to that presented by Hays and Matlock with the exception that a finite element model is used instead of a discrete element system for description of the load-displacement behavior of the frame. However, the finite element approach may permit description of the structural behavior of the system using fewer elements and hence may provide a more economical solution than that obtained by the discrete element model for equal accuracy.

1.4 Problem Approach

The method developed herein is similar to the displacement method for linear systems. A combination of incremental steps and iterative procedures are introduced in the process to obtain an acceptable degree of accuracy. For each load increment, repeated elastic solutions are performed until unbalanced forces at the nodal points meet a specified tolerance.

The pile supported structure is divided into a specific number of members and each member is subdivided into an assemblage of prismatic, straight elements. It is assumed that each element exhibits linearly elastic behavior during a load increment, and Castigliano's first theorem is applied to develop the incremental stiffness matrix for the element. Nonlinear material behavior is taken into account in the form of a mathematical expression relating bending moment and rotation at the end of the element. Nonlinear geometric effects necessitate changes of the displacement-transformation matrix and stiffness matrix due to initial forces in the element during an incremental step. To account for the nonlinear behavior of the soil, the diagonal matrix relating the incremental load transfer to the incremental displacement are directly added to the incremental element stiffness matrix. The final stiffness matrix obtained includes the effects of material, geometric, and soil support nonlinearities.

Incremental displacements due to an applied load increment are solved for by a variation of Gauss Elimination known as recursion-inversion procedure. A computer program was written to implement the method. The program provides displacements and reactions at all frame joints. In addition, the forces and displacements at every station in the member are also demonstrated.

A number of problems are solved to illustrate the ability of the analysis to predict the general load-displacement response of frame structures. Observations are presented concerning the significance of the numerical results along with a comparison of these results with existing analytical or experimental solutions.

CHAPTER II

METHOD OF ANALYSIS

2.1 General

During the solution process, the analysis of the structure proceeds through several stages. The entire structure is first visualized as a plane frame. Each member of the frame is then assumed to be composed of finite elements which are the basic theoretical units used in the analysis. The development of the element stiffness matrix, the assemblage of the element stiffness into the frame member stiffness matrix, the assemblage of member stiffness matrices into the frame stiffness matrix, and the iterative solution process required to account for nonlinear effects are described in this chapter.

2.2 Assumptions

The following assumptions are used in the development of the method:

1. A plane frame may be composed of either straight or curved members.

2. A curved member has a single plane of curvature that lies in the X-Y plane and its centroidal axis lies on a circular arc.

3. Loads are static and can be applied anywhere in the frame so that all displacements occur as deflections in the plane of curvature or as rotations about axes perpendicular to the plane.

4. The member is initially in a stress free condition.

5. The continuous soil system may be represented by discrete nonlinear, elastic springs acting at points along the pile.

6. Shearing deformations are negligible.

7. Bernolli's hypothesis of a linear distribution of strain through the depth of a member is valid.

8. The deformations (strain and curvature) are of an infinitesimal order, even though the displacements (axial, lateral and rotational) may be of any size.

9. Cross sections may be defined as a series of pieces which are symmetrical about the plane of the structure system. Various portions of a cross section may have different stress-strain curves.

10. Only static response of the structure results from any applied loads.

2.3 Plane Frame Definition

A plane frame such as that shown in Figure 1 is composed of either straight or curved members that lie in a single plane. For convenience, the plane is taken to be the X-Y plane of a right hand Cartesian coordinate system. All loads and displacements are assumed to occur in this plane. The end of a member or the intersection of two or more members is a joint. A member may be either rigidly or pin connected at a joint. The ends of all members rigidly connected at a joint rotate through the same angle. When a member is pinned at a joint, it is free to rotate independently of the joint and other members connected to the joint.

Every joint has three degrees-of-freedom, W_1, W_2, and W_3, as shown in Figure 2. Translational displacements W_1 and W_2 must be compatible

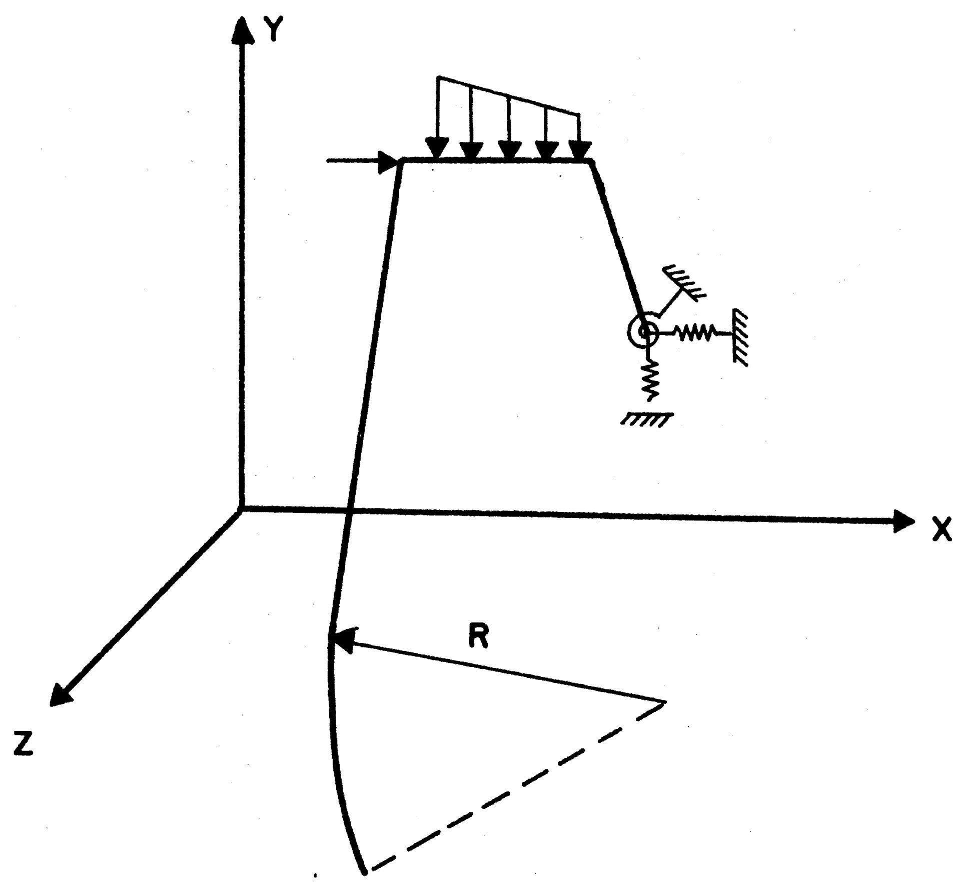


Figure 1. Plane Frame Model

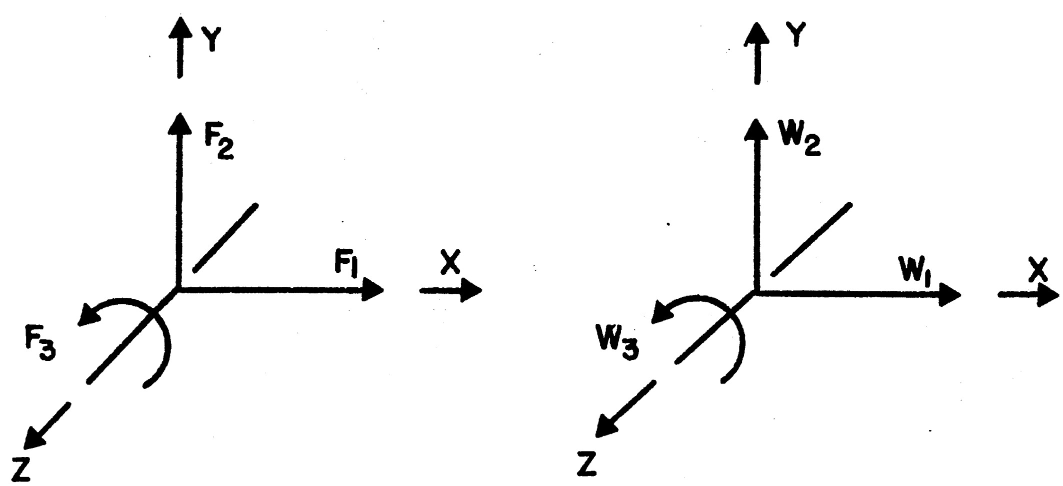


Figure 2. Joint Displacements and Forces

for all members connected to the joint. The rotational displacement W_3 may not be the same for all members at a joint, since some or all of the members may be pinned at the joint. Joint forces F_1, F_2, and F_3, shown in Figure 2, can be applied at any joint. Linear elastic spring restraints may be applied to each point.

2.3.1 Frame Member and Element Representation

Each member of the plane frame is divided into a finite number of straight line elements as shown in Figure 3. The end of the elements, or stations, are assigned sequential identification numbers starting from one at the left end of the member. Each element is identified by the smaller of its two end station numbers. A free body diagram of an element appears in Figure 4. There are three internal forces as shown in Figure 4(a) and three displacement components as shown in Figure 4(b) at each end of the element. These element-end-forces and end-displacements are related to an auxiliary, or member coordinate system, Reference (10).

2.4 Incremental Stiffness Matrix of an Element

Each of the elements has its own characteristic deflection response to the application of end forces. This response will be expressed quantitatively in terms of stiffness matrix [k]. (All matrices in this study are denoted by the matrix name enclosed in brackets.) In its final form, the stiffness matrix will include the following characteristics:

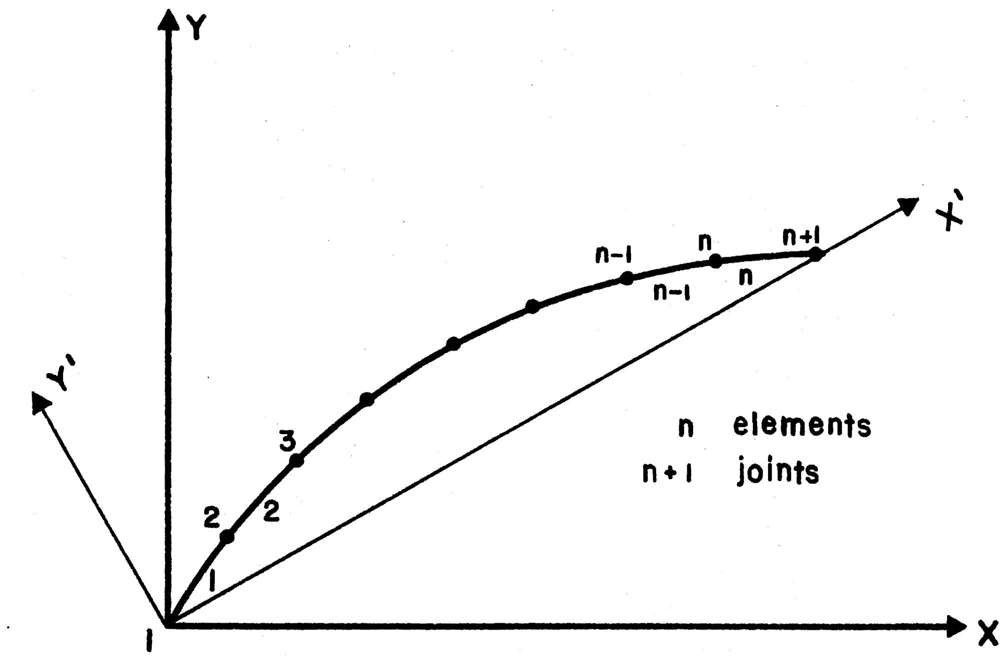


Figure 3. Member Model

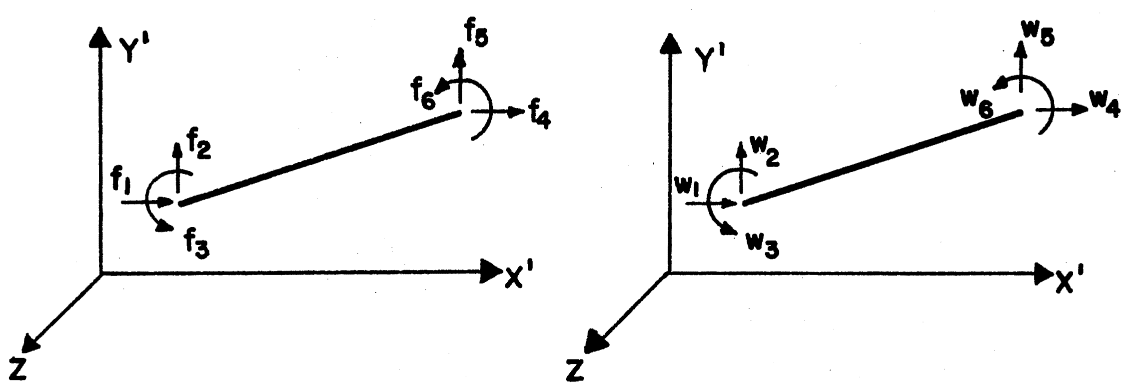


Figure 4. Element Model

Axial rigidity (AE) or response to axial forces;

Flexural rigidity (EI) or response to bending moments;

Initial forces or forces existing on an element at the beginning of load increment;

Large deflections or rotations from the original element position.

2.4.1 Matrix Formulation

Before the incremental stiffness matrix of an element is developed, the matrix method of linear elastic frame analysis will be discussed briefly, see Reference (21). The matrix formulation of the displacement method as used in elastic analysis is based on the equilibrium, stress-strain and compatibility relationships of a deformable body. Consideration of equilibrium results in the following expression relating the vector of applied forces at the element ends, $\{f\}$, to the vector of element internal force, $\{s\}$:

$$\{f\} = [A]\,\{s\} \tag{2.1}$$

in which [A] is known as the equilibrium matrix. By employing stress-strain (moment-rotation) concepts, the element internal forces, $\{s\}$, may be expressed in terms of the internal deformations, $\{v\}$:

$$\{s\} = [DD]\,\{v\} \tag{2.2}$$

in which [DD] is the symmetric matrix expressing the stress-strain relationship. Enforcing continuity results in the following expression relating displacements, $\{w\}$, to the internal deformations, $\{v\}$:

$$\{v\} = [B]\,\{w\} \tag{2.3}$$

where [B] is the compatibility matrix. It can be shown that the compatibility matrix is the transpose of the equilibrium matrix; thus,

$$\{f\} = [B]^T [DD] [B] \{w\}$$

or

$$\{f\} = [k] \{w\} \tag{2.4}$$

and

$$\{s\} = [DD][B] \{w\} \tag{2.5}$$

The force, displacement, and stiffness matrices in Equation (2.4) are then accumulated to form the equilibrium equations of the structural system and can be shown as

$$\{F\} = [k] \{w\} \tag{2.6}$$

where

$\{F\}$ = vector of forces of the system;

$\{w\}$ = vector of displacements of the system;

$[k]$ = stiffness matrix of the system.

Equation (2.6) represents a set of simultaneous algebraic equations which yield the displaced configuration for any applied loading. Since the applied forces, $\{F\}$, are known, these equations can be solved for the displacements, $\{w\}$, which in turn may be used in Equation (2.5) to solve for the boundary forces acting on the individual elements.

2.4.2 Differential Approach

For a nonlinear structural system, the displacements are not linear functions of the applied loading. In order to solve this problem, a differential point of view must be used (14) (41). The applied force vector, $\{f\}$, is replaced by the vector in Equation (2.4) in which $\{P\}$ is a parameter of the applied loads, $\lambda_i\{P\}$ denotes the applied load at point i. The derivative of the resulting equation is then taken with respect to P and the result is a set of simultaneous nonlinear, first order, ordinary differential equations:

$$\frac{d}{dP} \lambda_i\{P\} = \frac{d}{dP} ([k]\{w\}) \tag{2.7}$$

or

$$\lambda_i = [k^*] \frac{d}{dP} (\{w\}) \tag{2.8}$$

in which

$[k^*] = [B]^T [D] [B]$; and

$[D]$ = incremental force-deformation matrix of an element.

For the sake of simplicity, the stiffness matrix will first be developed in the form which does not include large deflections. The effect of geometric nonlinearity due to large displacements will be discussed later in this chapter. The compatibility matrix $[B]^T$ is therefore treated as being independent of the applied loading.

2.4.3 Moment-Rotation Equation

A mathematical expression for the nonlinear moment-rotation relationship is now required. Although several approaches are possible, the following equation developed by Richard (41) will be used in this study. This mathematical expression has been chosen because it gives accurate analytic form to the moment-rotation (force-deflection) relationships while at the same time keeping the mathematical expressions involved reasonably simple and amenable to computer programming. The relationships are represented by an equation of the form:

$$M = \frac{R\theta}{\left[1 + \left|\frac{R\theta}{M_p}\right|^n\right]^{1/n}} \tag{2.9}$$

in which M denotes the boundary moment in an element, R represents the stiffness 4EI/L for prismatic members, θ is the effective rotation of the element, M_p is the ultimate capacity of the moment, and n is the parameter defining the shape of the moment-rotation curve. (The numerical method to determine values of the above quantities from the cross section properties is shown in Appendix A.) Equation (2.9) may be expressed in nondimensionalized form as

$$\frac{T}{T_o} = \frac{E/E_o}{[1 + |\frac{E}{E_o}|^n]^{1/n}} \tag{2.10}$$

where

T = moment, force;

T_o = ultimate value of T;

E = rotation, deformation;

E_o = terminal value of E corresponding to T_o; and

n = curve fitting parameter.

Equation (2.10) is plotted in Figure 5 for various values of the curve fitting parameter n. Equation (2.9) can be solved for $R\theta$:

$$R\theta = \frac{M}{[1 - |\frac{M}{M_p}|^n]^{1/n}} \tag{2.11}$$

Differentiation of Equation (2.11) with respect to the load parameter P yields:

$$\frac{d}{dP} R\theta = \frac{dM/dP}{[1 + |\frac{M}{M_p}|^n]^{n+1/n}} \tag{2.12}$$

For an element ij in Figure 6, effective rotation θ_i, θ_j at points i and j can be expressed as:

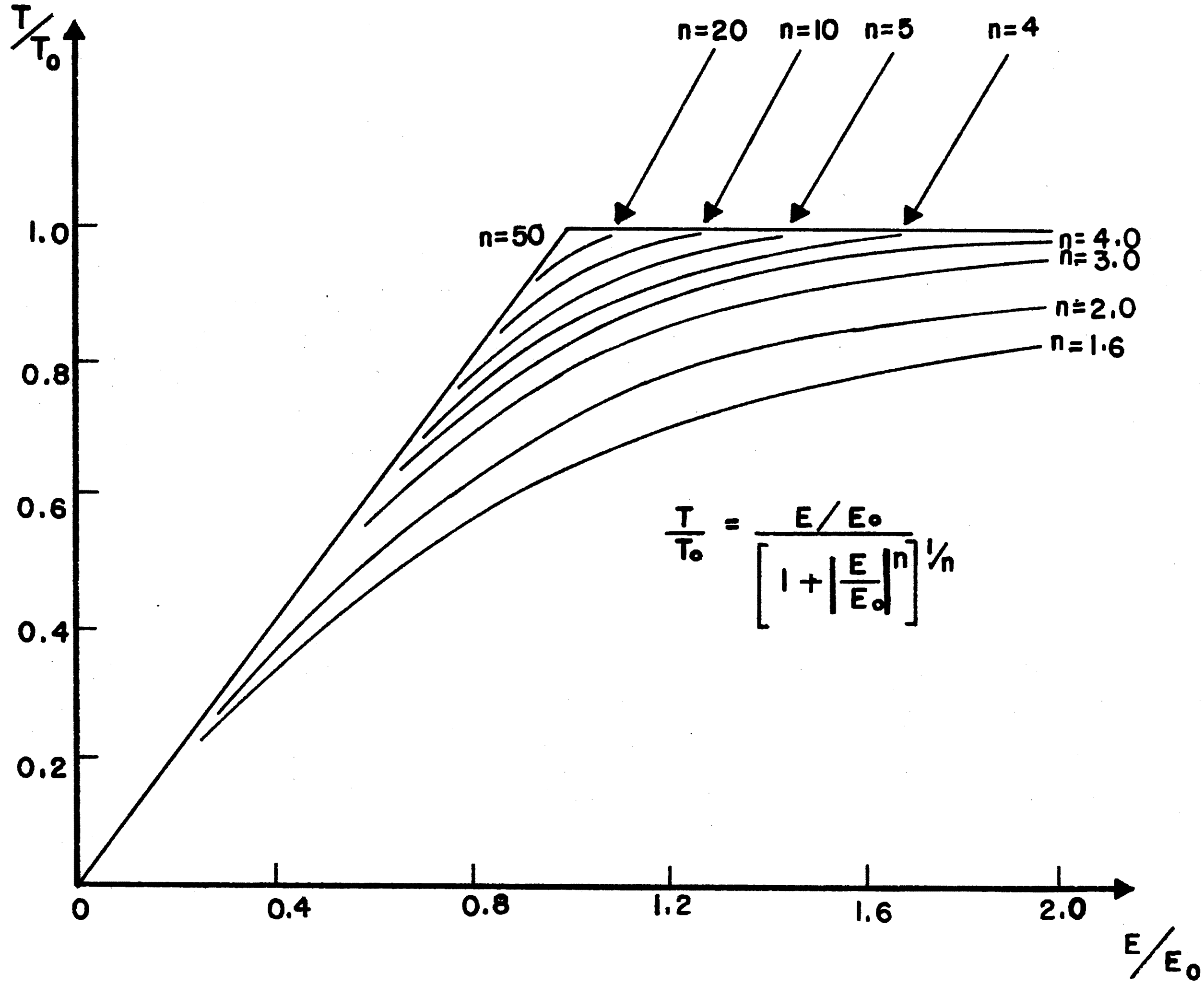


Figure 5. Nondimensionalized Moment-Rotation Equation

$$\theta_i = v_1 + \frac{v_2}{2} \tag{2.13a}$$

$$\theta_j = v_2 + \frac{v_1}{2} \tag{2.13b}$$

where v_1 and v_2 are the angle changes occurring at points i and j in the beam element shown in Figure 6. Equations (2.12), (2.13a), and (2.13b) are combined to obtain the following expression for a single beam element:

$$\begin{bmatrix} \dfrac{dv_1}{dP} \\ \\ \dfrac{dv_2}{dP} \end{bmatrix} = \begin{bmatrix} \dfrac{L/3EI}{[1 - |\frac{M_1}{M_p}|^n]^{n+1/n}} & -L/6EI \\ \\ -L/6EI & \dfrac{L/3EI}{[1 - |\frac{M_2}{M_p}|^n]^{n+1/n}} \end{bmatrix} \begin{bmatrix} \dfrac{dM_1}{dP} \\ \\ \dfrac{dM_2}{dP} \end{bmatrix} \tag{2.14}$$

where M_1, M_2 are the end moments at points i and j, respectively, in the element ij. Equation (2.14) is solved for the differential moments, to obtain:

$$\begin{bmatrix} \dfrac{dM_1}{dP} \\ \\ \dfrac{dM_2}{dP} \end{bmatrix} = \frac{6EI/L}{4 - A_1A_2} \begin{bmatrix} 2A_1 & A_1A_2 \\ \\ A_1A_2 & 2A_j \end{bmatrix} \begin{bmatrix} \dfrac{dv_1}{dP} \\ \\ \dfrac{dv_2}{dP} \end{bmatrix} \tag{2.15}$$

where

$$A_1 = [1 - |\frac{M_1}{M_p}|^n]^{n+1/n} \tag{2.16a}$$

$$A_2 = [1 - |\frac{M_2}{M_p}|^n]^{n+1/n} \tag{2.16b}$$

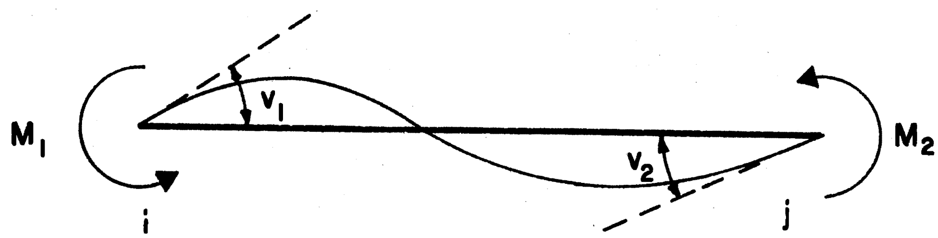


Figure 6. Moments and Rotations in the Beam Model

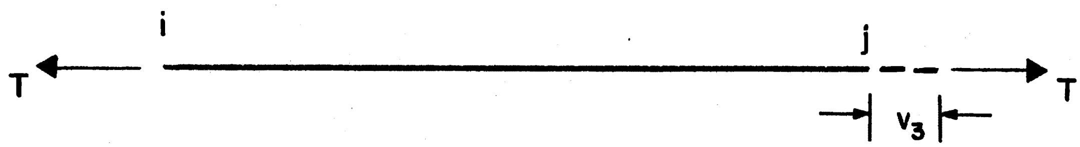


Figure 7. Force and Deflection in the Beam Model

To illustrate the behavior of the model, consider a large value of the curve fitting parameter, n. If neither end moment has reached the ultimate value ($M_1 < M_p$ and $M_2 < M_p$), Equation (2.16) becomes

$$\begin{bmatrix} \frac{dM_1}{dP} \\ \\ \frac{dM_2}{dP} \end{bmatrix} = \begin{bmatrix} 4EI/L & 2EI/L \\ \\ 2EI/L & 4EI/L \end{bmatrix} \begin{bmatrix} \frac{dv_1}{dP} \\ \\ \frac{dv_2}{dP} \end{bmatrix} \tag{2.17}$$

which indicates linear action for the beam.

2.4.4 Force-Deflection Equation

For axially loaded members, the force-deflection form of Equation (2.10) is

$$F = \frac{C\Delta}{[1 + |\frac{C\Delta}{F_o}|^n]^{1/n}} \tag{2.18}$$

in which F is the axial force in the element, C denotes the quantity AE/L for an element of constant cross section, Δ is the elongation of the element, F_o is the maximum axial load capacity of the element, and n denotes the parameter defining the shape of the curve. Equation (2.18) may be rewritten as:

$$C\Delta = \frac{F}{[1 - |\frac{F}{F_o}|^n]^{1/n}} \tag{2.19}$$

Differentiation of Equation (2.19) with respect to the load parameter P yields

$$C \frac{d\Delta}{dP} = \frac{1}{[1 - |\frac{F}{F_o}|^n]^{n+1/n}} \frac{dF}{dP} \tag{2.20}$$

Equation (2.20) may be solved for the differential force to obtain

$$\frac{dF}{dP} = C[1 - |\frac{F}{F_o}|^n]^{n+1/n} \frac{d\Delta}{dP} \tag{2.21}$$

For an element ij, which is subjected to an axial force (T) and given an elongation of v_3 as shown in Figure 7, Equation (2.21) can be expressed as

$$\frac{dT}{dP} = C[1 - |\frac{T}{T_o}|^n]^{n+1/n} \frac{dv_3}{dP} \tag{2.22}$$

2.4.5 Incremental Force-Deformation Matrix

From Equations (2.15) and (2.22), the relationship between increments of internal forces, $\{\Delta s\}$, to increments of internal deformations, $\{\Delta v\}$ may be stated as

$$\{\Delta s\} = [D]\{\Delta v\} \tag{2.23}$$

where

$$\{\Delta s\} = \{dT, dM_1, dM_2\}$$

$$\{\Delta v\} = \{dv_3, dv_1, dv_2\}$$

$$[D] = \begin{bmatrix} AEC_1/L & 0 & 0 \\ 0 & 2C_2A_1 & C_2A_1A_2 \\ 0 & C_2A_1A_2 & 2C_2A_2 \end{bmatrix}$$

and

$$C_1 = [1 - |\frac{T}{T_o}|^n]^{n+1/n}$$

$$C_2 = \frac{6EI/L}{4A_1A_2}$$

$$A_1 = [1 - |\frac{M_1}{M_p}|^n]^{n+1/n}$$

$$A_2 = [1 - |\frac{M_2}{M_p}|^n]^{n+1/n}$$

2.4.6 Deformation-Displacement Relationships

As a basis for the subsequent nonlinear treatment, equations are now developed to express a convenient set of element deformations, {v}, in terms of the element-end-displacements, {w}. Consider the member AB of Figure 8 of original length L_o and inclination θ_o, subjected to element-end-displacement,

$$\{w\} = \{w_1, w_2, w_3, w_4, w_5, w_6\}$$

such that the element moves to position A'B'. A set of element-end-deformations,

$$\{v\} = \{v_1, v_2, v_3\}$$

are defined such that v_3 is the extension of the element measured along A'B' and v_1, v_2 are the rotations with respect to Figure 9.

From Figure 10 it is seen that the horizontal and vertical projections of the deformable element are

$$x_A = x_o + w_4 - w_1 \tag{2.24a}$$

$$y_A = y_o + w_5 - w_2 \tag{2.24b}$$

in which x_o = horizontal projection of L_o and y_o = vertical projection of L_o. The length of the bar after deformation is

$$L_A = \sqrt{x_A^2 + y_A^2} \tag{2.25}$$

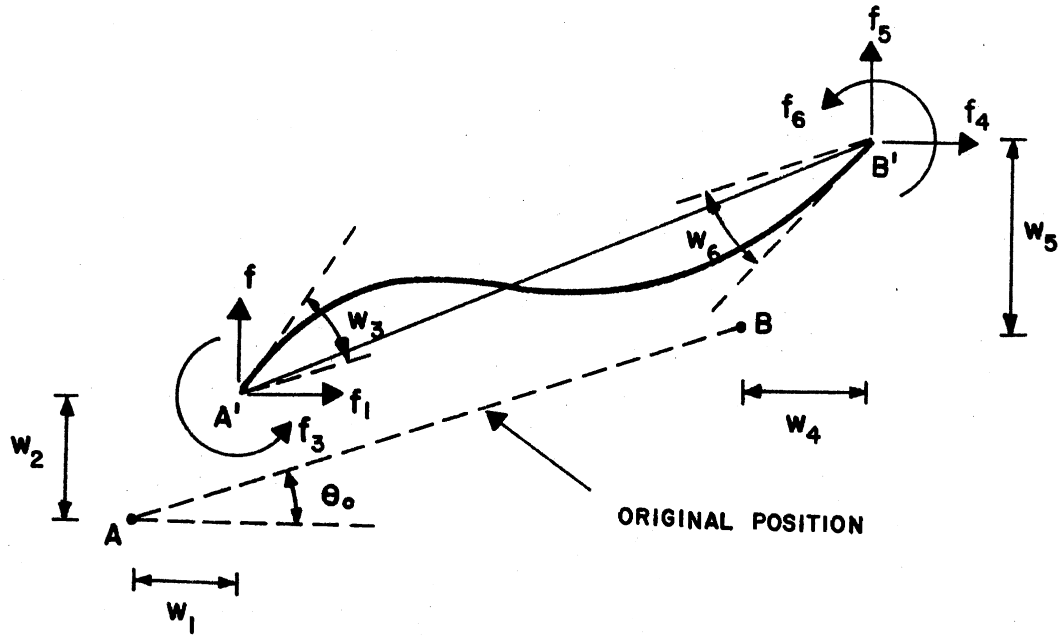


Figure 8. Displacements and Corresponding Forces at Ends of a Typical Element

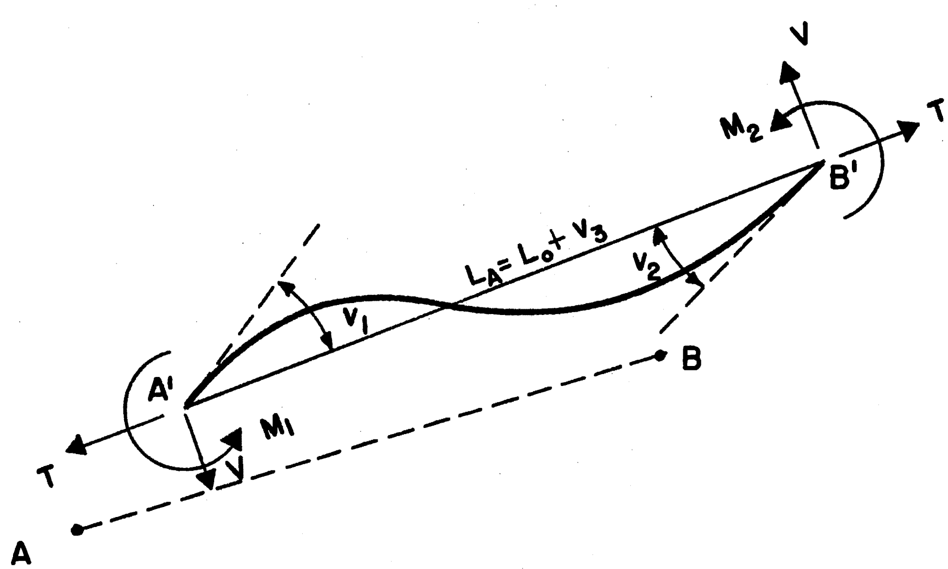


Figure 9. Force and End Deformations in the Element

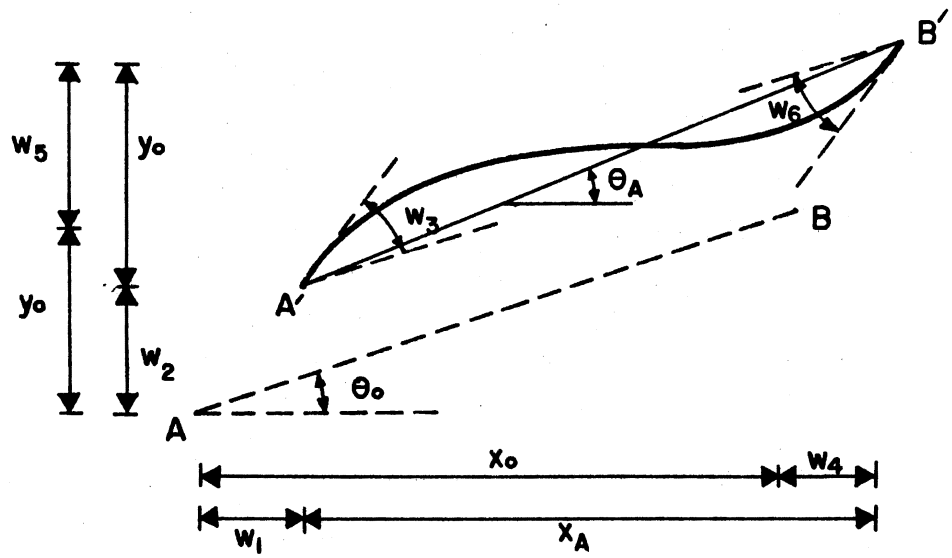


Figure 10. Initial and Final States of an Element

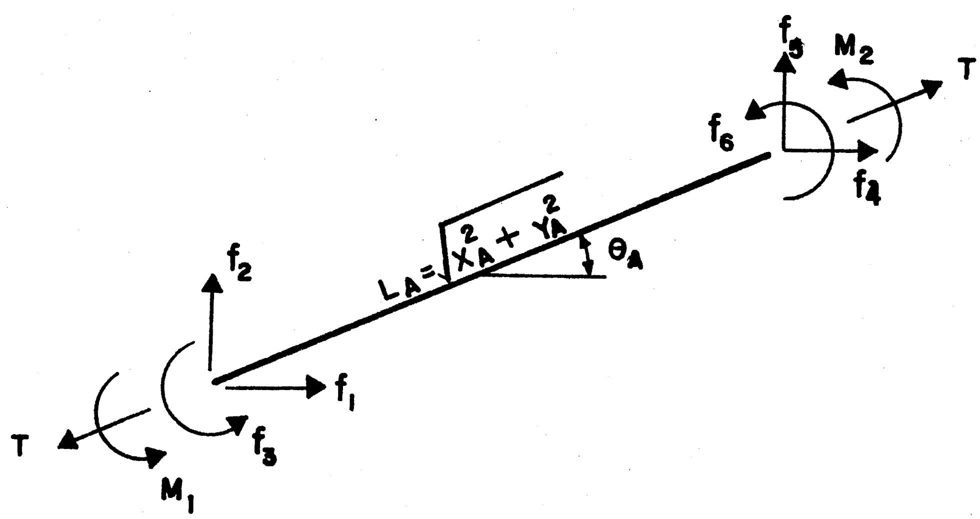


Figure 11. Internal Forces and Element End Forces for an Element

and change in length

$$v_3 = L_A - L_o \tag{2.26}$$

The angles θ_A and θ_o which the bar makes with the member axis (x'-axis) are given by

$$\theta_o = \tan^{-1}(y_o/x_o) \tag{2.27a}$$

$$\theta_A = \tan^{-1}(y_A/x_A) \tag{2.27b}$$

Therefore, the angle changes and v_1, v_2 are found from

$$v_1 = w_3 - (\theta_A - \theta_o) \tag{2.28a}$$

$$v_2 = w_6 - (\theta_A - \theta_o) \tag{2.28b}$$

Equations (2.24) through (2.28) are the deformation-displacement equations for the element. These equations are valid for large values of displacement since they contain no small displacement approximations.

2.4.7 Equilibrium Equations

A free body diagram of a typical element is shown in Figure 11. For equilibrium, the following relationships among the forces must exist:

$$f_1 = -T\cos\theta_A - v\sin\theta_A \tag{2.29a}$$

$$f_2 = -T\sin\theta_A + v\cos\theta_A \tag{2.29b}$$

$$f_3 = M_1 \tag{2.29c}$$

$$f_4 = -f_1 \tag{2.29d}$$

$$f_5 = -f_2 \tag{2.29e}$$

$$f_6 = M_2 \tag{2.29f}$$

where

$$V = (M_1 + M_2)/L_A$$

$$\cos\theta_A = x_A/L_A$$

$$\sin\theta_A = y_A/L_A$$

In matrix form,

$$\begin{bmatrix} f_1 \\ f_2 \\ f_3 \\ f_4 \\ f_5 \\ f_6 \end{bmatrix} = \begin{bmatrix} -x_A/L_A & -y_A/L_A^2 & -y_A/L_A^2 \\ -y_A/L_A & x_A/L_A^2 & x_A/L_A^2 \\ 0 & 1 & 0 \\ x_A/L_A & y_A/L_A^2 & y_A/L_A^2 \\ y_A/L_A & -x_A/L_A^2 & -x_A/L_A^2 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} T \\ M_1 \\ M_2 \end{bmatrix} \tag{2.30}$$

or alternatively,

$$\{f\} = [B]^T \{s\} \tag{2.31}$$

where

$$\{f\} = \{f_1, f_2, f_3, f_4, f_5, f_6\}$$

$$\{s\} = \{T, M_1, M_2\}$$

$$[B] = \begin{bmatrix} -x_A/L_A & -y_A/L_A & 0 & x_A/L_A & y_A/L_A & 0 \\ -y_A/L_A^2 & x_A/L_A^2 & 1 & y_A/L_A^2 & -x_A/L_A^2 & 0 \\ -y_A/L_A^2 & x_A/L_A^2 & 0 & y_A/L_A^2 & -x_A/L_A^2 & 1 \end{bmatrix}$$

2.4.8 Element Incremental Stiffness-Matrix

For many structures for which the material behavior is linear, the displacements of the joints during loading are small enough so that the displacement-transformation matrix [B] can be assumed constant. However, if the materials of a structure exhibit nonlinear behavior, large joint displacements may occur during loading. These large displacements cause changes in stiffness due to initial forces in the member and in the displacement-transformation matrix due to changes in geometry. A derivation of the stiffness matrix, including ghe effect of geometric nonlinearity using Castigliano's first theorem has been discussed by Hays and Matlock (20). Only an outline of the procedure is presented herein.

The relationship between the three internal forces, $\{s\}$, in the element and the end deformations, $\{v\}$, can be written as

$$s_i = f(v_1, v_2, v_3) \tag{2.32}$$

A linear approximation relating increments of internal forces, $\{\Delta s\}$, to increments of internal-deformations, $\{\Delta v\}$ may be stated as

$$\{\Delta s\} = [D] \{\Delta v\} \tag{2.33}$$

and D_{ij} is given by

$$D_{ij} = \frac{\partial s_i}{\partial v_j} \tag{2.34}$$

End deformations $\{v\}$ and end displacements are related by

$$v_i = f(w_1, w_2, w_3, w_4, w_5, w_6) \tag{2.35}$$

and increments of end-deformations, $\{\Delta v\}$, are related to increments in displacement, $\{\Delta w\}$, by

$$\{\Delta v\} = [B] \{\Delta w\} \tag{2.36}$$

B_{ij} is given as

$$B_{ij} = \frac{\partial v_i}{\partial w_j} \tag{2.37}$$

The element is assumed to exhibit linearly elastic behavior during a load increment, thus applying Castigliano's theorem, a element k_{ij} of an incremental stiffness [k] is given by (30)

$$k_{ij} = \frac{\partial^2 U}{\partial w_i \ \partial w_j} \tag{2.38}$$

in which U = strain energy of the element and can be expressed as

$$U = \sum_{\ell=1}^{3} \int s_\ell \ dv_\ell \tag{2.39}$$

Hence,

$$k_{ij} = \frac{\partial}{\partial w_j} [\frac{\partial}{\partial w_i} \sum_{\ell=1}^{3} \int s_\ell \ dv_\ell]$$

$$= \frac{\partial}{\partial w_j} (\sum_{\ell=1}^{3} s_\ell \frac{\partial v_\ell}{\partial w_i})$$

$$= \sum_{\ell=1}^{3} (s_\ell \frac{\partial^2 v_\ell}{\partial w_i \ \partial w_j} + \frac{\partial v_\ell}{\partial w_i} \cdot \frac{\partial s_\ell}{\partial w_j}) \tag{2.40}$$

From the chain rule of partial differentiation,

$$\frac{\partial s_\ell}{\partial w_j} = \sum_{m=1}^{3} \frac{\partial s_\ell}{\partial v_m} \cdot \frac{\partial v_m}{\partial w_j} \tag{2.41}$$

When Equations (2.40) and (2.41) are combined, the desired expression for k_{ij} is obtained as

$$k_{ij} = \sum_{\ell=1}^{3} [s_\ell \frac{\partial v_\ell^2}{\partial w_i \ \partial w_j} + \frac{\partial v_\ell}{\partial w_i} \sum_{m=1}^{3} (\frac{\partial s_\ell}{\partial v_m} \cdot \frac{\partial v_m}{\partial w_j})] \tag{2.42}$$

Because k_{ij} is composed of two terms, the stiffness matrix [k] may be considered to be composed to two portions, $[k]_s$ and $[k]_c$. Thus,

$$[k] = [k]_s + [k]_c \tag{2.43}$$

where $[k]_s$ is called the initial-stress stiffness matrix, due to the non-negligible presence of initial loading (30). This matrix is made up of all the k_{ij} that would arise if only the first term of Equation (2.43) were used. If an element undergoes a rigid body displacement, initial forces will be equal to zero regardless of how large the rigid body displacements are. Therefore, Equation (2.43) can be used without the designation on initial-stress stiffness matrix $[k]_s$.

The initial-stress stiffness matrix for the element was computed by taking the indicated second partial derivative of the deformation-displacement equations (Equations (2.24) through (2.28)). $[k]_s$ may be further subdivided into two portions, one due to internal axial force $[k]_{st}$ and another due to internal shear force $[k]_{sv}$, as shown below:

$$[k]_s = [k]_{st} + [k]_{sv} \tag{2.44}$$

in which

$$[k]_{st} = \frac{T}{L_A^3}\begin{bmatrix} y_A^2 & -x_A y_A & 0 & y_A^2 & x_A y_A & 0 \\ -x_A y_A & x_A^2 & 0 & x_A y_A & -x_A^2 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ -y_A^2 & x_A y_A & 0 & y_A^2 & -x_A y_A & 0 \\ x_A y_A & -x_A^2 & 0 & -x_A y_A & x_A^2 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

$$[k]_{sv} = \frac{V}{L_A^3}\begin{bmatrix} -2x_A y_A & x_A^2 - y_A^2 & 0 & 2x_A y_A & y_A^2 - x_A^2 & 0 \\ x_A^2 - y_A^2 & 2x_A y_A & 0 & y_A^2 - x_A^2 & -2x_A y_A & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 2x_A y_A & y_A^2 - x_A^2 & 0 & -2x_A y_A & x_A^2 - y_A^2 & 0 \\ y_A^2 - x_A^2 & -2x_A y_A & 0 & x_A^2 - y_A^2 & 2x_A y_A & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}$$

The conventional portion of the stiffness matrix could be computed by using the second term of Equation (2.43). However, identical results will be obtained for this portion if the triple matrix product is formed.

$$[k]_c = [B]^T \, [D] \, [B] \tag{2.45}$$

where [D] is given in Equation (2.23) and [B] is given in Equation (2.31). The final form of the element stiffness matrix is shown in Figure 12.

2.5 Nonlinear Soil Resistance-Deformation Behavior

When a member displaces against a supporting medium such as soil, distributed forces are developed which are often a nonlinear function of the member displacement. In this analysis soil resistance is represented by nonlinear springs acting at the nodal points along the member. The soil resistance-deformation characteristics for the clay soils considered in this study are developed according to the procedures given by Coyle and Reese (5) for the axial (tangential) springs, and by Matlock (31) for the lateral (normal) springs. These procedures are summarized in the following paragraphs.

2.5.1 Axial or Tangential Springs

Through comparisons of laboratory and field data, Coyle and Reese have developed a family of load transfer-displacement curves for axially loaded piles in clay. These curves are reproduced in Figure 13. Curve A is applicable for depths from 0 to 10 ft below the surface, Curve B for depths from 10 ft to 20 ft, and Curve C for depths below 20 ft.

$$
[K] = \frac{T}{L_A^3}\left[\begin{array}{ccc|ccc}
Y_A^2 & -X_AY_A & 0 & -Y_A^2 & X_AY_A & 0 \\
-X_AY_A & X_A^2 & 0 & X_AY_A & -X_A^2 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
\hline
-Y_A^2 & X_AY_A & 0 & Y_A^2 & -X_AY_A & 0 \\
X_AY_A & -X_A^2 & 0 & -X_AY_A & X_A^2 & 0 \\
0 & 0 & 0 & 0 & 0 & 0
\end{array}\right]
+ \frac{V}{L_A^3}\left[\begin{array}{ccc|ccc}
-2X_AY_A & X_A^2Y_A^2 & 0 & 2X_AY_A & Y_A^2-X_A^2 & 0 \\
X_A^2-Y_A^2 & 2X_AY_A & 0 & Y_A^2-X_A^2 & 2X_AY_A & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
\hline
2X_AY_A & Y_A^2-X_A^2 & 0 & -2X_AY_A & X_A^2-Y_A^2 & 0 \\
Y_A^2-X_A^2 & -2X_AY_A & 0 & X_A^2-Y_A^2 & 2X_AY_A & 0 \\
0 & 0 & 0 & 0 & 0 & 0
\end{array}\right] +
$$

$$
\left[\begin{array}{ccc|ccc}
-\frac{X_A}{L_A} & -\frac{Y_A}{L_A} & 0 & \frac{X_A}{L_A} & \frac{Y_A}{L_A} & 0 \\
-\frac{Y_A}{L_A^2} & -\frac{X_A}{L_A^2} & 1 & \frac{Y_A}{L_A^2} & -\frac{X_A}{L_A^2} & 0 \\
-\frac{Y_A}{L_A^2} & -\frac{X_A}{L_A^2} & 0 & \frac{Y_A}{L_A^2} & -\frac{X_A}{L_A^2} & 1
\end{array}\right]
\begin{bmatrix}
\frac{AEC_i}{L} & 0 & 0 \\
0 & 2C_2A_i & C_2A_iA_j \\
0 & C_2A_iA_j & 2C_2A_j
\end{bmatrix}
\begin{bmatrix}
-\frac{X_A}{L_A} & -\frac{Y_A}{L_A^2} & -\frac{Y_A}{L_A^2} \\
-\frac{Y_A}{L_A} & -\frac{X_A}{L_A^2} & -\frac{X_A}{L_A^2} \\
0 & 1 & 0 \\
\frac{X_A}{L_A} & \frac{Y_A}{L_A^2} & \frac{Y_A}{L_A^2} \\
\frac{Y_A}{L_A} & -\frac{X_A}{L_A^2} & -\frac{X_A}{L_A^2} \\
0 & 0 & 1
\end{bmatrix}
$$

$$A_i = \left[1 - \left|\frac{M_i}{M_p}\right|^n\right]^{\frac{n+1}{n}}$$

$$A_j = \left[1 - \left|\frac{M_j}{M_p}\right|^n\right]^{\frac{n+1}{n}}$$

$$C_1 = \left[1 - \left|\frac{T}{T_o}\right|^n\right]^{\frac{n+1}{n}}$$

$$C_2 = \frac{6EI/L}{4 - A_iA_j}$$

$$X_A = X_o + W_4 - W_1$$

$$Y_A = Y_o + W_5 - W_2$$

$$L_A = \sqrt{X_A^2 + Y_A^2}$$

$$V = \frac{M_1 + M_2}{L_A}$$

Figure 12. Element Stiffness Matrix

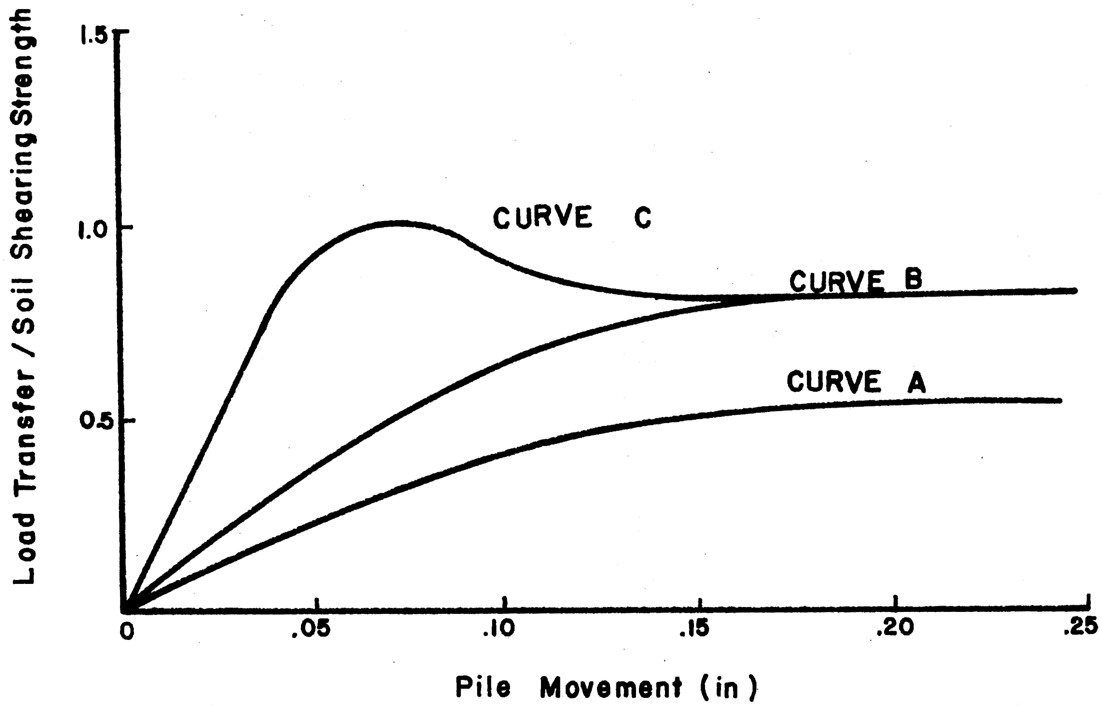


Figure 13. Load-Displacement Curves for Axially Loaded Piles

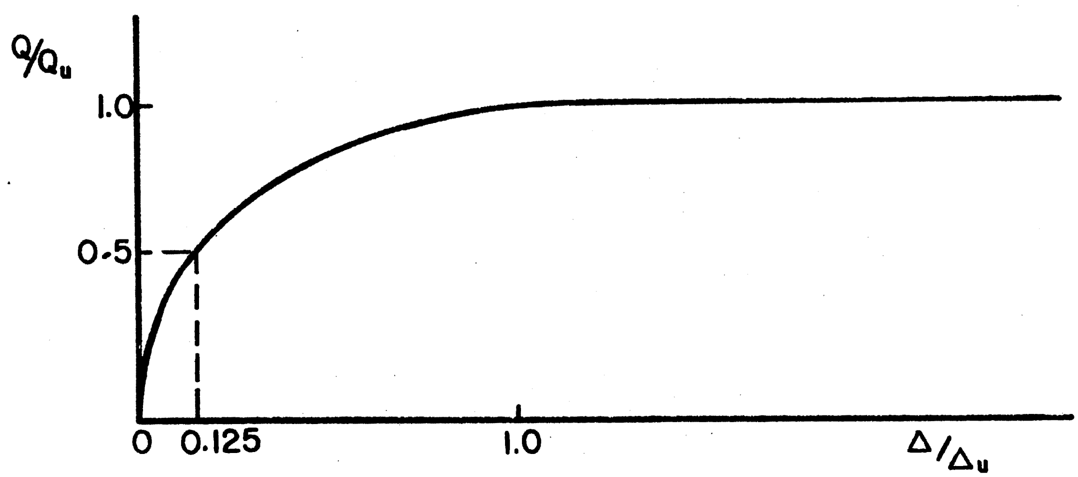


Figure 14. Load-Displacement Curves for Laterally Loaded Piles

These load-transfer curves are then fitted by an arithmetic expression so that they can be used easily in a computer program. The equations used to represent the nonlinear soil-resistance-deformation curves for the axial (tangential) springs are as follow:

Curve A:

$$0 < \Delta < 0.\ 6 \text{ in.} \quad q = c(1100.2\Delta^4 - 465.9\Delta^3 + 52.7\Delta^2 + 1.91\Delta) \tag{2.46a}$$

$$\Delta > 0.16 \text{ in.} \quad q = 0.51c \tag{2.46b}$$

Curve B:

$$0 < \Delta < 0.16 \text{ in.} \quad q = c(702\Delta^4 - 280.8\Delta^3 + 18.4\Delta^2 + 6.14\Delta) \tag{2.47a}$$

$$\Delta > 0.16 \text{ in.} \quad q = 0.82c \tag{2.47b}$$

Curve C:

$$0 < \Delta < 0.04 \text{ in.} \quad q = 20c\Delta \tag{2.48a}$$

$$0.04 < \Delta < 0.16 \text{ in.} \quad q = c(-12160\Delta^4 + 5629.5\Delta^3 - 946.5\Delta^2 + 69\Delta - 0.76) \tag{2.48b}$$

$$\Delta > 0.16 \text{ in.} \quad q = 0.82c \tag{2.48c}$$

where Δ = pile movement, q = soil resistance per unit area, and c = soil shear strength. The expressions shown above, and soil strength properties, are used to construct the axial (tangential) soil spring characteristics in this study.

2.5.2 Lateral or Normal Springs

The development of the lateral (normal) soil spring resistance-deformation behavior follows the recommendations of Matlock (31). Matlock expresses soil resistance according to the failure mode of soil. Near the surface where the soil failure is in the form of a wedge, the ultimate resistance is obtained from

$$Q_u = 3cd + \gamma dx + 0.5cx \tag{2.49a}$$

where Q_u = ultimate resistance per unit length of pile, c = soil shear strength, d is the pile diameter, γ = unit weight of soil, and x = distance below soil surface.

For depths at which failure is due to plastic flow, the ultimate resistance is given by

$$Q_u = 9cd \tag{2.49b}$$

The depth at which the translation from wedge failure to plastic flow is given by Matlock for a homogeneous soil medium as

$$x_r = \frac{6cd}{\gamma d + 0.5c} \tag{2.50}$$

For cases involving nonhomogeneous media or variations in shear strength, the soil is treated as a system of thin layers with x_r computed as a variable with depth according to the properties of each layer.

The displacement at which the soil attains its ultimate resistance is given by

$$\Delta_u = 20\varepsilon_c d \tag{2.51}$$

where ε_c is the strain which occurs at one-half of the maximum stress on a laboratory stress-strain curve. ε_c normally ranges between 0.005 and 0.020 with the intermediate value of 0.010 being satisfactory for most purposes.

For deformations less than Δ_u, values of resistance are given by

$$\frac{Q}{Q_u} = (\Delta/\Delta_u)^{1/3} \tag{2.52}$$

A nondimensional representation of the curve for lateral resistance-lateral displacement is shown in Figure 14.

2.6 Nonlinearly Elastic Frame Solution

The frame structure, treated as a series of line members intersecting at a number of structure joints, is well suited to using a large number of elements within each member. Thus, any actual variation of member properties, loading, or supporting conditions may be represented. If all elements were combined into one system of equations, the large number of equations would require a prohibitive amount of computer storage. Therefore, the individual members will be solved separately, in this study, by using as many elements as necessary to obtain the stiffness and fixed-end-force matrices for each member. These matrices are then combined to form the structure stiffness and load matrices using standard matrix techniques. The only unknowns will be the structural joint displacements. This condensing of the equilibrium equations results in considerable savings in computer time and storage required (20).

2.6.1 Frame Solution

Figure 15 shows the general flow diagram for a nonlinear frame solution. The tangent stiffness matrices for the members are formed in member coordinates by using the unit displacement definition of the stiffness term. Next, the member-fixed-end-force matrix is constructed from the solution of the member subjected to its member loads and zero end displacements. The tangent stiffness matrices for the members are transformed into structure coordinates and then combined to form the structure stiffness matrix. The structure load matrix is formed by subtracting the transformed fixed-end-forces from the applied joint loads at all joints. To account for linearly elastic joint supports, the

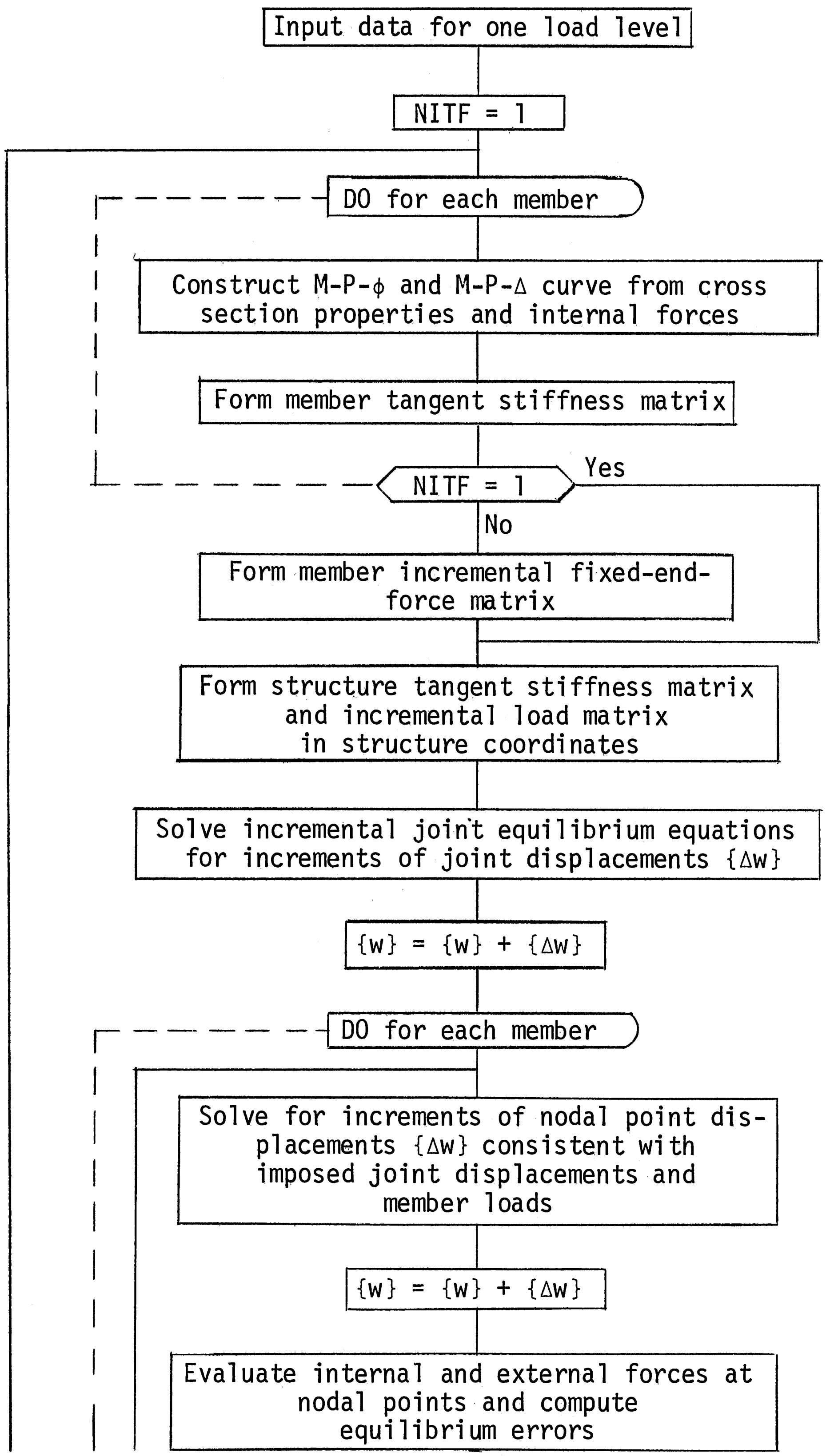


Figure 15. General Flow Diagram for Nonlinear Analysis of Frame

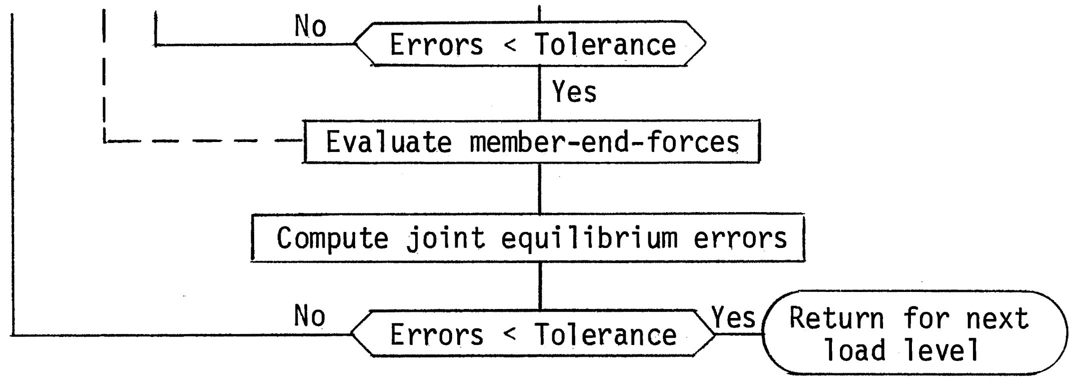


Figure 15. (Continued)

stiffnesses of the joint springs are added to the diagonal of the structure stiffness matrix. The solution of the simultaneous equations can be obtained by a two pass recursion method. The increments of displacements $\{\Delta W\}$ are obtained and added to the previous displacements $\{W\}$ to obtain the new estimate of displacements $\{W\}$.

2.6.2 Equilibrium at a Joint

The sum of all forces acting at each joint is equal to zero if an equilibrium position has been found. The magnitude of joint equilibrium errors is an indication of the joint loads not absorbed by the structure in the estimated position. If the errors are greater than a specified tolerance, the cycle is repeated with the increment joint loads taken as the equilibrium errors. When all joints have converged, the frame is in a position of equilibrium.

2.6.3 Member Solution

In order to find the member-end-forces corresponding to member loads and the current estimate of frame joint displacements, an iterative solution of the member, similar to that for the frame solution, is required. This member solution is somewhat simpler than the frame solution because all of the elements have their stiffness matrices developed for axes parallel to the member axes and only two elements are connected at any joint. An iterative procedure based upon the matrix displacement method (10) is now used to analyze an individual member composed of a finite number of elements. A flow diagram showing the member solution is given in Figure 16.

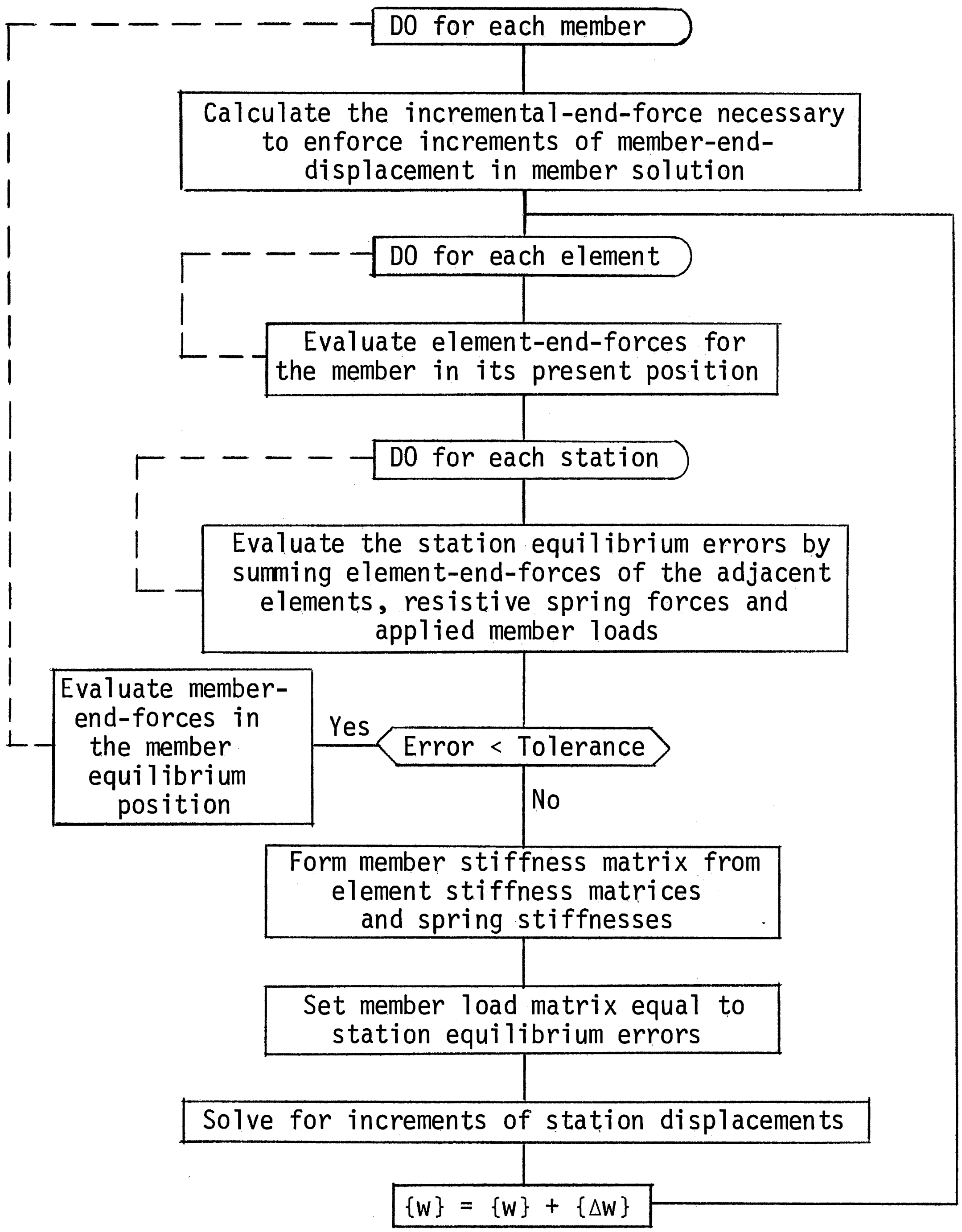


Figure 16. Iterative Solution of Member to Find Member-End-Forces in Equilibrium Position

The incremental member-end-forces necessary to enforce the increase in member-end-displacements are equal to the increase in member displacement times the large spring values at the member end. The large springs and corresponding large forces are used to enforce the member-end-displacements from the frame solution. The station equilibrium errors are used throughout the member solution as member loads; hence, the equilibrium errors at the end stations are set equal to the necessary, large incremental-end-forces.

Next, the element-end-forces are evaluated for each element in its current position. The element-end-displacements are known and hence the element deformations may be found from Equations (2.24) through (2.28) in this chapter. The internal forces may then be found from the moment-rotation and force-deformation relationships developed at the beginning of the program. Then the equilibrium equations can be solved for the element-end-forces.

The element stiffness matrices and spring stiffnesses are combined to form a member stiffness matrix. The load vector is formed directly from the station equilibrium errors. The equilibrium equations are then solved for the increments of member displacement $\{\Delta w\}$ using a two pass recursion technique (20). The new estimate of member displacements $\{w\}$ is found by adding the increments to the previous member displacements. The member solution is repeated until convergence occurs or a limiting number of iterations is reached.

2.6.4 Equilibrium at a Station

Equilibrium at each station is evaluated by summing element-end-forces of the adjacent members, member loads, and resistive spring forces at the station. A check is then made to see if the station equilibrium errors are less than the specified tolerance. If they are, the member is then considered to be in equilibrium. Next, the member-end-forces are evaluated for checking equilibrium in the frame solution. The member-end-forces are the element-end-forces at the end stations which have been corrected for member loads and spring forces at the end stations.

If any of the station equilibrium errors are larger than the specified tolerance, the member solution is repeated with increment station loads taken as the station equilibrium errors.

2.6.5 Member Tangent Stiffness Matrices

The tangent stiffness matrices for the member are formed in member coordinates. This 6x6 member stiffness matrix [k] needed for the frame solution is formed by applying 6 unit increments of displacements from the member's present position. The incremental-end-forces found from a member solution due to a unit increment of the jth member-end-displacement are the jth column of [k]. Since the tangent stiffness of the member is sought, it is not necessary that the 6 member solutions be iterative as was the member solution for a set of specified end displacements. Rather, a single member solution is made for each unit increment of displacement. The incremental member-end-forces are found by multiplying the increments of member displacements by the end element stiffness matrices and correcting for the member loads and incremental spring forces at the end stations.

2.6.6 Member Fixed-End-Forces Matrices

A fixed-end-forces matrix for the member is formed only on the first frame iteration. Succeeding iterations include the effects of the member loads in the joint equilibrium errors. The member fixed-end-forces matrix is found with the member fixed in its present position and a single solution will define the linear increment of fixed-end-forces.

2.7 Wind and Wave Forces

As stated previously, one of the goals of the effort described herein was to examine the effects of wind and wave loading on a frame structure. Although these forces may induce dynamic response of the structure, only static effects are considered. This approach is commonly used in initial design procedures. A structure member subjected to a passing wave is shown in Figure 17.

2.7.1 Wave Forces

The method of calculating wave forces on a fixed off-shore structure described in this study is based on the approach known as the Morison theory (36). The method is usually applicable to objects which are small compared to wave length. The force exerted by a fluid on an accelerating body is composed of two parts, one depending on friction effects and another depending upon the inertia of the displaced fluid. If it is assumed that a submerged structural member is of such a diameter that it does not distort the wave (that is, the ratio of wave length to the member diameter is very large) the "Morison Solution" can be stated

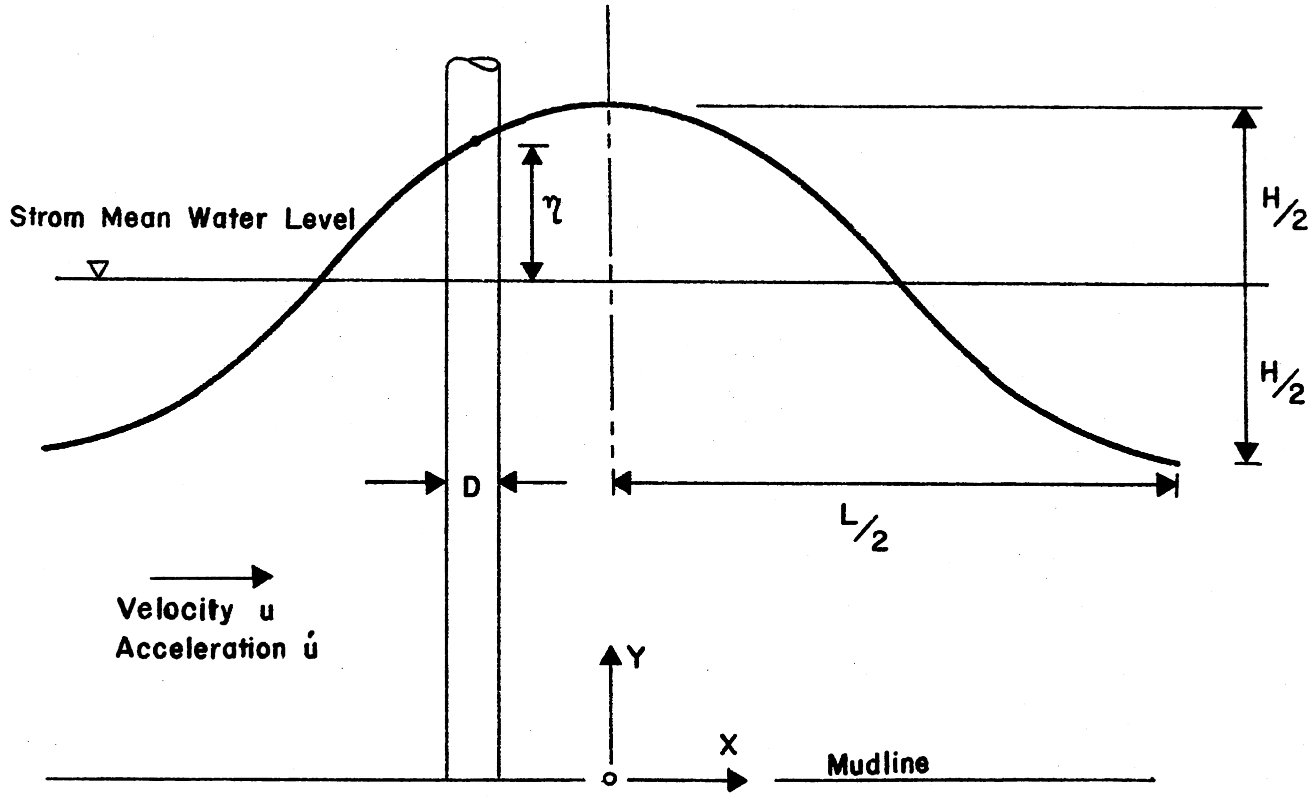


Figure 17. Wave and Structure Member System

as

$$f = f_D + f_I$$

$$= \frac{1}{2} \rho c_D D \, u|u| + \rho c_M \frac{\pi}{4} D^2 \frac{\partial u}{\partial t} \qquad (2.53)$$

in which

f = force per unit length at a point on the member;

f_D = maximum drag force per unit length at a point on the member;

f_I = maximum inertia force per unit length at a point on the member;

ρ = density of fluid;

u = velocity perpendicular to member due to wave motion;

$\frac{\partial u}{\partial t}$ = acceleration perpendicular to member due to wave motion;

D = member diameter;

c_M = inertia coefficient; and

c_D = drag coefficient.

Consequently, the problem of wave force prediction is reduced to one of determination of u, $\frac{\partial u}{\partial t}$, and the choice of drag and mass coefficient. The horizontal particle velocity under the crest for the highest wave in deep water is given by the Michell-Havelock theory (37). The horizontal particle velocities and accelerations for deep water are

$$u = \frac{c\pi H}{L} e^{kz} \cos\theta \qquad (2.54)$$

$$u = \frac{c}{T} \frac{2\pi^2 H}{L} e^{kz} \sin\theta \qquad (2.55)$$

For nonbreaking waves, Stroke's equations can be used for water surface elevation, Figure 17, as

$$\eta = \frac{H}{2} (\cos\theta + \frac{\pi H^2}{2L^2} \cos 2\theta) \qquad (2.56)$$

Here the wave speed c and wave length L are given by

$$c = gT/2\pi \tag{2.57}$$

$$L = gT^2/2\pi \tag{2.58}$$

where

θ = phase position = $kx - \omega t$;

k = wave number = $2\pi/L$;

ω = angular wave frequency = $2\pi/T$;

g = gravity acceleration;

H = wave height;

T = wave period;

z = vertical coordinate, usually measured upwards from mean water level;

x = horizontal coordinate, usually measured in direction of wave travel; and

t = time.

The selection of correct values of drag (c_D) and mass (c_M) coefficients in the calculation of wave forces has always been difficult because empirical data show a tremendous scatter in the calculated coefficient. Myers, Holm and McAllaster (37) present a summary of mean values of the coefficients obtained by various investigations. There is considerable discrepancy in the reported results, and it is well known that the steady-flow circular cylinder coefficient depends on Reynolds number and cylinder surface roughness. The coefficient averages of the summary are porbably the most representative published values available. The averages are $\overline{c}_D = 1.05$ and $\overline{c}_M = 1.40$ with the range $0.4 < c_D < 1.6$ and $0.93 < c_M < 2.3$.

Morison et al. (36) proposed the empirical equation, Equation (2.53), for wave forces on a vertical member with the velocity and acceleration components at right angles to the member axis. The vertical or the tangential components are ignored in the force evaluation. However, piles or other structural members are not always vertical. If the Morison concept is to be extended to inclined members (43), then the force expression will remain the same. The inertia and drag coefficient are also the same as before. The velocities and accelerations must be written in terms of normal velocity and acceleration components. The tangential components causing skin friction are neglected on the assumption that the friction force is small.

2.7.2 Wind Forces

In areas subject to high wind such as extratropical storms or hurricanes, wind forces can be appreciable factors in design considerations. In general, the wind-drag force (f_D) is expressed as (37)

$$f_D = c_D \rho_a \frac{U^2(z)}{2} \tag{2.59}$$

where

f_D = wind force per unit area;

c_D = drag coefficient;

ρ_a = mass density of air; and

$U(z)$ = wind speed in ft/sec at elevation z above the storm mean water level.

The drag coefficient depends on the object shape, roughness, orientation with respect to the wind vector, and Reynolds number. The variation of wind speed with elevation above the mean sea surface can be expressed as

$$U(z) = U(30) \left(\frac{z}{30}\right)^k \qquad \text{for } z < 600 \text{ ft} \tag{2.60}$$

in which U(30) is the basic wind velocity at 30 ft above the mean sea surface. Measurements have shown that the exponent depends primarily on the wind speed, surface roughness, and the stability of the air near the air-water interface (6). A reasonable value of k for offshore wind systems appears to be about 0.1.

2.8 Iterative Procedure

For a nonlinear but elastic analysis, explicit nodal point equilibrium equations may be difficult or impossible to write, especially when some of the stiffness parameters of the structure are in other than equation form; for example, nonlinear stress-strain curves described by discrete pairs of data points. In "exact" computational algorithms for large nonlinear structures, the nonlinear problem is most commonly solved by a Newton type of method in a series of linear steps (38). The method is illustrated diagrammatically in Figure 18, in which a solution which satisfies compatibility is successively corrected until it also satisfies equilibrium.

To clarify the iteration technique for multi-degree of freedom systems, consider a single degree of freedom structure in which a single load P is a nonlinear function of displacement. The relation between P and u is given by

$$P = f(u) \tag{2.61}$$

as shown graphically in Figure 19. The function for finding P need not be an explicit formula, but it must give a unique P for any given value of u. Assume that P_i and u_i are known and that, given P_{i+1}, it is desired to find u_{i+1}. From Figure 19, the increment in P is seen to be

$$\Delta P = P_{i+1} - P_i \tag{2.62}$$

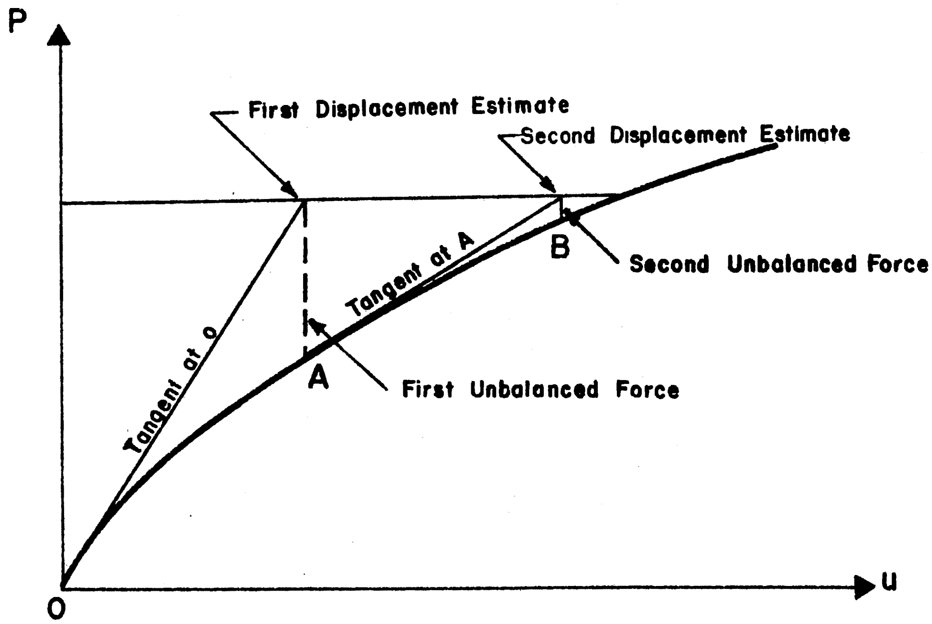


Figure 18. Diagrammatic Illustration of Newton Procedure

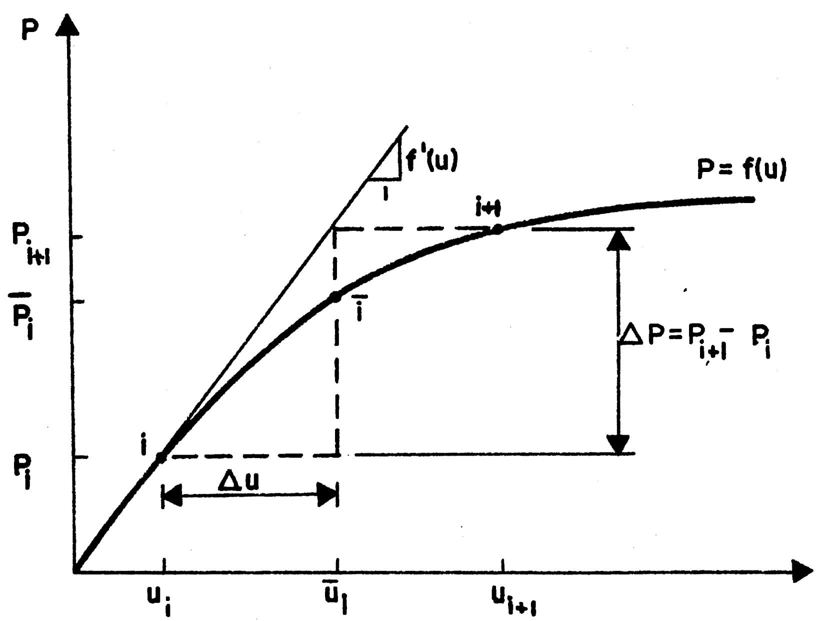


Figure 19. Graphical Interpretation of Iteration Process

The slope of tangent to the curve f'(u) at point i is obtained directly from differentiation of Equation (2.61) as

$$\Delta P = f'(u)\Delta u \tag{2.63}$$

The required Δu as obtained from:

$$P_{i+1} = P_i + f'(u)\Delta u \tag{2.64}$$

is the increment in the displacement necessary for the extension of the tangent at point i to reach the load P_{i+1}. When the new displacement $(u_i + \Delta u)$ is substituted in Equation (2.61), the force $\overline{P_i}$ is obtained which differs from P_{i+1} by a certain amount. If the desired accuracy has not been obtained, point $\overline{i}$ (see Figure 19) is used as the initial point and a new trial is initiated. The process is repeated until the desired accuracy has been obtained.

The iterative process, which was demonstrated on a simple geometric basis for a single-degree of freedom system, can be extended to a multi-degree of freedom system by using Taylor series as done by Lee (28). The same algorithm applies, except that the individual forces and displacements now become force vectors and displacement vectors, and the single stiffness matrix term becomes a square matrix. The stiffness is not actually inverted to solve for the linear increments in displacements, but instead a two pass recursion solution (shown in Appendix C) is used to solve for the desired increments of displacements.

CHAPTER III

COMPUTER PROGRAM

3.1 General

The method of analysis described in the preceding chapter was programmed in the FORTRAN language for solution on the IBM/360 Model 65 compute of Oklahoma State University. Only minor changes should be necessary to run the program on other types of computers having a FORTRAN complier.

A complete program listing is included in Appendix F. As currently dimensioned, the program permits a maximum of 30 members in a frame; and each member can be subdivided into a maximum of 40 elements. Because of the round-off errors which can be encountered, double precision computations for all real variables, with approximately 15 significant decimal digits, should be used.

The program consists of a main driver program, and thirty subroutines. Although some subroutines could be included in the main program or easily incorporated in other subroutines, the program in subroutine form has more flexibility and facilitates changes to take into consideration particular features of specific problems, if necessary.

3.2 Flow Chart

The summary flow diagram of the program is presented in Figure 20.

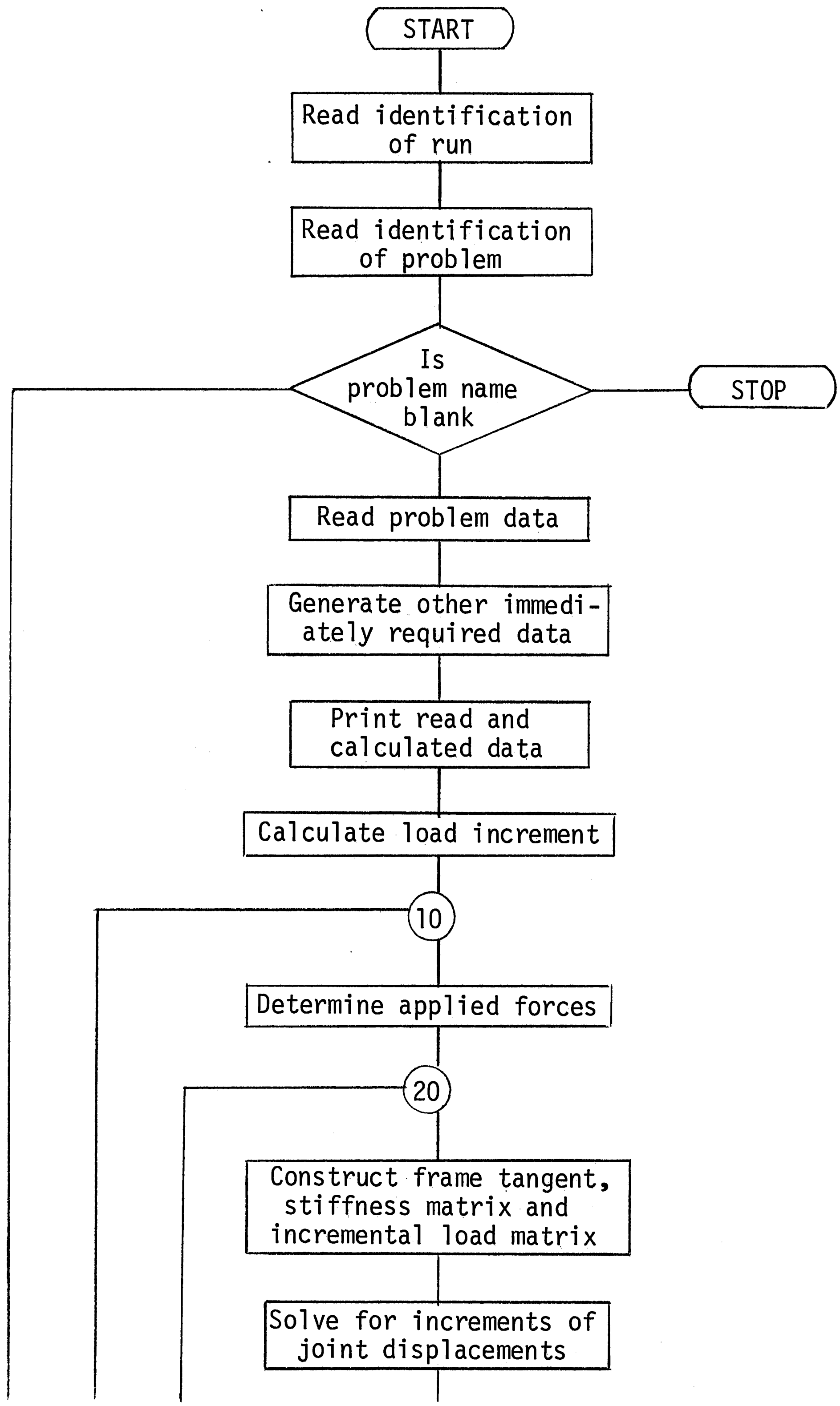


Figure 20. General Flow Chart

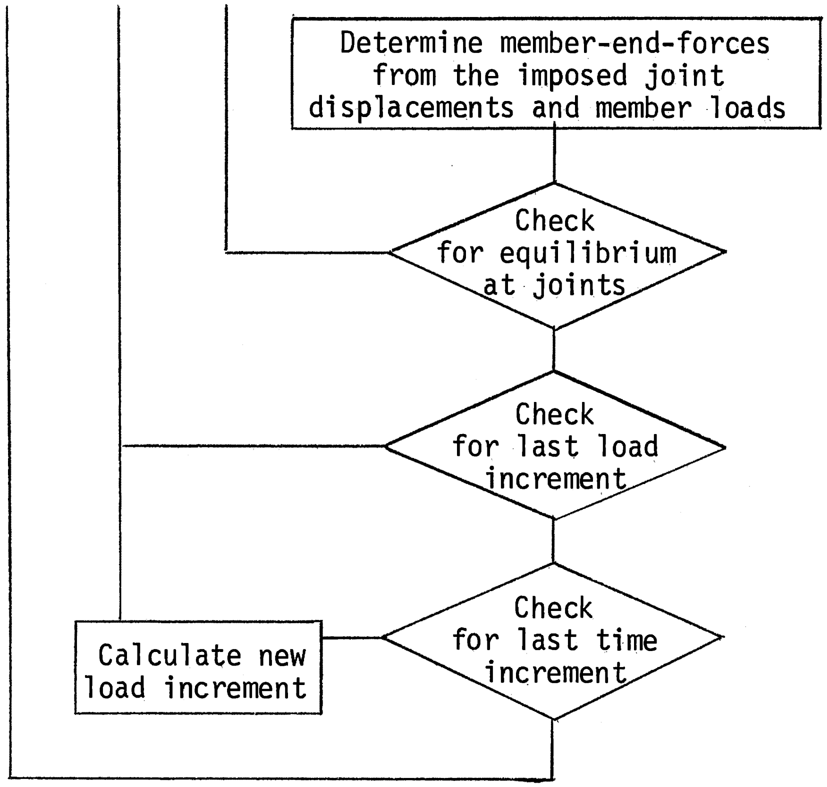


Figure 20. (Continued)

Flow charts of the subroutines, a guide for data input, and a FORTRAN listing of the program are given in Appendices D, E, and F, respectively.

3.3 Input List

Table 1. Program Control Data

Consists of two cards which are required for all problems. The first card specifies the problem type, the tables for which data from the previous problem are held, and allows the user to suppress output. The second card specifies the number of new data cards in Tables 2 through 7. Data cannot be held on the first problem of a computer run. A type 1 problem is one in which all displacements are assumed to be zero at the start of the solution. In a type 2 problem the displacements of the previous problem are the starting values for the new solution.

Table 2. Joint Locations

Defines the location of the structural joints of the frame. Joints are required at the intersections of two or more members and at the ends of members. Joints are also required at locations of supports and at hinges (points of zero flexural stiffness). In addition, joints are required at any points where a change in the nonlinear member stiffness properties may occur. Joint number and global coordinates of each joint are supplied in ascending order of joint number.

Table 3. Member Locations

Locates the members of the frame between the joints defined in Table 2. Number of members and the number of elements per member, which must be less than 40, are input in this table. Joint number and cross-section number are given from the "FROM" joint to the "TO" joint. If the nonlinear option is left blank, the second card describing the variations in linear stiffness properties within the member is required. The modulus of elasticity is held constant but the moment of inertia, and area may vary freely in the member.

Table 3B. Cross Section Properties

Describes the member cross section and gives the stress-strain curve for each piece in the section and the stress-strain multipliers. The final stress-strain curve used at a joint is the product of the stress-strain curve input in Table 3C and the stress and strain multipliers.

The cross-section is described as a series of up to 8 pieces; each piece may be specified by an area or by the form of rectangular or circular shape. The input format for specifying these segments is illustrated in Appendix E.

The program interpolates linearly between joints to define the cross-section properties of each element at mid-element. Therefore the cross-section should have the same number of pieces at both joints, and corresponding pieces should be input in the same order.

Table 3C. Stress-strain Curves

Gives the stress-strain curves which were located in Table 3B. The curves must be input so that the final value of strain is increasing in algebraic order. Symmetrical curves may be input by specifying only the positive displacement branch of the curve. The first point on a symmetrical curve must be the zero-zero point. A stress-strain curve at mid-element is found for each piece in the element by linear interpolation along the length of the member with respect to both stress and strain. Thus stress-strain curves at both joints of a member on the same piece must have the same number of points.

Table 4A. Member Load Data

Specifies the loading for various load types. One or more data cards are required to define each load. Four axis options are provided to permit the user to describer the member loads in the most convenient manner. Distances to concentrated loads and changes in distributed loads are given from the member's "FROM" joint and are positive in the direction of the chosen axis.

Table 4B. Selfweight

The selfweight of a member can be taken into account by specifying weight per unit volume for each member. These self-weights will be calculated internally and added to the member loads.

Table 4C. Wind and Wave Forces

Specifies the parameters required to find the wind and wave forces. This includes mass density of air and fluid, basic wind velocity (at 30 ft. above mean sea level), distance from bottom of the sea to the mean sea level, wave period and wave height. The drag coefficient and inertia coefficient for each member staying above the mud line must be given by the third and succeeding cards of this table. Time is an important factor used in the calculation of water-particle velocity and acceleration. Hence, the ratio of time to wave period, time increment and number of time increments must also be included in this table.

Table 5A. Linear Member Restraints

Gives the distributed spring supports in the direction of member coordinates. The springs are assumed to be concentrated at the station along a member. The input of linear member restrains is similar to the input of member loads of Table 4A.

Table 5B. Soil Data

Gives the characteristic of soils at different locations below the mud line. This includes soil shearing strength and soil density which are required in constructing the nonlinear soil support curves along the member. Penetration distance below the mud line must be negative and specified by a negative quantity.

Table 6. Joint Loads and Supports

Gives joint load and linear supports in the direction of the structure axes. A completely fixed support is obtained by specifying large horizontal, vertical and rotational springs at a joint. A pinned support would omit the rotational restraint and a free end of a cantilever would have no restraints.

A specified displacement can be enforced by specifying a large spring stiffness times the desired displacement. Each card in Table 6 contains joint loads and restraints for one joint. Cards are required only for joints with nonzero values.

Table 7. Iteration Control

Specifies the number of load increments required for this set of loads, the maximum number of iterations allowed in the frame and member solutions and the maximum allowable errors. A set of loads may be divided into certain number of load increments, if the number of load increments in this table is not equal to zero. The initial values of load applied on the members will be equal to the amount of increment loads. All loads on members have their values increased by equal amount of loads until the number of load increments is equal to the number indicated in the card. For example, if 3 is input as the number of load increments and the amount of concentrated load required on the member is equal to 15. The initial load on a member id equal to 5. With the load increment equal to 5, the second and third loads on a member are 10 and 15, respectively. The equilibrium errors and maximum number of iterations should be specified according to the user requirements. Usually if the load increments are not so large that the members undergo a severe change in stiffness, the solution should be converged in five or ten iterations.

3.4 Output Information

All input data are printed as read by the program. The output of this program is given in Tables 8 and 9.

Table 8. Joint Displacements and Reactions

Gives displacements and reactions for all frame joints. In global coordinates supported joints with spring restraints will have nonzero reactions.

Table 9. Member Results

Member end forces and moments are computed in member coordinate system. The member output lists the axial, lateral and rotational displacements as well as the axial force, shear and bending moment at every station (nodal point) along the member. If the member is a circular curve, the member end forces are transformed to the normal and tangential directions, shown in Figure 21, before printing.

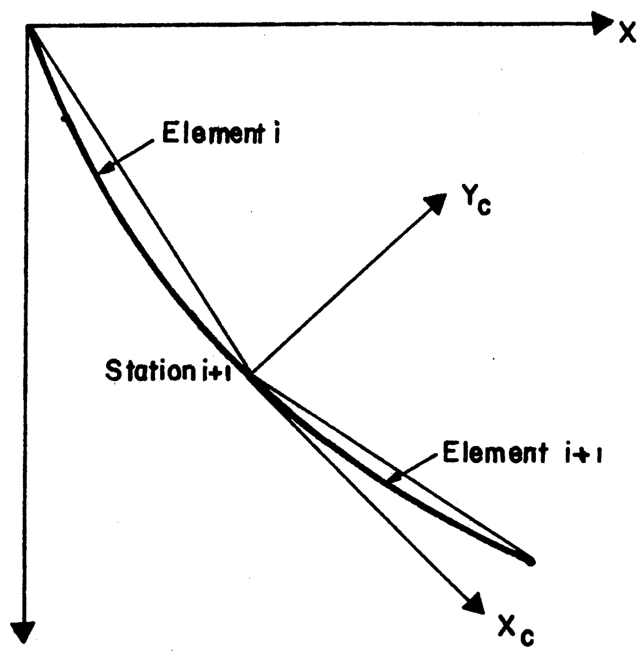


Figure 21. Normal and Tangential Coordinate System for Station i+1

CHAPTER IV

VERIFICATION AND APPLICATION

In order to illustrate the solution capability of the program and demonstrate its use, and also to verify the accuracy of the method of analysis, several problems have been solved. The results of the computer analysis are compared with those obtained by conventional closed form solutions, by methods used by other investigators or by existing experimental results.

In this chapter, some of these problems are described and solutions from the computer program are discussed. Sample coding listings for data input and selected print out sheets for the example problems are presented in Appendix G.

The following problems are discussed here.

1. Beam Solutions:

Example 1.1. This example problem demonstrates the general load-displacement response of a reinforced concrete beam which undergoes material and geometric nonlinearlities.

Example 1.2. Solution of a reinforced concrete circular arch, having an angle of opening of 180 degrees.

Example 1.3. Presents the solution for a slender reinforced concrete comparison member subjected to eccentric load in the plane of the member. The effect of secondary bending due to an axial load acting through member deformation caused by primary moments, is shown in this problem.

2. Frame Solution:

Example 2.1. A single bay, single story reinforced concrete frame is used as a test problem. The frame and loads are symmetric. External restraints are provided to brace the frame.

Example 2.2. The three-story steel frame with an I-section is used as an example problem. The frame and loads are symmetric but not braced against sway. The gravity loads remain constant throughout the test and the horizontal loads are varied.

The results of both problems are compared with experimental data and other analytical solution.

3. Pile Solution:

Example 3.1. Solution of a straight pile with a turbular section driven vertically into a nonhomogeneous soil medium is presented. Lateral load is applied at the pile head.

Example 3.2. A curved pile with the same cross-section properties, length and soil characteristics as the straight pile of example 3.1 is analyzed. Results obtained from the curved piles and straight piles are compared.

4. Pile Supported Frame:

Example 4.1. Solution of a plane frame, supported by long and flexible piles, similar to those in the offshore construction is presented. Loads due to gravity, wind and waves are considered in this problem. The effects of supports, material properties, and change in geometry are considered in this problem.

4.1 Beam Problems

4.1.1 Example 1.1. Reinforced Concrete Beam

A reinforced concrete beam with the cross section shown in Figure 22(a) was solved to demonstrate the nonlinear ability of the analysis. The beam is supported by hinges at both ends. Two concentrated loads are applied symmetrically at 36 in. from midspan, as shown in Figure 22(b). The nonlinear behavior of materials, expressed by the stress-strain curves of concrete and steel, is shown in Figures 22(c) and 22(d). The tensile strength of the concrete is ignored. The beam is divided into 30 elements.

The closed form solution of the beam is obtained as follows: the reinforcement ratio of the beam (ρ) is equal to $\rho = A_s/bd = 0.1875$. The reinforcement ratio that produces a balanced condition (ρ_b) can be shown to be $\rho_b = 0.04$. Since ρ is less than ρ_b, beam failure will be initiated by yielding of the steel. The ultimate moment is given by

$$M_u = A_s f_y \left(d - \frac{a}{2}\right) \tag{4.1}$$

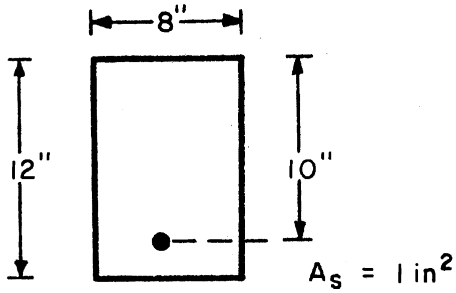
in which M_u = ultimate moment, A_s = steel area, f_y = yield stress of the steel, d = distance from the top fiber to the centroid of steel, and a = depth of the equivalent rectangular stress block. Hence,

$$M_u = 1.0 \times 47.0 \left(10 - \frac{47}{0.85x4x8x2}\right) = 429.4^{k\text{-}in.}$$

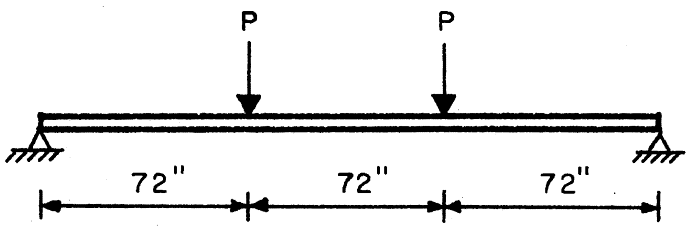
The maximum force on the beam is

$$P_{max} = M_u/72 = 5.96 \text{ kips.}$$

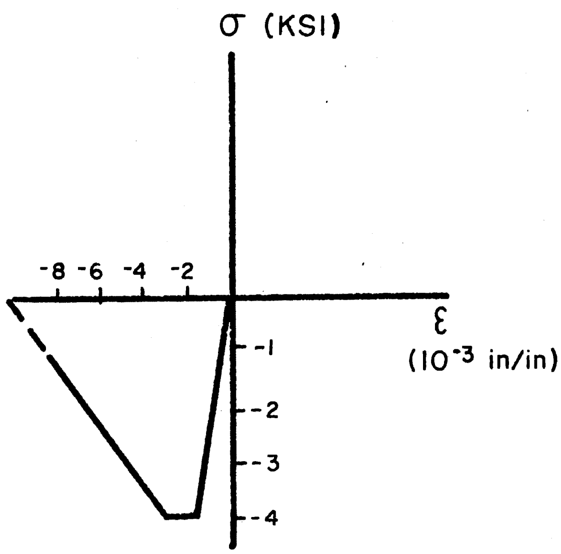
By assuming that the curvature is always equal to M/EI, the deflection of the beam can be shown to be



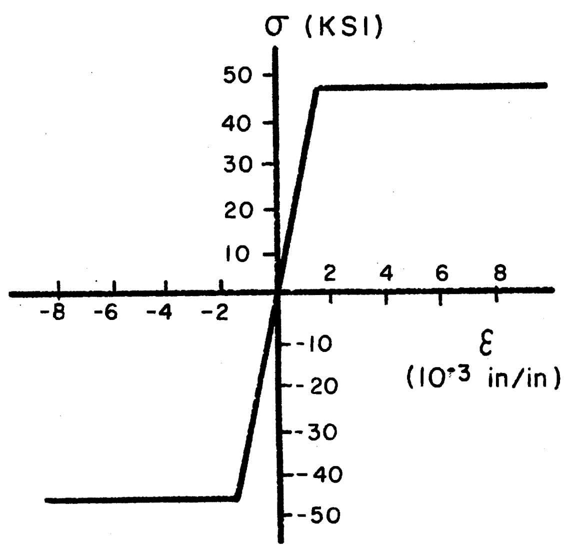
(a) Beam Cross Section



(b) Two-Hinged Reinforced Concrete Beam



(c) Concrete Stress-Strain Curve



(d) Steel Stress-Strain Curve

Figure 22. Reinforced Concrete Beam

$$\Delta = \frac{23}{648} \frac{PL^3}{EI} \tag{4.2}$$

where Δ = deflection at midspan, P = applied concentrated load, L = span length, EI = flexural rigidity of the beam. In this example problem, the moment of inertia of the cracked section, with no tension in concrete, is used for the determination of the deflection. The value of flexural rigidity (EI) of the cracked cross section is 1.53436×10^6 k-in^2.

The load-displacement curve, from Equation (4.2), is shown as a straight line in Figure 23 along with the results of the finite element solution. Good agreement is obtained within the elastic range. Due to the nonlinear behavior of material, the two curves diverge for loads greater than 5.64 kips. The considerable change of slope at the end of the curve may possibly be due to yielding of the steel. The solution failed to converge at a load of 6.3. Hence, a maximum load of 6.2 was indicated by the finite element analysis. A higher load is obtained due to the effect of tensile force in the beam. These forces created secondary bending moments which tend to reduce the deflections of the beam. The maximum moments obtained from this analysis is 430 k-in. which agrees with the closed form solution. The load-moment curve for various load levels is shown in Figure 24.

4.1.2 Example 1.2. Reinforced Concrete Circular Arch

For this problem, a two-hinged circular arch with an angle of opening of 180 degrees, as shown in Figure 25(a), is considered. A

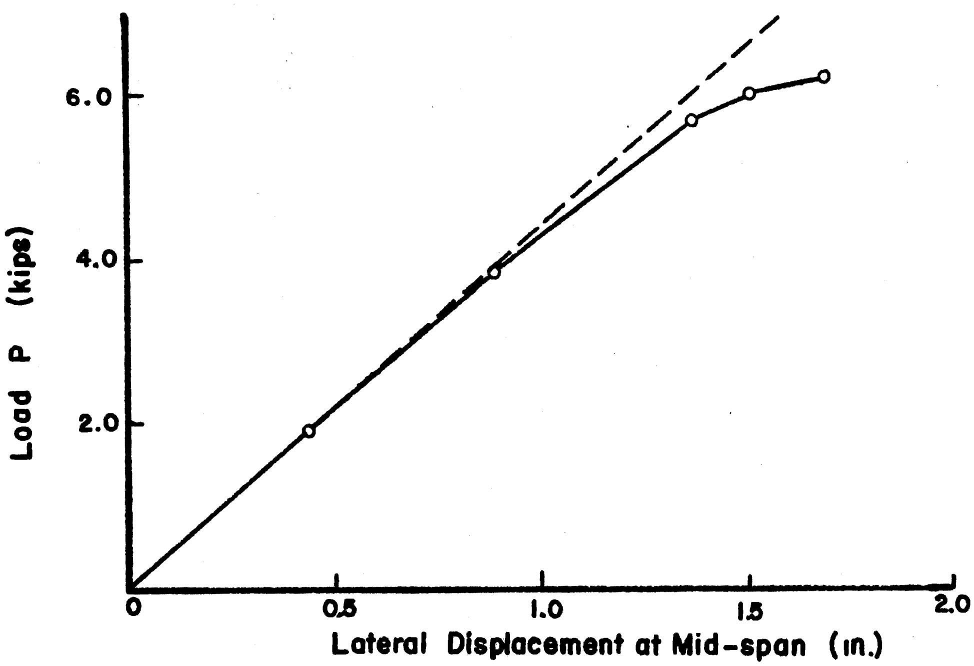


Figure 23. Load-Displacement Curve for the Beam

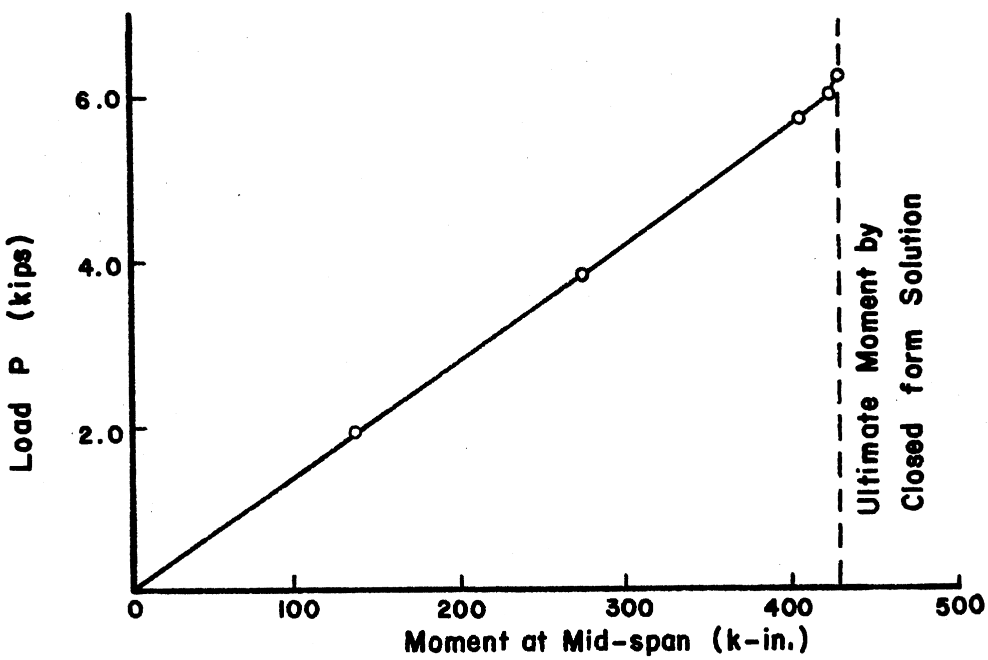
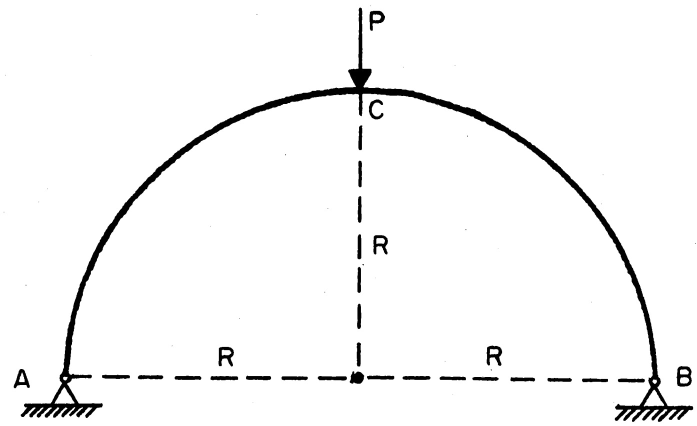
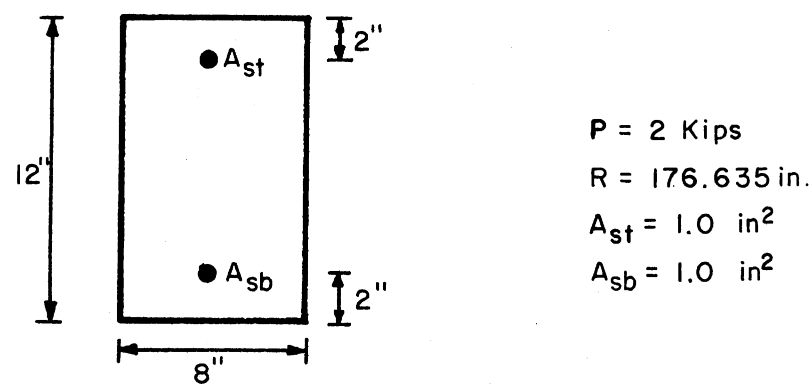


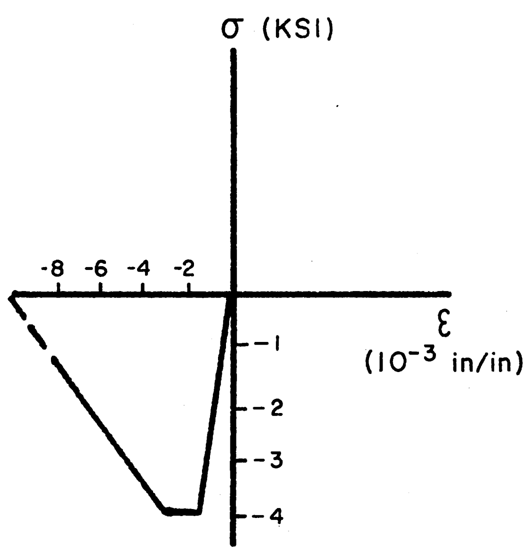
Figure 24. Moment Study for the Beam



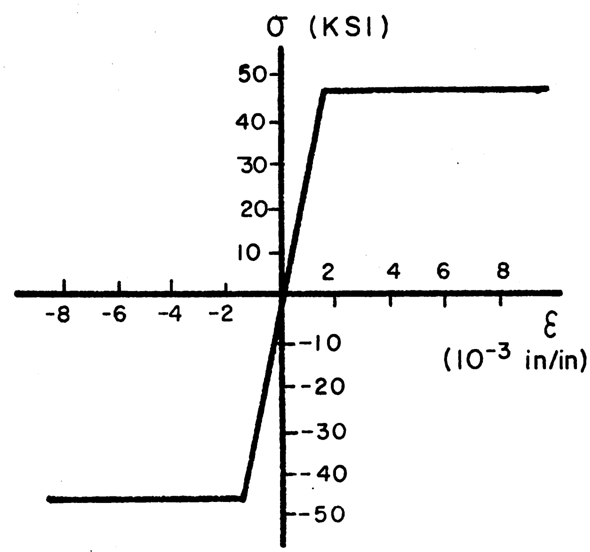
(a) Two-Hinged Circular Arch



(b) Cross Section and Problem Data



(c) Concrete Stress-Strain Curve



(d) Steel Stress-Strain Curve

Figure 25. A Two-Hinged Circular Arch of Reinforced Concrete

central concentrated load P = 2.0 kips is applied at the crown in the downward direction. The arch has a constant cross section of reinforced concrete with top and bottom reinforcement, as shown in Figure 25(b). Stress-strain curves for concrete and steel are given in Figures 25(c) and 25(d), respectively.

The solutions obtained by the program developed herein, Guimaraes' solution (16) and a closed form method are tabulated in Table I. It is observed that the moment at the crown, horizontal and vertical reactions obtained from this program, Guimaraes' solution, and the closed form solution are in good agreement. If the flexural stiffness (EI) for the cracked transformed section (tensile strength of concrete is neglected) is used, the vertical displacement at the crown is approximately three times that for the uncracked section.

4.1.3 Example 1.3. Reinforced Concrete Column

A reinforced concrete column bent in symmetrical single curvature with no transverse loads is studied in this example. The column is shown in Figure 26. An eccentric axial load is applied at 0.75 in. from the centroid of the column. Hognestad's stress-strain curve (21) for the concrete in compression, shown in Figure 27, is used in this analysis. The strength f_c' is taken as 4.79 ksi and the corresponding modulus of elasticity of the concrete is 3780 ksi. The value of ε_0 corresponding to the modulus is 0.00215 in./in. The reinforcing steel is assumed to have a modulus of elasticity of 30,000 ksi and a yield stress of 45 ksi. The column is divided into 20 equal length elements and is analyzed for several values of load.

TABLE I

COMPARISON OF RESULTS

Quantity	Closed Form Solution	Guimaraes (14) Solution	This Report Solution
Horizontal Reaction (k)	0.6360	0.6360	0.637
Vertical Reaction (k)	1.0000	1.0000	1.000
Moment at Crown (k-in.)	64.1860	64.1960	64.000
Deflection at Crown (in.)	-0.0418	-0.0426	-0.042 (-0.121)*

*Tensile strength of concrete neglected.

Horizontal reaction $H = -P/\pi$

Vertical reaction $V = -P/2$

Moment at crown $M = (V-H)R$

Vertical displacement at crown $V_c = \frac{PR^3}{8EI} \frac{3\pi^3 = 8\pi - 4}{\pi}$

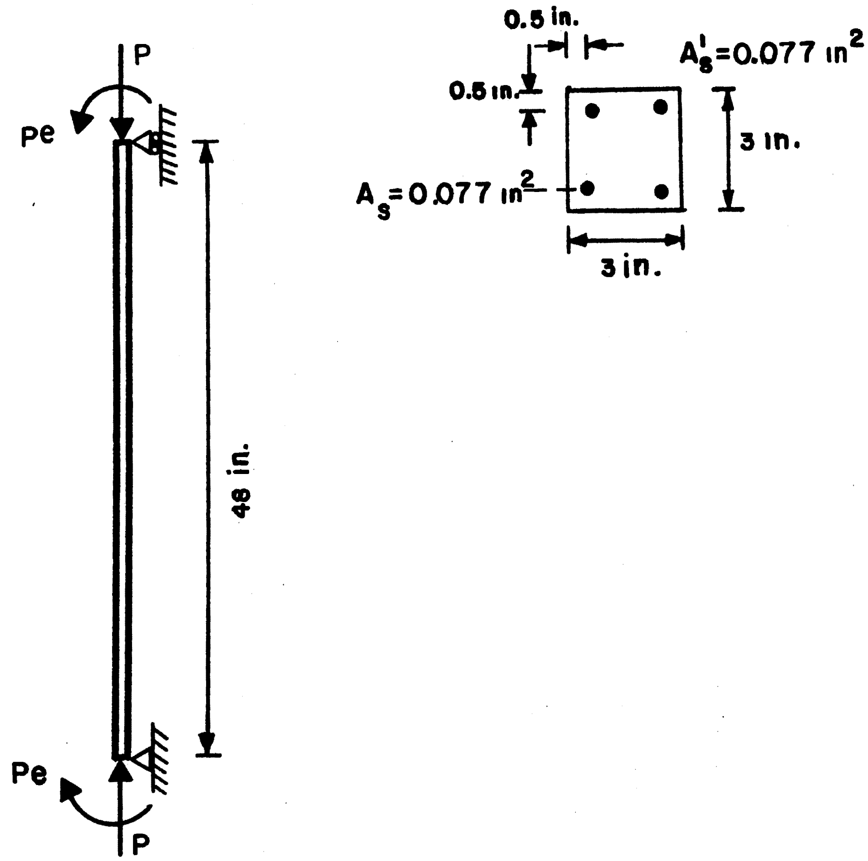


Figure 26. Reinforced Concrete Column

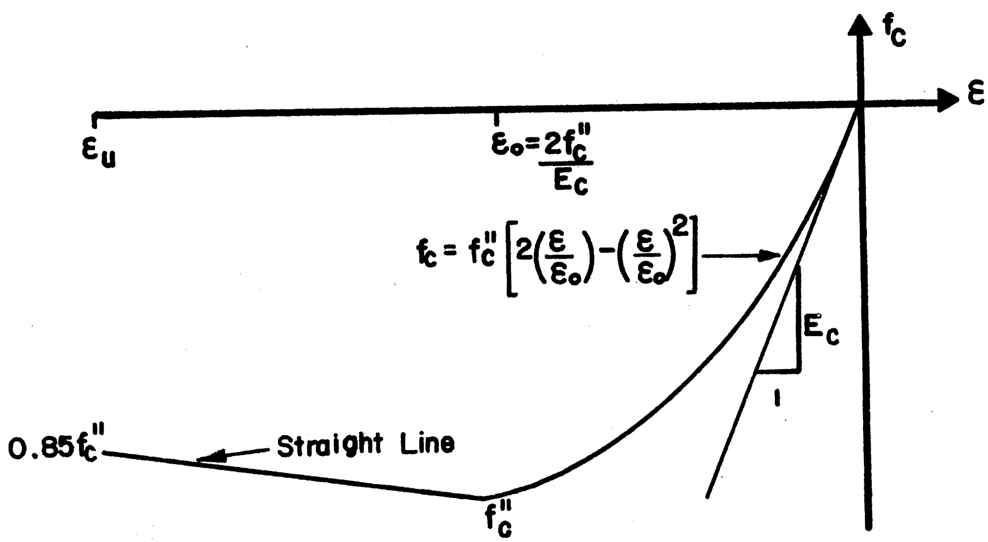


Figure 27. Hognestad's Compressive Stress-Strain Curve

An experimental investigation of the behavior of slender, square, pin-ended reinforced concrete column under short-term static loading has been conducted by Goyal and Jackson (15). They also developed an incremental method of analysis based on static equilibrium conditions of the section which can be expressed in terms of strain, section dimensions and material properties. They predicted a maximum load of 14.7 kip which is very close to the value 14.5 obtained experimentally.

Colville (4) considered the effect of tension cracking, nonlinearity of concrete and geometric nonlinearity, and performed a finite element analysis for a reinforced concrete column. However, he failed to consider the yield of steel. The result obtained from his analysis is therefore close to the experimental value up to 75 percent of the ultimate load.

ACI (1,2) presents the approximate design equations based on an approach in which the design moments are set equal to the moment obtained from conventional analysis magnified by a factor δ. The ACI values shown in Figure 28, are obtained in accordance with Clause 10.11.5, the flexural rigidity EI being defined by equation 10.7 of that Clause (1,2). The maximum load predicted by ACI is 16.4 kips. A comparison of results between the finite element analysis and the ACI equation is shown in Figure 28. It is seen that good agreement is obtained. The moment at the middle of the column does not increase linearly with applied load due to the decrease of column stiffness caused by increasing axial thrust.

The load-displacement curves of the column obtained from the finite element analysis, Colville's analysis (4), Goyal and Jackson's analysis (15), and test data are shown in Figure 29. It is observed that, the

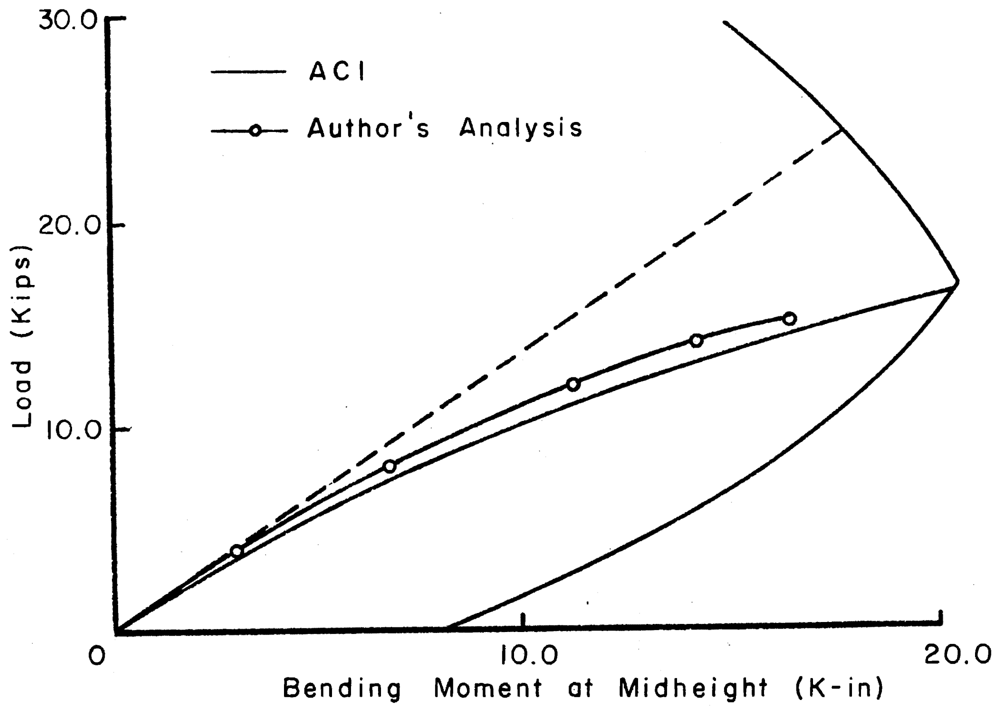


Figure 28. Load Moment Variation at Midheight

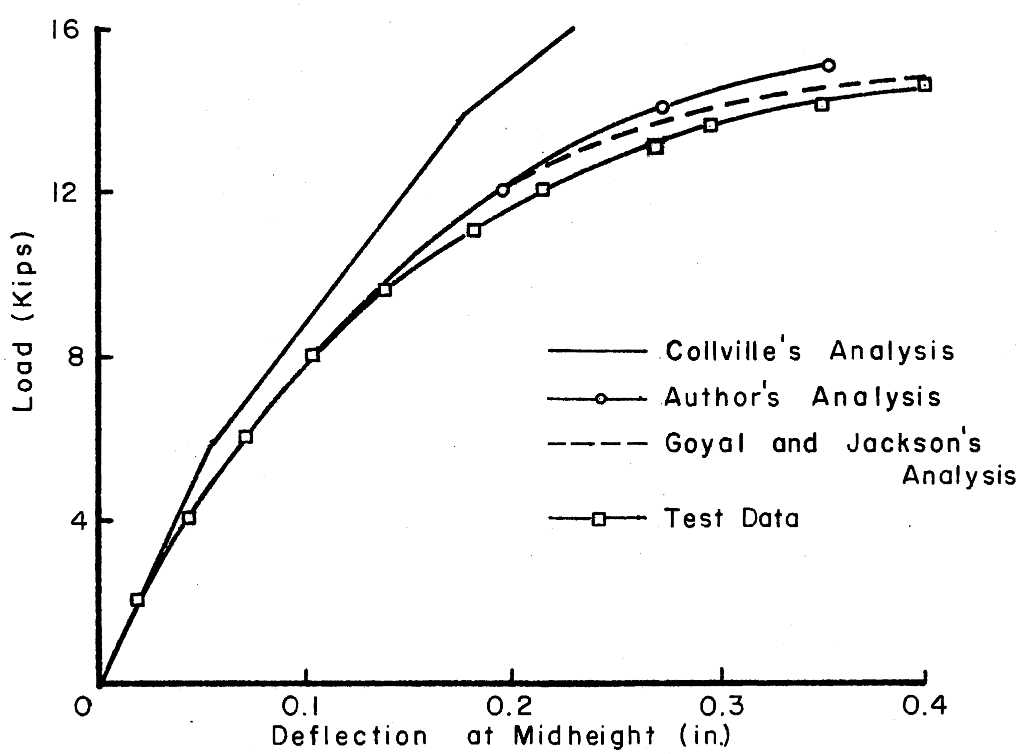


Figure 29. Load Deflection at Midheight

result obtained from this program and that of Goyal and Jackson (15) both agreed with experimental results. Failure occurred in the column at a thrust of 14.5 kips. This was below the load of 15.0 predicted by the author and 14.7 predicted by Goyal and Jackson (15). The finite element solution considers the effect of large displacement and thus, a load slightly in excess of maximum load calculated by Goyal and Jackson is obtained. The slightly higher load is also due to the fact that the mathematical expression for M-ϕ-T curves used in this analysis does not perfectly fit the actual M-ϕ-T curve.

4.2 Frame Problems

4.2.1 Example 2.1. Reinforced Concrete Frame With Columns in Single Curvature

Tests on a series of rectangular reinforced concrete frames were conducted by Furlong (29). The loads were applied so that the columns bent in symmetric single curvature. Frame F_2 of the test series was selected to verify the proposed nonlinear analysis. Results from the finite element method developed herein are compared with the discrete element solution conducted by Hays and Matlock (20), Gunnin's analysis (17), and Furlong's (9) analysis. Frame F_2 is loaded as shown in Figure 30. The beam load P and the column load P are increased proportionally to failure of the frame. The dimensions of the frame and cross sections of the members are given in Figure 30. The stress-strain relationship for the reinforcement in tension and compression is shown in Figure 31. The concrete is assumed to have no tensile strength and the stress-strain relationship developed by Hognestad for concrete in compression, as shown in Figure 32, is used in this analysis.

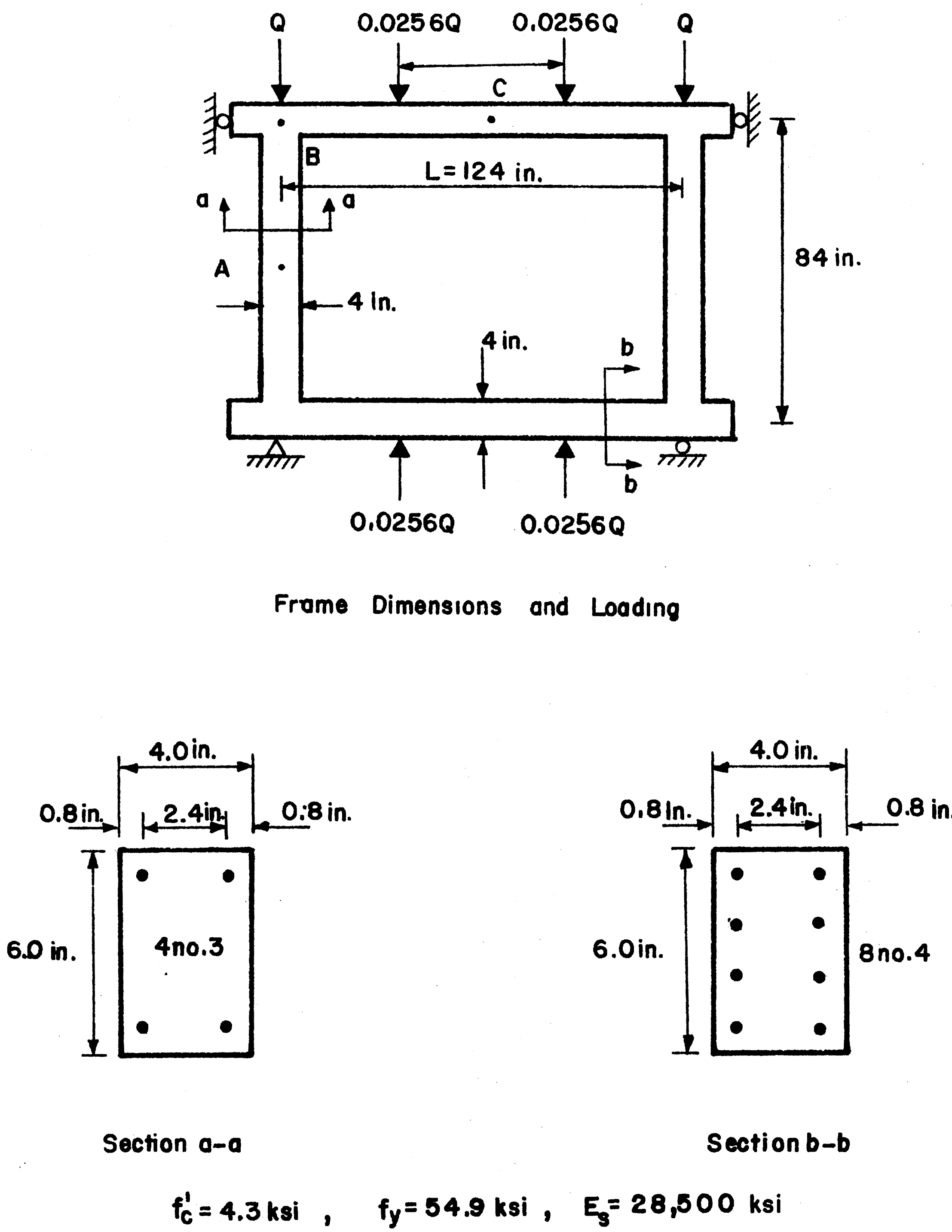


Figure 30. Concrete Frames in Single Curvature

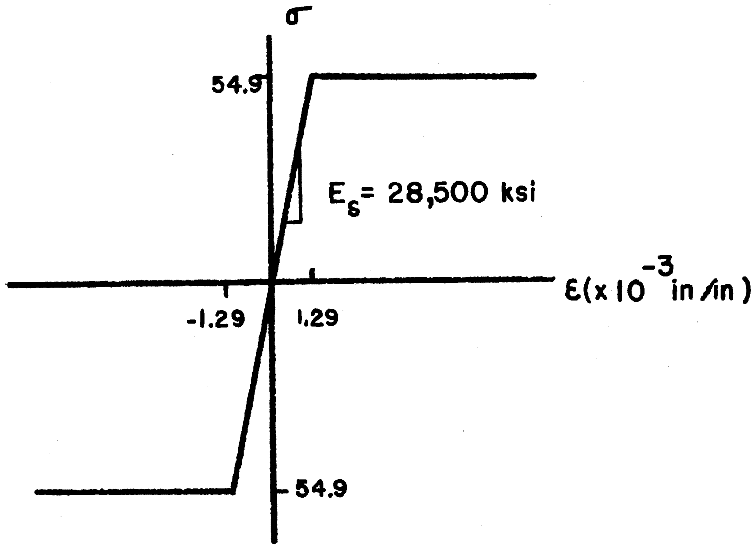


Figure 31. Stress-Strain Curve for Steel

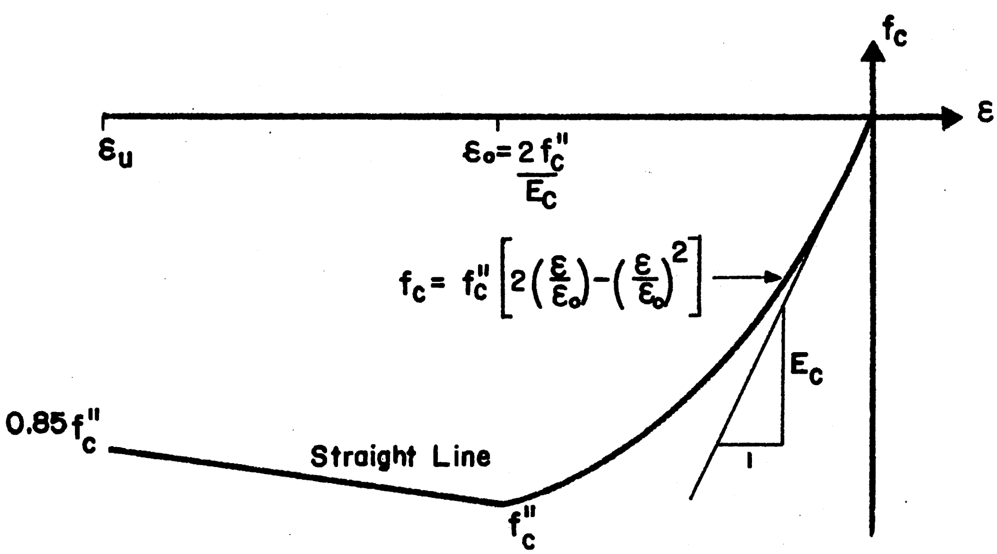


Figure 32. Hognestad's Compressive Stress-Strain Curve of Concrete

The collapse of frame F_2 predicted by Furlong is approximately 71.5 kips. Hays used the discrete element analysis and predicted the maximum load of 76.8 kips for the same frame. The last load at which convergence is attained by Gunnin's analysis is 64.6 kips. This is very close to 61.6 which is the failure load for frame F_2. However, he stated that the maximum load obtained does not correspond directly to the collapse of the frame since the interaction diagram has not been intersected. The failure load given by the procedure developed herein is 70 kips which is in better agreement with the experimental results than other approaches.

The load-moment plots from this analysis, Hays' analysis, and the test data are shown in Figure 33 for frame F_2. It can be seen from the result of this analysis that failure occurred in the column when the maximum moment at the middle of the column intersected the interaction diagram. This indicates that failure occurred by crushing of the concrete. The moments obtained from this analysis and discrete element analysis agree well with the test data although both of them are consistently lower than the test results.

The moment diagram for one-quarter of the frame is plotted on the tension side for two different load levels in Figure 34. Moment at the mid-span of the beam and at the corner of the frame obtained by this analysis are slightly higher than those obtained by Hays' analysis. This may be due to the error in the use of equations used in the discrete element model to describe the actual beam behavior. The difference in moments may also be due to the fact that moments obtained by the finite element procedure occurred exactly at the end of the element while the moment at the discrete rotational spring which is located at

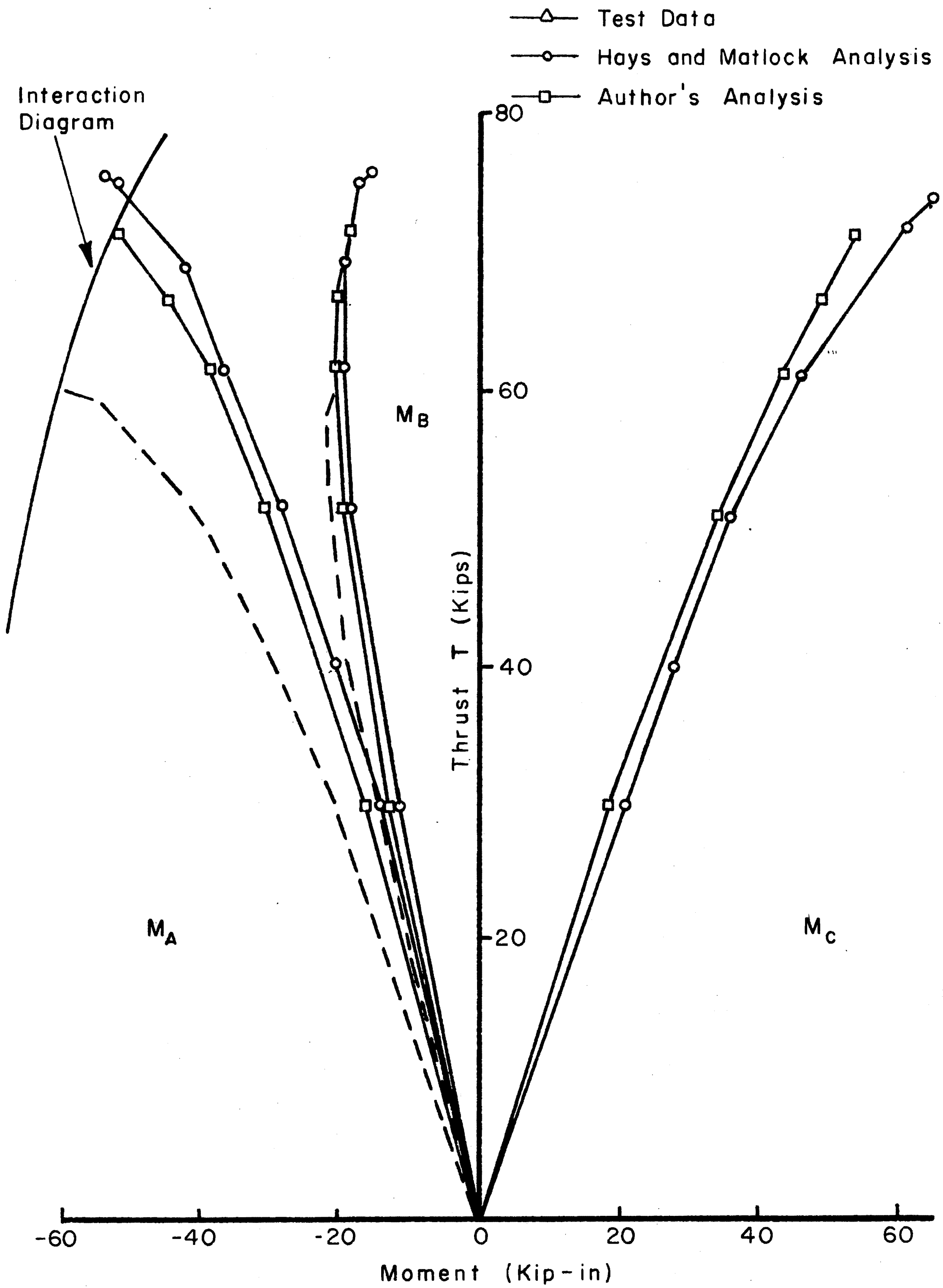


Figure 33. Load-Moment Variations at Corners and Centerlines

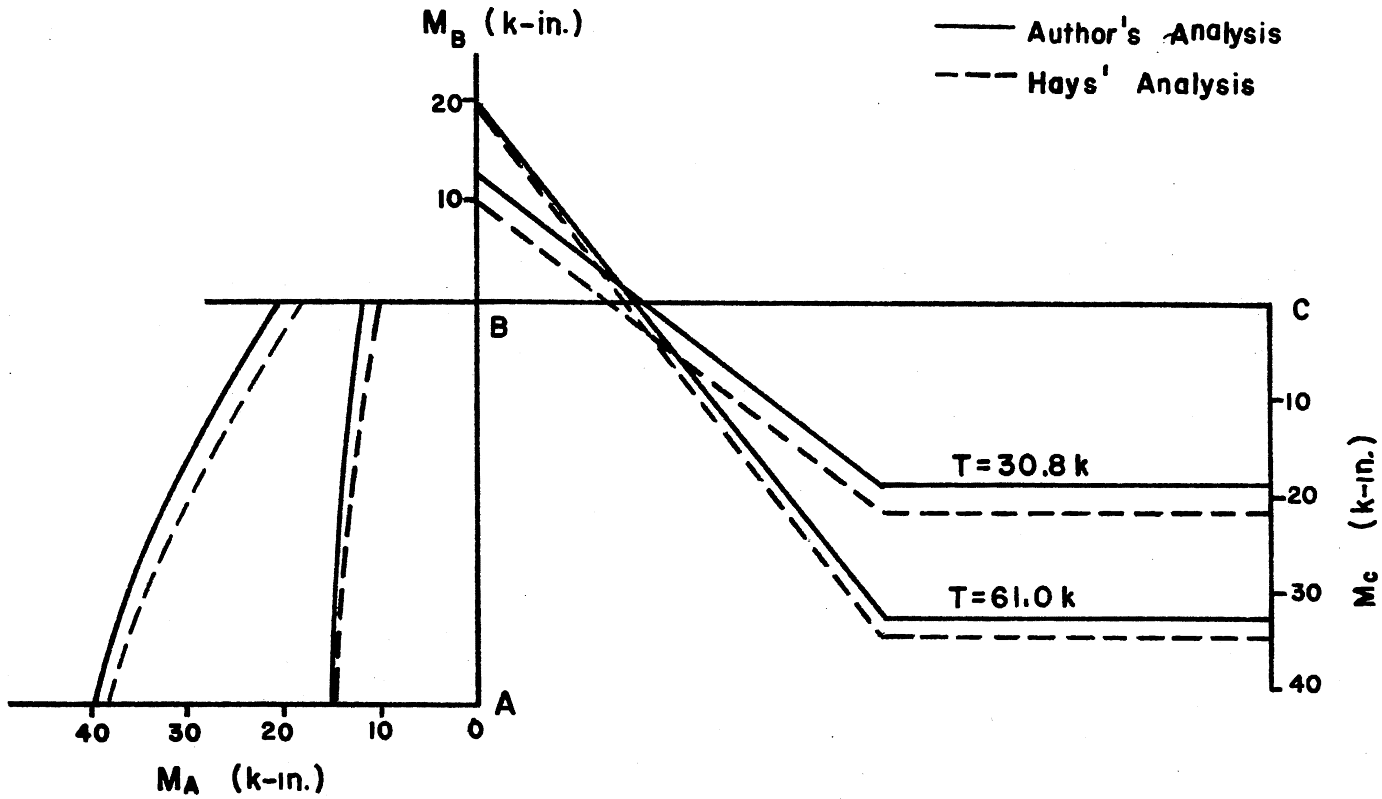


Figure 34. Moment Diagram for Quarter Frame at Various Load Levels

some distance from the end of the element is evaluated in the discrete model.

The deflections at mid-height of the two columns of frame F_2 are plotted against column load in Figure 35. The response predicted by the proposed analysis is closer to the test data than the result of the discrete element analysis.

From a review of this comparison for frame F_2, it would appear that the finite element procedure developed herein gives results that are in better agreement with the experimental results than either Hays' or Gunnin's analysis.

4.2.2 Example 2.2. Three Story Steel Frame

The results of a test of the three-story steel frame, experimented by Yarimci are shown in Hays' report (20), are shown in Figure 36. The 10WF25 beams and 5M18.9 column are made of A36 steel with a yield stress of 36 ksi and a modulus of elasticity of 29,500 ksi. The horizontal loads are increased until failure occurred.

Plots of applied horizontal load versus the horizontal deflection of the first story are shown in Figure 37. It is seen that good agreement is obtained between the proposed analysis and the test data. Results obtained from Hays' analysis are slightly higher due to errors in the equations used in the discrete element model to describe the actual beam behavior. The experimental value of the load parameter at instability is 1.62 kips, and the indicated collapse load is 1.60 kips using the proposed analysis and 1.65 kips using the discrete element analysis (20).

The relationship between the applied horizontal load parameter and the moments at the tops and bottoms of the ground floor columns

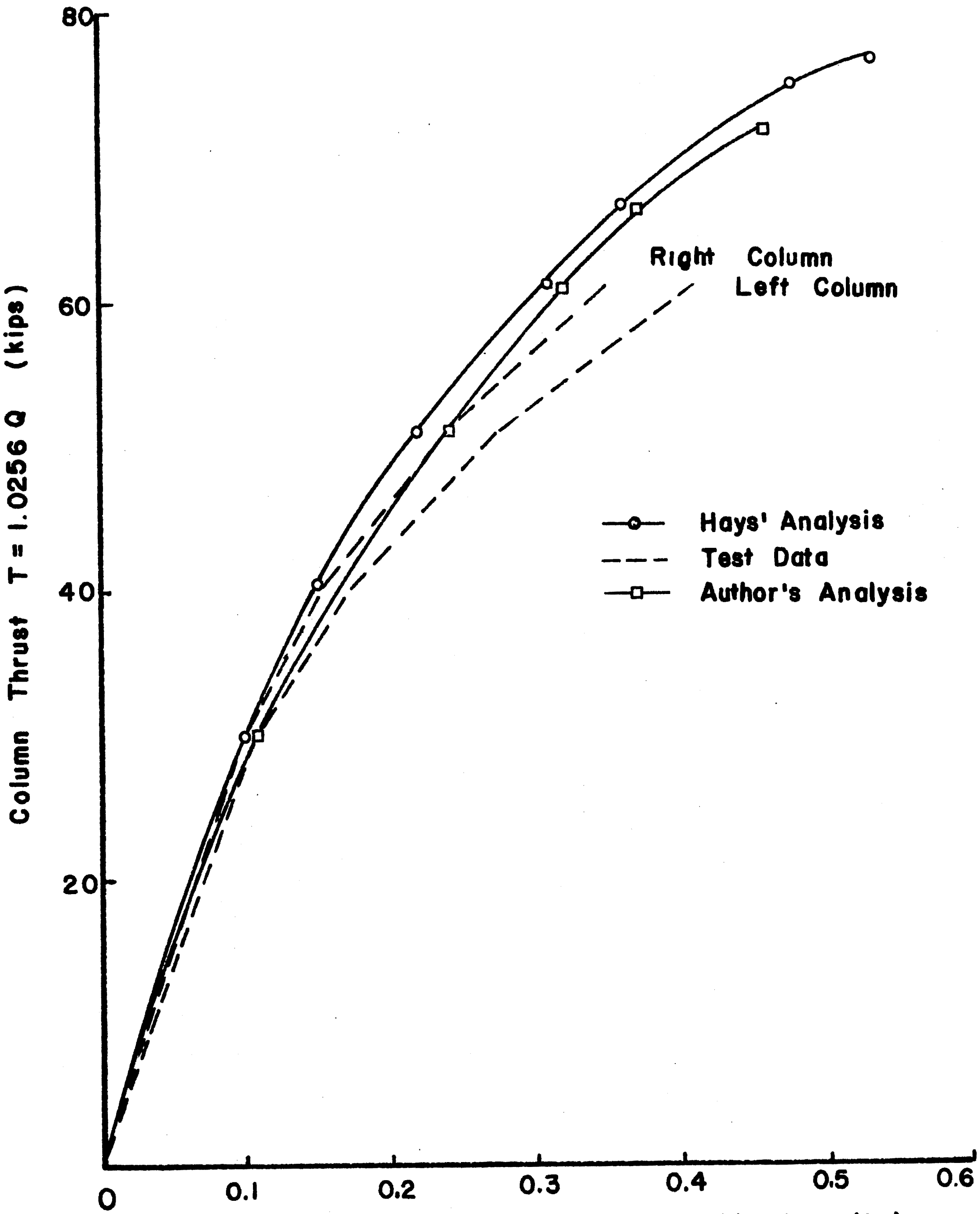


Figure 35. Load-Displacement Curves for Concrete Frames

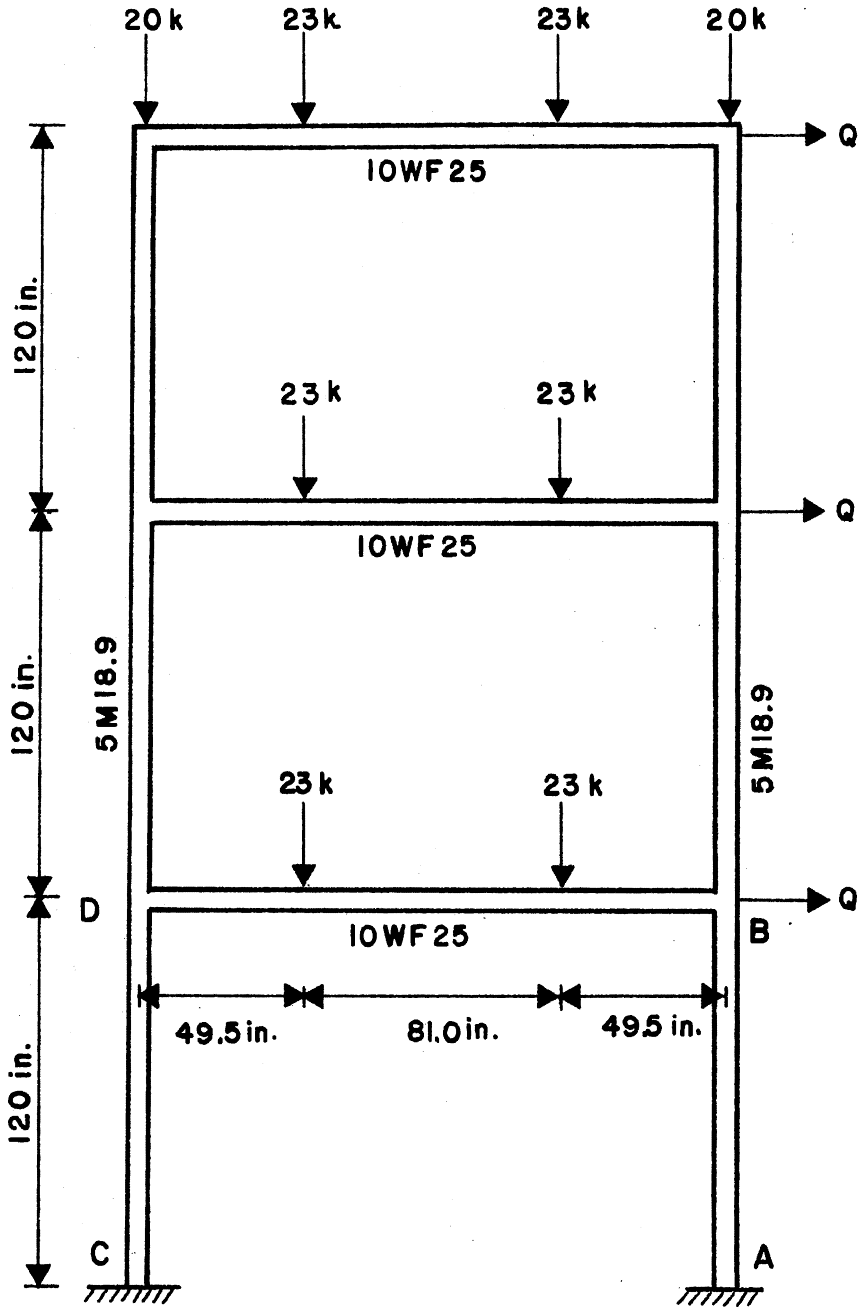


Figure 36. Three-Story Steel Frame Geometry and Loading

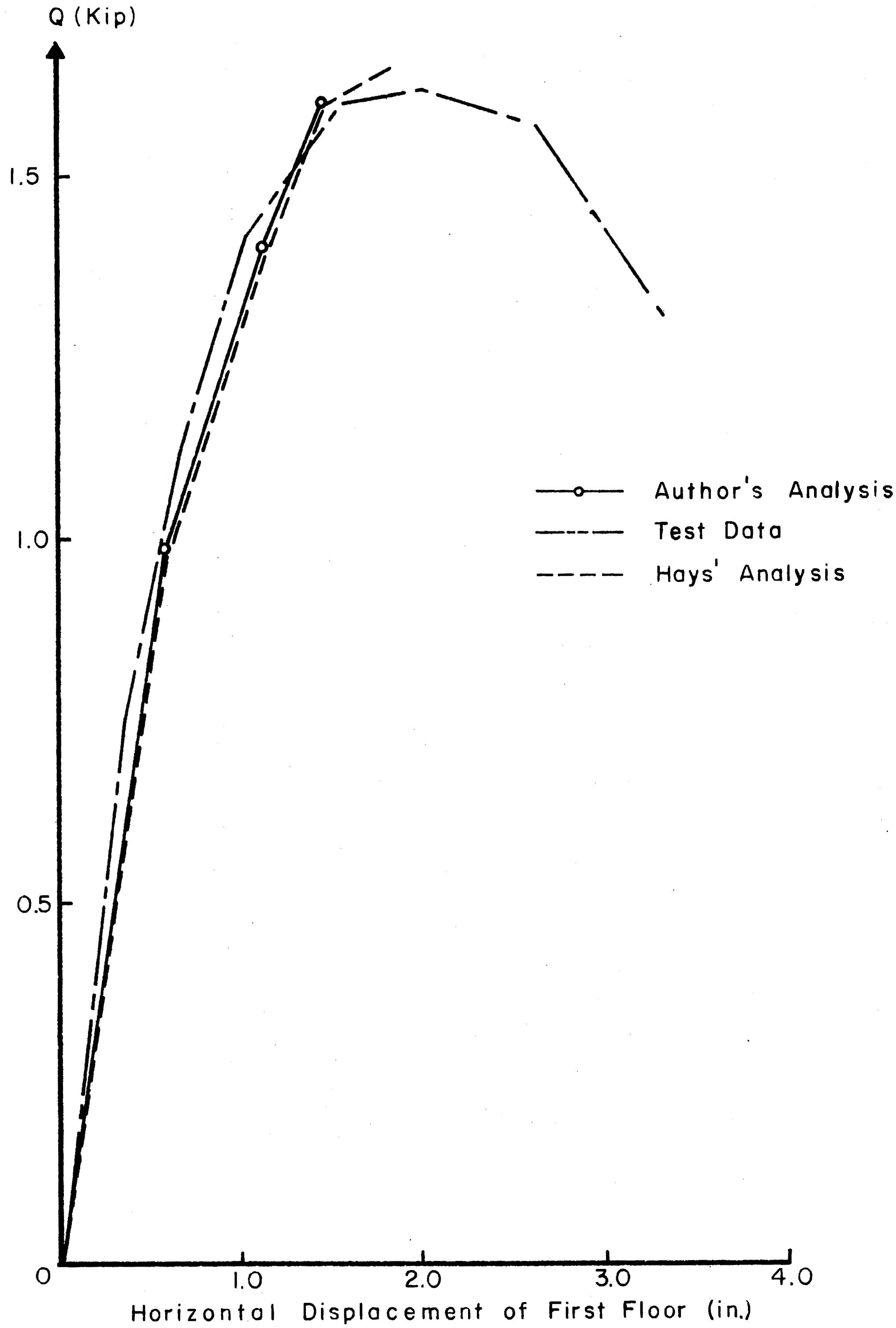


Figure 37. Comparison of Test Results and Theory of Three Story Frame

is shown in Figure 38. The column moments obtained from the finite element analysis are in general agreement with the discrete element solution, and both agreed with the test results.

It could be observed from the finite element solution that the stresses near the joints of all columns are at yield stress before the horizontal load is applied. Hence, inelastic unloading probably occurred in the columns during testing. No provision has been made in the analysis described herein for effects of inelastic reversal of strains. However, the generally good agreement between analytical and experimental results indicate that this effect was small.

4.3 Pile Problems

4.3.1 Example 3.1. Laterally Loaded Pile

This example, shown in Figure 39, is a laterally loaded pipe pile, 12.75 in. in diameter and 80 ft long, embedded in soft clay. The thickness of the wall if 0.5 in. The pile is composed of steel with a yield stress of 40 ksi and a modulus of elasticity of 30,000 ksi. The soil has a uniform shear strength of 300 psf from the surface to a depth of 10 ft, and a linear variation of shear strength from there to the 80 ft depth.

The results obtained from the proposed analysis are compared with those obtained from Moore's analysis (35). Plots of deflections and bending moments for a load of 12 kips are shown in Figures 40 and 41. It can be seen that most of the flexural effects have died out at less than half of the depth of the pile. Both Moore and the author used Matlock's criteria (31) for establishing the lateral q-w curve and Coyle's and Reese's criteria (5) for developing the axial q-w curve.

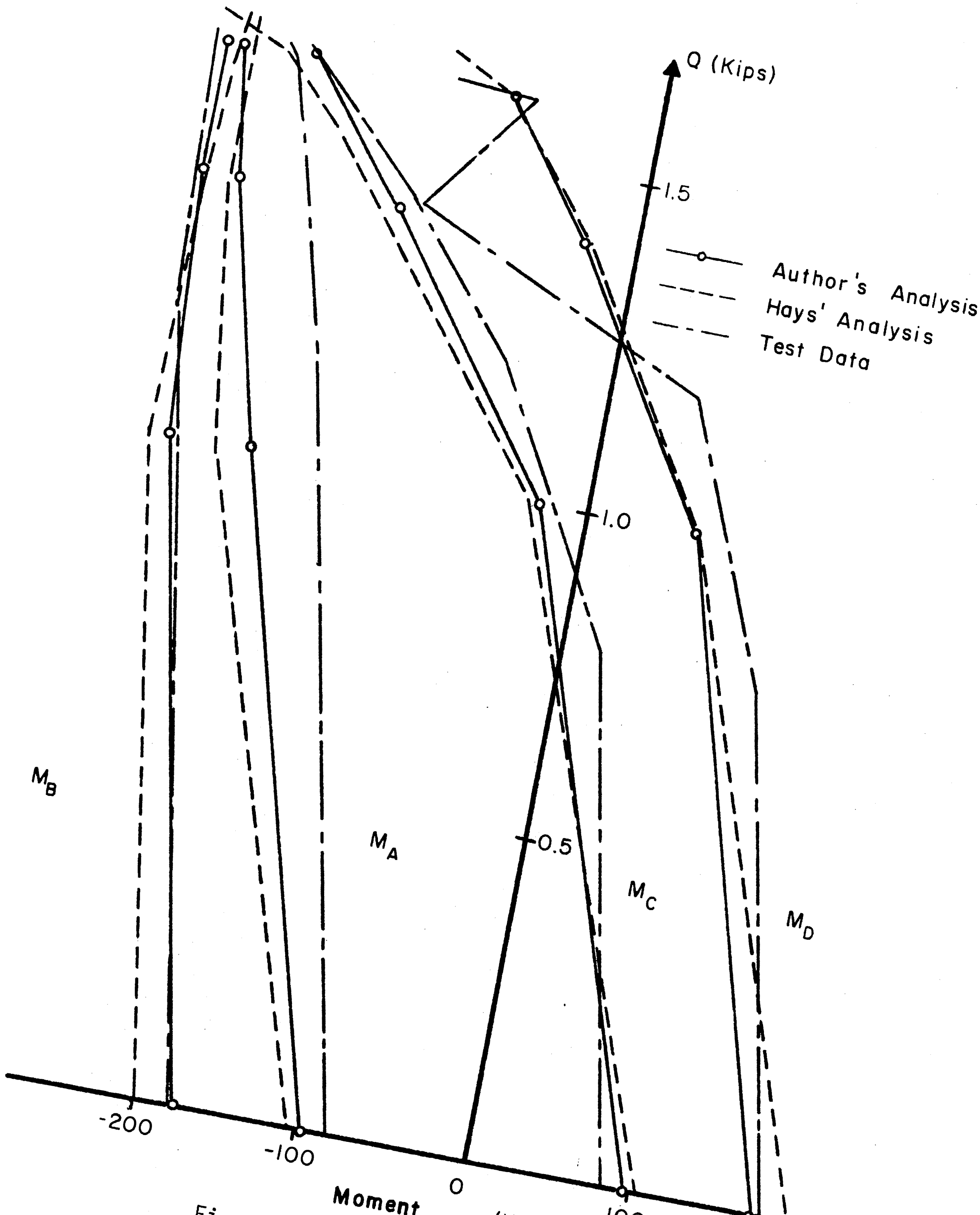


Figure 38. Load-Moment Variation

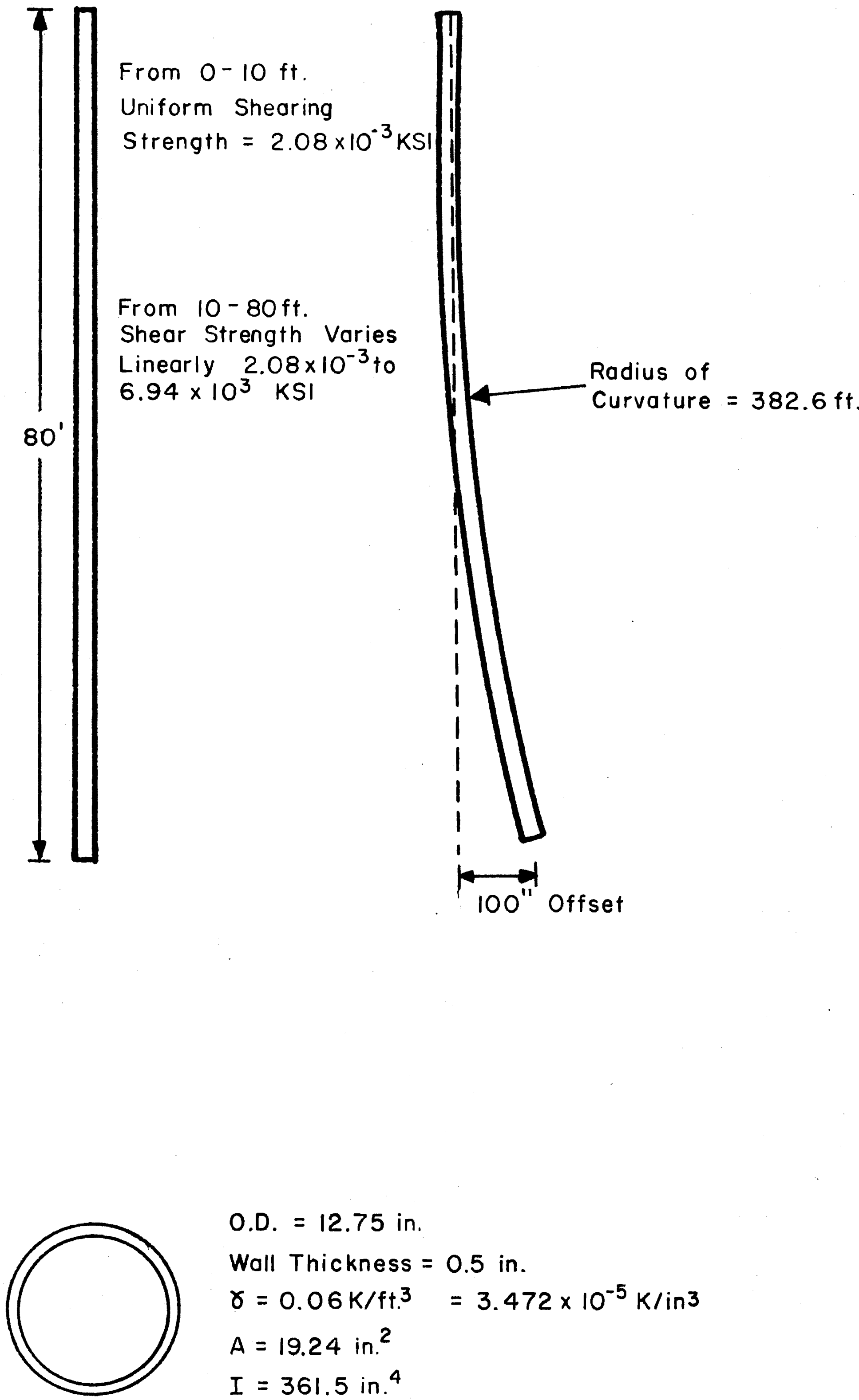


Figure 39. Straight and Curved Piles

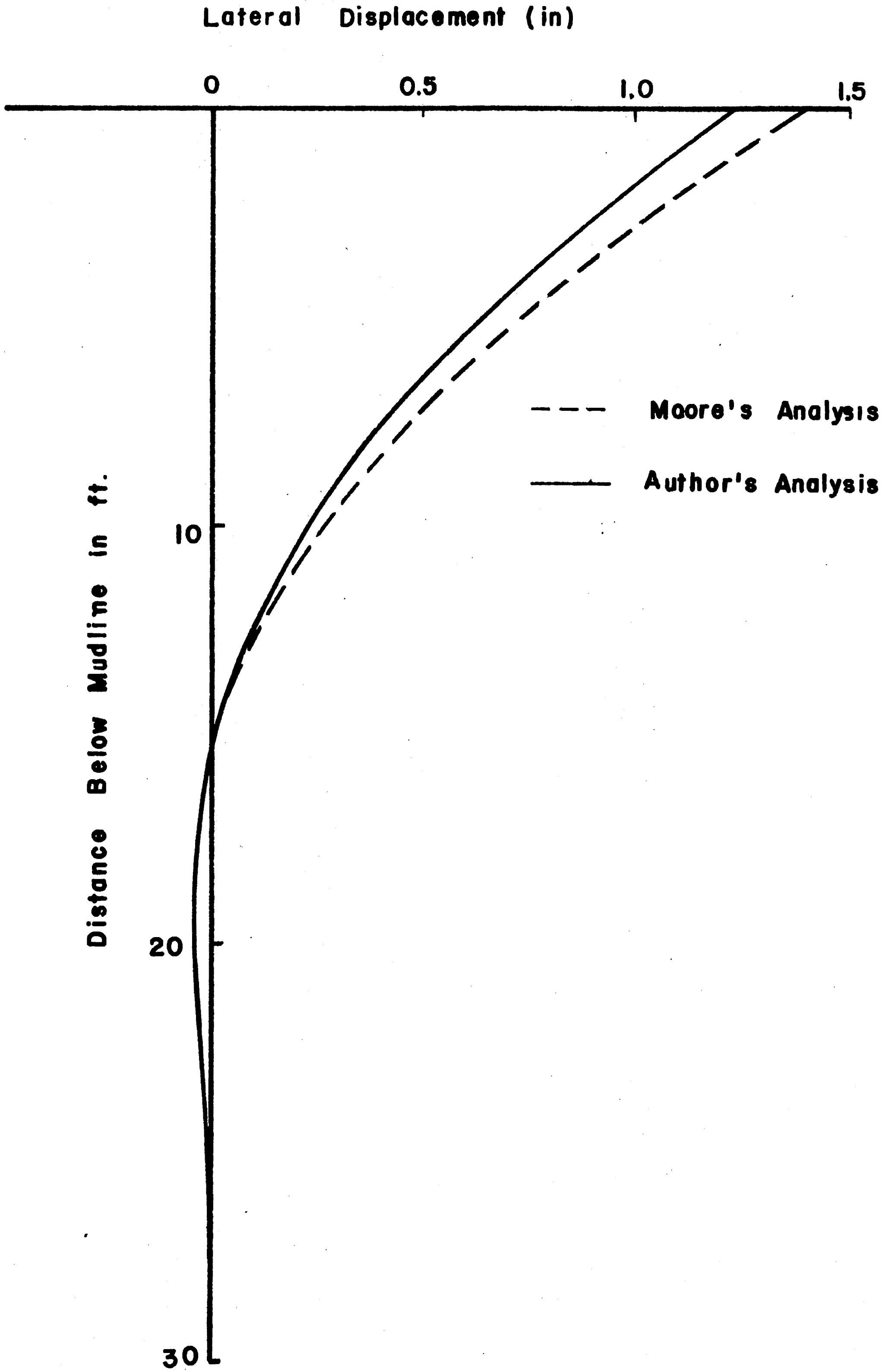


Figure 40. Pile Deflected Curve

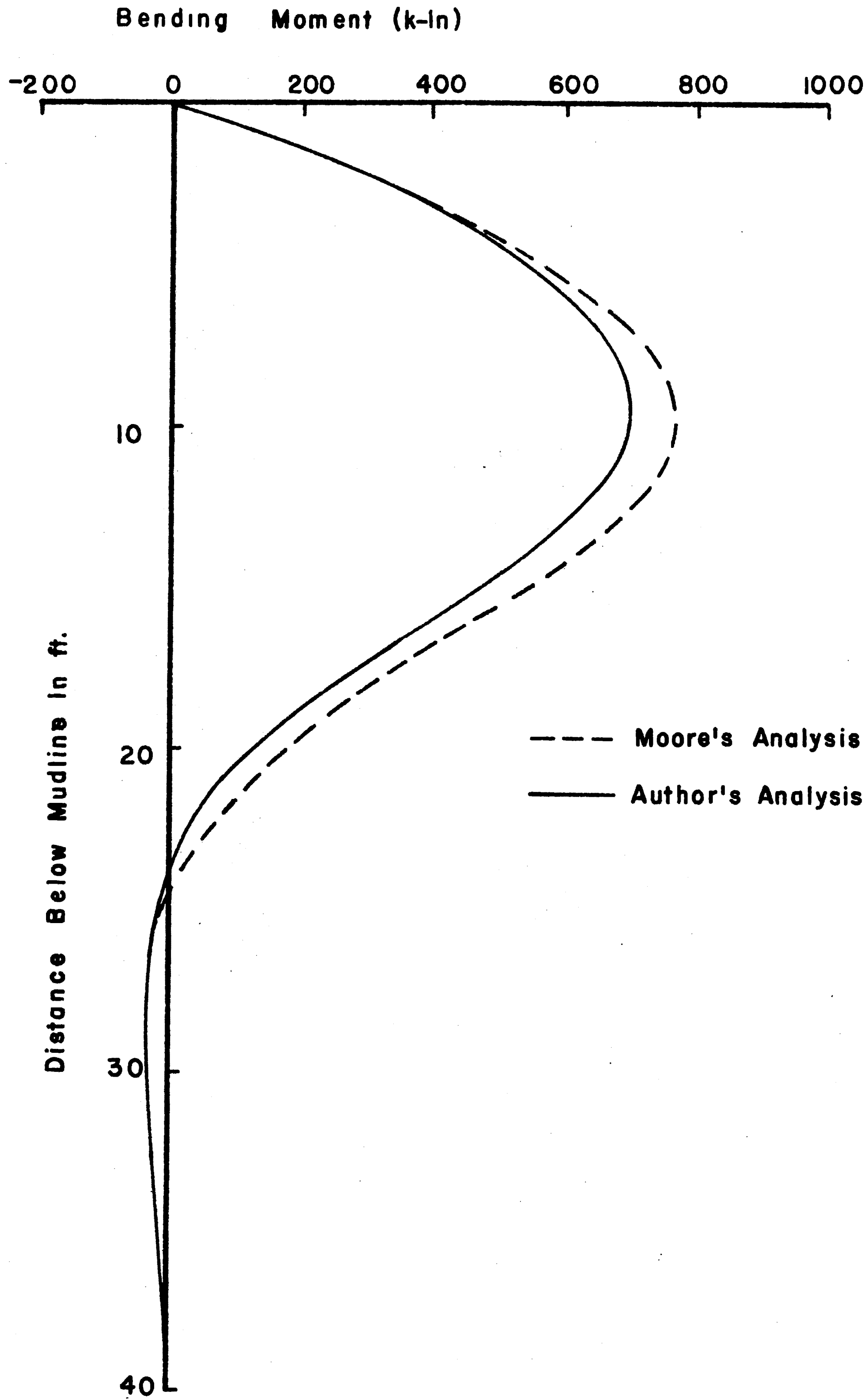


Figure 41. Bending Moment Diagram for the Pile

However, the results obtained from this analysis are slightly lower than Moore's. This is due to the fact that Moore used a series of straight line segments to express the q-w curves while the previously described mathematical expression has been used in this analysis. Therefore, the soil resisting force, corresponding to the displacement at any point, obtained from this analysis is higher than that obtained from Moore's analysis. Another factor that causes the difference in the solutions is that the ultimate soil resistance generated by this program is higher than that used by Moore in his analysis.

In order to determine the maximum capacity of piles subjected to lateral load, problems were run for loads equal to 12, 21, 25, 29, and 30 kips. The solution converged for all values of load except at 30 kips. From the load-displacement curve shown in Figure 42, it appears that the maximum value of lateral load has nearly been reached. The extreme flatness of the curves and the large joint displacements indicate the maximum useful load on the structure has indeed been reached.

The variation in maximum moment in the pile is plotted in Figure 43 versus lateral load. The nonlinearity of the curves is obvious. The curve indicates that the load required to yield the pile is 27 kips.

Lateral deflections and bending moments for the pile at loads of 12 kips and 29 kips are shown in Figures 44 and 45, respectively. The depth to which the soil is fully yielded laterally is seen to be approximately 10 ft. Zones of yielding in the pile are shown in Figure 45. The computer output for the pile at various loads is given in Appendix G.

4.3.2 Example 3.2. Curved Pile

Effects of curvature on the pile were examined for 100 in. offset

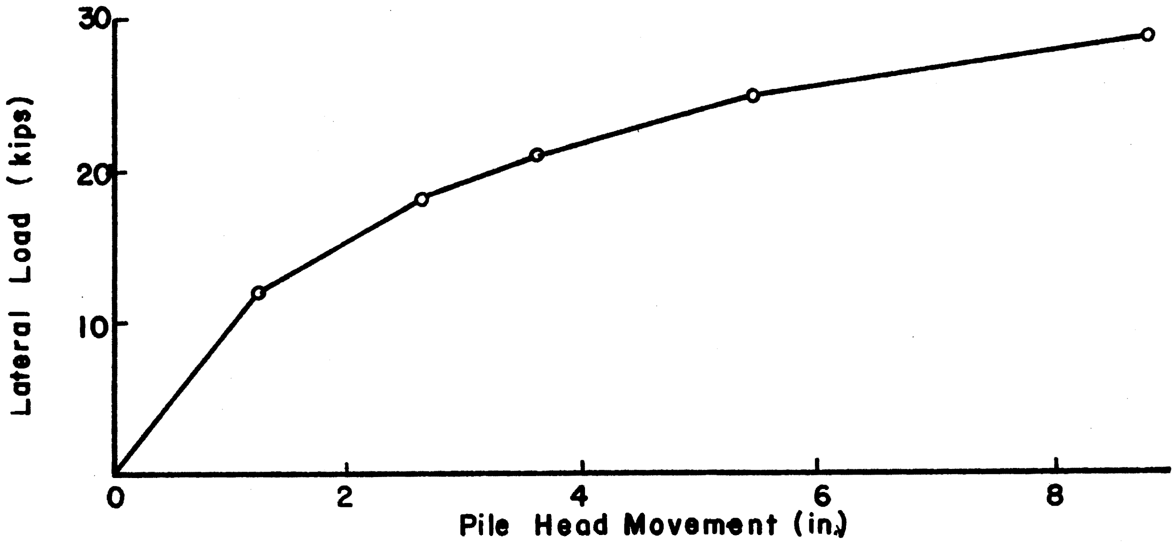


Figure 42. Load-Displacement Curve

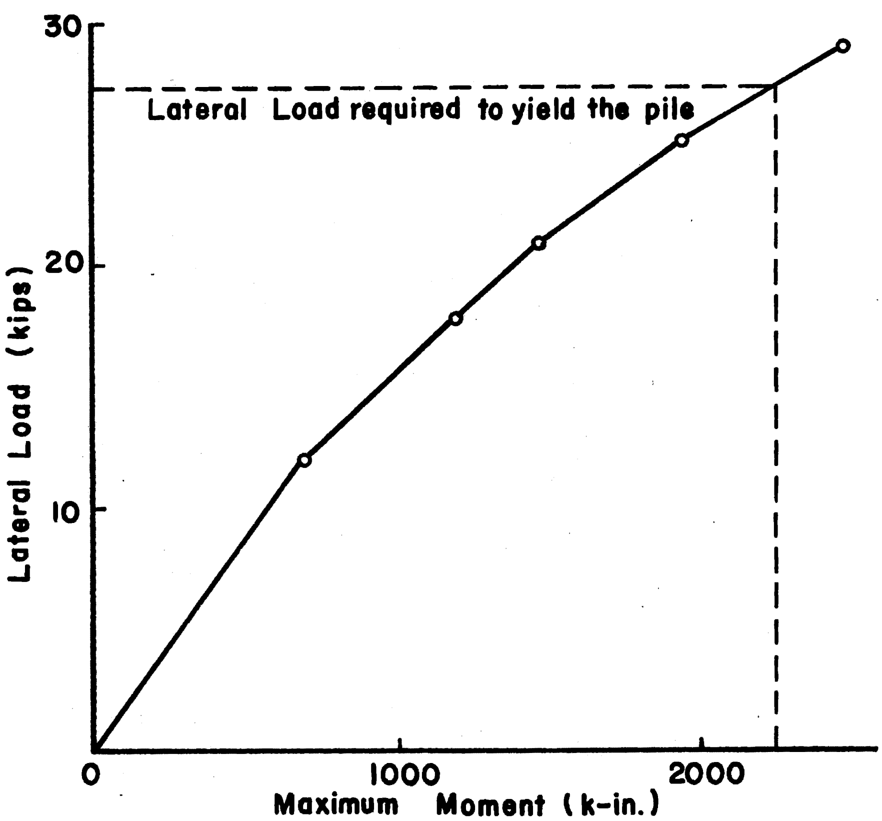


Figure 43. Lateral Load-Moment Curve

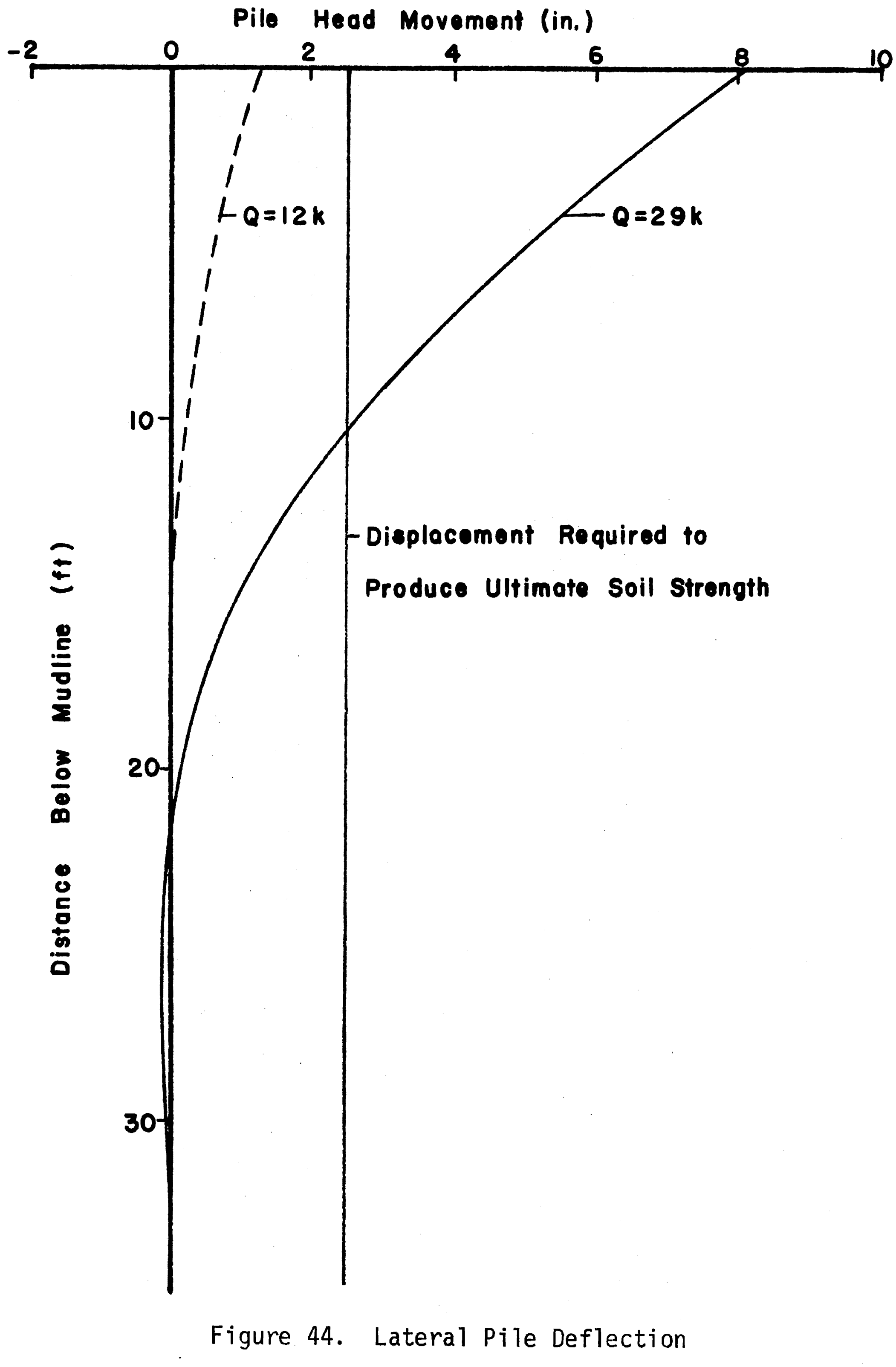


Figure 44. Lateral Pile Deflection

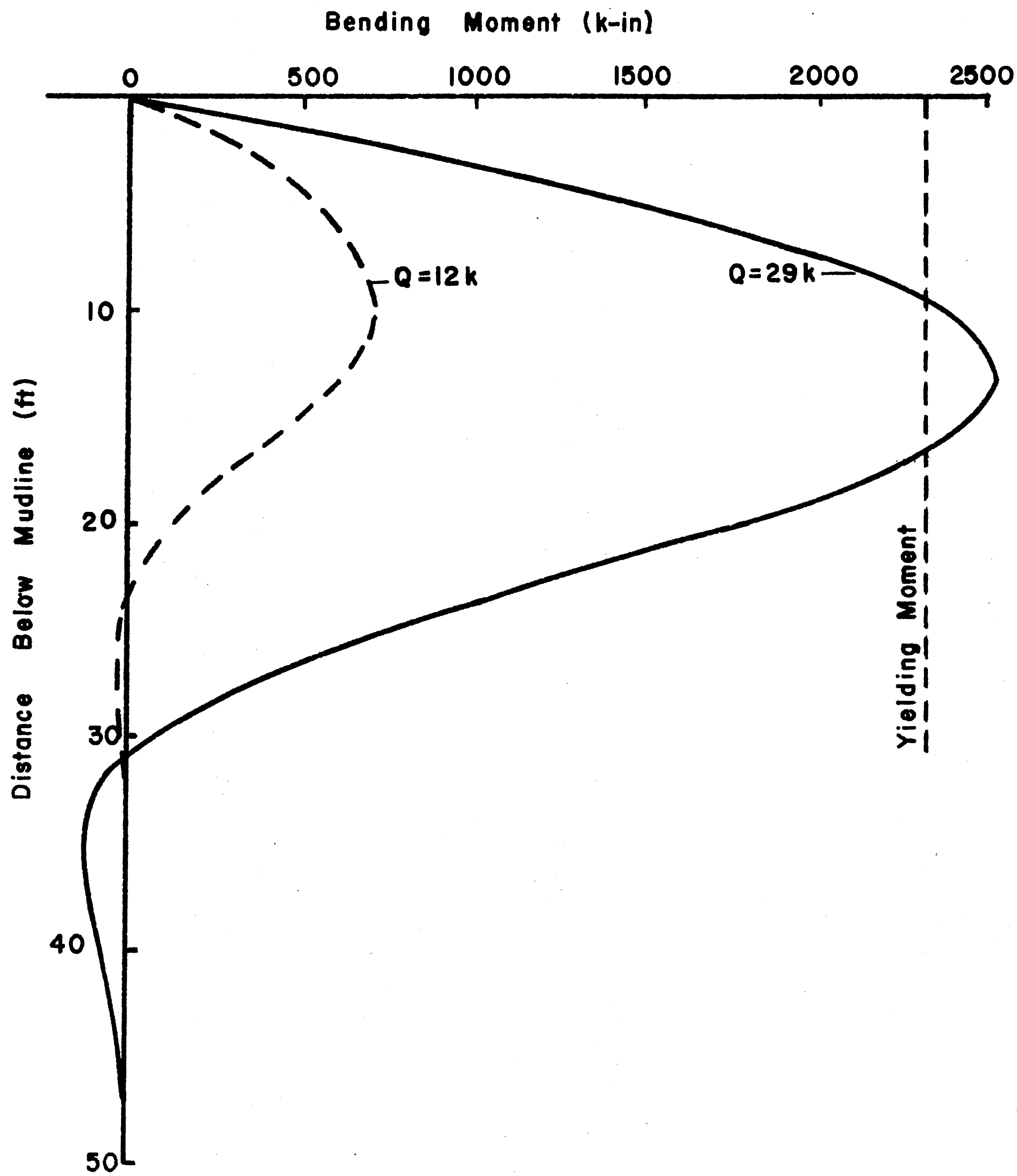


Figure 45. Bending Moment Diagram for the Pile

at the toe of the pile. The length, cross section of the pile, and soil description are exactly the same as those shown in example 3.1. The pile was investigated at two load levels: (1) 12 kips, and (2) 21 kips.

The results are in agreement with those presented in Reference (35), but as previously discussed, are consistently slightly lower than the results of Reference (35). Due to effects of curvature of the pile, the following results are obtained:

1. Negligibly small decreases are observed in lateral displacements and bending moments.

2. The pile head moves slightly upward.

3. There is a slight increase in compressive axial force.

4.4 Example 4.1. Pile Supported Plane Frame

A frame, representative of the type occurring in offshore construction, is shown in Figure 46 with its design loads. The plane of the frame is inclined; however, the projection on the vertical plane is used in this analysis. All sections are thin wall tubes, the outside diameter and wall thickness are given in Figure 46. A joint is required at each intersection of members, at the end of a member, and wherever a change in the member stiffness occurs. The joint numbers and member numbers are shown in Figure 47.

Soil characteristics are given in Table II. The soil support (q-w) curves need not be input since the program will automatically generate the soil support curves from the given soil characteristics.

In order to determine the magnitude of wind and wave forces acting on the frame, the wind and wave parameters such as wind velocity, wave height, and wave period are required. These parameters are given in Table III.

TABLE II

SOIL CHARACTERISTICS

Distance Below Mudline (ft)	Soil Shear Strength (ksi)
0	0.00153
12.0	0.00542
16.0	0.00861
109.0	0.00986
150.0	0.01040
170.0	0.01040

$\gamma = 2.6 \times 10^{-5}$ k/in.^{3}.

TABLE III

WIND AND WAVE PARAMETERS

Parameters	Numerical Values
Mass density of air	2.5×10^{-3} slug/ft^3
Basic wind velocity	100 mph
Wind constant (k)	0.1
Density of fluid	2.0 slug/ft^3
Wave period	7 sec
Wave height	50 ft
Wave C_D	1.0
Wave C_M	1.0
Wind C_D	2.0

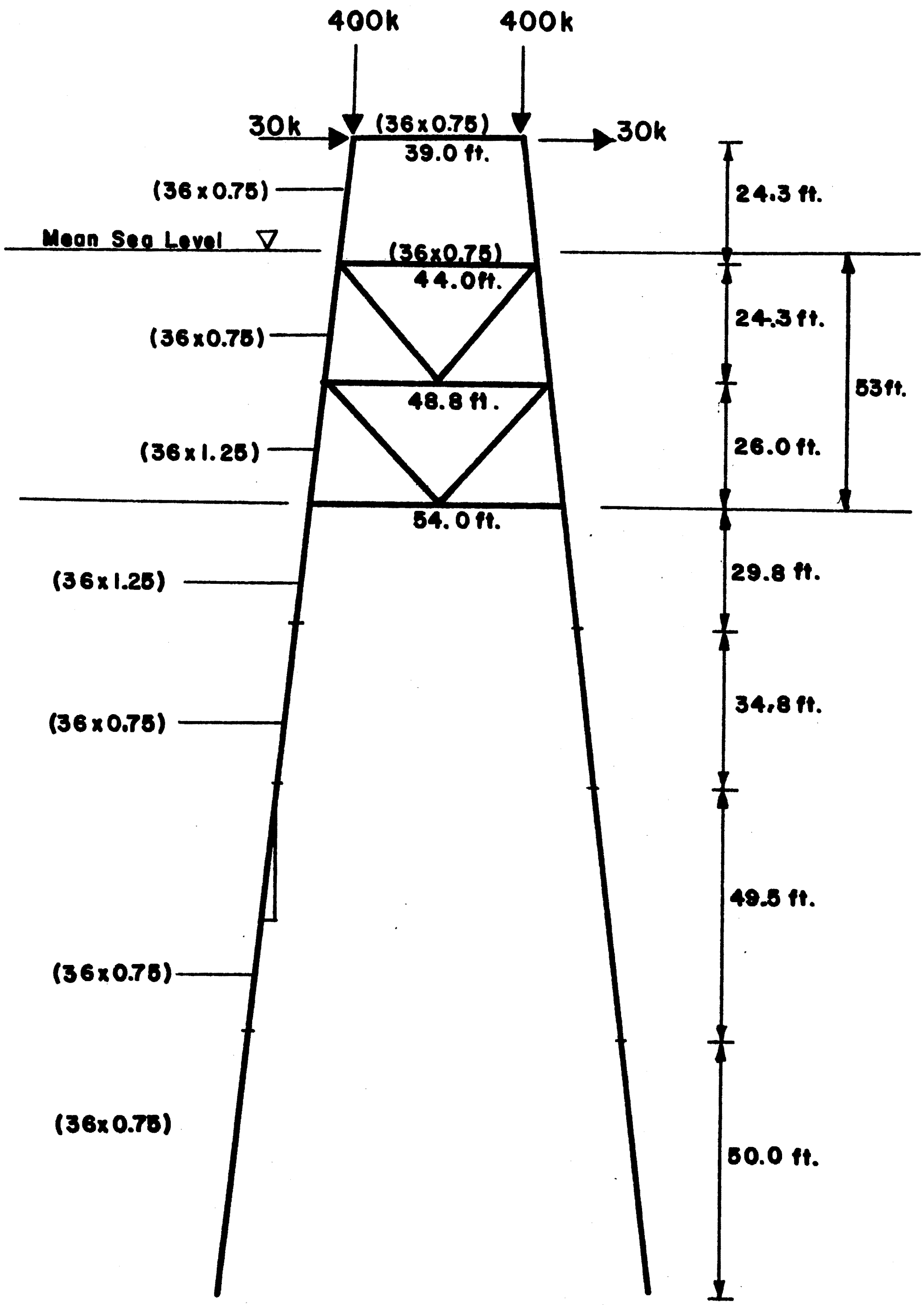


Figure 46. Frame, Member Size and Design Loads

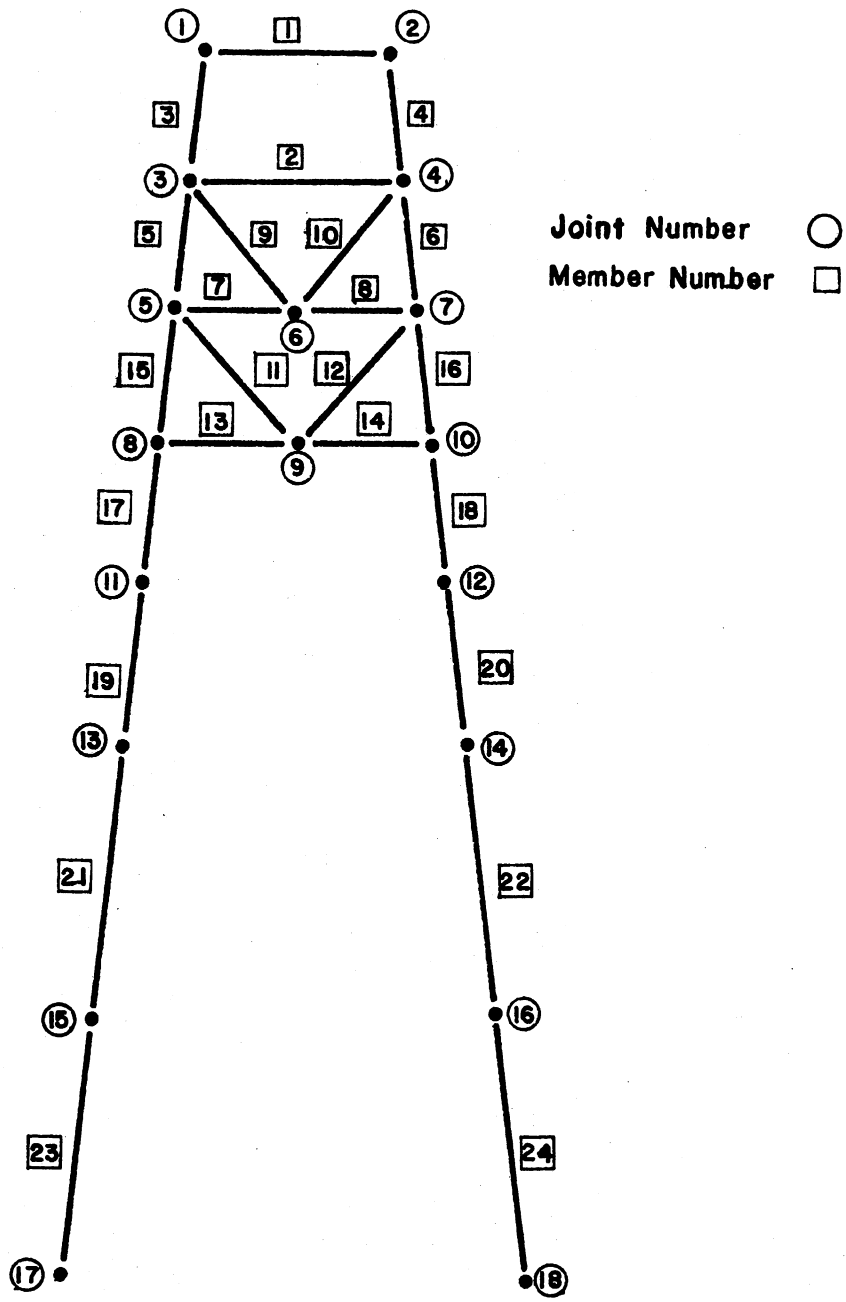


Figure 47. Joint Numbers and Member Numbers

The example problems are run for time equal to 0.0, 0.88 and 1.76 sec. The loads given in Figure 46 are held constant at their design values. The positions of the wave on the frame at times equal to 0.0, 0.88 and 1.76 sec. are shown in Figure 48. It can be seen that, at t = 0.0 part of the members to the right of the frame are above the water surface. At t = 0.88 sec., the entire frame is under water and finally at t = 1.76 sec., part of the members to the left of the frame are above the water surface. Figure 49 shows wind and wave forces along the members of the frame at time t = 0.0, 0.88 and 1.76 sec. It can be observed that the magnitude of wind forces are very small in comparison with the wave force.

Moments at joints 2 and 4 in member 4 are plotted versus the time (t) in Figure 50. It can be seen that the maximum moment is obtained at the time equal to 0.88 sec. However, the maximum moment obtained is lower than the amount of moment required to produce the yield stress in the member. Therefore, an inelastic unloading is not necessary for this particular example.

Lateral displacements at joints 2, 4 and 7 versus time are shown in Figure 51. The criteria condition obviously occurs at time t = 0.88 sec. when the entire frame is under water.

Lateral deflections and bending moments, for the critical condition, for the left and right piles are given in Figures 52 and 53, respectively. The deflection in the right pile is slightly in excess of the deflection obtained from the left pile. This is due to the higher axial load in the right pile which tends to reduce its stiffness considerably.

The computer output for the entire frame at time equal to 0.0, 0.88 and 1.76 sec. is given in Appendix G.

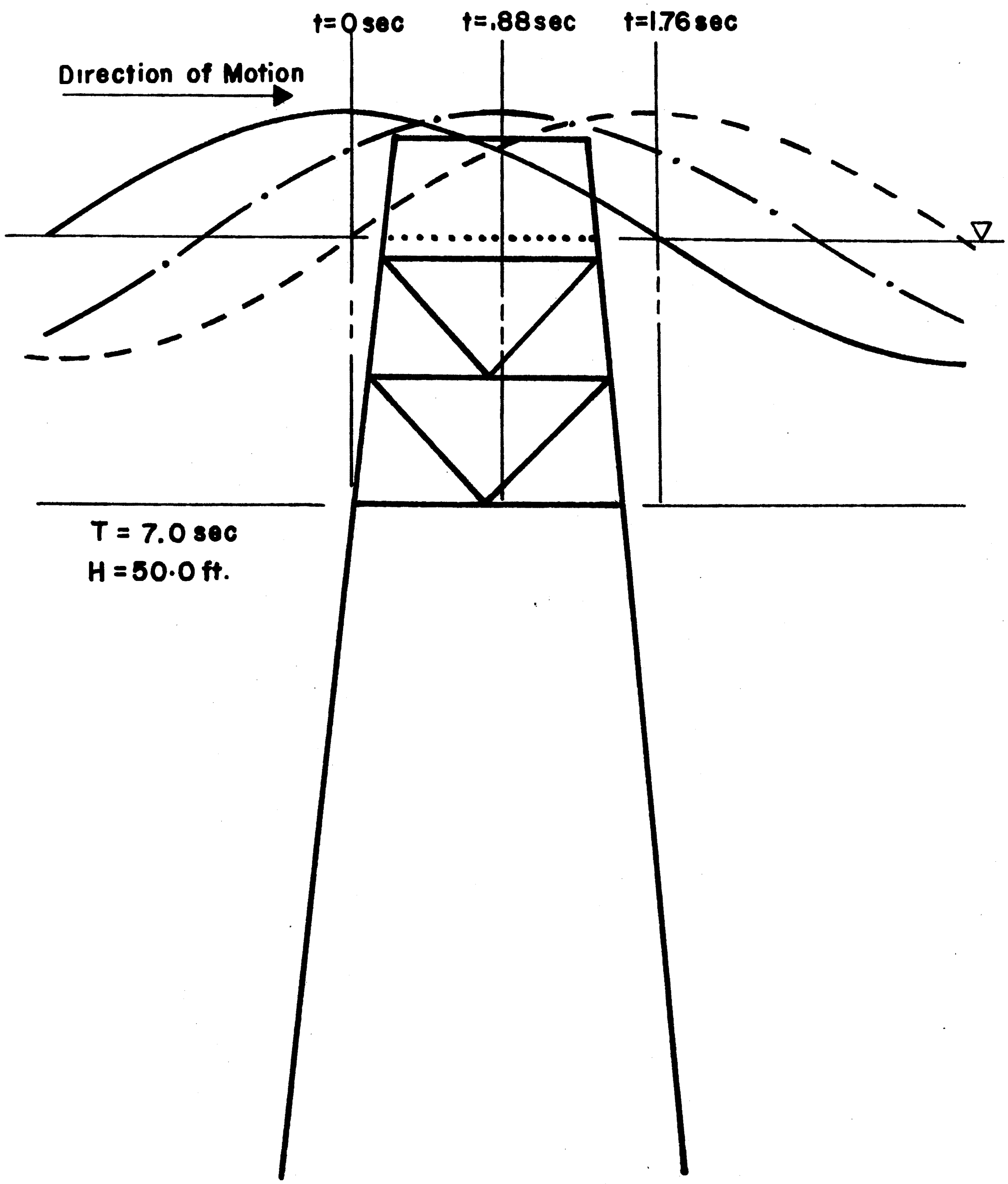


Figure 48. Sketch of Wave on the Frame

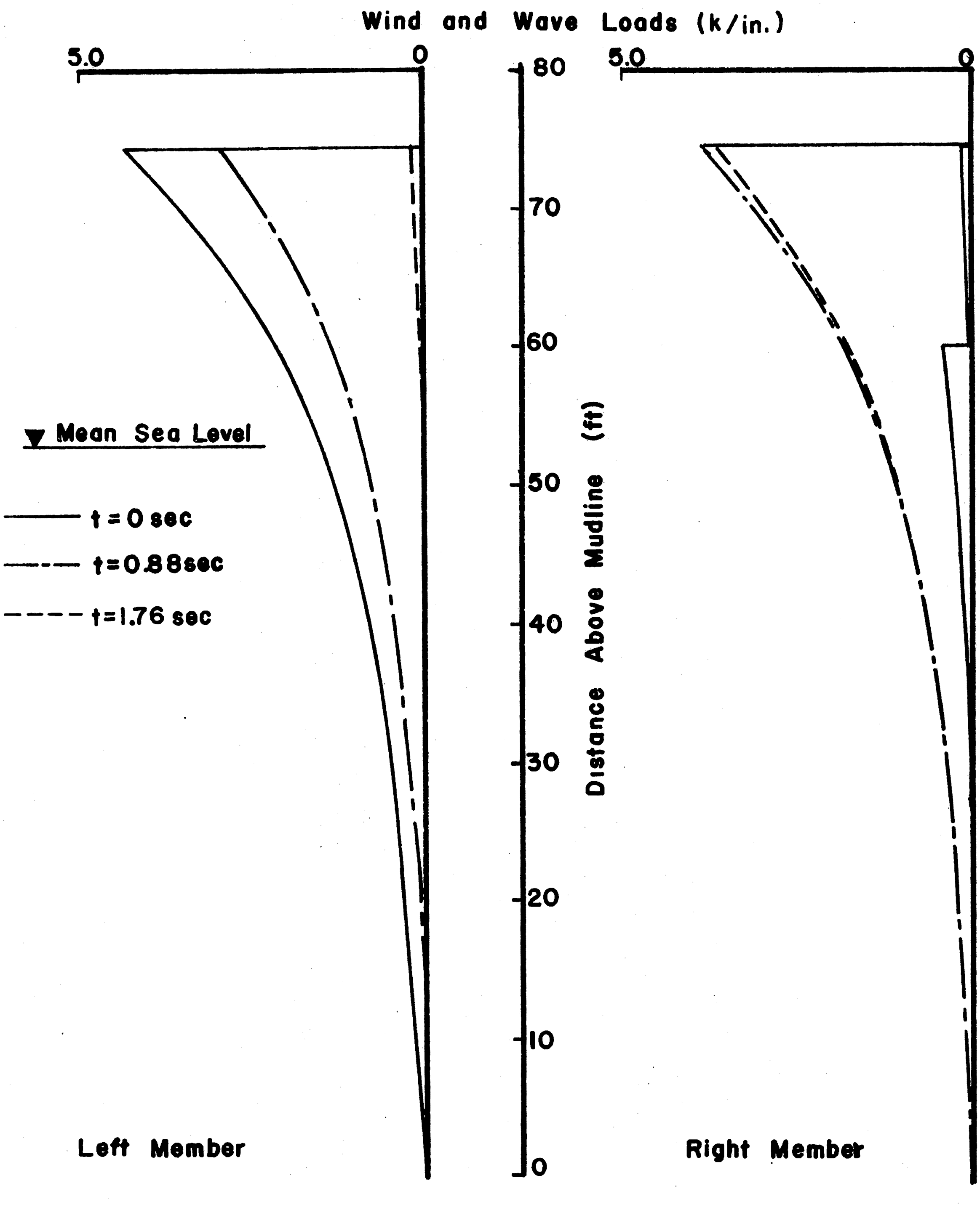


Figure 49. Variation in Wind and Wave Loads With Depth

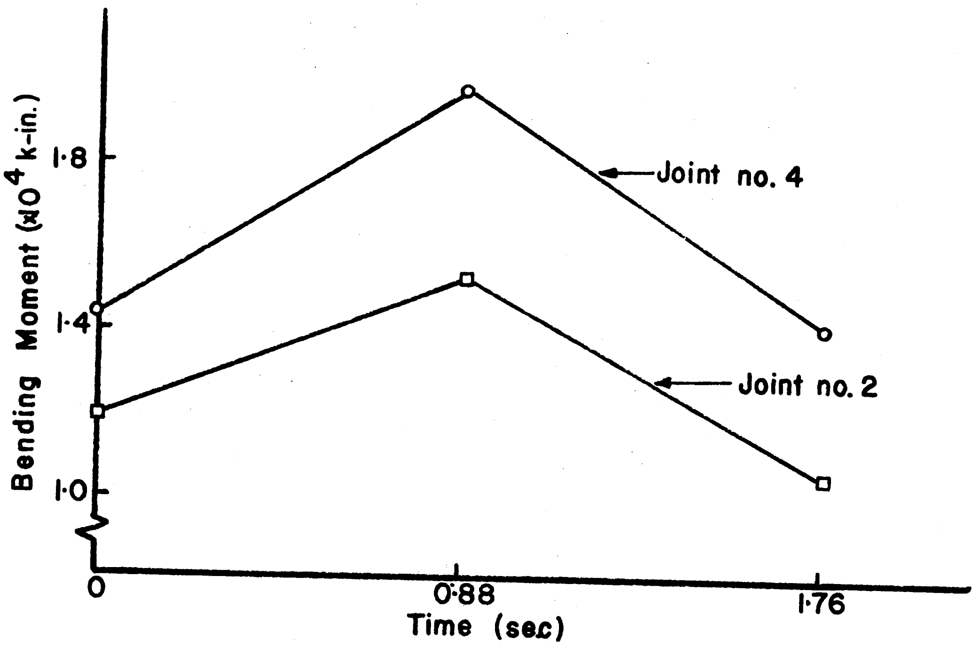


Figure 50. Variation in Bending Moment With Time in Member 4

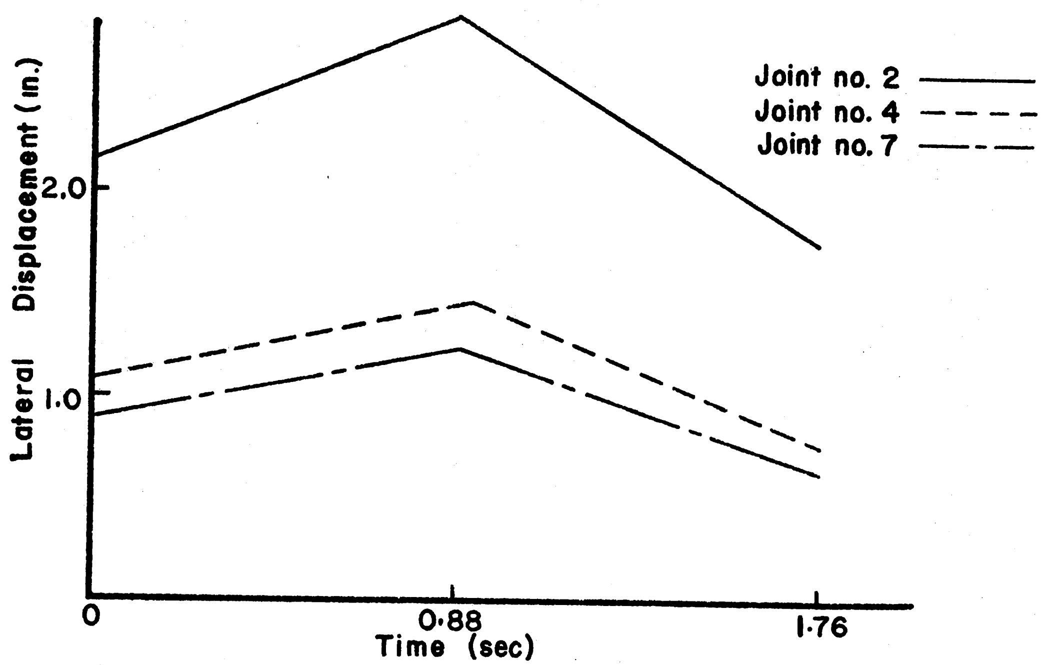


Figure 51. Lateral Displacement Versus Time

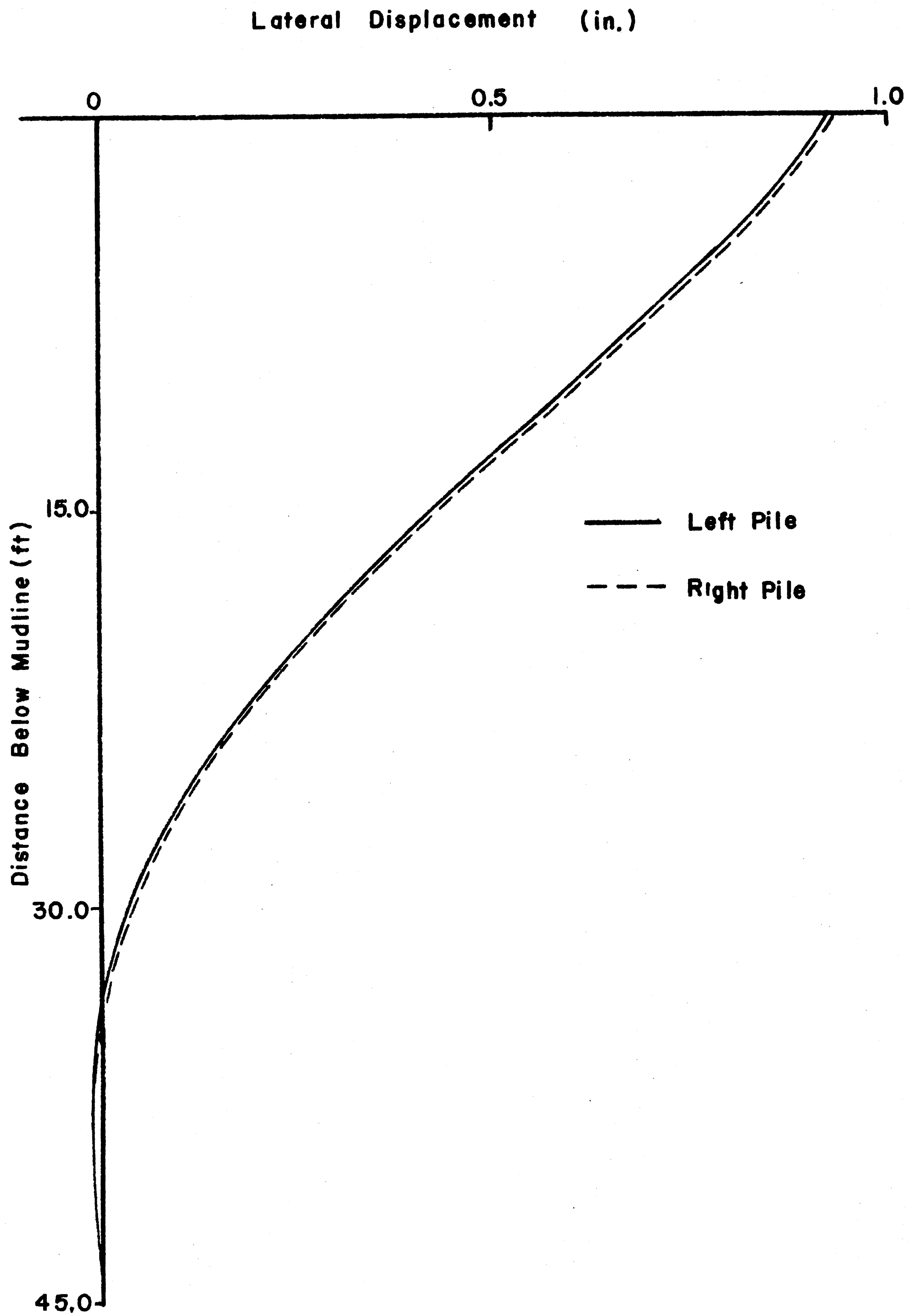


Figure 52. Lateral Deflected Curve

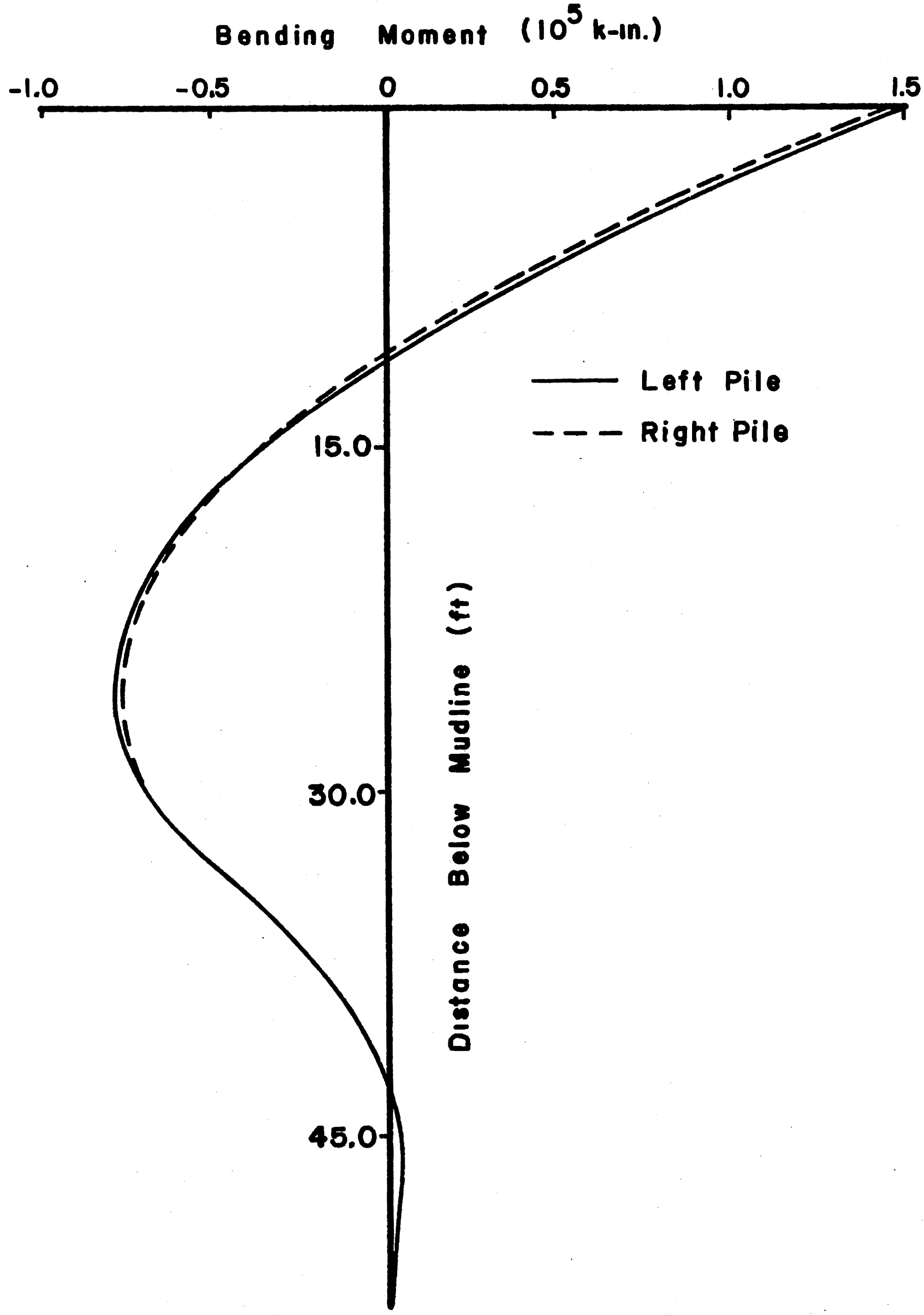


Figure 53. Bending Moment Diagram for the Left and Right Piles

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

5.1 Summary

A method of analysis of pile supported plane frames under static short term loads has been developed in this study. A mathematical model is used to represent the actual behavior of the structure. The effects of material, geometric and soil support nonlinearities are included in the analysis by revision of the stiffness matrix of the elements in the structure as deformations occur under the loads. The method of analysis is based on an iterative procedure in which unbalanced forces at the nodal points are applied to a temporary linear structure until an equilibrium position has been found.

The frame may be composed of straight or curved members. The frame member is divided into a finite number of straight elements. The program is capable of solving an entire system, including the piles, in one solution. Member solutions are made separately from the frame solution to reduce computer storage.

A numerical technique is used to determine the moment-rotation relationship of the cross-section with a nonlinear-stress-strain curve. This moment-rotation relationship is reduced to a mathematical expression which can be made to represent the behavior of the structural elements.

The displacements and internal forces of the structure are calculated at the end of every load increment.

The computer program was written in FORTRAN language for solution in the IBM/360 Model 65 computer of Oklahoma State University. The program in subroutine form is sufficiently general to handle a large variety of parameters, such as material properties, structural shape and cross-sections, and can easily be changed to take into consideration particular features of specific problems.

In order to illustrate the solution capability of the program and varify the accuracy of the method of analysis, several problems have been solved, and the results compared with the experimental data or the existing analysis.

5.2 Conclusions

From the present study the following conclusion can be drawn:

1. The proposed finite element procedure is capable of predicting the response of real structure subjected to complex system of loads and support conditions. The effects of material, geometric and soil support nonlinearities are included in the analysis. The computer results obtained from the proposed analysis are in better agreement with experimental data than those obtained by other investigators who fail to consider nonlinear behavior in the analysis.

2. In the nonlinear analysis, the finite element technique is more complicated mathematically than the discrete element technique and more time is required in the finite element analysis to generate element properties such as the element stiffness matrix. However, the equations used in the discrete element model to describe the actual beam behavior

create second-order errors. An accurate solution may be obtained by increasing the number of increments into which a member is divided, and thus making the element size smaller. Therefore, the finite element procedure can adequately represent smoothly varying load, stiffness changes, and supporting conditions with fewer elements than required for a discrete element solution of equal accuracy. The results obtained from the proposed analysis are more accurate than the discrete element solution when the same number of elements in the member are used.

5.3 Recommendation

The scope of this work is limited to the static response of two-dimensional frames even though the wind and wave forces may induce dynamic response of the structure. This dynamic and cyclic nature of the loading makes the inelastic unloading of the frame material and soil an important consideration. Therefore, the present method should be extended to include the effects of dynamic response and inelastic unloading. In addition the three dimensional characteristics of the frame could be included, however, a tremendous increase in computer time and storage would be required.

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APPENDIX A

DEVELOPMENT OF THE MOMENT-ROTATION EXPRESSION

The method of determining a moment-rotation relationship, as developed by Richard (41), is summarized in this appendix. The mathematical model of the flexural element used in the derivation of the moment-rotation relationship consists of a linearly elastic beam which is free of intermediate loading and has nonlinear springs on each end is shown in Figure 54. The moment-rotation characteristics of these springs are so determined as to represent the nonlinear behavior at the end of the actual element and can be presented as:

$$M_{ij} = \frac{R\theta_{ij}}{\left[1 + \left|\frac{R\theta_{ij}}{M_p}\right|^n\right]^{1/n}} \qquad \text{(A.1)}$$

in which

R = stiffness coefficient = $4EI/L$;

θ_{ij} = boundary rotation at i of element ij;

M_{ij} = boundary moment at i of element ij;

M_p = ultimate moment;

n = curve fitting parameter.

The moment-rotation relationship used in this study is, in general, dependent upon the cross section of the element and the axial load on the element as well as the shape of the material stress-strain curve. The relationship between moment and end rotation of an element such as shown in Figure 54 may be written as:

$$M_{ij} = \frac{4EI}{L} y_i + \frac{2EI}{L} y_j \qquad \text{(A.2)}$$

or

$$M_{ij} = \frac{4EI}{L} \theta_{ij} \qquad \text{(A.3)}$$

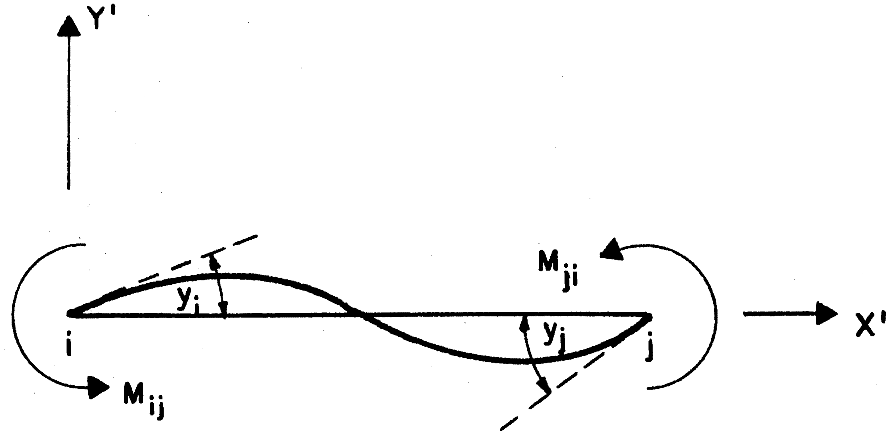


Figure 54. Mathematical Model of the Flexural Element

where

M_{ij} = boundary moment at i of element ij;

$_{ij}$ = boundary rotation at i of element ij

= $y_i + y_j/2.0$.

The relationship between moment and curvature for a linearly elastic element can be shown as

$$M_{ij} = EI\ \phi_{ij} \tag{A.4}$$

where ϕ_{ij} = curvature at i of element ij.

Equations (A.3) and (A.4) are combined to permit the rotation to be expressed as a linear function of curvature,

$$\theta_{ij} = \frac{L}{4}\ \phi_{ij} \tag{A.5}$$

Substitution of Equation (A.5) into Equation (A.1) yields the moment-curvature relationship

$$M_{ij} = \frac{EI\ \phi_{ij}}{\left[1 + \left|\frac{EI\ \phi_{ij}}{M_p}\right|^{n}\right]^{1/n}} \tag{A.6}$$

The moment-curvature curve for a particular cross-section can easily be obtained from an iterative procedure suggested by Gurfinkel and Robinson (18). This curve is then fitted by the moment-curvature expression shown in Equation (A.6). The values of EI, M_p, and n obtained from the curve fitting process are the parameters required in the moment-rotation expression shown in Equation (A.1).

Construction of Moment-Curvature Curve

The process for developing a moment-curvature curve is started by finding the initial conditions of strain and curvature for a given axial force on the section and moment equal to zero. To find the initial strain in this case is not difficult, since moments are taken about the plastic centroid, the section is then subjected to a uniform strain. The procedure for development of a moment-curvature curve with a constant force may then be accomplished by keeping an axial force (P) as a constant and increasing moments until the final conditions for moments are obtained.

An efficient procedure for determining strain distribution and curvature in a cross section subjected to bending moment and longitudinal load has been discussed by Gurfinkel and Robinson (18). Only an outline of the procedure is presented here.

The numerical procedure which solves the problem successfully, an extension of the Newton-Raphson method, is based on the following considerations. It can be assumed that for a given section and material properties, force (P) and bending moment (M) can be expressed as functions of ϕ and ε_4 as follow:

$$P = P(\phi,\ \varepsilon_4) \tag{A.7}$$

$$M = M(\phi,\ \varepsilon_4) \tag{A.8}$$

in which P = axial force; M = bending moment; ϕ = curvature; and ε_4 = axial strain at the top of the cross section. An expansion of the above equations may be approximated by Taylor's theorem as

$$P = \overline{P} + \frac{\partial P}{\partial \varepsilon_4}\,\delta\varepsilon_4 + \frac{\partial P}{\partial \phi}\,\delta\phi \tag{A.9}$$

$$M = \overline{M} + \frac{\partial M}{\partial \phi}\,\delta\phi + \frac{\partial M}{\partial \varepsilon_4}\,\delta\varepsilon_4 \tag{A.10}$$

in which

$\overline{P},\overline{M}$ = axial force and bending moment, respectively, at the beginning of load increment;

$\partial P/\partial \varepsilon_4$ = rate of change of axial force with top strain;

$\partial M/\partial \varepsilon_4$ = rate of change of bending moment with top strain;

$\partial P/\partial \phi$ = rate of change of force with curvature;

$\partial M/\partial \phi$ = rate of change of bending moment with curvature;

$\delta\phi,\partial\varepsilon_4$ = change in curvature and top strain, respectively, which occur during a load increment.

Once the four different rates of change have been determined, ϕ and ε_4 are readily available through a simultaneous solution of Equations (A.9) and (A.10). The required ϕ and ε_4 would then be

$$\phi = \overline{\phi} + \sigma\phi \tag{A.11}$$

$$\varepsilon_4 = \varepsilon_4 + \delta\varepsilon_4 \tag{A.12}$$

Because of the approximation involved in Equations (A.9) and (A.10), it is likely that Equations (A.11) and (A.12) will not provide a solution with the desired accuracy in the initial trial. The necessary check on the accuracy of solution can be made by using numerical integration with ϕ and ε_4 to find an axial load (P) and bending moment (M). If the agreement is not satisfactory a new cycle may be started with ϕ, ε_4, P, and M as new initial values. Figure 55 shows the flow diagram of the iteration process that was programmed for the electronic computer in this study.

Curve Fitting

The moment-curvature relationship shown in Equation (A.5) may be written in an alternate form as

$$\phi = \frac{M}{EI} [1 - |\frac{M}{M_p}|^{n}]^{-1/n}$$

The three parameters EI, M_p, and n required to define a moment-curvature relationship for a given axial load are computed in the following manner. First, the value of M_p can be set equal to the maximum moment and EI is computed from the slope of the first several points (ϕ, M). Next, the curve fitting parameter n may be assumed and the variance (V_n), for the assumed value of n, which is a measure of the "goodness" of the fit to the fitted curve,

$$V_n = \sum_{i=1}^{n} [\phi_i - \frac{M_i}{EI} (1 - \frac{M_i}{M_p})^{n} {}^{-1/n}]^2 \tag{A.14}$$

is computed. The variances (V_n) are computed for three assumed values of n, and a second-order curve can be fitted by the least-squares method to the points defined by (n, V_n). Then a better estimate to the value of n which causes the variance to be minimized can be computed by taking the derivative of the fitted second-order curve. The process can be repeated with the new estimate of n and two of the old estimates until n is essentially unchanged, and the variance of the fitted curve (A.13) is a minimum.

Given $\overline{P}$, $\overline{M}$, $\overline{\phi}$, $\overline{\varepsilon}_4$, P, M
Determine ϕ, ε_4
Corresponding to P, M

$$\Delta\phi = 1.0E - 5* \overline{\phi} + 1.0E - 10$$
$$\Delta\varepsilon_4 = 1.0E - 5*\varepsilon_4$$

1.0E - 10 is small positive quantity to prevent increment from being 0

$$\phi = \overline{\phi} + \Delta\phi, \quad \varepsilon_4 = \overline{\varepsilon}_4$$
$$\frac{\partial P}{\partial \phi} = \frac{P_\phi - P}{\Delta\phi}, \quad \frac{\partial M}{\partial \phi} = \frac{M_\phi - \overline{M}}{\Delta\phi}$$
$$\varepsilon_4 = \overline{\varepsilon}_4 + \Delta\varepsilon_4, \quad \phi = \overline{\phi}$$
$$\frac{\partial P}{\partial \varepsilon_4} = \frac{P_{\varepsilon_4} - P}{\Delta\varepsilon}, \quad \frac{\partial M}{\partial \varepsilon_4} = \frac{M_{\varepsilon_4} - \overline{M}}{\Delta\varepsilon_4}$$

Solve for $\delta\phi$ and $\delta\varepsilon_4$ from
$$P = \overline{P} + \frac{\partial P}{\partial \phi}\delta\phi + \frac{\partial P}{\partial \varepsilon_4}\delta\varepsilon_4$$
$$M = \overline{M} + \frac{\partial M}{\partial \phi}\delta\phi + \frac{\partial M}{\partial \varepsilon_4}\delta\varepsilon_4$$

$$\phi = \overline{\phi} + \delta\phi$$
$$\varepsilon_4 = \overline{\varepsilon}_4 + \delta\varepsilon_4$$

Determine P, M from ϕ, ε_4

Check for Tolerance — Yes → PRINT Result

No

$P = P$, $M = M$, $\phi = \phi$, $\varepsilon_4 = \overline{\varepsilon}_4$

Figure 55. Flow Diagram for Determination of Strain Distribution and Curvature in a Section Subjected to Bending Moment and Axial Load

The value of n, EI, and M_p obtained from the curve fitting process can be stored and used by the moment-rotation relationship in Equation (A.1).

APPENDIX B

DETERMINATION OF THRUST AND BENDING MOMENT BY NUMERICAL INTEGRATION OF THE NONLINEAR STRESS-STRAIN CURVE

Cross Section Description

The cross section used in the numerical integration can be specified by a series of rectangles. A section composed of nonrectangular pieces, such as trapezoids, will of course be only approximately represented. The general cross section shown in Figure 56(a) is used in developing the expression. This cross section is divided into m rectangles. In order to allow a variety of composite sections, different rectangles of the section may have different stress-strain curves. Each rectangle may be subdivided into n sub-rectangles such that each sub-rectangle will have a linear variation in stress over its depth.

The program also permits input of circular pieces and reinforcement with transverse areas A_s as discussed at the end of this appendix.

Stress-Strain Curve

A typical stress-strain curve for the materials of the cross section, including any reinforcement, is shown in Figure 57. A nonlinear stress-strain curve may be represented by a series of straight line segments. The more nonlinear the curve, the more points required to accurately define the curve. The curve is specified by giving a number of points on the curve.

Stress-Strain Distribution

A linear variation of strain is assumed over the depth of the section as shown in Figure 56(b). In a specified cross section, if the location of the centroid C, the strain at the centroid ε_c and the curvature ϕ are known, the strain at any point y is given by

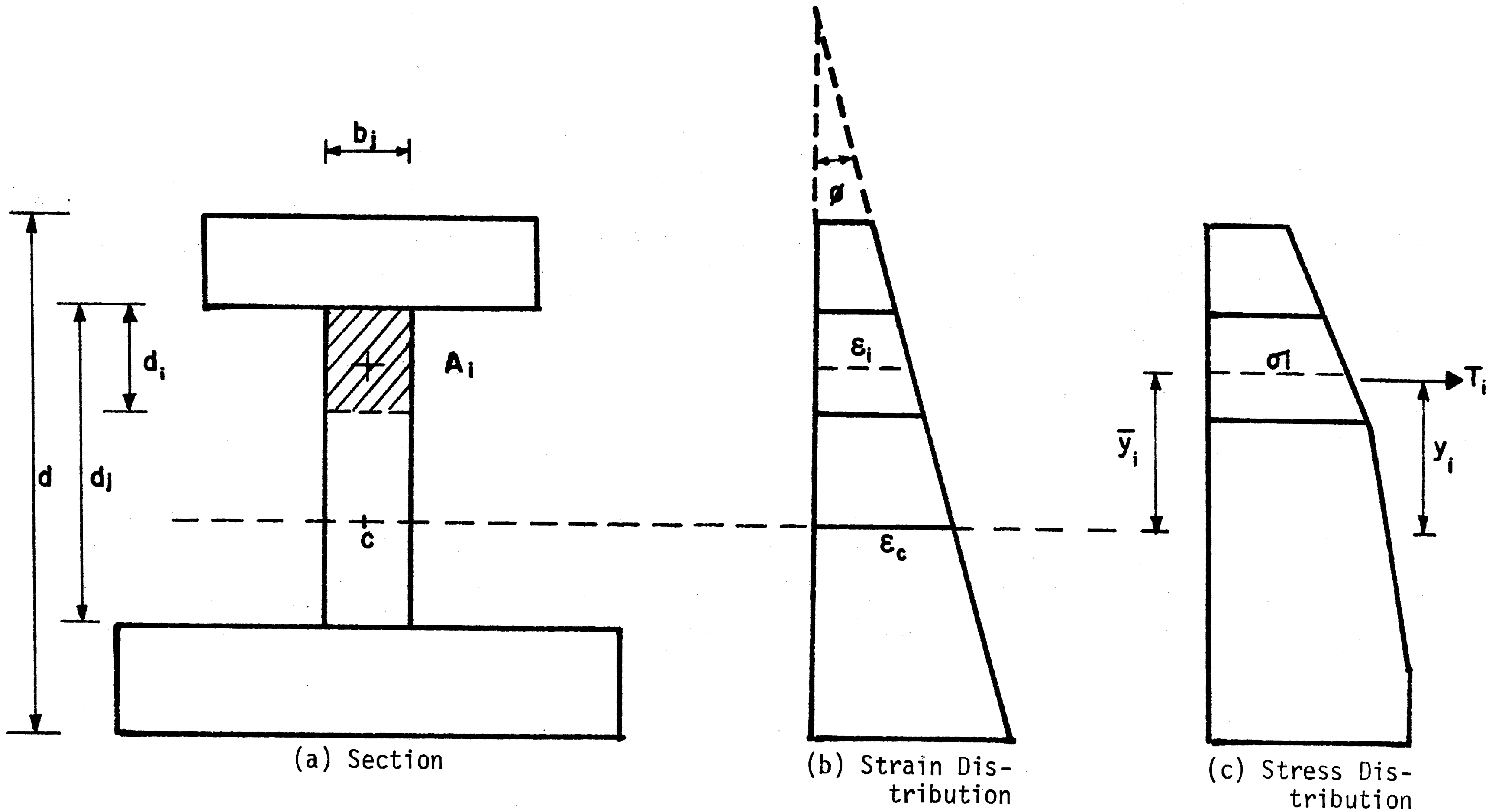


Figure 56. Stress and Strain Distribution

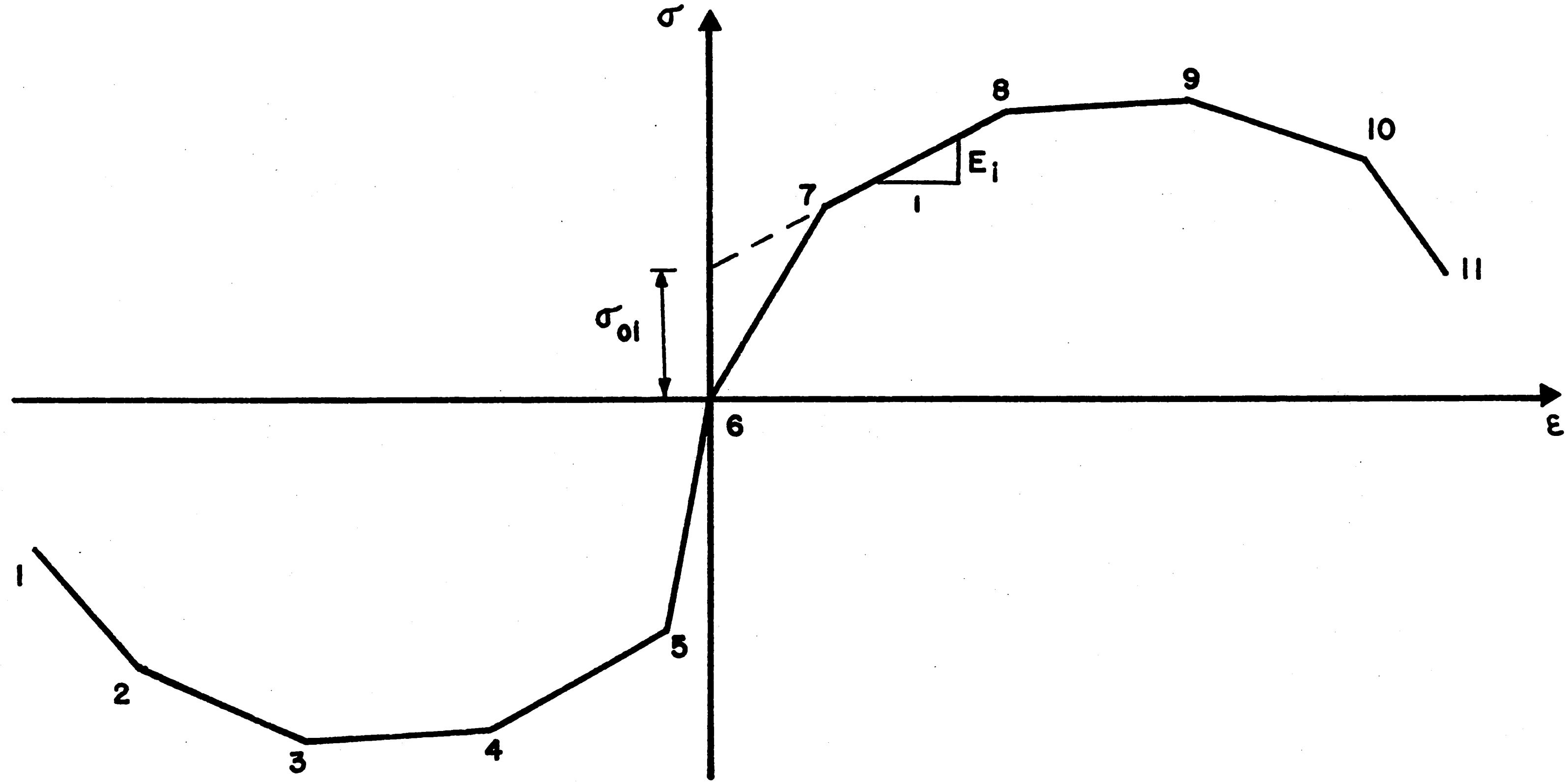


Figure 57. Typical Stress-Strain Curve

$$\varepsilon = \varepsilon_c - \phi_y \tag{B.1}$$

in which

ε = strain at any point and positive if the strain is tension;

ϕ = positive curvature tends to produce compressive strains on the top fibers;

y = distance from the centroid of the section positive when it goes in the same direction as positive member's y'-axis.

With the strain distribution so defined, the stress distribution is then found by using the stress-strain curves for each of the n rectangles. The jth rectangle, as shown in Figure 56(a), does not have a linear variation in stress over its depth. However, the jth rectangle will be subdivided into n subrectangles in such a way that each subrectangle will have a linear variation in stress over its depth d_i. The stress at any point in the sub-rectangle is

$$\sigma = \sigma_{0i} + E_i\varepsilon \tag{B.2}$$

Equations (B.1) and (B.2) may be combined to yield

$$\sigma = \sigma_{0i} + E_i(\varepsilon_c + \phi y). \tag{B.3}$$

Thrusts and Moments

The thrust T_i acting on the sub-rectangular area A_i is found by integrating the stress over the area

$$T_i = \int_{A_i} \sigma \, dA_i \tag{B.4}$$

$$T_i = \int_{A_i} [\sigma_{0i} + E_i(\varepsilon_c - \phi y)] \, dA_i \tag{B.5}$$

$$T_i = (\sigma_{0i} + E_i\varepsilon_c) \int_{A_i} dA_i - E_i\phi \int_{A_i} y \, dA_i \tag{B.6}$$

$\int y \, dA_i$ is equal to the first moment of the area and may also be defined as $\bar{y}_i A_i$, where $\bar{y}_i$ is the distance from the centroid of the section to the centroid of the area A_i as shown in Figure 56(a). Hence,

$$T_i = (\sigma_{0i} + E_i\varepsilon_c)A_i - E_i\phi\bar{y}_iA_i. \tag{B.7}$$

The thrust T over the entire cross section is found by summing up T_i for all the sub-rectangles. Thus,

$$T = \sum_{j=1}^{m} \sum_{i=1}^{n} (\sigma_{0i} + E_i\varepsilon_c - E_i\phi\bar{y}_i)A_i \tag{B.8}$$

From Equation (B.3) the multiple of A_i in Equation (B.8) is seen to be $\bar{\sigma}_i$ which is the stress at the centroid of the sub-rectangles. Therefore,

$$T = \sum_{j=1}^{m} \sum_{i=1}^{n} \bar{\sigma}_iA_i \tag{B.9}$$

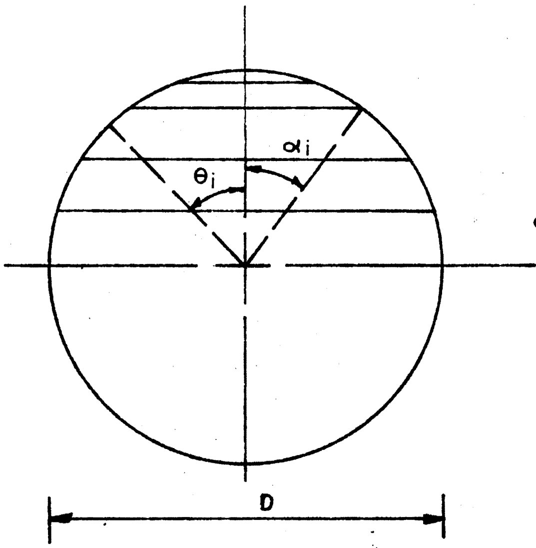
The moment of T_i about the centroid of the section, M_i, is found by the multiplication of T_i and the distance from the centroid of the resultant stress block to the centroid of the section y_i. The total moment M on the cross section is found to be

$$M = \sum_{j=1}^{m} \sum_{i=1}^{n} T_i\, y_i \tag{B.10}$$

It should be observed that the procedure developed above is exact for a section actually composed of all rectangular pieces and whose stress-strain curves consist of finite number of straight line segments as shown in Figure 56(b).

Circular Sections

The program allows input of a piece of a section having the properties of a solid circle or thin wall tube. For a solid circular section, each piece is subdivided into 10 layers as shown in Figure 58. For a tubular tube, each piece is subdivided by the program into 20 equal



$$R = D/2.0$$

$$\theta_i = (i - 0.5)\pi/10.0$$

$$\alpha_i = i\pi/5.0$$

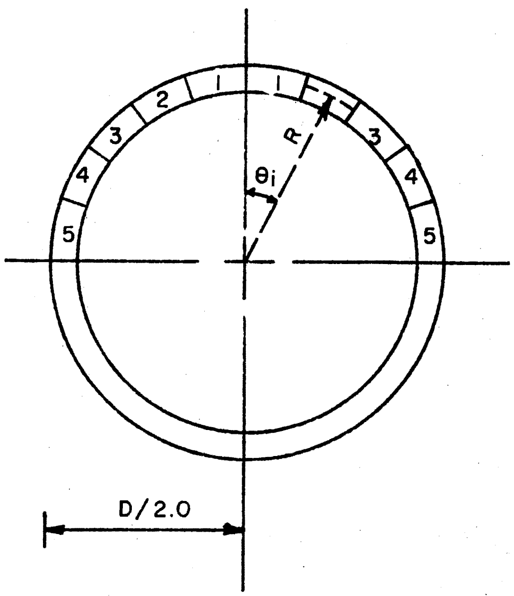
$$A_i = \frac{i\pi R^2}{10.0} - \frac{R^2}{2.0}\sin 2\alpha_i - \sum_{n=1}^{i-1} A_n$$

$$d_i = \frac{\pi R}{10.0}\sin\theta_i$$

$$b_i = A_i/d_i$$

$$\overline{Y}_i = R\cos\theta_i$$

Figure 58. Solid Circular Section



$$R = (D-t)/2.0$$

$$A_i = \frac{\pi}{5}Rt$$

$$\theta_i = \frac{(i-0.5)\pi}{10.0}$$

$$d_i = \frac{\pi R}{10.0}\sin\theta_i$$

$$b_i = A_i/d_i$$

$$\overline{Y}_i = R\cos\theta_i$$

Figure 59. Tubular Tube

radial segments as shown in Figure 59. Equivalent rectangular properties for each segment are calculated. Then the equivalent rectangles are used in the numerical integration procedure described above.

Reinforcement

From the variation of strain over the depth of the section and location of the reinforcement which is provided by the distance from the centroid of the section, the strain at the centroid of the reinforcement area ε_s can be determined from Equation (B.1). The value of stress corresponding to the strain σ_s can be determined from the stress-strain curve for the particular material. The thrust and bending moment due to the reinforcement are found by Equations (B.9) and (B.10), respectively.

APPENDIX C

SOLUTION OF SIMULTANEOUS EQUATIONS

The system of linear simultaneous equations, discussed earlier in Chapter IV and obtained from the frame solution or the member solution, is solved by a variation of Gauss elimination known as the recursion-inversion procedure. For the sake of simplicity, the equations obtained from the member solution will be discussed as an example in this appendix.

The equation may be expressed in the compact form as:

$$\bar{a}_i \bar{U}_{i-1} + \bar{b}_i \bar{U}_i + \bar{c}_i \bar{U}_{i+1} + \bar{d}_i = 0 \tag{C.1}$$

where $\bar{a}_i$, $\bar{b}_i$, and $\bar{c}_i$ are (3 x 3) matrices of stiffness coefficients, and $\bar{d}_i$ is a (3 x 1) vector of loads.

Evaluation of this equation at every station in the member leads to a set of simultaneous, linear, matrix equations in the unknown displacements of the stations. An efficient procedure for solution of these equations has been discussed by Endres and Matlock (8). Only an outline of the procedure is given here.

At each interior station i, the unknown displacements $\bar{U}_i$ and $\bar{U}_{i+1}$ satisfy the equation

$$\bar{U}_i = \bar{A}_i + \bar{B}_i \bar{U}_{i+1} \tag{C.2}$$

if

$$\bar{A}_i = -(\bar{a}_i \bar{B}_{i-1} + \bar{b}_i)^{-1} (\bar{a}_i \bar{A}_{i-1} + \bar{d}_i) \tag{C.3}$$

and

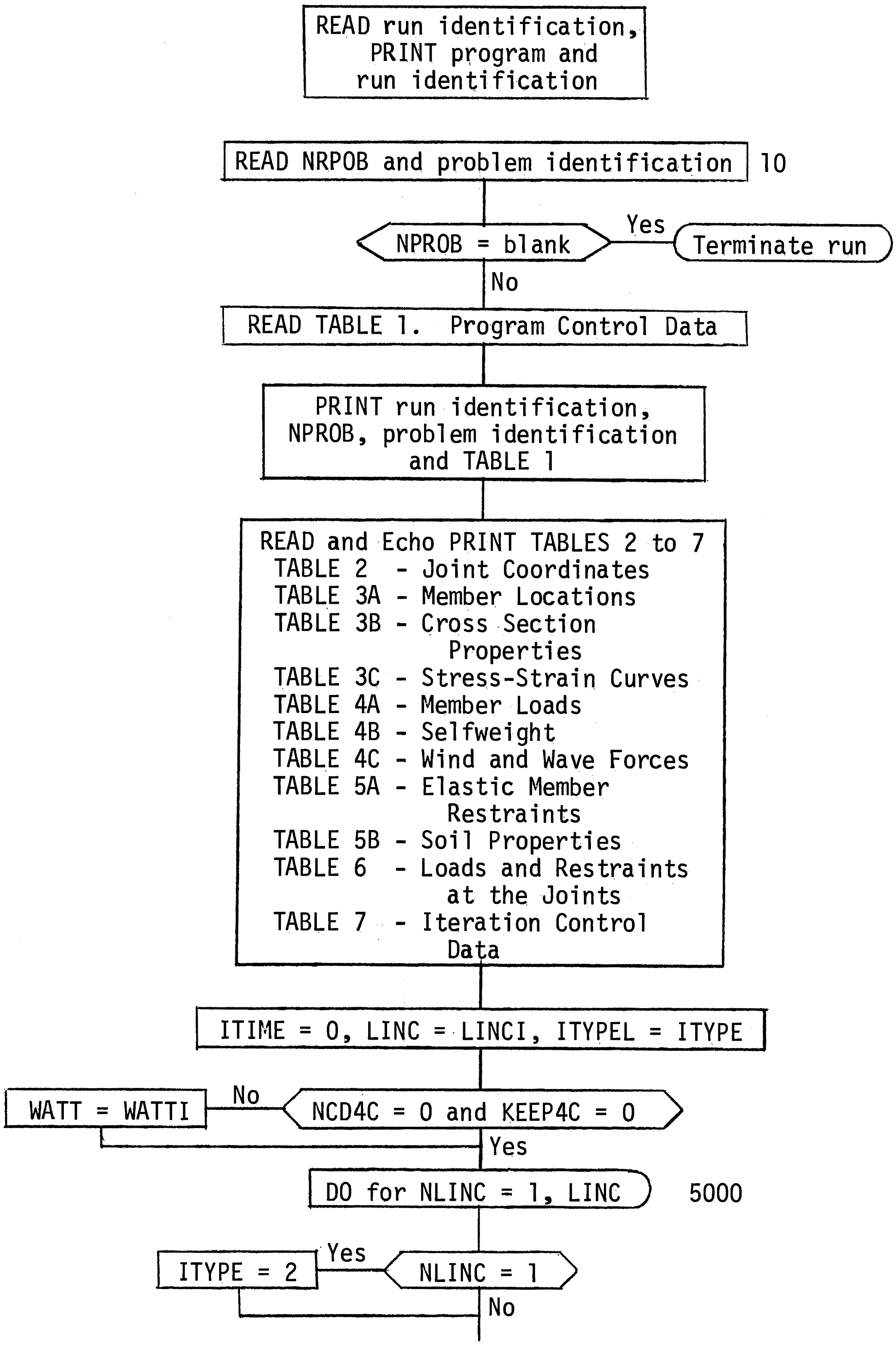
$$\bar{B}_i = -(\bar{a}_i \bar{B}_{i-1} + \bar{b}_i)^{-1} \bar{c}_i \tag{C.4}$$

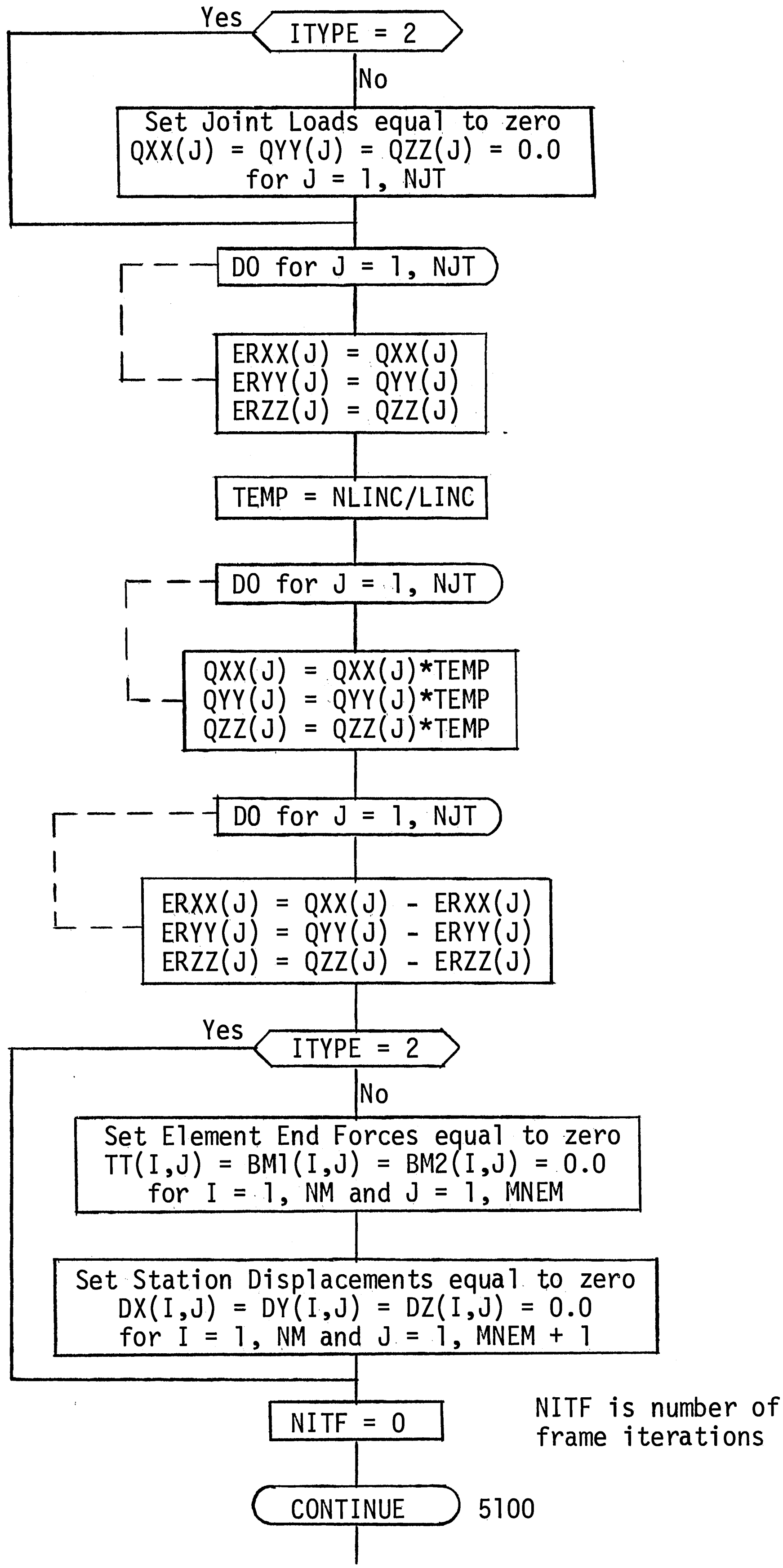
where the subscript -1 indicates the inverse of the matrix. Since evaluation of Equation (C.1) at end station 1 results in $\bar{a}_i = 0$, values of $\bar{A}_i$ and $\bar{B}_i$ may be determined sequentially for each station beginning at station 1 and proceeding to the final station n. At station n evaluation of Equation (C.1) leads to zero values for both $\overline{c}_n$ and $\overline{B}_n$. Hence, Equation (C.2) yields $\overline{U}_n = \overline{A}_n$. Since $\overline{A}_n$ can be evaluated from known data, a solution for $\overline{U}_n$ is obtained. Other values for displacement vectors may be obtained by back substitution in Equation (C.2).

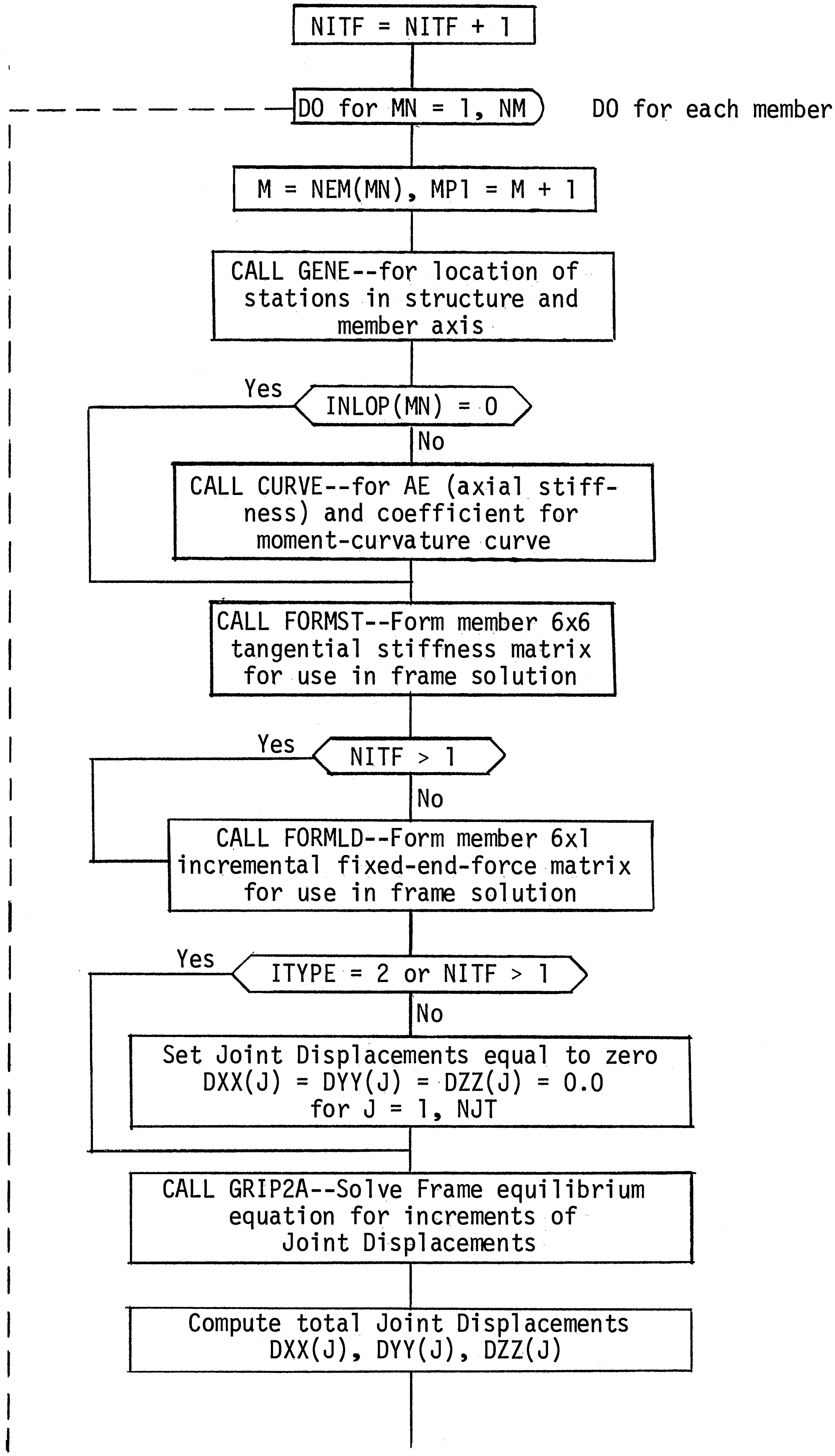
APPENDIX D

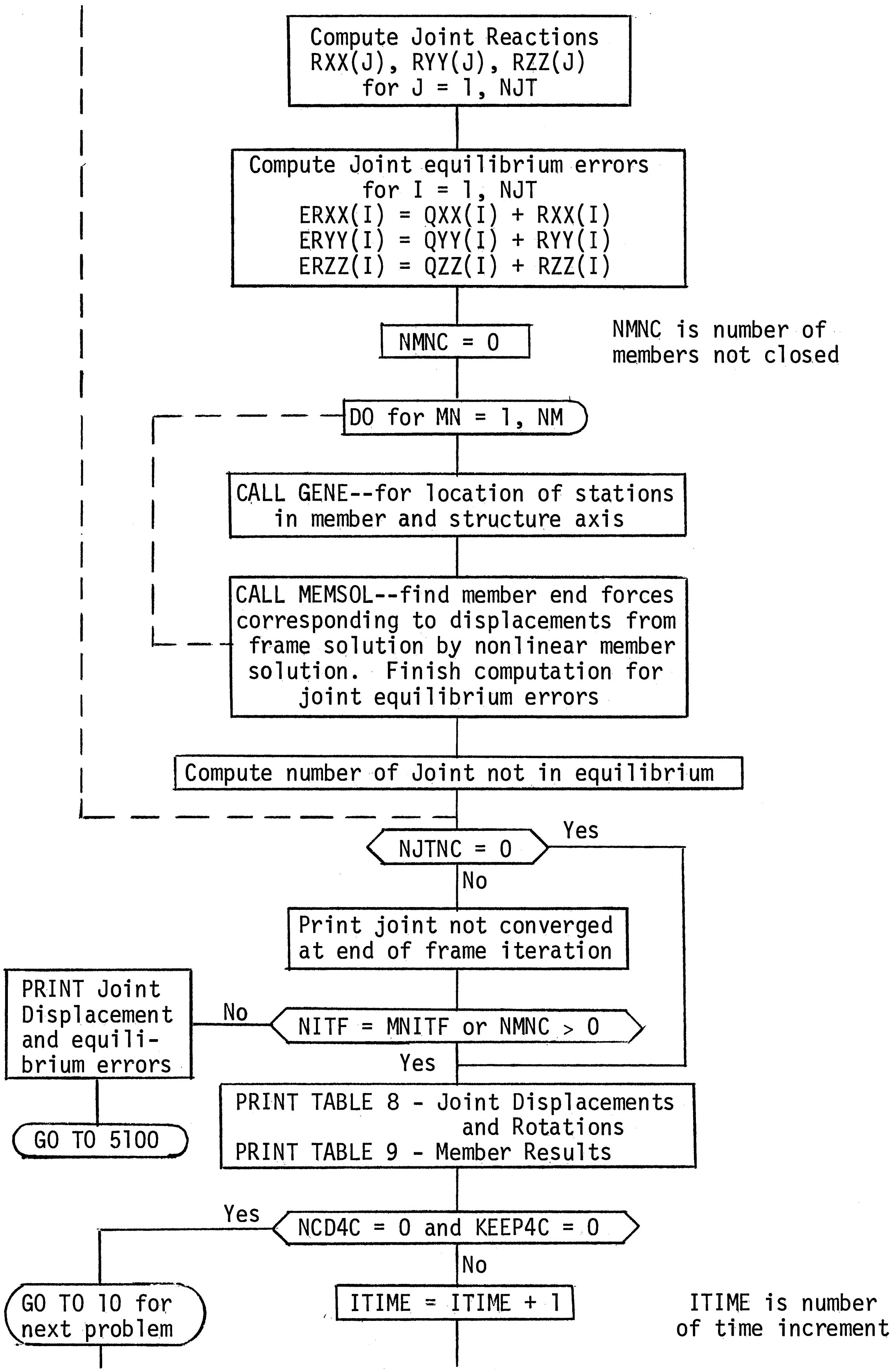
PROGRAM FLOW CHARTS

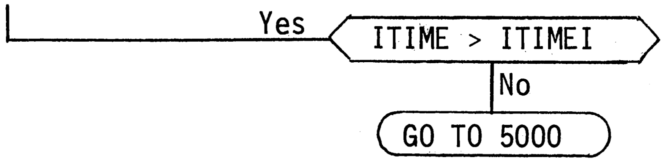
Flow Diagram for Main Program



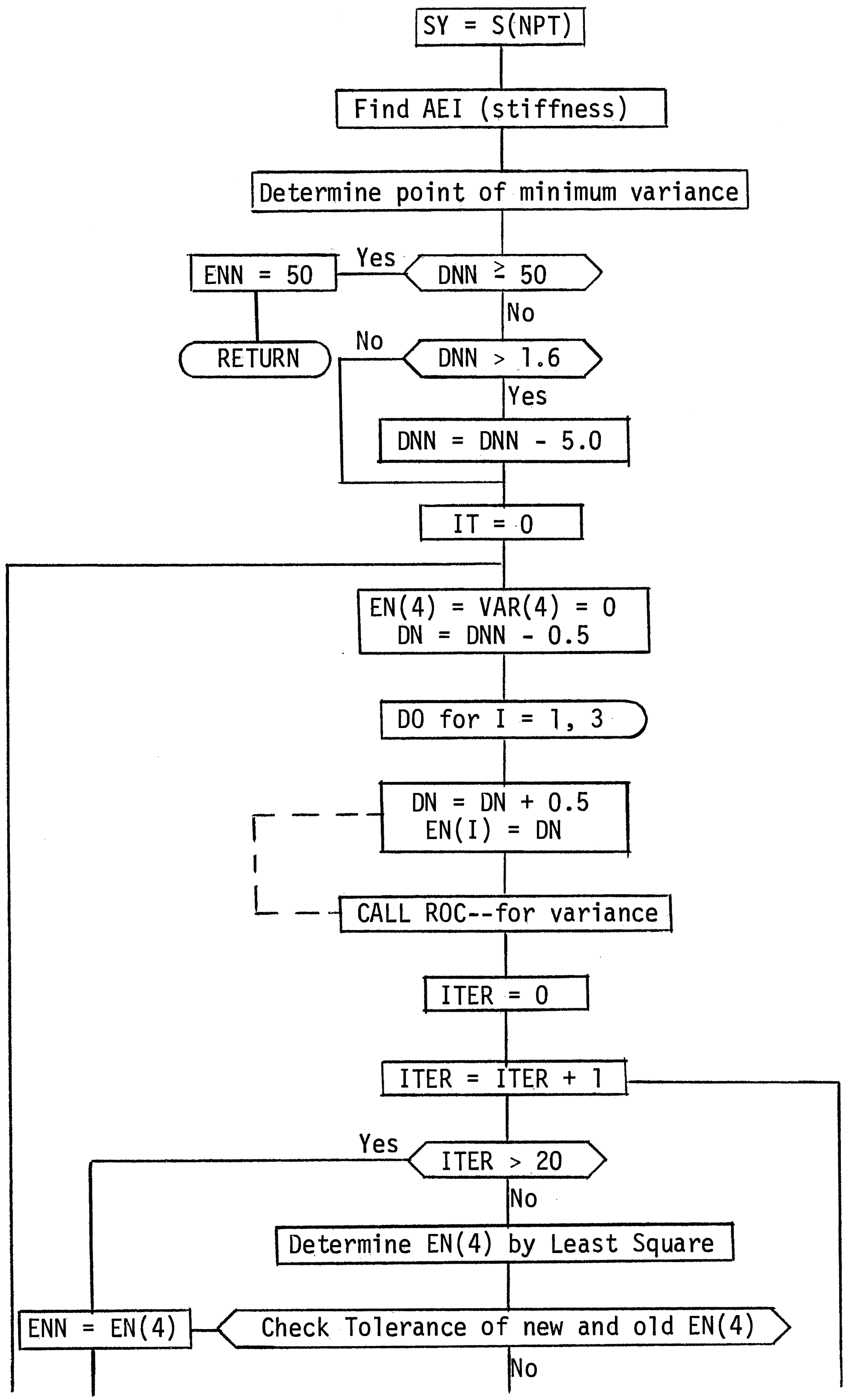

Yes
ITYPE = 2
No
Set Joint Loads equal to zero
QXX(J) = QYY(J) = QZZ(J) = 0.0
for J = 1, NJT
DO for J = 1, NJT
ERXX(J) = QXX(J)
ERYY(J) = QYY(J)
ERZZ(J) = QZZ(J)
TEMP = NLINC/LINC
DO for J = 1, NJT
QXX(J) = QXX(J)*TEMP
QYY(J) = QYY(J)*TEMP
QZZ(J) = QZZ(J)*TEMP
DO for J = 1, NJT
ERXX(J) = QXX(J) - ERXX(J)
ERYY(J) = QYY(J) - ERYY(J)
ERZZ(J) = QZZ(J) - ERZZ(J)
Yes
ITYPE = 2
No
Set Element End Forces equal to zero
TT(I,J) = BM1(I,J) = BM2(I,J) = 0.0
for I = 1, NM and J = 1, MNEM
Set Station Displacements equal to zero
DX(I,J) = DY(I,J) = DZ(I,J) = 0.0
for I = 1, NM and J = 1, MNEM + 1
NITF = 0
NITF is number of
frame iterations
CONTINUE
5100

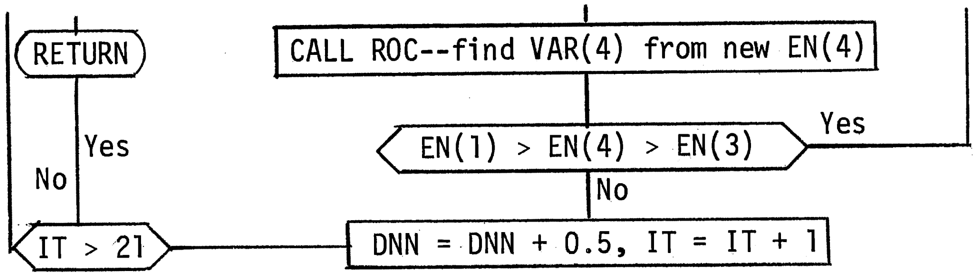

NITF = NITF + 1
DO for MN = 1, NM
DO for each member
M = NEM(MN), MP1 = M + 1
CALL GENE--for location of stations in structure and member axis
Yes
INLOP(MN) = 0
No
CALL CURVE--for AE (axial stiff- ness) and coefficient for moment-curvature curve
CALL FORMST--Form member 6x6 tangential stiffness matrix for use in frame solution
Yes
NITF > 1
No
CALL FORMLD--Form member 6x1 incremental fixed-end-force matrix for use in frame solution
Yes
ITYPE = 2 or NITF > 1
No
Set Joint Displacements equal to zero DXX(J) = DYY(J) = DZZ(J) = 0.0 for J = 1, NJT
CALL GRIP2A--Solve Frame equilibrium equation for increments of Joint Displacements
Compute total Joint Displacements DXX(J), DYY(J), DZZ(J)


Compute Joint Reactions
RXX(J), RYY(J), RZZ(J)
for J = 1, NJT
Compute Joint equilibrium errors
for I = 1, NJT
ERXX(I) = QXX(I) + RXX(I)
ERYY(I) = QYY(I) + RYY(I)
ERZZ(I) = QZZ(I) + RZZ(I)
NMNC = 0
NMNC is number of members not closed
DO for MN = 1, NM
CALL GENE--for location of stations in member and structure axis
CALL MEMSOL--find member end forces corresponding to displacements from frame solution by nonlinear member solution. Finish computation for joint equilibrium errors
Compute number of Joint not in equilibrium
NJTNC = 0
Yes
No
Print joint not converged at end of frame iteration
NITF = MNITF or NMNC > 0
No
Yes
PRINT Joint Displacement and equilibrium errors
GO TO 5100
PRINT TABLE 8 - Joint Displacements and Rotations
PRINT TABLE 9 - Member Results
NCD4C = 0 and KEEP4C = 0
Yes
No
GO TO 10 for next problem
ITIME = ITIME + 1
ITIME is number of time increment


Yes
ITIME > ITIMEI
No
GO TO 5000

Subroutine Fit




RETURN
CALL ROC--find VAR(4) from new EN(4)
Yes
EN(1) > EN(4) > EN(3)
Yes
No
No
IT > 21
DNN = DNN + 0.5, IT = IT + 1

APPENDIX E

GUIDE FOR DATA INPUT

GUIDE FOR DATA INPUT--Card Forms

IDENTIFICATION OF RUN (2 alphanumeric cards per run)

20A4
1 — 80

1 — 80

IDENTIFICATION OF PROBLEM (one card each problem; problem stops if PROB NAME blank)

PROB NAME	Description of problem (alphanumeric) 19A4
1 — 4	11 — 80

The data cards must be stacked in proper order for the program to run.

A consistent set of units of kips and inches must be used for all input data.

All input data must be right justified in the field.

All 5 space words are understood to be integers.

All 10 space words are floating-point decimal numbers.

The problem number may contain alphanumeric characters.

TABLE 1. PROGRAM CONTROL DATA (two cards per problem)

ENTER "1" TO HOLD PRIOR DATA IN TABLES 2 TO 7

PROB TYPE	T2	T3A	T3B	T3C	T4A	T4B	T4C	T5A	T5B	T6	T7
I5	I5	I5	I5	I5	I5	I5	I5	I5	I5	I5	I5

6 10 15 20 25 30 35 40 45 50 55 60 65 80

Number of Cards in TABLES 2 through 7 for this Problem

TABLE	2	3A	3B	3C	4A	4B	4C	5A	5B	6	7
	I5	I5	I5	I5	I5	I5	I5	I5	I5	I5	I5

11 15 20 25 30 35 40 45 50 55 60 65 80

PROBLEM TYPE 1 - DISPLACEMENTS not held from preceding problem start the iterative solution with zero displacements.

PROBLEM TYPE 2 - DISPLACEMENTS held from preceding problem use the displacements from the previous problem in the first iteration.

All "KEEP" blocks must be blank for the first problem of a run.

Two cards are required in TABLE 1 for all problems.

TABLE 2. JOINT LOCATIONS (number of cards according to TABLE 1)

JOINT NUMBER	GLOBAL COORDINATES X	GLOBAL COORDINATES Y	
I5	E10.3	E10.3	
6 10	16 25	35	80

Joint number must be input in ascending order started from one to their total number.

The total number of joints must not exceed 25.

If TABLE 2 is kept, no new information may be added to it.

If TABLE 2 is to be revised, it must be supplied with all of the required data.

Y must be set equal to zero at the bottom of the sea or at the ground level.

TABLE 3A. MEMBER LOCATIONS (number of cards per TABLE 1)

			AT "FROM" JOINT			AT "TO" JOINT					COORD. OF CENTER CIRCLE IN GLOBAL X-Y PLANE	
NO. OF MEM.	ELEM. PER MEM.	NON-LINEAR OPT.	JOINT NO.	CROSS SEC. NO.	PIN OPT.	JOINT NO.	CROSS SEC. NO.	PIN OPT.	SYM. SEC.	ENTER "1" FOR CURVE MEM.	XC	YC
I5	I5	I5	I5	I5	I5	I5	I5	I5	I5	I5	E10.3	E10.3
6–10	15	20	25	30	35	40	45	50	55	60	70	80

		AT "FROM" JOINT		AT "TO" JOINT		
MODULUS OF ELASTICITY		MOMENT OF INERTIA	AREA	MOMENT OF INERTIA	AREA	
E10.3		E10.3	E10.3	E10.3	E10.3	
11–20		31–40	50	60	70	80

The value of XC and YC are the global coordinates of the circular center of curvature of the circular are in the global X-Y plane.

Number of member must be input in ascending order started from 1 to their total number.

If TABLE 3A is held from the previous problem, no new information will be added.

If TABLE 3A is to be revised, it must be supplied with all of the required data.

Cross section may have any number from 1 to 20.

Maximum difference in joint numbers for joints that are connected by member is 5.

The maximum number of elements into which a number may be divided is 40.

Member station numbering begins with 1 for the first station at the left joint and proceeds in sequential order to the last station at the right joint.

Station coordinates are generated at equal intervals for either the straight member or curved member.

If any of the member stiffness properties are nonlinear, the nonlinear option is set equal to "1" and the second card describing the variation in the linear stiffness properties of the member is not required.

If the nonlinear option is left blank, the second card describing the variation in the linear stiffness properties of the member is required; all cross section numbers in the first card must be set equal to zero.

If "PIN OPTION" is equal to "1", the member is assumed pinned at the joint; if blank, the member is assumed rigidly connected at the joint.

The members are assumed to be straight line or segment of circular curves.

If columns 56-60 are left blank, the member is assumed to be straight.

If "1" is inserted in columns 56-60, the member is assumed to be a circular arc.

The total number of members in the frame must not exceed 30.

SYMMETRIC CROSS SECTION is set equal to "1" when the cross section of that member is symmetry.

TABLE 3B. CROSS SECTION PROPERTIES (Number of cards as per TABLE 1)

CROSS SEC. NO.	NO. OF SEGMENT	(first card of set)
I5	I5	
6 10	15	80

Second and succeeding cards of set:

CURVE NO.	STRESS MULT.	STRAIN MULT.	WIDTH OR DIAMETER	DEPTH OR THICKNESS	CENTROIDAL DISTANCE	AREA OPTION	
I5	E10.3	E10.3	E10.3	E10.3	E10.3	E10.3	
6 10	20	30	40	50	60	70	80

Cross sections do not have to be input in the order of their numbers.

Cross sections are defined as a series of up to 8 pieces. Each piece may be either a rectangle, circular, thin-wall, or an area which has a unique stress-strain curve number up to 5.

Maximum segment allowed for each cross section area is 8.

The centroidal distance input for the segment is the distance from the member X'-axis to the centroid of the segmental area. This distance is positive if it is in the same direction as of the member Y'-axis.

Linear interpolation along the length of the member between corresponding pieces is provided in the program; thus, the cross section input at the two joints should have the same number of pieces and the pieces should be input in the same order.

Interpolation between different types of cross sections is not allowed.

All data input for a cross section number replaces the previous data, if any, for that cross section number.

For a rectangular section, the value of "AREA OPTION" in columns 61-70 must be blank.

For a solid area, only the "centroidal distance" and "AREA OPTION" are required; columns 31-50 must be blank.

For a thin-wall section, the value of "AREA OPTION" in columns 61-70 must be equal to 2.0. Data in columns 31-40 is standing for outside diameter. Data in columns 41-50 is standing for the thickness of thin-wall. Data in columns 51-60 is standing for centroidal distance.

Again, if the thickness of the thin wall in columns 41-50 is equal to zero, that is a solid circular segment.

The maximum number of cards allowed for TABLE 3B is 50.

TABLE 3C. STRESS-STRAIN CURVE (number of cards as per TABLE 1; 2 cards per curve)

CURVE NO.	NO. OF PTS.	SYM. OPT.	STRESS VALUES										
I5	I5	I5	F10.3										
6 10	15	20	26 30	35	40	45	50	55	60	65	70	75	80

STRAIN VALUES										
F10.3										
26 30	35	40	45	50	55	60	65	70	75	80

Stress-Strain curves do not have to be input in the order of the curve number.

If the "SYMMETRIC OPTION" is equal to "1", then a symmetrical branch is provided internally.

The first value of sigma and epsilon must be equal to zero if the symmetric option is used.

Symmetrical curves may be input by specifying only the positive strain branch including the 0,0 point.

Corresponding pieces in a cross section at the joint must have the same number of points on the stress-strain curve. This allows linear interpolation along the length of the member.

The maximum number of curves allowed is 5.

The stress-strain curves must be input in such a manner that the final strain values will be in ascending algebraic order.

For a nonsymmetrical curve, the strain values must be input from negative to positive.

TABLE 4A. MEMBER LOAD (number of cards as per TABLE 1)

MEM. NO.	AXIS OPT.		"FROM" DISTANCE	"TO" DISTANCE	LOAD // TO X OR X' AXIS	LOAD // TO Y OR Y' AXIS	MOMENT ABOUT Z-AXIS
I5	I5		E10.3	E10.3	E10.3	E10.3	E10.3

6 10 15 20 30 40 50 60 70 80

Member loads do not have to be input in the order of their numbers.

Concentrated loads may not be specified at a distance of 0.0.

Applied loads can be input by using only one card or multiple cards.

Concentrated loads, member loads with only uniform loads over their full length or partially uniform loading may be input with individual card; other loading requires two or more cards.

Variable and partial uniform loading must be input in section by using two or more cards input consecutively.

If more than one card is used to describe a member load, the number of member is required for the first card only.

Concentrated loads are established as full values at single point by setting final distance = initial distance.

All sections, except concentrated load, must have their "TO" distance larger in absolute value than their "FROM" distance by more than the length of one element.

Member loads may be input by any one of the four axis options as follows:

Axis option 1--load is in the direction of member axis; distance is in the direction of member axis.
Axis option 2--load is in the direction of structure axis; distance is in the direction of member axis.
Axis option 3--load is in the direction of structure axis; distance is in the direction of structure X-axis.
Axis option 4--load is in the direction of structure axis; distance is in the direction of structure Y-axis.

An applied load is positive if its vector has the same sense as the corresponding global axis.

An applied moment is positive if its vector given by the right hand screw rule has the same sense as the global Z-axis.

Maximum number of cards allowed in TABLE 4A is 20.

Maximum number of cards allowed for each member is 10.

If "HOLDING OPTION" has been used, only loads in the member other than the one that has already been loaded in the previous problem is allowed to be added to the old data.

More than one axis can be used to describe a member load.

More than one set of loads can be applied on a member, but the number of axis is required on the first card of every set of loads; number of member is required on the first card of the first set only.

TABLE 4B. SELF-WEIGHT (number of cards as per TABLE 1)

WEIGHT PER UNIT VOLUME	MEMBER NUMBER									
	I5	I5	I5	I5	I5	I5	I5	I5	I5	I5
6 15	21 25	30	35	40	45	50	55	60	65	70 80

The repetition of member number allows the user to assign self-weight to 10 members with one card.

If "HOLDING OPTION" is used, all the members will be assigned the same old self-weight unless a new self-weight has been assigned by the cards added.

If the number of the member does not appear in the cards read, zero self-weight will be assigned to those members.

TABLE 4C. WIND AND WAVE FORCES (number of cards as per TABLE 1)

MASS DENSITY OF AIR	BASIC WIND VELOCITY	WIND CONSTANT	MEAN SEA LEVEL	
E10.3	E10.3	E10.3	E10.3	
6–15	15–25	25–35	35–45	80

NO. OF TIME INCR.	MASS DENSITY OF FLUID	WAVE PERIOD	WAVE HEIGHT	TIME PERIOD (t/T)	TIME INCREMENT (Δt/T)	
I5	E10.3	E10.3	E10.3	E10.3	E10.3	
6–10	10–20	20–30	30–40	40–50	50–60	80

DRAG COEFF. OF WIND	DRAG COEFF. OF WAVE	INERTIA COEFF. OF AIR	MEMBER NUMBER							
E10.3	E10.3	E10.3	I5	I5	I5	I5	I5	I5	I5	I5
6–15	15–25	25–35	41–45	45–50	50–55	55–60	60–65	65–70	70–75	75–80

If TABLE 4C is kept, no new information may be added.

If TABLE 4C is to be revised, it must be supplied with all of the required data.

The wind load can be assigned to the structure which is not taller than 600 ft.

For inland structure, set YSEA = 0 such that only wind load will be taken into account.

TABLE 5A. ELASTIC MEMBER RESTRAINT (number of cards as per TABLE 1)

MEM. NO.	"FROM" DISTANCE	"TO" DISTANCE	LOAD // TO X OR X' AXIS	LOAD // TO Y OR Y' AXIS	MOMENT ABOUT Z-AXIS	
I5	E10.3	E10.3	E10.3	E10.3	E10.3	
6 10	21 30	40	50	60	70	80

Elastic restraints do not have to be input in the order of their numbers.

Concentrated spring may not be specified at the distance of 0.0.

Elastic restraints for a member can be input by using only one card or multiple cards.

Concentrated spring and uniform distributed spring over their full length or partially distributed may be input with individual card; other type of elastic restraint requires two or more cards.

Variable and partially uniform spring must be input in section by using two or more cards input consecutively and sections may overlap.

If more than one card is used to describe a member load, the number of member is required for the first card on all sets of loads applied on a member.

Concentrated springs are established as full values at single point by setting final distance equal to initial distance.

All sections, except concentrated spring, must have their "TO" distances larger than their "FROM" distances by more than the length of one element.

Maximum cards for this table are 20.

Maximum cards for each member are 10.

If TABLE 5A is kept, no new information may be added to it.

If TABLE 5A has to be revised, it must be supplied with all of the required information.

TABLE 5B. SOIL SUPPORTING DATA (number of cards as per TABLE 1)

PENETRATION "FROM"	PENETRATION "TO"	SOIL SHEARING STRENGTH	DENSITY OF SOIL	
E10.3	E10.3	E10.3	E10.3	
6–15	25	31–40	50	80

Penetration below the ground level must be input in ascending order starting from 0.

Negative sign is required at tall distance below ground level.

Maximum number of cards for this table is 20.

Only one card or multiple cards can be used to describe the distance same as shown in the previous table.

If TABLE 5B is kept from the previous problem, no new data may be added to it.

If TABLE 5B is to be revised, it must be supplied with all of the required data.

TABLE 6. JOINT LOADS AND LINEAR SPRING SUPPORTS IN STRUCTURE AXES (Number of cards as per TABLE 1)

JOINT NO.	LOAD // TO X-AXIS	LOAD // TO Y-AXIS	MOMENT ABOUT Z-AXIS	RESTRAINT // TO X-AXIS	RESTRAINT // TO Y-AXIS	ROTATIONAL RESTRAINT ABOUT Z-AXIS	
I5	E10.3	E10.3	E10.3	E10.3	E10.3	E10.3	
6 10	20	30	40	50	60	70	80

All joint loads and linear supports (restraints) are specified with respect to the structure axes.

Joint loads and restraints are accumulated in TABLE 6.

Structure supports may be input as joint restraints (linearly elastic springs). Complete fixity of a joint may be achieved

Complete freedom of joint movements is obtained by not specifying any restraints at a joint.

A displacement may be enforced by specifying a very large restraint and a corresponding force equal to the desired displacement times the large restraint.

If the "HOLDING OPTION" for TABLE 6 is set equal to 1, the new joint load will be added to the old joint load kept from the previous problem.

TABLE 7. ITERATION CONTROL (3 cards unless held from previous problem)

NO. OF LOAD INCREMENT	
I5	
6–10	80

MAX. NO. OF ITERATIONS	FORCE ERROR	MOMENT ERROR		
I5	E10.3	E10.3	FRAME ITERATION	
6–10	16–25	35		80

MAX. NO. OF ITERATIONS	FORCE ERROR	MOMENT ERROR		
I5	E10.3	E10.3	MEMBER ITERATION	
6–10	16–25	35		80

The maximum number of iterations for the frame and member solutions should be specified to save computer time. Normally, convergence will have been reached within five iterations.

APPENDIX F

LISTING OF COMPUTER PROGRAM

```
C        MAIN PROGRAM
C
C     * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C     *                                                               *
C     *     LANGUAGE:       FORTRAN IV                                *
C     *                                                               *
C     *     COMPUTER:       IBM  /360  MODEL 65                       *
C     *                                                               *
C     *     PROGRAMMER:     CHITSANTI DHANASOBHON                     *
C     *                                                               *
C     *     PURPOSE:        A NONLINEAR ANALYSIS OF                   *
C     *                     PILE SUPPORTED PLANE FRAMES               *
C     *                                                               *
C     *                     PH.D.  DISSERTATION                       *
C     *                     OKLAHOMA STATE UNIVERSITY                 *
C     *                     JULY, 1976                                *
C     *                                                               *
C     * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * * *
C
C     MAIN PROGRAM
C>--->NLPSS
C>--->NONLINEAR PILE SUPPORTED STRUCTURE ANALYSIS
      IMPLICIT REAL * 8(A-H,O-Z)
C
C>--->DIMENSIONS
      DIMENSION ID1(40),ID2(19),JJ(10),QXXI(25),QYYI(25),QZZI(25)
      DIMENSION SMMT(21),FOMT(6),RXX(25),RYY(25),RZZ(25),NEM(30),DC(3,3)
      DIMENSION RM(17,126),RO(126),W(126),SL(17),SU(18)
C
C>--->COMMON
C
      COMMON / T1 / ITYPEL,KEEP4B,KEEP4C,NCD4B,NCD4C,NCD5BT,NCD4AT
      COMMON / T2 / XJ(25),YJ(25),XCN(30),YCN(30)
      COMMON / T3A / INLOP(30),IPINL(30),IPINR(30),KURVEN(30),ISYMA(30)
      COMMON / T3A1 / EL(30),FL1(30),AEL1(30),FL2(30),AEL2(30),NAL(30),
     1                NAR(30)
      COMMON / T3A2 / DC1(30),DC2(30),JT1(30),JT2(30)
      COMMON /T3BC / SM(50),EM(50),BI(50),DI(50),YI(50),SAREAI(50),
     1SIGT(5,10),EPST(5,10),NSG(20),NCI3B(20),NSS(50),NPT(5),ISYM(5)
      COMMON / T4A / XLL(20),XRL(20),QXL(20),QYL(20),QZL(20),SWT(30),
     1NCI4A(30),NCT4A(30)
      COMMON / T4C / AID,BWV,WIK,YSEA,FLD,WAT,WAH,WATT,WAK,WICD(30),
     1                WACD(30),WACM(30)
      COMMON / T5AB / XLS(20),XRS(20),QXS(20),QYS(20),QZS(20),PEF(20),
     1PET(20),CO(20),GAMA(20),NCI5A(30),NCT5A(30),KEEP5A,NCD5A ,NCD5B,
     2KEEP5B
      COMMON / T6 / QXX(25),QYY(25),QZZ(25),SXX(25),SYY(25),SZZ(25),
     1                ERXX(25),ERYY(25),ERZZ(25)
      COMMON / T7 / ERR1,ERR2,ER1,ER2,NLINC,LINC,MNITF,MNITM
      COMMON / CONST / MN,M,MP1,ZERO,PI
      COMMON / SGEN / XM(41),YM(41),DC1M(40),DC2M(40),
     1                XS(41),YS(41),DC1S(40),DC2S(40),DXY
      COMMON / SMID / DB(8),DDP(8),DIY(8),DAREA(8),DSIGL(8,10),
     1DEPSL(8,10),B(8),DP(8),Y(8),SAREA(8),WIDTH,AREAT,AEL,FL,
     2EPSTS(10),SIGTS(10),STRESS(8,19),STRAIN(8,19),NPTS(8),NSEGL
      COMMON / BLK4 / ST1,ST2,ST3,ST4,ST5,ST6,ST12,ST45
      COMMON / BLK5 / NFSUB,NITF
      COMMON / BLK6 / QT1,QT2,QT3,QT4,QT5,QT6
      COMMON / RI / NL,ML,J1
      COMMON / SCURVE / EIP(30,40),EIN(30,40),ENP(30,40),ENN(30,40),
     1BMYP(30,40),BMYN(30,40),AE(30,40)
      COMMON / SITER / PBAR,BMBAR,PHEBAR,EPTBAR,YBAR,KOFFC
      COMMON / BLOCK1 / QX(41),QY(41),QZ(41)
      COMMON / BLOCK2 / DX(30,41),DY(30,41),DZ(30,41)
      COMMON / BLOCK3 / TT(30,40),BM1(30,40),BM2(30,40)
      COMMON/BLOCK4/SX(41),SY(41),SZ(41),SXY(41),SQX(41),SQY(41),SQZ(41)
      COMMON / BLOCK5 / FOMM(30,6),SMC(30,21),IMC(30)
      COMMON / BLOC10 / U1,V1,W1,U2,V2,W2
      COMMON / BLOC11 / SEET(6,6)
      COMMON / BLOCK6 / DXX(25),DYY(25),DZZ(25),NITM(30)
      COMMON / BLOCK7 / V(3),P(3),VV(3),PP(3)
      COMMON / BLK3 / NM
C
C>--->DATA
C
      DATA MNJT,MNM,MNEM,MDJT /25,30,40,5/
       DATA MHB,MNCS,MNSG,MNSS / 17,20,8,5 /
      DATA ITEST,NEW /4H    ,4HNEW /
      ZERO = 0.0
      PI = 3.1415926
C
C>--->PROGRAM AND PROBLEM IDENTIFICATION
C
      READ1000,(ID1(I),I=1,40)
   10 READ1000,NPROB,(ID2(I),I=1,19)
      IF (NPROB.EQ.ITEST) GO TO 999
      PRINT 2000
      PRINT 2001,(ID1(I),I=1,40)
      PRINT 2002,NPROB,(ID2(I),I=1,19)
C
C>--->INPUT TABLE 1 PROGRAM CONTROL DATA
C
     0READ 1010,ITYPE,KEEP2,KEEP3A,KEEP3B,KEEP3C,KEEP4A,KEEP4B,KEEP4C,
     1KEEP5A,KEEP5B,KEEP6,KEEP7,NCD2,NCD3A,NCD3B,NCD3C,NCD4A,NCD4B,
     2NCD4C,NCD5A,NCD5B,NCD6,NCD7
     0PRINT 2010,ITYPE,KEEP2,KEEP3A,KEEP3B,KEEP3C,KEEP4A,KEEP4B,KEEP4C,
     1KEEP5A,KEEP5B,KEEP6,KEEP7,NCD2,NCD3A,NCD3B,NCD3C,NCD4A,NCD4B,
     2NCD4C,NCD5A,NCD5B,NCD6,NCD7
C
C>--->TEST ALL HOLD OPTIONS BLANK FOR NEW PROBLEM
C
      IF (NEW.EQ.ITEST) GO TO 20
      KEKE=KEEP2+KEEP3A+KEEP3B+KEEP3C+KEEP4A+KEEP4B+KEEP4C+KEEP5A+KEEP5B
     *     +KEEP6+KEEP7
      IF(KEKE.NE.0) GO TO 900
      NEW=ITEST
C>--->READ,ECHOPRINT AND DISTRIBUTE TABLE 2 - JOINT COORDINATES
C
   20 PRINT 2020
      IF (KEEP2.EQ.0) GO TO 30
      IF (NCD2.NE.0) GO TO 901
      PRINT 2121
      GO TO 60
C
C>--->READ ALL NEW DATA
C
```

```
   30 IF(NCD2.LT.2) GO TO 902
      DO 40 I=1,NCD2
      READ 1020,J,XJ(J),YJ(J)
      PRINT 2040,J,XJ(J),YJ(J)
   40 CONTINUE
      NJT=NCD2
   50 IF(NJT.GT.MNJT) GO TO 903
C
C>--->READ,ECHO PRINT TABLE 3A - MEMBER LOCATIONS
C
   60 IF (KEEP3A.EQ.1) GO TO 70
      IF (NCD3A.LT.1) GO TO 904
      GO TO 80
   70 IF (NCD3A.NE.0) GO TO 905
C
C>--->PRINT HEADING FOR THE FIRST TABLE OF TABLE 3A
C
   80 PRINT 2060
      IF (KEEP3A.EQ.0) GO TO 90
C
C>--->NO NEW DATA
C
      PRINT 2120
      GO TO 160
C
C>--->FOR NEW DATA SET INITIAL VALUE OF EI AND AE EQUAL TO ZERO
C
   90 DO 100 J = 1,MNM
      FL1(J)=0.0
      FL2(J)=0.0
      AEL1(J)=0.0
      AEL2(J)=0.0
  100 CONTINUE
      NCOUNT=0
C
C>--->INPUT NONLINEAR MEMBER PROPERTIES
C
  110 READ 1030,NM,NEM(NM),INLOP(NM),JT1(NM),NAL(NM),IPINL(NM),JT2(NM),
     1NAR(NM),IPINR(NM),ISYMA(NM),KURVEN(NM),XCN(NM),YCN(NM)
C
C>--->CHECK FOR BAD DATA
C
      IF (NM.LE.0.OR.NM.GT.MNM) GO TO 906
      IF(NEM(NM).GT.MNEM.OR.NEM(NM).LE.0) GO TO 907
      IF (INLOP(NM).LT.0.OR.INLOP(NM).GT.1) GO TO 908
      IF (JT1(NM).GT.MNJT.OR.JT1(NM).LT.0) GO TO 909
      IF(JT2(NM).GT.MNJT.OR.JT2(NM).LT.0) GO TO 909
      IF (JT1(NM).GT.NJT.OR.JT2(NM).GT.NJT) GO TO 909
      IF (NAL(NM).GT.MNCS.OR.NAL(NM).LT.0) GO TO 910
      IF (NAR(NM).GT.MNCS.OR.NAR(NM).LT.0) GO TO 910
      IF (IPINL(NM).LT.0.OR.IPINL(NM).GT.1) GO TO 911
      IF (IPINR(NM).LT.0.OR.IPINR(NM).GT.1) GO TO 911
      NCOUNT=NCOUNT+1
      IF (INLOP(NM).EQ.1) GO TO 120
C
C>--->INPUT LINEAR PROPERTIES OF MEMBER
C
      READ 1040 ,EL(NM),FL1(NM),AEL1(NM),FL2(NM),AEL2(NM)
      AEL1(NM) = AEL1(NM) * EL(NM)
      FL1(NM) = FL1(NM) * EL(NM)
      AEL2(NM) = AEL2(NM) * EL(NM)
      FL2(NM) = FL2(NM) * EL(NM)
      NCOUNT=NCOUNT+1
C
C>--->CHECK FOR BAD DATA
C
  120 IF (NAL(NM).GT.0.AND.NAR(NM).GT.0) GO TO 130
      IF (FL1(NM).LT.0.OR.FL2(NM).LE.0) GO TO 912
      IF(AEL1(NM).LT.0.OR.AEL2(NM).LE.0) GO TO 912
      GO TO 140
  130 TEMP=FL1(NM)+FL2(NM)+AEL1(NM)+AEL2(NM)
      IF (TEMP. GT.1.0E-10) GO TO 913
  140 IF(NCOUNT. LT. NCD3A) GO TO 110
      DO 150 J=1, NM
      PRINT 2070, J, NEM(J), INLOP(J), JT1(J), NAL(J), IPINL(J),
     1JT2(J),NAR(J),IPINR(J)
  150 CONTINUE
C
C>--- >PRINT HEADING OF SECOND TABLE OF TABLE 3A
C
  160 PRINT 2080
      IF(KEEP3A.NE.1) GO TO 170
C
C>--->NO NEW DATA
C
      PRINT 2120
      GO TO 190
  170 DO 180 J=1,NM
      IF(INLOP(J).EQ.1) GO TO 180
      PRINT 2090,J,EL(J),FL1(J),AEL1(J),FL2(J),AEL2(J)
  180 CONTINUE
C
C>--->PRINT HEADING OF THIRD TABLE OF TABLE 3A
C
  190 PRINT 2100
      IF(KEEP3A.NE.1) GO TO 200
C
C>----NO NEW DATA
C
      PRINT 2120
      GO TO 230
  200 IDJT = 0
      IDJ=0
      DO 220 J=1,NM
      J1=JT1(J)
      J2=JT2(J)
      TEMP1 = XJ(J2) - XJ(J1)
      TEMP2 = YJ(J2) - YJ(J1)
C
C>--->COMPUTE LENGTH AND DIRECTION COSINE
C
      ZL = DSQRT(TEMP1*TEMP1 + TEMP2*TEMP2)
      DC1(J) = TEMP1/ZL
      DC2(J) = TEMP2/ZL
C
C>--->COMPUTE HALF BAND WIDTH OF FRAME
```

```
C
      IDJT = IABS(J2 - J1)
      IF(IDJT.GT.IDJ) IDJ=IDJT
C
C>--->PRINT DATA ON THE TABLE
C
      IF(KURVEN(J).EQ.1) GO TO 210
      PRINT 2110,J,ZL,DC1(J),DC2(J)
      GO TO 220
  210 PRINT 2111,J,ZL,DC1(J),DC2(J),XCN(J),YCN(J)
  220 CONTINUE
      IF(IDJ.GT.MDJT) GO TO 914
C
C>--->READ AND ECHO PRINT TABLE 3B-CROSS-SECTION AREA PROPERTIES
C
C>--->PRINT  TABLE 3B HEADING
  230 PRINT 2130
      IF(NCD3B.GT.0.OR.KEEP3B.EQ.1) GO TO 240
      PRINT 2121
      GO TO 300
  240 IF(NCD3B.NE.0) GO TO 250
      PRINT 2120
      GO TO 300
  250 IF (KEEP3B.EQ.1) PRINT 2140
      IF(KEEP3B.NE.1) NCT3B=0
      NC=0
  260 READ 1050,NAT,NSGT
      PRINT 2150,NAT,NSGT
      IF(NAT.GT.MNCS.OR.NAT.LT.0) GO TO 910
      IF(NSGT.LE.0.OR.NSGT.GT.MNSG) GO TO 915
      NSG(NAT)=NSGT
      NCI3B(NAT)=NCT3B+1
      PRINT 2160
      DO 290 J=1,NSGT
      NCT3B=NCT3B+1
      READ1060,NSS(NCT3B),SM(NCT3B),EM(NCT3B),BI(NCT3B),
     2 DI(NCT3B),YI(NCT3B),SAREAI(NCT3B)
      IF(NSS(NCT3B).LT.0.OR.NSS(NCT3B).GT.MNSS)GO TO 916
      IF(SAREAI(NCT3B).GT.1.0E-10) GO TO 270
      PRINT 2170,J,NSS(NCT3B),SM(NCT3B),EM(NCT3B),BI(NCT3B),
     2DI(NCT3B),YI(NCT3B)
      GO TO 290
  270 IF(BI(NCT3B).GT.1.0E-10) GO TO 280
      PRINT2180,J,NSS(NCT3B),SM(NCT3B),EM(NCT3B),YI(NCT3B),SAREAI(NCT3B)
      GO TO 290
  280 PRINT 2190,J,NSS(NCT3B),SM(NCT3B),EM(NCT3B),BI(NCT3B),
     2DI(NCT3B),YI(NCT3B)
  290 CONTINUE
      NC=NC+1+NSG(NAT)
      IF(NC.LT.NCD3B) GO TO 260
      IF( NC.GT.NCD3B) GO TO 917
  300 CONTINUE
C
C>--->READ AND ECHO PRINT TABLE 3C-STRESS-STRAIN CURVE
C
C>----PRINT HEADING OF TABLE 3C
      PRINT 2200
      IF(NCD3C.GT.0.OR.KEEP3C.EQ.1) GO TO 310
C
C>--->NO DATA
C
      PRINT 2121
      GO TO 360
  310 IF(NCD3C.NE.0) GO TO 320
C
C>--->USING DATA FROM PREVIOUS PROBLEM
C
      PRINT 2120
      GO TO 360
  320 IF(KEEP3C.EQ.1) PRINT 2140
      NCD3C2=NCD3C/2
      IF(NCD3C2*2.NE.NCD3C) GO TO 918
C
C>--->INPUT STRESS-STRAIN CURVE IN TWO CARDS
C
      DO 350 J=1,NCD3C2
      READ1065,NC,NPTT,ISYM(NC),(SIGT(NC,I),I=1,10),(EPST(NC,I),I=1,10)
      NPT(NC)=NPTT
      IF(ISYM(NC).EQ.1) GO TO 330
      PRINT 2210,NC,NPT(NC),(SIGT(NC,I),I=1,NPTT)
      PRINT 2212 , (EPST(NC,I),I=1,NPTT)
      GO TO 340
  330 PRINT 2211,NC,NPT(NC),(SIGT(NC,I),I=1,NPTT)
      PRINT 2212 , (EPST(NC,I),I=1,NPTT)
  340 IF(ISYM(NC).EQ.1.AND.SIGT(NC,1).GT.1.0E-10) GO TO 919
      IF(ISYM(NC).EQ.1.AND.EPST(NC,1).GT.1.0E-10) GO TO 919
      IF(ISYM(NC).NE.1.AND.ISYM(NC).NE.0) GO TO 920
      IF(NPTT.LT.2.OR.NPTT.GT.10) GO TO 921
      IF(NC.LT.0.OR.NC.GT.MNSS) GO TO 922
  350 CONTINUE
  360 CONTINUE
C
C>--->READ AND ECHO PRINT TABLE 4A APPLIED MEMBER LOAD
C
C>--->PRINT TABLE HEADING
      PRINT 2220
      IF(NCD4A.GT.0.OR.KEEP4A.EQ.1)GO TO 370
      PRINT 2121
      NCD4AT = 0
      GO TO 520
  370 IF(NCD4A.NE.0) GO TO 380
      PRINT 2120
      GO TO 520
  380 CONTINUE
C
C>--->INITIALIZE CONTROL CONSTANTS
C
      IF(KEEP4A.EQ.1) GO TO 400
      DO 390 J=1, MNM
      NCI4A(J)=0
  390 NCT4A(J) = 0
      NCD4AT=0
      GO TO 410
  400 PRINT 2140
  410 PRINT 2221
C>---> START READING CARDS
```

```
      DO 510 II=1,NCD4A
      READ 1070,MNT,IAXOPT,XLLT,XRLT,QXLT,QYLT,QZLT
      IF(MNT.NE.0) MN=MNT
      IF(IAXOPT.NE.0) IAXOP=IAXOPT
      IF(KURVEN(MN).EQ.1.AND.IAXOP.NE.1) GO TO 923
      IF(MNT.EQ.0.OR.IAXOPT.EQ.0) GO TO 420
      PRINT 2230,MN,IAXOP,XLLT,XRLT,QXLT,QYLT,QZLT
      GO TO 430
  420 PRINT 2240, XLLT,XRLT,QXLT,QYLT,QZLT
  430 IF(NCI4A(MN).EQ.0) NCI4A(MN)=NCD4AT+II
      NC=NCI4A(MN)+NCT4A(MN)
C>--->CHECK FOR BAD DATA
      IF(IAXOP.LT.1.OR.IAXOP.GT.4) GO TO 924
      IF(DABS(XLLT).GT.DABS(XRLT)) GO TO 925
C>--->CONVERT DISTANCES TO MEMBER CO-ORDINATES
      GO TO (460,460,450,440),IAXOP
  440 XLL(NC)=XLLT/DC2(MN)
      XRL(NC)=XRLT/DC2(MN)
      GO TO 470
  450 XLL(NC)=XLLT/DC1(MN)
      XRL(NC)=XRLT/DC1(MN)
      GO TO 470
  460 XLL(NC)=XLLT
      XRL(NC) = XRLT
  470 IF(IAXOPT.EQ.0) XRL(NC)=-1.0
      DIFF=DABS(XLLT-XRLT)
      IF(IAXOP.EQ.1) GO TO 490
      IF(IAXOP.EQ.2.OR.DIFF.LT.1.0E-10) GO TO 480
C>--->AXIS OPTIONS 3 OR 4
      TEMP1=DABS(DC1(MN))
      TEMP2=DABS(DC2(MN))
      QXL(NC)=QXLT*DC1(MN)*TEMP2+QYLT*DC2(MN)*TEMP1
      QYL(NC)=QYLT*DC1(MN)*TEMP1-QXLT*DC2(MN)*TEMP2
      GO TO 500
C
C>--->AXIS OPTION 2 OR CONCENTRATED LOAD
C
  480 QXL(NC)=QXLT*DC1(MN)+QYLT*DC2(MN)
      QYL(NC)=-QXLT*DC2(MN)+QYLT*DC1(MN)
      GO TO 500
C
C>--->AXIS OPTION 1 - LOAD ALREADY IN MEMBER AXIS
C
  490 QXL(NC)=QXLT
      QYL(NC)=QYLT
  500 CONTINUE
      QZL(NC)=QZLT
      NCT4A(MN)=NCT4A(MN)+1
  510 CONTINUE
  520 NCD4AT=NCD4AT+NCD4A
      IF (NCD4AT.GT.50) GO TO 926
C
C     READ AND ECHO PRINT TABLE4B SELFWEIGHT
C
C     PRINT TABLE HEADING
      PRINT 2250
      IF(NCD4B.GT.0.OR.KEEP4B.EQ.1) GO TO 530
C
C     NO NEW DATA
C
      PRINT 2121
      GO TO 610
  530 IF(NCD4B.NE.0) GO TO 540
C
C     USING 1 DATA FROM PREVIOS PROBLEM
C
      PRINT 2120
      GO TO 610
  540 IF(KEEP4B.EQ.1) GO TO 560
C
C     INITIALIZE SELFWEIGHT EQUAL TO ZERO
C
      DO 550 J=1,MNM
  550 SWT(J) = 0.0
  560 DO 600 J=1,NCD4B
      READ 1080,WT,(JJ(I),I=1,10)
      II=0
      DO 570 I=1,10
      IF(JJ(I).GT.MNM.OR.JJ(I).LT.0) GO TO 927
      IF(JJ(I).EQ.0) GO TO 580
  570 II=II+1
  580 PRINT 2260,WT,(JJ(I),I=1,II)
      DO 590 I=1,II
      J1=JJ(I)
      IF(J1.GT.NM)GO TO 928
  590 SWT(J1)=WT
  600 CONTINUE
  610 CONTINUE
C
C     READ AND ECHO PRINT TABLE 4 C WIND AND WAVE FORCE
C
C     PRINT HEADING OF TABLE 4 C
      PRINT 2270
      IF(KEEP4C.NE.1) GO TO 620
      IF(NCD4C.NE.0) GO TO 929
C
C     USING DATA FROM PREVIOUS PROBLEM
C
      PRINT 2120
      GO TO 680
  620 IF(NCD4C.NE.0) GO TO 630
C
C     NO DATA
C
      PRINT 2121
      GO TO 680
C
C     START READIND AND ECHO PRINT
C
  630 READ 1090,AID,BWV,WIK,YSEA,ITIMEI,FLD,WAT,WAH,WATTI,WADTT
      PRINT 2280,AID,BWV,WIK,YSEA,FLD,WAT,WAH,WATTI,WADTT,ITIMEI
      NM2=NCD4C-2
      DO 670 J=1,NM2
      READ 1100,WICDT,WACDT,WACMT,(JJ(I),I=1,8)
      II = 0
      DO 640 I = 1,8
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      IF(JJ(I).GT.MNM) GO TO 928
      IF(JJ(I).EQ.0) GO TO 650
  640 II=II+1
  650 PRINT 2290,WICDT,WACDT,WACMT,(JJ(I),I=1,II)
      DO 660 I=1,II
      J1=JJ(I)
      WICD(J1)=WICDT
      WACD(J1)=WACDT
  660 WACM(J1)=WACMT
  670 CONTINUE
      WAK = 0.102648/(WAT*WAT)
  680 CONTINUE
C
C     READ AND ECHO PRINT TABLE5A ELASTIC MEMBER RESTRAIN
C
C     PRINT TABLE HEADING
      PRINT 2300
      IF(NCD5A.GT.0.OR.KEEP5A.EQ.1) GC TO 690
      PRINT 2121
      GO TO 750
  690 IF(NCD5A.NE.0) GO TO 700
      PRINT 2120
      GO TO 750
C
C>--->INITIALIZE CONTROL CONSTANTS
C
  700 IF(KEEP5A) 930,705,930
  705 DO 710 J = 1,MNM
      NCI5A(J) = 0
  710 NCT5A(J) = 0
      PRINT 2301
C
C>--->START READING CARDS
C
      DO 740 J = 1,NCD5A
      READ 1070 , MNT,XLS(J),XRS(J),QXS(J),QYS(J),QZS(J)
      IF(MNT) 720,715,720
  715 PRINT 2240,XLS(J),XRS(J),QXS(J),QYS(J),QZS(J)
      GO TO 730
  720 MN = MNT
      PRINT 2231,MN,XLS(J),XRS(J),QXS(J),QYS(J),QZS(J)
  730 IF(NCI5A(MN).EQ.0) NCI5A(MN) = J
      IF(XLS(J).LT.0.AND.XRS(J).LT.0) GO TO 932
      IF(MNT.EQ.0) XRS(J) = -1.0
      NCT5A(MN) = NCT5A(MN) + 1
  740 CONTINUE
  750 CONTINUE
C
C     READ AND ECHO PRINT TABLE 5B - SOIL DATA
      PRINT 2310
      IF(NCD5B.GT.0.OR.KEEP5B.EQ.1) GC TO 850
      PRINT 2121
      GO TO 880
  850 IF(KEEP5B.NE.1) GO TO 860
      IF(NCD5B.NE.0) GO TO 934
      PRINT 2120
      GO TO 880
  860 DO 870 J=1,NCD5B
      READ 1110,PEF(J),PET(J),CO(J),GAMA(J)
      PRINT 2320,PEF(J),PET(J),CO(J),GAMA(J)
  870 CONTINUE
      NCD5BT=NCD5B
  880 CONTINUE
C
C     READ AND ECHO PRINT TABLE 6 - JOINT LOADS AND
C     LINEAR SUPPORT IN STRUCTURE AXES
C
C     PRINT TABLE HEADING
      PRINT 2330
      IF(KEEP6.EQ.1) GO TO 3030
C
C     ZERO JOINT DATA
C
      DO 3020 I=1,MNJT
      QZZI(I) = 0.0
      QYYI(I) = 0.0
      QXXI (I) = 0.0
      SXX(I)=0.0
      SYY(I)=0.0
 3020 SZZ(I)=0.0
      IF(NCD6.NE.0) GO TO 3050
      PRINT 2121
      GO TO 3070
 3030 IF(NCD6.NE.0) GO TO 3040
      PRINT 2120
      GO TO 3070
 3040 PRINT 2140
 3050 PRINT 2340
      DO 3060 J=1,NCD6
      READ 1120,I,QXXT,QYYT,QZZT,SXXT,SYYT,SZZT
      PRINT 2350,I,QXXT,QYYT,QZZT,SXXT,SYYT,SZZT
      IF(I.GT.NJT.OR.I.LT.0) GO TO 935
C
C     ACCUMULATE DATA
C
      QXXI(I) = QXXI(I) + QXXT
      QYYI(I) = QYYI(I) + QYYT
      QZZI(I) = QZZI(I) + QZZT
      SXX(I)=SXX(I)+SXXT
      SYY(I)=SYY(I)+SYYT
      SZZ(I)=SZZ(I)+SZZT
 3060 CONTINUE
 3070 CONTINUE
C
C>--->READ AND ECHO PRINT TABLE 7-ITERATION CONTROL
C
C>--->PRINT TABLE HEADING
      PRINT 2360
      IF(KEEP7.EQ.1) GO TO 3120
      IF(NCD7.NE.3) GO TO 936
      READ 1130,LINCI
      READ 1020,MNITF,ERR1,ERR2
      READ1020,MNITM,ER1,ER2
      PRINT 2370,LINCI
      PRINT 2380
      PRINT 2400,MNITF,ERR1,ERR2
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      PRINT 2390
      PRINT 2400,MNITM,ER1,ER2
      GO TO 3130
 3120 PRINT 2120
 3130 CONTINUE
C
C     START SOLUTION
C
      ITIME=0
      LINC=LINCI
      ITYPEL=ITYPE
      IF(NCD4C.NE.0.OR.KEEP4C.NE.0)WATT=WATTI
 5000 DO 9999 NLINC=1,LINC
      IF (NLINC.NE.1) ITYPEL=2
C
C     JOINT LOAD AND JOINT EQUILIBRIUM ERROR
C
      IF (ITYPEL-2) 5010,5030,5010
 5010 DO 5020 J = 1,NJT
      QXX(J)=0.0
      QYY(J)=0.0
      QZZ(J) = 0.0
 5020 CONTINUE
 5030 DO 5040 J=1,NJT
      ERXX(J)=QXX(J)
      ERYY(J)=QYY(J)
      ERZZ(J)=QZZ(J)
 5040 CONTINUE
      TEMP=NLINC/LINC
      DO 5050 J=1,NJT
      QXX(J)=QXXI(J)*TEMP
      QYY(J)=QYYI(J)*TEMP
      QZZ(J)=QZZI(J)*TEMP
 5050 CONTINUE
      DO 5060 J=1,NJT
      ERXX(J)=QXX(J)-ERXX(J)
       ERYY(J)=QYY(J)-ERYY(J)
      ERZZ(J)=QZZ(J)-ERZZ(J)
 5060 CONTINUE
      IF (ITYPEL.EQ.2) GO TO 5090
C
C     ZERO FORCE IN THE ELEMENT
C
      DO 5075 I=1,NM
      DO 5070 J=1,MNEM
      TT(I,J)=0.0
      BM1(I,J)=0.0
      BM2(I,J)=0.0
 5070 CONTINUE
 5075 CONTINUE
C
C     ZERO MEMBER DISPLACEMENT
C
      M = MNEM + 1
      DO 5085 I=1,NM
      DO 5080 J=1,M
      DX(I,J)=0.0
      DY(I,J)=0.0
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      DZ(I,J)=0.0
 5080 CONTINUE
 5085 CONTINUE
 5090 CONTINUE
      NITF=0
 5100 CONTINUE
      NITF=NITF+1
C
C     FORM MEMBER STIFFNESS MATRIX AND MEMBER FIXED-END-FORCE MATRICES
C
      DO 5800 MN=1,NM
      M=NEM(MN)
      MP1=M+1
C
C     CALL GEN TO LOCATE STATION COORDINATES
C
      CALL GENE
C
      IF (INLOP(MN).EQ.0) GO TO 5500
      CALL CURVE
C     CALL FORMST CALCULATES MEMBER 6X6 STIFFNESS MATRIX
C     AND TAKING ADVANTAGE OF SYMMETRY STORE IN COMPACT VECTOR
C     SMMT(I=1,21)
C
 5500 CALL FORMST(RM,RO,W,SL,SU,SMMT)
      DO 5510 I=1,21
 5510 SMC(MN,I)=SMMT(I)
      IF (NITF.GT.1) GO TO 5750
C
C     SUBROUTINE FORMLD CALCULATE MEMBER INCREMENTAL FIXED-END-FORCE
C     MATRIX ON FIRST ITERATION OF EACH PROBLEM
C
      CALL FORMLD (RM,RO,W,SL,SU,FOMT)
      DO 5710 I=1,6
 5710 FOMM(MN,I)=FOMT(I)
      GO TO 5800
C
C     SET FIXED END FORCE MATRIX TO NULL MATRIX FOR NULL LOADING
C
 5750 DO 5780 I=1,6
 5780 FOMM(MN,I)=0.0
 5800 CONTINUE
C
C     START SOLUTION OF FRAM JOINT EQUILIBRIUM EQUATIONS
C     SET CONTROL CONSTANTS FOR FRAM SOLUTION
C
      NL=3*NJT
      IHB=3*IDJ+2
      ML=1
      NFSUB=21
      IF ((ITYPEL.EQ.2.OR.NITF.GT.1) GO TO 6300
C
C     ZERO JOINT DISPLACEMENT UNLESS HOLDING FROM THE PREVIOUS
C     PROBLEM OR PREVIOUS ITERATION
C
      DO  6250 I=1,NJT
      DXX(I)=0.0
      DYY(I) = 0.0
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6250 DZZ(I)=0.0
6300 CONTINUE
C
C     CALL GRIP2A FOR SOLUTION OF FRAM JOINT EQUILIBRIUM
C     EQUATION .GRIP2A CALL FSUB1 WHICH CALLS FSUB2 TO SET UP
C     FRAM EQUATION
C
      CALL GRIP2A(RM,RO,W,SL,SU,IHB)
C
C     ADD ON INCREMENT OF JOINT DISPLACEMENT
C
      J=0
      DO 6500 I=1,NJT
      J=J+1
      DXX(I)=DXX(I)+W(J)
      J=J+1
      DYY(I)=DYY(I)+W(J)
      J=J+1
      DZZ(I)=DZZ(I)+W(J)
 6500 CONTINUE
C
C     SOLVE FOR JOINT REACTION
C
      DO 6600 I=1,NJT
      RXX(I)=-SXX(I)*DXX(I)
      RYY(I)=-SYY(I)*DYY(I)
      RZZ(I)=-SZZ(I)*DZZ(I)
 6600 CONTINUE
C
C     COMPUTE FOR EACH JOINT THE SUM OF APPLIED JOINT LOAD AND
C     THE REACTION-WHEN THE APPROPRIATE MEMBER AND FORCE ARE
C     SUBTRACTED FROM THIS SUM THE RESULT IS JOINT EQUILIBRIUM ERROR
C
      DO 7250 I=1,NJT
      ERXX(I)=QXX(I)+RXX(I)
      ERYY(I)=QYY(I)+RYY(I)
      ERZZ(I)=QZZ(I)+RZZ(I)
 7250 CONTINUE
      PRINT 155,NITF
C
C     START NONLINEAR MEMBER SOLUTION
C
      NMNC=0
      DO 7500 MN=1,NM
      M=NEM(MN)
      MP1=M+1
      IMC(MN)=0
      NITM(MN)=0
C
C     LOCATIONS OF ALL STATIONS IN EACH MEMBER
C
      CALL GENE
      IF(INLCP(MN).EQ.0) GO TO 7300
C
C     CALL SUBROUTINE MEMSOL FOR ITERATIVE SOLUTIO OF MEMBER TO FIND
C     MEMBER AND FORCE FOR JOINT EQUILIBRIUM CHECK IN FRAM SOLUTION
C
 7300 CALL MEMSOL (RM,RO,W,SL,SU)
      IF (IMC(MN).EQ.1) NMNC=NMNC+1
 7500 CONTINUE
C
C     COMPUTE THE NUMBER OF JOINT NOT CLOSE
C     SKIP CHECKS CORRESPONDING TO SPECIFIED DISPLACEMENTS
C
      NJNC=0
      DO 8700 I=1,NJT
      IF (DABS(ERXX(I)).GT.ERR1) GO TO 8600
      IF (DABS(ERYY(I)).GT.ERR1) GO TO 8600
      IF (DABS(ERZZ(I)).GT.ERR2) GO TO 8600
      GO TO 8700
 8600 NJNC=NJNC+1
 8700 CONTINUE
      IF (NJNC.EQ.0) GO TO 8900
      PRINT 175,NJNC,NITF
      IF(NITF.EQ.MNITF.OR.NMNC.GT.0) GO TO 8950
C
C     PRINT SUMMARY OF FRAM ITERATION
C
      PRINT 181,NITF
      DO 8800 I=1,NJT
      PRINT 182,I,DXX(I),DYY(I),DZZ(I),ERXX(I),ERYY(I),ERZZ(I)
 8800 CONTINUE
      GO TO 5100
 8900 PRINT 177,NITF
 8950 CONTINUE
      IF (NMNC.GT.0) PRINT 185,NMNC,NITF
C
C     PRINT TABLE 8 JOINT DISPLACEMENT AND REACTIONS
C
      PRINT  2000
      PRINT 2001,(ID1(I),I=1,40)
      PRINT 2002,NPROB,(ID2(I),I=1,19)
      IF (NJNC.GT.0.OR.NMNC.GT.0) PRINT 777
      PRINT 151
      DO 8965   I=1,NJT
      PRINT 152,I,DXX(I),DYY(I),DZZ(I),RXX(I),RYY(I),RZZ(I)
 8965 CONTINUE
C
C     PRINT TABLE 9 OUTPUT MEMBER RESULT
C
      DO 8995 MN=1,NM
      M=NEM(MN)
      MP1 = M + 1
C
C     CALL GEN TO LOCATE STATION COORDINATES
C
      CALL GENE
C
C     LOAD IN MEMBER AND STORE MEMBER END LOADS IN QT1-QT6
C
      CALL LOAD
      QT1=QX(1)
      QT2=QY(1)
      QT3=QZ(1)
      QT4=QX(MP1)
      QT5=QY(MP1)
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      QT6=QZ(MP1)
C
C     MEMBER STIFFNESS DATA
C
      CALL SSP
C
C     PRINT HEADING
C
      PRINT 2000
      PRINT 2001,(ID1(I),I=1,40)
      PRINT 2002,NPROB,(ID2(I),I=1,19)
      PRINT 51
      IF (NJNC.GT.0.OR.NMNC.GT.0) PRINT 777
      IF (IMC(MN).EQ.1) PRINT 99
      PRINT 61,MN,JT1(MN),JT2(MN)
      PRINT 101
C
C     PRINT COMPLETE RESULT
C
C     FORM STARTED JOINT
      CALL ELEND(1)
      P(1)=-U1+SQX(1)+QT1
      P(2) = V1 - SQY(1) - QT2
      P(3)=-W1+SQZ(1)+QT3
      V(1)=DX(MN,1)
      V(2) = DY(MN,1)
      V(3)=DZ(MN,1)
      IF (KURVEN(MN).EQ.1) GO TO 8970
      PRINT 111,XM(1),YM(1),V(1),V(2),V(3),P(1),P(2),P(3)
      GO TO 8975
C
C     FORM TRANSFORMATION MATRIX
C
 8970 DC(1,3)=0.0
      DC(2,3)=0.0
      DC(3,2)=0.0
      DC(3,1)=0.0
      DC(3,3)=1.0
      DC(1,1)=DC1M(1)
      DC(2,2)=DC1M(1)
      DC(1,2)=DC2M(1)
      DC(2,1)=-DC(1,2)
C
C     TRANSFORM FORCE AND DISPLACEMENT TO NORMAL AND TANGENTIAL
C
      CALL MATM31(DC,V,VV)
      CALL MATM31(DC,P,PP)
      PRINT 111,XM(1),YM(1),VV(1),VV(2),VV(3),PP(1),PP(2),PP(3)
C
C     INTERIOR STATION
C
 8975 DO 8985 J=2,M
      P(1)=U2
      P(2)=-V2
      P(3)=W2
      CALL ELEND(J)
      P(1)=(P(1)-U1)*0.5
      P(2)=(P(2)+V1)*0.5
      P(3)=(P(3)-W1)*0.5
      V(1)=DX(MN,J)
      V(2)=DY(MN,J)
      V(3)=DZ(MN,J)
      IF (KURVEN(MN).EQ.1) GO TO 8980
      PRINT 111,XM(J),YM(J),V(1),V(2),V(3),P(1),P(2),P(3)
      GO TO 8985
 8980 DC(1,3)=0.0
      DC(2,3)=0.0
      DC(3,1)=0.0
      DC(3,2)=0.0
      DC(3,3)=1.0
      DC(1,1)=0.5*(DC1M(J)+DC1M(J-1))
      DC(2,2)=DC(1,1)
      DC(1,2)=0.5*(DC2M(J)+DC2M(J-1))
      DC(2,1)=-DC(1,2)
C
C     TO NORMAL AND TANGENTIAL DIRECTION
C     TRANSFORM FORCE AND DISPLACEMENT
C
      CALL MATM31(DC,V,VV)
      CALL MATM31(DC,P,PP)
      PRINT 111,XM(J),YM(J),VV(1),VV(2),VV(3),PP(1),PP(2),PP(3)
 8985 CONTINUE
C
C     END STATION
C
      P(1)=U2-SQX(MP1)-QT4
      P(2)=-V2+SQY(MP1)+QT5
      P(3)=W2-SQZ(MP1)-QT6
      V(1)=DX(MN,MP1)
      V(2)=DY(MN,MP1)
      V(3)=DZ(MN,MP1)
      IF (KURVEN(MN).EQ.1) GO TO 8990
      PRINT 111,XM(MP1),YM(MP1),V(1),V(2),V(3),P(1),P(2),P(3)
      GO TO 8995
 8990 DC(1,3)=0.0
      DC(2,3)=0.0
      DC(3,1)=0.0
      DC(3,2)=0.0
      DC(3,3)=1.0
      DC(1,1)=DC1M(M)
      DC(2,2)=DC(1,1)
      DC(1,2)=DC2M(M)
      DC(2,1)=-DC(1,2)
      CALL MATM31(DC,V,VV)
      CALL MATM31(DC,P,PP)
      PRINT 111,XM(MP1),YM(MP1),VV(1),VV(2),VV(3),PP(1),PP(2),PP(3)
 8995 CONTINUE
 9999 CONTINUE
      IF (NCD4C.EQ.0.AND.KEEP4C.EQ.0) GO TO 10
      ITIME=ITIME+1
      IF (ITIME.GT.ITIMEI) GO TO 10
      LINC=1
      ITYPEL = 2
      WATT=WATT+WADTT
      GO TO 5000
90000 FORMAT(///22H    ILLEAGAL KEEP DATA)
```

```
9010 FORMAT(///48H      CANNOT BOTH KEEP AND ADD DATA TO THIS TABLE)
9020 FORMAT(///52H      INSUFFICIENT JOINT COORDINATE IN TABLE 2          )
9030 FORMAT(///52H      NUMBER OF JOINT IN TABLE 2 MUST BE LESS THAN 30)
9040 FORMAT(///52H      INSUFFICIENT MEMBER INFORMATION IN TABLE 3A       )
9060 FORMAT(///52H      MEMBER NUMBER MUST BE FROM 1 TO 30                )
9070 FORMAT(///52H      NUMBER OF ELEMENT IN TABLE 3A MUST BE 1 TO 50     )
9080 FORMAT(///52H      NONLINEAR OPTION IN TABLE 3A MUST BE 1 OR 0       )
9090 FORMAT(///33H      JOINT NUMBER IS UNIDENTIFIED  )
9100 FORMAT(///52H      AREA NUMBER IN TABLE 3A MUST BE FROM 1 TO 20      )
9110 FORMAT(///52H      PIN OPTION IN TABLE 3A MUST BE 1 OR 0             )
9120 FORMAT(///52H      LINEAR MEMBER,EI,AE IN TABLE 3A MUST NOT BE 0     )
9130 FORMAT(///52H      NONLINEAR MEMBER,EI,AE IN TABLE 3A MUST BE 0      )
9140 FORMAT(///52H      JOINT DIFFERENT IN A MEMBER MUST BE LESS THAN 5)
9150 FORMAT(///52H      NUMBER OF SEGMENT IN TABLE 3B MUST BE 1 TO 8      )
9160 FORMAT(///52H      STRESS-STRAIN CURVE NUMBER IN TABLE 3B MUST BE
    1 11HFROM 1 TO 8 )
9170 FORMAT(///52H      NUMBER OF CARDS IN TABLE 3B DO NOT MATCH          )
9180 FORMAT(///52H      NUMBER OF CARD IN TABLE 3C MUST BE EVEN           )
9190 FORMAT(///52H      FOR SYM. CURVE IN TABLE 3C FIRST PT. MUST BE 0 )
9200 FORMAT(///52H      IN TABLE 3C SYMMETRIC OPTION MUST BE 0 OR 1       )
9210 FORMAT(///53H      IN TABLE 3C NUMBER OF POINT IN THE CURVE MUST BE
    1 10H 2 TO 10       )
9220 FORMAT(///52H      IN TABLE 3C CURVE NUMBER MUST BE FROM 1 TO 5      )
9230 FORMAT(///52H      IN TABLE 4A CURVE MEMBER CAN HAVE LOAD IN AXIS
    1 10H1 ONLY         )
9240 FORMAT(///52H      IN TABLE 4A AXIS OPTION MUST BE 1,2,3 OR 4        )
9250 FORMAT(///52H      FROM AND TO DISTANCE MUST NOT BE LESS THAN 0      )
9260 FORMAT(///52H      NUMBER OF CARD IN TABLE 4A MUST BE LESS THAN 50)
9280 FORMAT(///52H      MEMBER NUMBER IS UNIDENTIFIED IN TABLE 4B         )
9360 FORMAT(///52H      NUMBER OF CARDS FOR TABLE 7 MUST BE EQUAL TO 3 )
9980 FORMAT(/,32H     CHECK INPUT DATA FOR TABLE ,I1,
    1        10H , PROBLEM ,1X,A4)
1000 FORMAT(20A4)
1010 FORMAT(5X,12I5,/,10X,11I5)
1020 FORMAT(5X,I5,5X,2E10.3)
1030 FORMAT(5X,9I5,5X,I5,2E10.3)
1040 FORMAT(10X,E10.3,10X,4E10.3)
1050 FORMAT(5X,2I5)
1060 FORMAT(5X,I5,6E10.3)
1065 FORMAT(5X,3I5,5X,10F5.0,/,25X,10F5.0)
1070 FORMAT(5X,2I5,5X,5E10.3)
1080 FORMAT(5X,E10.3,5X,10I5)
1090 FORMAT(5X,4E10.3,/,5X,I5,5E10.3)
1100 FORMAT(5X,3E10.3,5X,8I5)
1110 FORMAT(2(5X,2E10.3))
1120 FORMAT(5X,I5,6E10.3)
1130 FORMAT(5X,I5)
2000 FORMAT(1H1)
2001 FORMAT(5X,20A4)
2002 FORMAT(/9H      PROB,/,5X,20A4)
2010 FORMAT(/////35H      TABLE 1 - PROGRAM CONTROL DATA
    1         /17H      PROBLEM TYPE,I5
    2        //70H      TABLE NUMBER              2  3A  3B  3C  4A  4B  4C
    3  5A  5B   6   7
    4        //23H      PRIOR-DATA OPTIONS,3X,11I4
    1         /17H      (1=YES,0=NO)
    5        //26H      NUMBER OF CARDS ADDED
    6         /26H      FOR THIS PROBLEM       ,11I4)
2020 FORMAT(/////32H      TABLE 2 - JOINT COORDINATES
    1         //11H      JOINT
    2         /34H      NUMBER    X-COORD     Y-COORD,/)
2040 FORMAT(5X,I4,2X,2(2X,E10.3))
2060 FORMAT(///33H      TABLE 3A - MEMBER PROPERTIES
    1         //61H      MEMBER  ELEM PER NON       FROM  JOINT           T
    20  JOINT
    3         /63H      NUMBER   NUMBER  LIN   NO.  AREA   PIN     NO.
    4AREA   PIN,//)
2070 FORMAT(2(6X,I3),4(3X,I3),5X,3(I3,3X))
20800FORMAT(///61H      MEMBER  MODULUS OF        FROM JOINT
    1TO JOINT
    2         /62H      NUMBER  ELASTICITY       EI         AE          EI
    3         AE,//)
2090 FORMAT(5X,I4,4X,E10.3,2(2X,2E10.3))
21000FORMAT(///79H      MEMBER                                           MEMB
    1ER   CENTER-X    CENTER-Y
    2         /79H      NUMBER      LENGTH      COSINE-X     COSINE-Y     TYP
    3E    COORDINATE  COORDINATE,//)
2110 FORMAT(5X,I4,4X,3(E10.3,2X),8HSTRAIGHT)
2111 FORMAT(5X,I4,4X,3(E10.3,2X),5HCURVE,3X,2(E10.3,2X))
2120 FORMAT(/41H      USING DATA FROM THE PREVIOUS PROBLEM)
2121 FORMAT(/25H      NO DATA IN THE TABLE)
2130 FORMAT(/////40H      TABLE 3B - CROSS SECTION PROPERTIES)
2140 FORMAT(/46H      USING DATA FROM THE PREVIOUS PROBLEM PLUS)
2150 FORMAT(/29H      CROSS SECTION NUMBER    =,I5,
    1         /29H      NUMBER OF SEGMENT       =,I5)
2160 FORMAT(/83H      SEG SEG  CUR    STRESS      STRAIN    WIDTH OR    DEP
    1TH OR  CENTROIDAL  SEGMENTAL
    2         /83H      NUM TYPE NUM MULTIPLIER MULTIPLIER  DIAMETER    TH
    1ICKNESS  DISTANCE     AREA             )
2170 FORMAT(4X,I3,2X,'RECT',I3,2X,5(E10.3,1X))
2180 FORMAT(4X,I3,2X,'AREA',I3,2X,2(E10.3,1X),22X,2(E10.3,1X))
2190 FORMAT(4X,I3,2X,'CIRC',I3,2X,5(E10.3,1X))
2200 FORMAT(/////35H      TABLE 3C - STRESS-STRAIN CURVE)
22100FORMAT(//37H      STRESS-STRAIN CURVE NUMBER      =,I3
    1         /37H      NUMBER OF POINTS IN THIS CURVE =,I3
    2         /41H      CURVE SYMMETRY                  =  NO
    3         // 8H      SIG,10F7.3      )
22110FORMAT(//37H      STRESS-STRAIN CURVE NUMBER      =,I3
    1         /37H      NUMBER OF POINTS IN THIS CURVE =,I3
    2         /41H      CURVE SYMMETRY                  = YES
    3         // 8H      SIG,10F7.3      )
2212 FORMAT(//8H      EPS,10F7.3)
2220 FORMAT(/////35H      TABLE 4A - APPLIED MEMBER LOAD)
2221 FORMAT( //36H      MEMBER AXIS       FROM         TO
    1         /72H      NUMBER OPT    DISTANCE     DISTANCE         QX
    2         QY          QZ)
2230 FORMAT(6X,2(I3,3X),5(E10.3,2X))
2240 FORMAT(18X,5(E10.3,2X))
2250 FORMAT(/////26H      TABLE 4B - SELFWEIGHT
    1//38H      WT PER UNIT VOL     MEMBER NUMBER       )
2260 FORMAT (5X,E10.3,10X,10I3)
2270 FORMAT(/////36H      TABLE 4C - WIND AND WAVE FORCES)
22800FORMAT(//30H      MASS DENSITY OF AIR     =,E10.3
    1         /30H      BASIC WIND VELOCITY     =,E10.3
    2         /30H      WIND CONSTANT           =,E10.3
    3         /30H      MEAN SEA LEVEL          =,E10.3
```

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    4         //30H      DENSITY OF FLUID         =,E10.3
    5          /30H      WAVE PERIOD              =,E10.3
    6          /30H      WAVE HEIGHT              =,E10.3
    7          /30H      TIME/PERIOD              =,E10.3
    8          /30H      TIME INCREMENT/PERIOD    =,E10.3
    9          /30H      NUMBER OF TIME INCREMENT=,I3
    1         //58H         WINA CD      WAVE CD      WAVE CM       MEMBER NU
   2MBER)
2290 FORMAT(5X,3(E10.3,2X),3X,8I3)
2300 FORMAT(/////39H      TABLE 5A - ELASTIC MEMBER RESTRAIN)
2310 FORMAT(/////25H      TABLE 5B - SOIL DATA
    1         //49H      PENETRATION DISTANCE    SOIL SHEAR       SOIL
    2          /50H         FROM          TO       STRENGTH      DENSITY)
2320 FORMAT(5X,4(E10.3,2X))
2330 FORMAT(/////46H      TABLE 6 - JOINT LOADS AND LINEAR SUPPORTS)
23400FORMAT(/76H     JOINT  FORCE(X)   FORCE(Y)   MOMENT(Z)  SPRING(X)
   1 SPRING(Y)  SPRING(Z))
2350 FORMAT(5X,I5,6(1X,E10.3))
2360 FORMAT(/////32H      TABLE 7 - ITERATION CONTROL)
2370 FORMAT(//30H      NUMBER OF LOAD INCREMENT=,I3)
2380 FORMAT(//20H      FRAME ITERATION)
2390 FORMAT(//21H      MEMBER ITERATION)
24000FORMAT(/34H     MAXIMUM NUMBER OF ITERATION =,I3,
    1         /19H     FORCE ERROR  =,E10.3,
    2         /19H     MOMENT ERROR =,E10.3)
23010FORMAT( //36H     MEMBER            FROM            TO
    1          /72H     NUMBER          DISTANCE     DISTANCE          QX
    2      QY          QZ)
2231 FORMAT(6X,I3,9X,5(E10.3,2X))
 155 FORMAT(///30H      ***** FRAME ITERATION NO ,I5,6H *****,//)
 175 FORMAT(///,5X,I5,47H JOINTS NOT CONVERGED AT END OF FRAME ITERATIO
   1N,I5)
 181 FORMAT(//,15X,27H SUMMARY OF FRAME ITERATION,I5,//5X,74HJOINT
   1          JOINT DISPLACEMENTS           JOINT EQUILIBRIUM ERRORS,
   2/,5X,76H NO          DISP(X)      DISP(Y)  ROTATION(Z)      ERR(X)
   3 ERR(Y)      ERR(Z),//)
 182 FORMAT(5X,I4,5X,6E11.3)
 177 FORMAT(///45H      ALL JOINTS CONVERGED AT END OF ITERATION,I5)
 185 FORMAT(///8H     ***,I5,67H MEMBERS NOT CLOSED AT END OF SPECIFIED
   1NUMBER OF MEMBER ITERATIONS,/,34H      DURING FRAME ITERATION NUMBE
   2R,I5,4H ***)
 777 FORMAT(37H      ***  SOLUTION DID NOT CLOSED ***)
 151 FORMAT(50H      TABLE 8 - JOINT DISPLACEMENTS AND REACTIONS  ,
   1///,20X,15HDISPLACEMENTS  ,16X,10H REACTIONS,//,5X,70HJOINT  DISP(
   2X)    DISP(Y)  ROTATION(Z) REACT(X)    REACT(Y)    REACT(Z) ,//)
 152 FORMAT(5X,I5,6E11.3)
  51 FORMAT(30H      TABLE 9 - MEMBER RESULTS ,/)
  61 FORMAT(18H      MEMBER NUMBER,I5,/,20H      GOES FROM JOINT,I5,9H TO
   1 JOINT,I5)
  99 FORMAT(//,78H      *** MEMBER DIDNOT CONVERGE AT END OF SPECIFIED
   1NUMBER OF ITERATIONS ***  )
 101 FORMAT(74H      ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL A
   1ND TANGENTIAL AXES,//,
   231X,15H DISPLACEMENTS ,21X,7H FORCES,//,
   316H         DISTANCE,/,
   483H          X          Y        AXIAL     LATERAL    ROTATIONAL    AXIAL
   5     SHEAR      MOMENT,/)
 111 FORMAT(4X,2F8.2,6E11.3)
```

```
C
C>--->ERROR MESSAGES
C
  900 PRINT 9000
      NT = 1
  998 PRINT 9980,NT,NPROB
  999 CALL EXIT
  901 PRINT 9010
      NT=2
      GO TO 998
  902 PRINT 9020
      GO TO 999
  903 PRINT 9030
      GO TO 999
  904 PRINT 9040
      GO TO 999
  905 PRINT 9010
      NT = 3
      GO TO 998
  906 PRINT 9060
      NT = 3
      GO TO 998
  907 PRINT 9070
      GO TO 999
  908 PRINT 9080
      GO TO 999
  909 PRINT 9090
      GO TO 999
  910 PRINT 9100
      GO TO 999
  911 PRINT 9110
      GO TO 999
  912 PRINT 9120
      GO TO 999
  913 PRINT 9130
      GO TO 999
  914 PRINT 9140
      GO TO 999
  915 PRINT 9150
      GO TO 999
  916 PRINT 9160
      GO TO 999
  917 PRINT 9170
      GO TO 999
  918 PRINT 9180
      GO TO 999
  919 PRINT 9190
      GO TO 999
  920 PRINT 9200
      GO TO 999
  921 PRINT 9210
      GO TO 999
  922 PRINT 9220
      GO TO 999
  923 PRINT 9230
      GO TO 999
  924 PRINT 9240
      GO TO 999
```

```
925 PRINT 9250
    GO TO 999
926 PRINT 9260
    GO TO 999
927 PRINT 9060
    NT = 4
    GO TO 998
928 PRINT 9280
    GO TO 999
929 PRINT 9010
    NT = 4
    GO TO 998
930 PRINT 9010
    NT = 5
    GO TO 998
932 PRINT 9250
    NT = 5
    GO TO 998
934 PRINT 9010
    NT = 5
    GO TO 998
935 PRINT 9090
    NT = 6
    GO TO 998
936 PRINT 9360
    GO TO 999
    END
```

```
      SUBROUTINE CIRCLE(B,DP,Y,IP)
      IMPLICIT REAL * 8(A-H,O-Z)
C
C     CHANGE CIRCULAR SEGMENT INTO RECTANGULAR SEGMENT
C     IP = SEGMENT NUMBER
C
      IF(IP.NE.1) GO TO 10
      RA = 0.5*(B - DP)
      T = DP
      YC = Y
   10 ZIP = IP
      ZIP = ZIP - 0.5
      TE = ZIP*0.3141592
      DP = 0.3141592*RA*DSIN(TE)
      Y = YC + RA * DCOS(TE)
      IF(DP.LT.1.0E-10) GO TO 20
      AREA = RA*T*0.6283184
      GO TO 30
   20 IF(IP.GT.5) ZIP = 11 - IP
      ZIP = ZIP - 1.0
      AREA = RA*RA*(ZIP*0.3141592 - DSIN(ZIP*0.6283184))
      ZIP = ZIP + 1.0
      AREA = RA*RA*(ZIP*0.3141592 - DSIN(ZIP*0.6283184)) - AREA
   30 B = AREA / DP
      RETURN
      END
```

```
      SUBROUTINE CURVE
      IMPLICIT REAL * 8(A-H,O-Z)
C
C>--->M-PHI AND FORCE-EPSILON CURVE
C
      COMMON / SCURVE / EIP(30,40),EIN(30,40),ENP(30,40),ENN(30,40),
     1BMYP(30,40),BMYN(30,40),AE(30,40)
      COMMON / BLOCK3 / TT(30,40),BM1(30,40),BM2(30,40)
      COMMON / T3A / INLOP(30),IPINL(30),IPINR(30),KURVEN(30),ISYMA(30)
      COMMON / T3A1 / EL(30),FL1(30),AEL1(30),FL2(30),AEL2(30),NAL(30),
     1                NAR(30)
      COMMON / SITER / PBAR,BMBAR,PHEBAR,EPTBAR,YBAR,KOFFC
      COMMON / SMID / DB(8),DDP(8),DIY(8),DAREA(8),DSIGL(8,10),
     1DEPSL(8,10),B(8),DP(8),Y(8),SAREA(8),WIDTH,AREAT,AEL,FL,
     2EPSTS(10),SIGTS(10),STRESS(8,19),STRAIN(8,19),NPTS(8),NSEGL
      COMMON / SFIT / S(30),E(30)
      COMMON / CONST / MN,M,MP1,ZERO,PI
C>--->FIND AVERAGE FORCES
      SP = 0.0
      DO 70 J = 1,M
   70 SP = SP + TT(MN,J)
      TEMP = M
      SP = SP/TEMP
      DO 700 N = 1,M
      CALL MIDDLE(N,ZERO)
C
C>--->FORCE-EPSILON CURVE WHEN MOMENT AND CURVATURE ARE EQUAL TO ZERO
C
      DO 100 JJ = 1,NSEGL
      NPTT = NPTS(JJ)
      IF(JJ - 1) 80,80,90
   80 GEPM = STRAIN(1,1)
      PEPM = STRAIN(1,NPTT)
   90 IF(GEPM.LT.STRAIN(JJ,1)) GEPM = STRAIN(JJ,1)
      IF(PEPM.GT.STRAIN(JJ,NPTT)) PEPM = STRAIN(JJ,NPTT)
  100 CONTINUE
      TEMP1 = 0.0
      SUM = 0.0
      YBAR = GEPM
      IF(SP.GE.0.0) YBAR = PEPM
      J = 1
  115 TEMPJ = J
      IF(J.GT.30) GO TO 125
      E(J) = TEMPJ*YBAR/40.0
      CALL TOTALF(BMT,S(J),E(J),ZERO,KOFFC)
      TEMP = S(J)/E(J)
      IF(TEMP.LT.0.7*TEMP1) GO TO 125
      IF(TEMP.GT.TEMP1) TEMP1=TEMP
      SUM = SUM + TEMP
      J = J + 1
      GO TO 115
  125 AE(MN,N) = SUM/(TEMPJ-1.0)
C>--->M-PHI CURVE
      IF(ISYMA(MN).EQ.1) GO TO 110
      IF(SP.GT.0.0) SP = 0.0
  110 IF(SP) 130,170,130
  130 EPTBAR = SP/AE(MN,N)
      GO TO 180
```

```
  170 EPT1= 0.0
      BMT = 0.0
      YBAR = 0.0
      KOFFC = 0
      GO TO 190
  180 EPT1= EPTBAR
C
C>--->DETERMINE YBAR
C
      YBAR = -BMT/SP
C
C>--->MAXIMUM MOMENT AND CURVATURE
C
  190 CALL FAIL(SP,YBAR,EMP,EMN,CURP,CURN)
C
C>--->START ITERATION
C
      DENOM1 = 20.0
      PCR = EMP
  200 IF(KOFFC.NE.0) DENOM1 = DENOM1 - 2.0
      IF(DENOM1.GT.0) GO TO 210
      SP = 0.0
      GO TO 110
  210 PBAR = SP
      EPTBAR = EPT1
      BMBAR = 0.0
      PHEBAR = 0.0
      S(1) = PCR/DENOM1
      J = 1
      NN = 1
      GO TO 250
  240 NN = 4
      PBAR = SP
      EPTBAR = TEMP
      IF(J.NE.1) GO TO 245
      KOFFC = 2
      GO TO 200
  245 BMBAR = S(J-1)
      PHEBAR = E(J-1)
  250 DENOM = NN
      DO 300 I = 1,NN
      IF(J.EQ.1) GO TO 260
      S(J) = S(J-1) + PCR/(DENOM1*DENOM)
  260 TEMP = EPTBAR
         CALL ITER(SP,S(J),E(J),EPT2)
      IF(KOFFC.EQ.2.AND.J.LT.8) GO TO 200
      IF(KOFFC.NE.0.AND.NN.EQ.4) GO TO 320
      IF(KOFFC.NE.0) GO TO 240
      PBAR = SP
      BMBAR = S(J)
      EPTBAR = EPT2
      PHEBAR = E(J)
      J = J + 1
  300 CONTINUE
      IF(NN.EQ.4) NN=1
      GO TO 250
  320 NPT = J - 1
      IF(PCR.LT.0.0) GO TO 360
      CALL FIT(NPT,EIP(MN,N),ENP(MN,N),BMYP(MN,N))
      IF(ISYMA(MN).EQ.0) GO TO 340
      EIN(MN,N) = EIP(MN,N)
      ENN(MN,N) = ENP(MN,N)
      BMYN(MN,N) = BMYP(MN,N)
      GO TO 380
  340 PCR = EMN
      DENOM1 = 10.0
      KOFFC = 0
      GO TO 200
  360 CALL FIT(NPT,EIN(MN,N),ENN(MN,N),BMYN(MN,N))
  380 CONTINUE
      IF(NAL(MN).EQ.NAR(MN)) GO TO 720
  700 CONTINUE
      RETURN
  720 DO 740 J = 2,M
      AE(MN,J) = AE(MN,1)
      EIP(MN,J) = EIP(MN,1)
      ENP(MN,J) = ENP(MN,1)
      BMYP(MN,J) = BMYP(MN,1)
      EIN(MN,J) = EIN(MN,1)
      ENN(MN,J) = ENN(MN,1)
      BMYN(MN,J) = BMYN(MN,1)
  740 CONTINUE
      RETURN
      END

      SUBROUTINE FAIL(P,YBAR,EMP,EMN,CURP,CURN)
      IMPLICIT REAL * 8(A-H,O-Z)
C
C     SUBROUTINE ' FAIL ' FIND MOMENT AND CURVATURE AT POINT OF FAILURE
C     P = GIVEN FORCE ON THE ELEMENT
C     YBAR = DISTANCE FROM X'-AXIS TO THE POINT OF APPLIED LOAD
C     SUCH THAT WHEN MOMENT EQUAL TO ZERO CURVATURE ALSO EQUAL TO ZERO
C     EMP,EMN = POSITIVE AND NEGATIVE MOMENT AT FAILURE
C      CURP,CURN = POSITIVE AND NEGATIVE CURVATURE AT FAILURE
C
      COMMON / SMID / DB(8),DDP(8),DIY(8),DAREA(8),DSIGL(8,10),
     1DEPSL(8,10),B(8),DP(8),Y(8),SAREA(8),WIDTH,AREAT,AEL,FL,
     2EPSTS(10),SIGTS(10),STRESS(8,19),STRAIN(8,19),NPTS(8),NSEGL
C>--->FIND YTOPM,YBOTM AND STRAIN AT THOSE POINTS
C
      DO 100 J = 1,NSEGL
      IF(SAREA(J).GT.1.0E-10) GO TO 50
      YB = Y(J) - 0.5*DP(J)
      YT = YB + DP(J)
      GO TO 60
   50 YB = Y(J) - 0.5*B(J)
      YT = YB + B(J)
   60 IF(J.GT.1) GO TO 80
      YTOPM = YT
      YBOTM = YB
      EPTOP = STRAIN(J,1)
      EPBOT = STRAIN(J,1)
   80 IF(YTOPM.GT.YT) GO TO 90
      YTOPM = YT
      EPTOP = STRAIN(J,1)
   90 IF(YBOTM .LT.YB) GO TO 100
      YBOTM = YB
```

```
      EPBOT = STRAIN(J,1)
  100 CONTINUE
      TOL = P/20.0
      IF(TOL.LT.0.01) TOL = 0.01
C
C>--->FOR POSITIVE M-PHI CURVE
C
      ITM = 1
      TD = YTOPM - YBOTM
      ESP = EPTOP
      YTEM = YTOPM
  104 PHI = -ESP/TD
      GO TO 110
C
C>--->FOR NEGATIVE M- PHI CURVE
C
  105 ITM = 1
      TD = YTOPM - YBOTM
      ESP = EPBOT
      YTEM = YBOTM
  106 PHI = ESP/TD
  110 EP = ESP + PHI*YTEM
      CALL TOTALF(BMT,TH,EP,PHI,KOFFC)
      IF(DABS(TH - P).LT.TOL) GO TO 170
      IF(DABS(TH).LT.DABS(P)) GO TO 120
      IF(ITM.NE.1) GO TO 130
      PHI1 = PHI
      PHI = 2.0*PHI
      ITM = 2
      T1 = TH
      GO TO 110
  120 IF(ITM .NE.1) GO TO 130
      PHI1 = PHI
      PHI = PHI/2.0
      ITM = 2
      T1 = TH
      GO TO 110
  130 DPHI = (P - TH)*(PHI1 - PHI)/(T1 - TH)
      PHI1 = PHI
      PHI = PHI + DPHI
      T1 = TH
      GO TO 110
  170 IF(PHI.LT.0.0) GO TO 180
C
C>--->CORRECTION OF MOMENT
C
      EMP = BMT + P*YBAR
      CURP = PHI
      GO TO 105
C
C>--->CORRECTION OF MOMENT
C
  180 EMN = BMT + P*YBAR
      EMN = BMT + P*YBAR
      CURN = PHI
      RETURN
      END
```

```
      SUBROUTINE FIT (NPT,A,ENN,SY)
C
C     SUBROUTINE FIT FITS THE MATHEMATIC EXPRESSION THROUGH THE GENERATED
C     MOMENT CURVATURE OR FORCE-STRAIN DATA
C
      IMPLICIT REAL*8 ( A-H,C-Z )
      DIMENSION               EN(4),VAR(4),AA(5,6),X(5)
      COMMON / SFIT / S(30),E(30)
      SY = S(NPT)
      TEMP = 1.0E+50
      IF(S(1).GT.0.0.AND.E(1).GT.0.0) GO TO 9
      DO 8 I = 1,NPT
      S(I) = DABS(S(I))
    8 E(I) = DABS(E(I))
    9 SYY = DABS(SY)
      CALL AEI(NPT,A)
      BN = -3.5
      DO 10 I = 1,11
      BN = BN + 5.0
      CALL ROC(V,BN,NPT,A,SYY)
      IF(V.GT.TEMP) GO TO 10
      TEMP = V
      DNN = BN
   10 CONTINUE
      IF(DNN.LT.50.0) GO TO 20
      ENN = 50.0
      RETURN
   20 IF(DNN.LT.1.6) GO TO 30
      DNN = DNN - 5.0
   30 CONTINUE
      IT = 0
   40 EN(4) = 0.0
      VAR(4) = 0.0
      DN = DNN-0.5
      DO 50 I = 1,3
      DN = DN + 0.5
      EN(I) = DN
      CALL ROC(VAR(I),EN(I),NPT,A,SYY)
   50 CONTINUE
      ITER = 0
   60 ITER = ITER + 1
      IF(ITER.GT.20) STOP
      DO 70 I = 1,3
      AA(I,1) = 1.0
      AA(I,2) = EN(I)
      AA(I,3) = EN(I)**2
   70 AA(I,4) = VAR(I)
      CALL SOLVER(3,AA,X)
      TEMP = EN(4)
      EN(4) = -X(2)/(2.0*X(3))
      IF(DABS(TEMP-EN(4)).GT..10) GO TO 90
   75 N = EN(4)*10. + 0.5
      ENN = N
      ENN = ENN/10.0
      RETURN
   90 CALL ROC(VAR(4),EN(4),NPT,A,SYY)
      IF(EN(4).LT.EN(3).AND.EN(4).GT.EN(1)) GO TO 110
      DNN = DNN + 0.5
```

```
      IT = IT + 1
      IF (IT.LE.21) GO TO 40
  100 GO TO 75
  110 IF(EN(4) - EN(2)) 120,100,130
  120 EN(3) = EN(2)
      EN(2) = EN(4)
      VAR(3) = VAR(2)
      VAR(2) = VAR(4)
      GO TO 60
  130 EN(1) = EN(2)
      EN(2) = EN(4)
      VAR(1) = VAR(2)
      VAR(2) = VAR(4)
      GO TO 60
      END

      SUBROUTINE AEI(NPT,A)
C
C     SUBROUTINE AEI CALCULATE THE VALUE OF A =   EI OR   AE FROM THE
C     AVERAGE OF THE SEVERAL POINTS (MOMENT,CURVATURE) OR (FORCE,EPSILON)
C
      IMPLICIT REAL*8 ( A-H,O-Z )
      COMMON / SFIT / S(30),E(30)
      TEMP = 0.0
      SUM = 0.0
      DO 10 I = 1,NPT
      AP = S(I)/E(I)
      IF(AP.LT.0.5*TEMP) GO TO 20
      IF(AP.GT.TEMP) TEMP = AP
      SUM = SUM + AP
      XI = I
   10 CONTINUE
   20 A = SUM/XI
      RETURN
      END

      SUBROUTINE ROC(VAR,EN,NPT,A,SYY)
C
C     SUBROUTINE RCC DETERMINE VARIENCE OF THE ASSUME VALUE OF N
C
      IMPLICIT REAL*8 ( A-H,O-Z )
      COMMON / SFIT / S(30),E(30)
      VAR = 0.0
      DO 60 I = 1,NPT
      PRINT 1,S(I),E(I),A,SYY,EN
    1 FORMAT(5X,5E11.3)
      IF((A*E(I)/SYY).GT.57.00.AND.EN.GE.41.0) GO TO 70
      IF((A*E(I)/SYY).GT.37.00.AND.EN.GE.46.0) GO TO 70
      IF((A*E(I)/SYY).GT.26.00.AND.EN.GE.51.0) GO TO 70
      TEMP = S(I) - A*E(I)/(1.0 + (A*E(I)/SYY)**EN)**(1.0/EN)
   60 VAR = VAR + TEMP*TEMP
      RETURN
   70 VAR = 1.0E+50
      RETURN
      END

      SUBROUTINE SOLVER ( N,A,X)
C
C     SUBROUTINE SOLVER SOLVES N SIMULTANEOUS ALGEBRAIC EQUATIONS BY
C      GAUSSIAN ELIMINATION
C
      IMPLICIT REAL*8 ( A-H,O-Z )
      DIMENSION A(5,6), X(5)
      NM1 = N - 1
      NP1 = N + 1
      DO 10 IR = 1,NM1
      IRP1 = IR + 1
      DO 10 I = IRP1,N
      EM = -A(I,IR)/A(IR,IR)
      DO 10 J = IRP1,NP1
      A(I,J) = A(I,J) + EM*A(IR,J)
   10 CONTINUE
      X(N) = A(N,NP1)/A(N,N)
      DO 30 I = 2,N
      J = N + 1 - I
      JP1 = J + 1
      SUM = 0.0
      DO 20 K = JP1 ,N
   20 SUM = SUM + A(J,K) * X(K)
   30 X(J) = (A(J,NP1) - SUM)/A(J,J)
      RETURN
      END

      SUBROUTINE MATMPY(A,M1,N1,B,N2,C)
      IMPLICIT REAL * 8(A-H,O-Z)
C>--->SUBROUTINE MATMPY MULTIPLIES A N1*M1 MATRIX TIMES A N1*N2 MATRIX B
C>--->TO YIELD THE M1*N2 MATRIX C
      DIMENSION A(6,6),B(6,6),C(6,6)
      DO 25 I = 1,M1
      DO 25 J = 1,N2
      C(I,J) = 0
      DO 25 K = 1,N1
   25 C(I,J) = A(I,K)*B(K,J) + C(I,J)
      RETURN
      END

      SUBROUTINE ITER(P,BM,PHE,EPT)
      IMPLICIT REAL * 8(A-H,O-Z)
C
C     SUBROUTINE ' ITERATION ' DETERMINE THE VALUE OF STRAIN AND
C     CURVATURE FROM THE KNOWN VALUE OF FORCE AND BENDING MOMENT
C
      COMMON / SITER / PBAR,BMBAR,PHEBAR,EPTBAR,YBAR,KOFFC
      COMMON / SMID / DB(8),DDP(8),DIY(8),DAREA(8),DSIGL(8,10),
     1DEPSL(8,10),B(8),DP(8),Y(8),SAREA(8),WIDTH,AREAT,AEL,FL,
     2EPSTS(10),SIGTS(10),STRESS(8,19),STRAIN(8,19),NPTS(8),NSEGL
C
C>--->DISTANCE FROM X'-AXIS TO TOP FIBER
C
      I = 0
      DO 100 J = 1,NSEGL
      YT = Y(J) + (0.5*DP(J))
      IF(J.EC.1) GO TO 90
      IF(YMAX - YT) 90,100,100
   90 YMAX = YT
```

```
  100 CONTINUE
  200 DELPHE = 0.0001*PHEBAR
      DELEPT = 0.0001*EPTBAR
      IF(DELEPT.EQ.0.0) DELEPT =-1.0E-08
      IF(DELPHE.EQ.0.0) DELPHE = 1.0E-08
C
C>--->FORCE AND MOMENT WHEN PHE = PHEBAR+ DELPHE
C
      PHE = PHEBAR + DELPHE
      EP = EPTBAR + (PHE*YMAX)
      CALL TOTALF(BMPHE,PPHE,EP,PHE,KCFFC)
      BMPHE = BMPHE + PPHE*YBAR
C
C>--->FORCE AND MOMENT WHEN EPT = EPTBAR + DELEPT
C
      PHE = PHEBAR
      EPT = EPTBAR + DELEPT
      EP = EPT + PHE*YMAX
      CALL TCTALF(BMEPT,PEPT,EP,PHE,KGFFC)
      BMEPT = BMEPT + PEPT*YBAR
C
C>--->CALCULATE CONSTANT
C
      PWPHE = (PPHE - PBAR)/DELPHE
      PWEPT = (PEPT - PBAR)/DELEPT
      BMWPHE = (BMPHE - BMBAR)/DELPHE
      BMWEPT = (BMEPT - BMBAR)/DELEPT
C
C>--->DELBM AND DELP
C
      DELBM = BM - BMBAR
      DELP = P - PBAR
C
C>--->DELTA EPSILON AND DELTA PHI
C
      DENOM = (PWPHE*BMWEPT) - (PWEPT*BMWPHE)
      IF(DENOM.EQ.0.0) GO TO 300
      DEPT = ((DELBM*PWPHE) - (DELP*BMWPHE))/DENOM
      DPHE = -((DELBM*PWEPT) - (DELP*BMWEPT))/DENOM
  250 PHEBAR = PHEBAR + DPHE
      EPTBAR = EPTBAR + DEPT
      EP = EPTBAR + PHEBAR*YMAX
C
C>--->CALCULATE FORCE AND MOMENT
C
      CALL TOTALF(BMBAR,PBAR,EP,PHEBAR,KOFFC)
      I = I + 1
      BMBAR = BMBAR + (PBAR*YBAR)
      IF(I.GT.10) GO TO 300
      IF(DABS(P-PBAR).GT.0.01) GC TO 200
      IF(DABS(BM-BMBAR).GT.0.1  ) GC TO 200
  300 EPT = EPTBAR
      PHE = PHEBAR
      IF(I.GT.10) KOFFC = 1
      IF(DENOM.EQ.0.0) KOFFC = 2
      RETURN
      END
```

```
      SUBROUTINE FAEJR(T,BM,EP,CUR,KOFFC)
      IMPLICIT REAL * 8(A-H,O-Z)
C
C     SUBROUTINE ' FAEJR ' SUBDIVIDES THE RECTANGLES INTO SUBRECTANGLES
C     EACH OF WHICH HAS A LINEAR STRESS-STRAIN CURVE OVER IT, FOR THE
C     NUMERICAL INTEGRATION OF THE STRESS-STRAIN  CURVE TO FIND
C     AXIAL THRUST(T) AND BENDING MOMENT (BM) AROUBD X'-AXIS
C
      COMMON/ SFAEJR / EPJR(19),SIJR(19),YY,BB,DPDP,AREA,NNPT
      DIMENSION DA(10),EPC(10),YY1(10)
C
C     ZERO THRUST AND BENDING MOMENT
C
      T = 0.0
      BM = 0.0
C
C>--->CHECK FOR STEEL AREA
C
      IF(BB.GT.1.0E-10) GO TO 90
      DA(1) = AREA
      EPC(1) = EP - YY*CUR
      YY1(1) = YY
      NN3 = 1
      GO TO 4000
C
C>--->COMPUTE STRAIN AND Y DISTANCE FOR TOP AND BOTTOM OF RECTANGLE
C
   90 YB = YY - 0.5*DPDP
      YT = YB + DPDP
      EPB = EP - YB*CUR
      EPT = EP - YT*CUR
      R = 1.0
      IF(EPB.LT.EPT) GO TO 100
C
C>--->REVERSE IF CURVATURE IS POSITIVE TO MAKE EPB LESS THAN EPT
C
      ET = EPB
      EPB = EPT
      EPT = ET
      YTT = YT
      YT = YB
      YB = YTT
      R = -1.0
  100 CONTINUE
C
C>--->FIND FIRST POINT ON STRESS-STRAIN CURVE ON OR BELOW RECTANGLE
C
      DO 200 K = 1,NNPT
      IF(EPB.GE.EPJR(K)) GO TO 200
      NN1 = K - 1
      GO TO 300
  200 CONTINUE
      NN1 = NNPT
  300 CONTINUE
      NNP = NN1 + 1
      IF(NNP.GT.NNPT) GC TO 410
C
C>--->FIND FIRST POINT ABOVE RECTANGLE
```

```
C
      DO 400 K = NNP,NNPT
      IF(EPT.GT.EPJR(K)) GO TO 400
      NN2 = K
      GO TO 500
  400 CONTINUE
  410 NN2 =NNPT + 1
  500 CONTINUE
C
C>--->NUMBER OF SUBRECTANGLE
C
      NN3 = NN2 - NN1
      IF(NN3.NE.1) GO TO 1200
C
C>--->CALCULATE PROPERTIES FOR WHOLE RECTANGLE
C
      DA(1) = BB*DPDP
      EPC(1) = 0.5*(EPB + EPT)
      IF(EPC(1).GT.1.0E-10) GO TO 1000
      YY1(1) = YY
      GO TO 4000
 1000 YY1(1) = YB + R*DPDP*(0.5*EPB + EPT)/(3.0*EPC(1))
      GO TO 4000
C
C>--->CALCULATE PROPERTIES FOR THE FIRST RECTANGLE
C
 1200 DD = -R*(EPJR(NNP) - EPB) / CUR
      DA(1) = BB*DD
      EPC(1) = (EPB + EPJR(NNP))*0.5
      YY1(1) = YB + (R*DD*(0.5*EPB+EPJR(NNP)))/(3.0*EPC(1))
      YTT = YB + DD*R
C
C>--->CALCULATE PROPERTIES FOR LAST RECTANGLE
C
      DD = -R*(EPT - EPJR(NN2 - 1)) / CUR
      DA(NN3) = BB*DD
      EPC(NN3) = (EPT + EPJR(NN2 - 1))*0.5
      YY1(NN3) = YT -(R*DD*(1.0-(0.5*EPJR(NN2-1)+EPT)/(3.0*EPC(NN3))))
      IF(NN3.EQ.2) GO TO 4000
      NN4 = NN3 - 1
      K = NN1
C
C>--->CALCULATE PROPERTIES FOR THE REMAINING SUBRECTANGLES
C
      DO 3000 N = 2,NN4
      K = K + 1
      KP1 = K + 1
      DD = -R*(EPJR(KP1) - EPJR(K))/CUR
      DA(N) = BB*DD
      EPC(N) = 0.5*(EPJR(KP1) + EPJR(K))
      YY1(N) = YTT + R*DD*(0.5*EPJR(K)+EPJR(KP1))/(3.0*EPC(N))
      YTT = YTT + DD*R
 3000 CONTINUE
 4000 CONTINUE
C
C>--->DO FOR EACH SUBRECTANGLE
C
      DO 5000 N = 1,NN3
      EPT = EPC(N)
C
C>--->COMPUTE STRESS AT CENTROID OF SUBRECTANGLE (SIG)
C
      DO 4040 NP = 2,NNPT
      IF(EPT - EPJR(NP)) 4045,4055,4040
 4040 CONTINUE
      NP = NNPT
      GO TO 4050
 4045 IF(EPT - EPJR(1)) 4050 ,4055,4055
 4050 KOFFC = 1
 4055 NP = NP - 1
      NPP = NP + 1
      SIG = SIJR(NP) + (SIJR(NPP)-SIJR(NP))*(EPT - EPJR(NP))/(EPJR(NPP)
     1-EPJR(NP))
      DT = SIG*DA(N)
      T = T + DT
      BM = BM - DT * YY1(N)
 5000 CONTINUE
      RETURN
      END

      SUBROUTINE TOTALF(BMT,P,EP,CUR,KOFFC)
      IMPLICIT REAL * 8(A-H,O-Z)
C
C     SUBROUTINE ' TOTAL FORCE ' COMPUTE THE TOTAL FORCES AND BENDING
C     MOMENT ACTING ON THE CROSS SECTION
C     INPUT PHI AND EPSILON AT X'-AXIS
C     OUTPUT FORCES AND BENDING MOMENT AROUND X'-AXIS
C
      COMMON / SMID / DB(8),DDP(8),DIY(8),DAREA(8),DSIGL(8,10),
     1DEPSL(8,10),B(8),DP(8),Y(8),SAREA(8),WIDTH,AREAT,AEL,FL,
     2EPSTS(10),SIGTS(10),STRESS(8,19),STRAIN(8,19),NPTS(8),NSEGL
      COMMON/ SFAEJR / EPJR(19),SIJR(19),YY,BB,DPDP,AREA,NNPT
      KOFFC = 0
      BMT = 0.0
      P = 0.0
      DO 40 J = 1,NSEGL
      AREA = SAREA(J)
      BB = B(J)
      YY = Y(J)
      DPDP = DP(J)
      NNPT = NPTS(J)
      DO 30 K = 1,NNPT
      EPJR(K) = STRAIN(J,K)
   30 SIJR(K) = STRESS(J,K)
      NPP = 1
      IF(BB.GT.1.0E-10.AND.AREA.GT.1.0) NPP = 10
      DO 39 IP = 1,NPP
      IF(NPP.EQ.10) CALL CIRCLE(BB,DPDP,YY,IP)
      CALL FAEJR(T,BM,EP,CUR,KOFFC)
      BMT = BMT + BM
      P = P + T
   39 CONTINUE
   40 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE GENE
      IMPLICIT REAL * 8(A-H,C-Z)
C     SUBROUTINE ' GENERATE ' ASSIGN THE NODAL POINTS COORDINATES FOR
C     BOTH STRAIGHT AND CURVE MEMBER IN THE MEMBER AND STRUCTURE AXES
C     XM( ) , YM( ) = COORDINATES OF NODAL POINTS IN MEMBER AXES
C     XS( ) , YS( ) = COORDINATES OF NODAL POINTS IN STRUCTUER AXES
C     DC1M( ) , DC2M( ) = DIRECTION COSINE OF THE ELEMENT IN MEMBER AXES
C     DC1S( ) , DC2S( ) = DIRECTION COSINE OF THE ELEMENT IN STRUCTURE
C     AXES
C     DXY = ELEMENT LENGTH
      COMMON / SGEN / XM(41),YM(41),DC1M(40),DC2M(40),
     1                XS(41),YS(41),DC1S(40),DC2S(40),DXY
      COMMON / T3A / INLOP(30),IPINL(30),IPINR(30),KURVEN(30),ISYMA(30)
      COMMON / T3A2 / DC1(30),DC2(30),JT1(30),JT2(30)
      COMMON / CONST / MN,M,MP1,ZERC,PI
      COMMON / T2 / XJ(25),YJ(25),XCN(30),YCN(30)
      J1 = JT1(MN)
      XL = XJ(J1)
      YL = YJ(J1)
      J2 = JT2(MN)
      XR = XJ(J2)
      YR = YJ(J2)
      DENOM = M
      IF(KURVEN(MN).EQ.1) GO TO 140
C
C>--->STRAIGHT MEMBER
C
C>--->CHANGE IN LENGTH IN X AND Y DIRECTION
      DX = (XR - XL) / DENOM
      DY = (YR - YL) / DENOM
      DXY = DSQRT ( DX*DX + DY*DY )
C
C>--->NODAL POINTS LOCATION IN STRUCTURE COORDINATES AND MEMBER
C     COORDINATES
C
      DO 100 J = 1,MP1
      TEMP = J - 1
      XS(J) = XL + TEMP*DX
      YS(J) = YL + TEMP*DY
      XM(J) = TEMP*DXY
      YM(J) = 0.0
  100 CONTINUE
C
C>--->DIRECTION COSINE IN STRUCTURE AND MEMBER COORDINATES
C
      DO 120 J = 1,M
      DC1S(J) = DC1(MN)
      DC2S(J) = DC2(MN)
      DC1M(J) = 1.0
  120 DC2M(J) = 0.0
      RETURN
C
C>--->CURVE MEMBER
C
  140 XC = XCN(MN)
      YC = YCN(MN)
      DX = XR - XC
      DY = YR - YC
      RADIUS = DSQRT( DX*DX + DY*DY )
      DX = XR - XL
      DY = YR - YL
      CHORD = DSQRT( DX*DX + DY*DY )
      ANGLE = 2.0*DARSIN(0.5*CHORD/RADIUS)
      DANGLE = ANGLE / DENOM
C
C>--->ESTABLISH DIRECTION COSINE FOR XPM AXIS WRT X-Y AXIS
C
      CX = (XL - XC) / RADIUS
      CY = (YL - YC) / RADIUS
C
C>--->GENERATES COORDINATES OF STATION ON CURVE WRT XY SYSTEM AND MEMBER
C     SYSTEM
C
      DO 160 J = 1,MP1
      TEMP = J - 1
      ANGLE = TEMP * DANGLE
      XPM = RADIUS * DCOS(ANGLE)
      YPM = RADIUS * DSIN(ANGLE)
      XS(J) = CX * XPM - CY*YPM + XC
      YS(J) = CY*XPM + CX*YPM + YC
      XM(J) = (XS(J) - XL) * DC1(MN) + (YS(J) - YL) * DC2(MN)
      YM(J) = (YS(J) - YL) * DC1(MN) - (XS(J) - XL) * DC2(MN)
  160 CONTINUE
C
C>--->DIRECTION COSINE
C
      DXY = DSQRT((XS(2) - XS(1))*(XS(2) - XS(1)) + (YS(2) - YS(1)) *
     1(YS(2) - YS(1)))
      DO 180 J = 1,M
      JP1 = J + 1
      DC1S(J) = (XS(JP1) - XS(J)) / DXY
      DC2S(J) = (YS(JP1) - YS(J)) / DXY
      DC1M(J) = (XM(JP1) - XM(J)) / DXY
  180 DC2M(J) = (YM(JP1) - YM(J)) / DXY
      RETURN
      END
```

```
      SUBROUTINE LOAD
      IMPLICIT REAL * 8(A-H,O-Z)
C
C     SUBROUTINE LOAD DETERMINE ALL KINDS OF LOADS AT THE STATION
C
      COMMON / SGEN / XM(41),YM(41),DC1M(40),DC2M(40),
     1                XS(41),YS(41),DC1S(40),DC2S(40),DXY
      COMMON / BLOCK1 / QX(41),QY(41),QZ(41)
      COMMON / T1 / ITYPEL,KEEP4B,KEEP4C,NCD4B,NCD4C,NCD5BT,NCD4AT
      COMMON / CONST / MN,M,MP1,ZERO,PI
      COMMON / T3A2 / DC1(30),DC2(30),JT1(30),JT2(30)
      COMMON / T4A / XLL(20),XRL(20),QXL(20),QYL(20),QZL(20),SWT(30),
     1NCI4A(30),NCT4A(30)
      COMMON / T7 / ERR1,ERR2,ER1,ER2,NLINC,LINC,MNITF,MNITM
      COMMON / SMID / DB(8),DDP(8),DIY(8),DAREA(8),DSIGL(8,10),
     1DEPSL(8,10),B(8),DP(8),Y(8),SAREA(8),WIDTH,AREAT,AEL,FL,
     2EPSTS(10),SIGTS(10),STRESS(8,19),STRAIN(8,19),NPTS(8),NSEGL
C
C>--- ZERO LOADS
C
      DO 100 J=1,MP1
      QX(J)=0.0
      QY(J)=0.0
      QZ(J)=0.0
  100 CONTINUE
      IF(NCD4AT) 160,160,120
C
C>--->APPLIED LOADS
C
  120 CALL DFORCE(NCI4A    ,NCT4A    ,XLL,XRL,QXL,QYL,QZL,QX,QY,QZ)
C
C>--->ADJUST FOR LOAD INCREMENT
C
      TEMP1 = NLINC
      TEMP2 = LINC
      TEMP = TEMP1/TEMP2
      DO 140  J=1,MP1
      QX(J)= QX(J)*TEMP
      QY(J)=QY(J)*TEMP
  140 QZ(J)=QZ(J)*TEMP
C
C>--->WIND AND WAVE FORCES
C
  160 IF(NCD4C.EQ.0.AND.KEEP4C.EQ.0) GO TO 180
      CALL WWF
C
C>--->SELF WEIGHT
C
  180 IF(NCD4B.EQ.0.AND.KEEP4B.EQ.0) GO TO 200
      DO 190 J = 1,M
      OPJ = 0.0
      CALL MIDDLE(J,OPJ)
C
C>--->DETERMINE SELFWEIGHT OF THE ELEMENT AND TRANSFORM TO MEMBER
C>--->AXIS THEN CALCULATE FORCE FOR BOTH END STATIONS OF THE ELEMENT
C
      WTT=-AREAT*DXY*SWT(MN)
      TEMP=0.5*WTT*DC2(MN)
      JP1=J+1
      QX(JP1)=QX(JP1)+TEMP
      QX(J)=QX(J)+TEMP
      TEMP=0.5*WTT*DC1(MN)
      QY(JP1)=QY(JP1)+TEMP
      QY(J)=QY(J)+TEMP
  190 CONTINUE
  200 CONTINUE
      RETURN
      END

      SUBROUTINE MEMENI(W,FMMI)
      IMPLICIT REAL * 8(A-H,O-Z)
C
C>--->SUBROUTINE ' MEMENI ' COMPUTES THE INCREMENTAL MEMBER END FORCES
C     FOR FINDING INCREMENTAL FIXED END FORCES AND TANGENT STIFFNESS
C
      DIMENSION W(126),SEE3(3,3),WT(3),FMMT(3),FMMI(6)
      COMMON / BLK4 / ST1,ST2,ST3,ST4,ST5,ST6,ST12,ST45
      COMMON / BLK6 / QT1,QT2,QT3,QT4,QT5,QT6
      COMMON / CONST / MN,M,MP1,ZERO,PI
      COMMON / BLOC11 / SEET(6,6)
C
C>--->COMPUTE INCREMENTAL ELEMENT END FORCES ON ELEMENT NUMBER 1
C>--->FROM ELEMENT STIFFNESS MATRIX
C
      CALL ELEMST(1)
      DO 100 I=1,3
      WT(I)=W(I)
      DO 100 J=1,3
      SEE3(I,J)=SEET(I,J)
  100 CONTINUE
C
C>--->MULTIPLY ELEMENT STIFFNESS MATRIX TIME INCREMENTS OF MEMBER
C>--->DISPLACEMENTS AT MEMBER END
C
      CALL MATM31(SEE3,WT,FMMT)
      DO 150 I=1,3
  150 FMMI(I)=FMMT(I)
      DO 200 I=1,3
       WT(I)=W(I+3)
       DO 200 J=1,3
        SEE3(I,J)=SEET(I,J+3)
  200 CONTINUE
C
C>--->MULTIPLY ELEMENT STIFFNESS MATRIX TIMES INCREMENTS OF MEMBER
C     DISPLACEMENTS AT FIRST STATION INSIDE MEMBERS END
C
      CALL MATM31(SEE3,WT,FMMT)
      DO 250 I=1,3
  250 FMMI(I)=FMMI(I)+FMMT(I)
C
C>--->COMPUTE INCREMENTAL ELEMENT END FORCES ON ELEMENT NUMBER M
C     FROM ELEMENT STIFFNESS MATRIX
      CALL ELEMST(M)
      DO 600 I=1,3
      WT(I) = W(I+3*(M-1))
      DO 600 J=1,3
      SEE3(I,J)=SEET(I+3,J)
  600 CONTINUE
```

```
C
C>--->MULTIPLY ELEMENT STIFFNESS MATRIX TIMES INCREMENTS
C      OF MEMBER DISPLACEMENTS AT MEMBERS END
C
      CALL MATM31(SEE3,WT,FMMT)
      DO 650 I=1,3
      FMMI(I+3)=FMMT(I)
  650 CONTINUE
      DO 700 I=1,3
      WT(I) = W(I+3*M)
      DO 700 J=1,3
  700 SEE3(I,J)=SEET(I+3,J+3)
C
C>--->MULTIPLIT ELEMENT STIFFNESS MATRIX TIMES INCREMENTS OF MEMBER
C      DISPLACEMENTS AT FIRST STATION INSIDE MEMBERS END
C
      CALL MATM31(SEE3,WT,FMMT)
      DO 750 I=1,3
  750 FMMI(I+3)=FMMI(I+3)+FMMT(I)
C
C>--->ADD ON INCREMENTAL END LOADS AND INCREMENTAL SPRING
C       FORCES AT END STATIONS
      FMMI(1)=FMMI(1)+ST1*W(1)-QT1+ST12*W(2)
      FMMI(2)=FMMI(2)+ST2*W(2)-QT2+ST12*W(1)
      FMMI(3)=FMMI(3)+ST3*W(3)-QT3
      FMMI(4) = FMMI(4) + ST4*WT(1) - QT4 + ST45*WT(2)
      FMMI(5) = FMMI(5) + ST5*WT(2) - QT5 + ST45*WT(1)
      FMMI(6) = FMMI(6) + ST6*WT(3) - QT6
      RETURN
      END
```

```
      SUBROUTINE FORMST(RM,RO,W,SL,SU,SMMT)
      IMPLICIT REAL * 8(A-H,O-Z)
C
C     SUBROUTINE ' FORMST ' CALCULATE MEMBER (6*6) STIFFNESS MATRIX
C     AND TAKE ADVANTAGE OF SYMMETRY STORES IN COMPACT VECTOR SMMT(21)
C     MEMBER 6*6 STIFFNESS MATRIX STORED AS 21*1 VECTOR AS SHOWN BELOW
C           1
C           2   7
C           3   8  12
C           4   9  13  16
C           5  10  14  17  19
C           6  11  15  18  20  21
C
      DIMENSION FMMI(6),SMMT(21)
      DIMENSION RM(17,126),RO(126),W(126),SL(17),SU(18)
      COMMON / BLK4 / ST1,ST2,ST3,ST4,ST5,ST6,ST12,ST45
      COMMON / BLK5 / NFSUB,NITF
      COMMON / BLK6 / QT1,QT2,QT3,QT4,QT5,QT6
      COMMON / RI / NL,ML,J1
      COMMON / T3A / INLOP(30),IPINL(30),IPINR(30),KURVEN(30),ISYMA(30)
      COMMON/BLOCK4/SX(41),SY(41),SZ(41),SXY(41),SQX(41),SQY(41),SQZ(41)
      COMMON / CONST / MN,M,MP1,ZERO,PI
      COMMON / BLOCK8 / ERX(41),ERY(41),ERZ(41)
C
C>--->SET TEMPOPARY CONTROL CONSTANTS
C
      NL = 3*MP1
      ML = 1
      NFSUB = 22
C
C>--->ZERO MEMBER INCREMENT LOADS
C
      DO 1800 I = 1,MP1
      ERX(I) = 0.0
      ERY(I) = 0.0
 1800 ERZ(I) = 0.0
C
C>--->SUBROUTINE SSP DISTRIBUTED LINEAR AND NONLINEAR SPRING CONSTANT
C     TO THE STATIONS, VALUE OF RESISTIVE SPRING FORCES SQX,SQY,SQZ AND
C>--->SPRING STIFFNESS SX,SY,SZ,SXY ARE DETERMINE
C
      CALL SSP
C
C>--->STORE MEMBER END RESTRAINTS ST1-ST6
C
      ST1 = SX(1)
      ST2 = SY(1)
      ST3 = SZ(1)
      ST12 = SXY(1)
      ST4 = SX(MP1)
      ST5 = SY(MP1)
      ST6 = SZ(MP1)
      ST45 = SXY(MP1)
C
C>--->ZERO MEMBER END LOADS
C
      QT1 = 0.0
      QT2 = 0.0
```

```
      QT3 = 0.0
      QT4 = 0.0
      QT4 = 0.0
      QT5 = 0.0
      QT6 = 0.0
C
C>--->SET MEMBER END RESTRAINTS TO 1.0E40 FOR SIX MEMBER SOLUTIONS
C
      SX(1) = 1.0E40
      SY(1) = 1.0E40
      SZ(1) = 1.0E40
      SXY(1) = 0.0
      SX(MP1) = 1.0E40
      SY(MP1) = 1.0E40
      SZ(MP1) = 1.0E40
      SXY(MP1) = 0.0
C
C>--->ZERO PIN END ROTATION RESTRAINTS
C
      IF(IPINL(MN).EQ.1) SZ(1) = 0.0
      IF(IPINR(MN).EQ.1) SZ(MP1) = 0.0
C
C>--->UNIT INCREMENT FOR DISP. FOR FIRST COLUMN  OF STIFFNESS MATRIX
C
      ERX(1) = 1.0E40
C
C>--->CALL GRIP2A TO SOLVE MEMBER FOR UNIT INCREMENT OF DISPLACEMENT
C
      CALL GRIP2A(RM,RO,W,SL,SU,5)
      ERX(1) = 0.0
C
C>--->CALL MEMENI TO FIND INCREMENTAL END FORCES WHICH ARE STIFFNESS
C     TERMS IN ONE COLUMN OF STIFFNESS MATRIX
C
      CALL MEMENI(W,FMMI)
      DO 3350 KK = 1,6
 3350 SMMT(KK) = FMMI(KK)
C
C>--->SET MULTIPLE LOAD OPTION FOR REMAINING SOLUTIONS
C
      ML = -1
C
C>--->UNIT INCREMENT OF DISP. FOR SECOND COLUMN OF STIFFNESS MATRIX
C
      ERY(1) = 1.0E40
      CALL GRIP2A(RM,RO,W,SL,SU,5)
      ERY(1) = 0.0
      CALL MEMENI(W,FMMI)
      DO 3450 KK = 2,6
 3450 SMMT(KK+5) = FMMI(KK)
      IF(IPINL(MN).LE.0) GO TO 3500
C
C>--->ZERO STIFFNESS FOR PIN CONNECTIONS
C
      SMMT( 3) = 0.0
      SMMT( 8) = 0.0
      SMMT(12) = 0.0
      SMMT(13) = 0.0
      SMMT(14) = 0.0
      SMMT(15) = 0.0
      GO TO 3575
C
C>--->UNIT INCREMENT OF DISP. FOR THIRD COLUMN OF STIFFNESS MATRIX
C
 3500 ERZ(1) = 1.0E40
      CALL GRIP2A(RM,RO,W,SL,SU,5)
      ERZ(1) = 0.0
      CALL MEMENI(W,FMMI)
      DO 3550 KK = 3,6
 3550 SMMT(KK+9) = FMMI(KK)
C
C>--->UNIT INCREMENT OF DISP. FOR FOURTH COLUMN OF STIFFNESS MATRIX
C
 3575 ERX(MP1) = 1.0E40
      CALL GRIP2A(RM,RO,W,SL,SU,5)
      ERX(MP1) = 0.0
      CALL MEMENI(W,FMMI)
      DO 3650 KK = 4,6
 3650 SMMT(KK+12) = FMMI(KK)
C
C>--->UNIT INCREMENT OF DISP. FOR FIFTH COLUMN OF STIFFNESS MATRIX
C
      ERY(MP1) = 1.0E40
      CALL GRIP2A(RM,RO,W,SL,SU,5)
      ERY(MP1) = 0.0
      CALL MEMENI(W,FMMI)
      DO 3750 KK = 5,6
 3750 SMMT(KK+14) = FMMI(KK)
      IF(IPINR(MN).LE.0) GO TO 3800
C
C>--->ZERO STIFFNESS FOR PIN CONNECTIONS
C
      SMMT( 6) = 0.0
      SMMT(11) = 0.0
      SMMT(15) = 0.0
      SMMT(18) = 0.0
      SMMT(20) = 0.0
      SMMT(21) = 0.0
      GO TO 4000
C
C>--->UNIT INCREMENT OF DISP. FOR SIXTH COLUMN OF STIFFNESS MATRIX
C
 3800 ERZ(MP1) = 1.0E40
      CALL GRIP2A(RM,RO,W,SL,SU,5)
      ERZ(MP1) = 0.0
      CALL MEMENI(W,FMMI)
      SMMT (21) = FMMI(6)
 4000 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE ELEMST(I)
      IMPLICIT REAL * 8(A-H,O-Z)
C
C     SUBROUTINE ELEMST FORMS THE ELEMENT 6*6 STIFFNESS MATRIX
C
      DIMENSION BQ(6,6),BT(6,6),D(6,6),TM(6,6)
      COMMON / BLOCK3 / TT(30,40),BM1(30,40),BM2(30,40)
      COMMON / BLOCK2 / DX(30,41),DY(30,41),DZ(30,41)
      COMMON / SCURVE / EIP(30,40),EIN(30,40),ENP(30,40),ENN(30,40),
     1BMYP(30,40),BMYN(30,40),AE(30,40)
      COMMON / T3A / INLOP(30),IPINL(30),IPINR(30),KURVEN(30),ISYMA(30)
      COMMON / BLOC10 / U1,V1,W1,U2,V2,W2
      COMMON / CONST / MN,M,MP1,ZERO,PI
      COMMON / BLOC11 / SEET(6,6)
      COMMON / SGEN / XM(41),YM(41),DC1M(40),DC2M(40),
     1                XS(41),YS(41),DC1S(40),DC2S(40),DXY
      COMMON / SMID / DB(8),DDP(8),DIY(8),DAREA(8),DSIGL(8,10),
     1DEPSL(8,10),B(8),DP(8),Y(8),SAREA(8),WIDTH,AREAT,AEL,FL,
     2EPSTS(10),SIGTS(10),STRESS(8,19),STRAIN(8,19),NPTS(8),NSEGL
C>--->U1 = XA, V1 = YA, W1 = TLA
      U1 = XM(I+1) - XM(I) + DX(MN,I+1) - DX(MN,I)
      V1 = YM(I+1) - YM(I) + DY(MN,I+1) - DY(MN,I)
      W1 = DSQRT(U1*U1 + V1*V1)
C>--->U2 = XA/TLA, V2 = YA/TLA
      U2 = U1/W1
      V2 = V1/W1
C
C>--->FORM THE TRANSPOSE OF ELEMENT DEFORMATION DISPLACEMENT MATRIX
C
      BT(1,1) = -U2
      BT(2,1) = -V2
      BT(3,1) = 0.0
      BT(4,1) = U2
      BT(5,1) = V2
      BT(6,1) = 0.0
C>--->U2 = XA/TLA*TLA, V2 = YA/TLA*TLA
      U2 = U2/W1
      V2 = V2/W1
      BT(1,2) = -V2
      BT(2,2) = U2
      BT(3,2) = 1.0
      BT(4,2) = V2
      BT(5,2) = -U2
      BT(6,2) = 0.0
      BT(1,3) = -V2
      BT(2,3) = U2
      BT(3,3) = 0.0
      BT(4,3) = V2
      BT(5,3) = -U2
      BT(6,3) = 1.0
      IF(INLOP(MN) .EQ.1) GO TO 90
C
C>--->CALL MIDDLE TO DETERMINE AE AND EI FOR THE ELEMENT
C
      CALL MIDDLE(N,ZERO)
C
C>--->COMPUTE INCREMENTAL FORCE DEFORMATION MATRIX FOR ELEMENT
C
      D(1,1) = AEL/W1
      D(1,2) = 0.0
      D(1,3) = 0.0
      D(2,1) = 0.0
      D(2,2) = 4.0*FL/W1
      D(3,2) = 2.0*FL/W1
      D(3,1) = 0.0
      D(3,2) = D(2,3)
      D(3,3) = D(2,2)
      GO TO 150
   90 IF(BM2(MN,I)-BM1(MN,I)) 100,120,120
  100 TEMP = DABS(BM1(MN,I)/BMYN(MN,I))
      U2 = (1.0-TEMP**ENN(MN,I))**((ENN(MN,I)+1.0)/ENN(MN,I))
      TEMP = DABS(BM2(MN,I)/BMYN(MN,I))
      V2 = (1.0-TEMP**ENN(MN,I))**((ENN(MN,I)+1.0)/ENN(MN,I))
      W2 = 6.0*EIN(MN,I)/(W1*(4.0-U2*V2))
      GO TO 140
  120 TEMP = DABS(BM1(MN,I)/BMYP(MN,I))
      U2 = (1.0-TEMP**ENP(MN,I))**((ENP(MN,I)+1.0)/ENP(MN,I))
      TEMP = DABS(BM2(MN,I)/BMYP(MN,I))
      V2 = (1.0-TEMP**ENP(MN,I))**((ENP(MN,I)+1.0)/ENP(MN,I))
      W2 = 6.0*EIP(MN,I)/(W1*(4.0-U2*V2))
C
C>--->COMPUTE INCREMENTAL FORCE DEFORMATION MATRIX FOR THE ELEMENT
C
C>--->U2 = A1, V2 = A2, W2 = C2
  140 D(1,1) = AE(MN,I)/W1
      D(2,2) = 2.0*W2*U2
      D(3,3) = 2.0*W2*V2
      D(1,2) = 0.0
      D(2,1) = 0.0
      D(1,3) = 0.0
      D(3,1) = 0.0
      D(2,3) = W2*U2*V2
      D(3,2) = D(2,3)
C
C>--->FORM FIRST PART OF TRIPLE PRODUCT
C
  150 CALL MATMPY(BT,6,3,D,3,TM)
C
C>--->FORM THE ELEMENT DEFORMATION DISPLACEMENT MATRIX
C
      DO 160 K = 1,3
      DO 160 J = 1,6
  160 BQ(K,J) = BT(J,K)
C
C>--->COMPLETE THE TRIPLE PRODUCT
C
      CALL MATMPY(TM,6,3,BQ,6,SEET)
C
C>--->COMPUTE FOR CONVENIENCE
C
      TEMP = TT(MN,I)/(W1*W1*W1)
C>---> U2 = XA*XA*TEMP, V2 = YA*YA*TEMP, W2 = XA*YA*TEMP
      U2 = U1*U1*TEMP
      V2 = V1*V1*TEMP
      W2 = U1*V1*TEMP
C
```

```
C>--->COMPUTE THE PORTION OF THE INITIAL STRESS MATRIX DUE TO THRUST
C
      TM(1,1) = V2
      TM(1,2) = -W2
      TM(1,3) = 0.0
      TM(1,4) = -V2
      TM(1,5) = W2
      TM(1,6) = 0.0
      TM(2,2) = U2
      TM(2,3) = 0.0
      TM(2,4) = W2
      TM(2,5) = -U2
      TM(2,6) = 0.0
      TM(3,3) = 0.0
      TM(3,4) = 0.0
      TM(3,5) = 0.0
      TM(3,6) = 0.0
      TM(4,4) = V2
      TM(4,5) = -W2
      TM(4,6) = 0.0
      TM(5,5) = U2
      TM(5,6) = 0.0
      TM(6,6) = 0.0
C
C>--->ADD ON TO ELEMENT STIFFNESS MATRIX
C
      N1 = 0
      DO 180 K = 1,6
      N1 = N1 + 1
      DO 180 J = N1,6
      SEET(K,J) = SEET(K,J) + TM(K,J)
      SEET(J,K) = SEET(K,J)
  180 CONTINUE
C
C>--->COMPUTE FOR CONVENIENCE
C
      TEMP = (BM1(MN,I)+BM2(MN,I))/(W1*W1*W1*W1)
      U2 = (U1*U1-V1*V1)*TEMP
      V2 = 2.0*U1*V1*TEMP
C
C>--->COMPUTE THE PORTION OF THE INITIAL STRESS MATRIX DUE TO SHEAR
C
      TM(1,1) = -V2
      TM(1,2) = U2
      TM(1,3) = 0.0
      TM(1,4) = V2
      TM(1,5) = -U2
      TM(1,6) = 0.0
      TM(2,2) = V2
      TM(2,3) = 0.0
      TM(2,4) = -U2
      TM(2,5) = -V2
      TM(2,6) = 0.0
      TM(3,3) = 0.0
      TM(3,4) = 0.0
      TM(3,5) = 0.0
      TM(3,6) = 0.0
      TM(4,4) = -V2
```

```
      TM(4,5) = U2
      TM(4,6) = 0.0
      TM(5,5) = V2
      TM(5,6) = 0.0
      TM(6,6) = 0.0
C
C>--->ADD ON TO ELEMENT STIFFNESS MATRIX
C
      N1 = 0
      DO 200 K = 1,6
      N1 = N1 + 1
      DO 200 J = N1,6
      SEET(K,J) = SEET(K,J) + TM(K,J)
      SEET(J,K) = SEET(K,J)
  200 CONTINUE
      RETURN
      END



      SUBROUTINE FORMLD(RM,RO,W,SL,SU,FOMT)
      IMPLICIT REAL * 8(A-H,O-Z)
C
C     SUBROUTINE ' FORMLD ' CALCULATES MEMBER INCREMENTAL FIXED END
C     FORCE MATRIX ON FIRST ITERATION OF EACH PROBLEM
C
      DIMENSION FOMT(6),WT(3),FT(3)
      DIMENSION RM(17,126),RO(126),W(126),SL(17),SU(18)
      COMMON / BLOCK2 / DX(30,41),DY(30,41),DZ(30,41)
      COMMON / BLOCK3 / TT(30,40),BM1(30,40),BM2(30,40)
      COMMON / BLOCK5 / FOMM(30,6),SMC(30,21),IMC(30)
      COMMON / BLOCK8 / ERX(41),ERY(41),ERZ(41)
      COMMON / CONST / MN,M,MP1,ZERO,PI
      COMMON / BLK6 / QT1,QT2,QT3,QT4,QT5,QT6
      COMMON / RI / NL,ML,J1
      COMMON / T1 / ITYPEL,KEEP4B,KEEP4C,NCD4B,NCD4C,NCD5BT,NCD4AT
      COMMON / BLOCK1 / QX(41),QY(41),QZ(41)
      COMMON/BLOCK4/SX(41),SY(41),SZ(41),SXY(41),SQX(41),SQY(41),SQZ(41)
      COMMON / BLOC10 / U1,V1,W1,U2,V2,W2
      COMMON / BLK5 / NFSUB,NITF
      IF(ITYPEL.EQ.1) GO TO 2400
C
C>--->STORE EXISTING MEMBER END FORCES AS MEMBER END LOADS
C
      QT1 = FOMM(MN,1)
      QT2 = FOMM(MN,2)
      QT3 = FOMM(MN,3)
      QT4 = FOMM(MN,4)
      QT5 = FOMM(MN,5)
      QT6 = FOMM(MN,6)
 2400 CONTINUE
C
C>--->LOADS ON MEMBER
C
      CALL LOAD
```

```
C
C>--->START COMPUTATION OF  STATION EQUILIBRIUM ERRORS BY ADDING
C>--->ADJACENT ELEMENT END FORCES AT STATION
C
C>--->DO FOR EACH ELEMENT
      DO 3400 I = 1,M
      CALL ELEND(I)
      ERX(I) = ERX(I) + U1
      ERY(I) = ERY(I) + V1
      ERZ(I) = ERZ(I) + W1
      ERX(I+1) = ERX(I+1) + U2
      ERY(I+1) = ERY(I+1) + V2
      ERZ(I+1) = ERZ(I+1) + W2
 3400 CONTINUE
C
C>--->COMPLETE CALCULATIONS BY ADDING IN LOADS AND SPRING FORCES
C
C>--->DO FOR EACH STATION
      DO 3800 I = 1,MP1
      ERX(I) = QX(I) - ERX(I) + SQX(I)
      ERY(I) = QY(I) - ERY(I) + SQY(I)
      ERZ(I) = QZ(I) - ERZ(I) + SQZ(I)
 3800 CONTINUE
      QT1 = QT1 + ERX(1)
      QT2 = QT2 + ERY(1)
      QT3 = QT3 + ERZ(1)
      QT4 = QT4 + ERX(MP1)
      QT5=QT5+ERY(MP1)
      QT6 = QT6 + ERZ(MP1)
C
C>--->CALL GRIP2A FOR FOR SOLUTION OF MEMBER INCREMENTAL LOAD
C
      CALL GRIP2A(RM,RO,W,SL,SU,5)
C
C>--->CALL MEMENI FOR CALCULATION OF INCREMENTAL FIXED END FORCES
C
      CALL MEMENI(W,FOMT)
      RETURN
      END
```

```
      SUBROUTINE MEMSOL (RM,RO,W,SL,SU)
      IMPLICIT REAL * 8(A-H,O-Z)
C
C     SUBROUTINE ' MEMBER SOLUTION ' DOES THE ITERATIVE NONLINEAR MEMBER
C     SOLUTION THIS SOLUTION IS REQUIRED TO FIND THE MEMBER END FORCES
C     FOR THE JIONT EQUILIBRIUM CHECK AND FOR THE FINAL MEMBER SOLUTION
C
      DIMENSION DC(3,3),DMM(3),SA(3,3),DMS(3),FMM(6),FMT(3)
      DIMENSION RM(17,126),RO(126),W(126),SL(17),SU(18)
      COMMON / SCURVE / EIP(30,40),EIN(30,40),ENP(30,40),ENN(30,40),
     1BMYP(30,40),BMYN(30,40),AE(30,40)
      COMMON / T3A / INLOP(30),IPINL(30),IPINR(30),KURVEN(30),ISYMA(30)
      COMMON / T3A2 / DC1(30),DC2(30),JT1(30),JT2(30)
      COMMON / BLOCK2 / DX(30,41),DY(30,41),DZ(30,41)
      COMMON / BLOCK8 / ERX(41),ERY(41),ERZ(41)
      COMMON / BLOCK5 / FOMM(30,6),SMC(30,21),IMC(30)
      COMMON / BLOCK3 / TT(30,40),BM1(30,40),BM2(30,40)
      COMMON / BLOCK6 / DXX(25),DYY(25),DZZ(25),NITM(30)
      COMMON / T6 / QXX(25),QYY(25),QZZ(25),SXX(25),SYY(25),SZZ(25),
     1              ERXX(25),ERYY(25),ERZZ(25)
      COMMON / SGEN / XM(41),YM(41),DC1M(40),DC2M(40),
     1              XS(41),YS(41),DC1S(40),DC2S(40),DXY
      COMMON / SMID / DB(8),DDP(8),DIY(8),DAREA(8),DSIGL(8,10),
     1DEPSL(8,10),B(8),DP(8),Y(8),SAREA(8),WIDTH,AREAT,AEL,FL,
     2EPSTS(10),SIGTS(10),STRESS(8,19),STRAIN(8,19),NPTS(8),NSEGL
      COMMON / BLOCK7 / V(3),P(3),VV(3),PP(3)
      COMMON / T7 / ERR1,ERR2,ER1,ER2,NLINC,LINC,MNITF,MNITM
      COMMON / RI / NL,ML,J1
      COMMON / CONST / MN,M,MP1,ZERO,PI
      COMMON / BLOCK1 / QX(41),QY(41),QZ(41)
      COMMON/BLOCK4/SX(41),SY(41),SZ(41),SXY(41),SQX(41),SQY(41),SQZ(41)
      COMMON / BLOC10 / U1,V1,W1,U2,V2,W2
      COMMON / BLK5 / NFSUB,NITF
C
C>--->SET TEMPORARY CONTROL CONSTANT
C
      NL = 3*MP1
      ML = 1
      NFSUB = 22
C
C>--->SET UP MEMBER TRANSFORMATION MATRIX DC
C
      DC(1,3) = 0.0
      DC(2,3) = 0.0
      DC(3,1) = 0.0
      DC(3,2) = 0.0
      DC(3,3) = 1.0
      DC(1,1) = DC1(MN)
      DC(1,2) = DC2(MN)
      DC(2,1) = -DC(1,2)
      DC(2,2) = DC(1,1)
C
C>--->LOAD IN MEMBER
C
      CALL LOAD
C>--->STORE MEMBER END LOADS QT1 - QT6
C
      QT1 = QX(1)
```

```
      QT2 = QY(1)
      QT3 = QZ(1)
      QT4 = QX(MP1)
      QT5 = QY(MP1)
      QT6 = QZ(MP1)
C
C>--->SET MEMBER END DISPLACEMENTS IN STRUCTURE COORDINATES DMS
C>--->EQUAL TO STRUCTURE JOINT DISPLACEMENTS AT FROM JOINT
C
      J1I = JT1(MN)
      DMS(1) = DXX(J1I)
      DMS(2) = DYY(J1I)
      DMS(3) = DZZ(J1I)
C
C>--->TRANSFORM DMS TO DMM AT FROM JOINT
C
      CALL MATM31(DC,DMS,DMM)
C
C>--->SET MEMBER END LOADS TO 1.0E40 TIMES DMM AT FROM JOINT
C
      ERX(1) = (DMM(1) - DX(MN,1))*1.0E40
      ERY(1) = (DMM(2) - DY(MN,1))*1.0E40
      IF(IPINL(MN).EQ.1) GO TO 3120
      ERZ(1) = (DMM(3) - DZ(MN,1))*1.0E40
      GO TO 3150
 3120 ERZ(1) = 0.0
 3150 CONTINUE
C
C>--->REPEAT ABOVE FOR TO JOINT
C
      J2I = JT2 (MN)
      DMS(1) = DXX(J2I)
      DMS(2) = DYY(J2I)
      DMS(3) = DZZ(J2I)
      CALL MATM31(DC,DMS,DMM)
      ERX(MP1) = (DMM(1) - DX(MN,MP1))*1.0E40
      ERY(MP1) = (DMM(2) - DY(MN,MP1))*1.0E40
      IF(IPINR(MN).EQ.1) GO TO 3220
      ERZ(MP1) = (DMM(3) - DZ(MN,MP1))*1.0E40
      GO TO 3250
 3220 ERZ(MP1) = 0.0
 3250 CONTINUE
 3500 CONTINUE
C
C>--->START ITERATIVE SOLUTION FOR MEMBER DISPLACEMENTS CONSISTENT WITH
C>--->APPLIED LOADS AND IMPOSED DISPLACEMENTS FROM FRAME SOLUTION
C
      CALL SSP
C
C>--->SET MEMBER END RESTRAINTS EQUAL TO 1.0E40 FOR MEMBER SOLUTION
C
      SX(1) = 1.0E40
      SY(1) = 1.0E40
      SZ(1) = 1.0E40
      SXY(1) = 0.0
      SX(MP1) = 1.0E40
      SY(MP1) = 1.0E40
      SZ(MP1) = 1.0E40
```

```
C>--->IF MAX. NUMBER OF MEMBER ITERATIONS SET IMC = 1 AND STOP ITERATION
C
      IMC(MN) = 1
      GO TO 4250
C
C>--->SOLVE MEMBER FOR LINEAR INCREMENT OF DISPLACEMENT
C
 3890 CALL GRIP2A(RM,RO,W,SL,SU,5)
C
C>--->INCREMENT MEMBER DISPLACEMENTS
C
      J = 1
      DO 3900 I = 1,MP1
      DX(MN,I) = DX(MN,I) + W(J)
      J = J + 1
      DY(MN,I) = DY(MN,I) + W(J)
      J = J + 1
      DZ(MN,I) = DZ(MN,I) + W(J)
      J = J + 1
 3900 CONTINUE
C
C>--->ZERO EQUILIBRIUM ERRORS AT THE STATIONS
C
      ERX(1) = 0.0
      ERY(1) = 0.0
      ERZ(1) = 0.0
      ERX(MP1) = 0.0
      ERY(MP1) = 0.0
      ERZ(MP1) = 0.0
C
C>--->EVALUATES INTERNAL  FORCES IN THE ELEMENTS
C
C>--->INTERNAL FORCES
      DO 4100 J = 1,M
      THETAO = DATAN(DC2M(J)/DC1M(J))
      U1 = XM(J+1) - XM(J) + DX(MN,J+1) - DX(MN,J)
      V1 = YM(J+1) - YM(J) + DY(MN,J+1) - DY(MN,J)
      THETAA = DATAN(V1/U1)
      W1 = DSQRT(U1*U1+V1*V1)
      V(3) =(W1 - DXY)/DXY
      V(2) = THETAO - THETAA + DZ(MN,J+1)
      V(1) = THETAO - THETAA + DZ(MN,J)
      IF(INLOP(MN).EQ.0) GO TO 4090
C
C>--->P,BM1T,BM2T FROM THE KNOWN CURVE
C
      DO 4080 I = 1,3
      GO TO (4010,4020,4030),I
 4010 E = V(1) + V(2)/2.0
      IF(E) 4040,4070,4050
 4020 E = V(2) + V(1)/2.0
      IF(E) 4050,4070,4040
 4030 P(3) = AE(MN,J)*V(3)
      GO TO 4095
 4040 SYS= BMYP(MN,J)
      EN = ENP(MN,J)
      R = EIP(MN,J)*4.0*E/W1
      GO TO 4060
```

```
      SXY(MP1) = 0.0
C
C>--->ZERO PINNED END ROTATIONAL RESTRAINTS
C
C
      IF(IPINL(MN).EQ.1) SZ(1) = 0.0
      IF(IPINR(MN).EQ.1) SZ(MP1) = 0.0
C
C>--->ZERO INTERIOR STATION EQUILIBRIUM ERRORS
C
      DO 3510 I = 2,M
      ERX(I) = 0.0
      ERY(I) = 0.0
 3510 ERZ(I) = 0.0
      NITM(MN) = NITM(MN) + 1
      NITM1 = NITM(MN) - 1
C
C>--->DO FOR EACH ELEMENT
C>--->COMPUTE FORCES ON END OF ELEMENT
C
      DO 3600 I = 1,M
      CALL ELEND(I)
C
C>--->COMPUTE PARTIAL EQUILIBRIUM ERRORS BY SUM FORCES ON ADJ. ELEMENT
C
      IF(I.EQ.1.AND.IPINL(MN).EQ.1) ERZ(1) = W1
      IF(I.EQ.1) GO TO 3550
      ERX(I) = ERX(I) + U1
      ERY(I) = ERY(I) + V1
      ERZ(I) = ERZ(I) + W1
      IF(I.EQ.M  .AND.IPINR(MN).EQ.1) ERZ(MP1) = W2
      IF(I.EQ.M  ) GO TO 3600
 3550 ERX(I+1) = ERX(I+1) + U2
      ERY(I+1) = ERY(I+1) + V2
      ERZ(I+1) = ERZ(I+1) + W2
 3600 CONTINUE
C
C>--->ADD STATION LOADS AND STATION RESISTIVE SPRING  FORCES TO COMPLETE
C>--->COMPUTATION OF EQUILIBRIUM ERRORS
C
      DO 3800 I = 2,M
      ERX(I) = QX(I) - ERX(I) + SQX(I)
      ERY(I) = QY(I) - ERY(I) + SQY(I)
      ERZ(I) = QZ(I) - ERZ(I) + SQZ(I)
 3800 CONTINUE
      IF(IPINL(MN).EQ.1) ERZ(1) = QZ(1) - ERZ(1) + SQZ(1)
      IF(IPINR(MN).EQ.1) ERZ(MP1) = QZ(MP1) - ERZ(MP1) + SQZ(MP1)
C
C>--->COMPUTE EQUILIBRIUM ERRORS WITH SPECIFIED TOLERANCES
C
      DO 3825 I = 1,MP1
      IF(DABS(ERX(I)).GT.ER1) GO TO 3850
      IF(DABS(ERY(I)).GT.ER1) GO TO 3850
      IF(DABS(ERZ(I)).GT.ER2) GO TO 3850
 3825 CONTINUE
      GO TO 4200
 3850 IF(NITM(MN).LE.MNITM) GO TO 3890
C
 4050 SYS = BMYN(MN,J)
      EN = ENN(MN,J)
      R = EIP(MN,J)*4.0*E/W1
 4060 TEMP = DABS(R/SYS)
      P(I) = R/(1.0+TEMP**EN)**(1.0/EN)
      GO TO 4080
 4070 P(I) = 0.0
 4080 CONTINUE
C
C>--->LINEAR MEMBER
C
 4090 CALL MIDDLE(J,ZERO)
      P(1) = 4.0*FL*(V(1)+0.5*V(2))/W1
      P(2) = 4.0*FL*(V(2)+V(1)*0.5)/W1
      P(3) = AEL*V(3)
C>--->EQUATE P( ) TO TT,BM1,BM2
 4095 TT(MN,J) = P(3)
      BM2(MN,J) = P(2)
      BM1(MN,J) = P(1)
 4100 CONTINUE
      GO TO 3500
 4200 CONTINUE
      PRINT 52,MN,NITM1
   52 FORMAT(/,11H     MEMBER,I5,26H CONVERGED AFTER ITERATION,I5,//)
      GO TO 4300
 4250 PRINT 53,MN,NITM1
   53 FORMAT(/,11H     MEMBER,I5,30H NOT CONVERGED AFTER ITERATION,I5//)
C
C>--->CALCULATE MEMBER END FORCES
C
C>--->FIND FORCES ON ELEMENT NUMBER 1
 4300 CALL ELEND(1)
      FMM(1) = U1 - SQX(1) - QT1
      FMM(2) = V1 - SQY(1) - QT2
      FMM(3) = W1 - SQZ(1) - QT3
C
C>--->FIND FORCES ON LAST ELEMENT
C
      CALL ELEND(M)
      FMM(4) = U2 - SQX(MP1) - QT4
      FMM(5) = V2 - SQY(MP1) - QT5
      FMM(6) = W2 - SQZ(MP1) - QT6
C
C>--->SUBSTRACT MEMBER END FORCES FROM JOINT EQUILIBRIUM ERRORS TO
C>--->COMPLETE  COMPUTATION OF JOINT EQUILIBRIUM ERRORS
C
      J1I= JT1 (MN)
      ERXX(J1I)= ERXX(J1I)- (FMM(1)*DC1(MN)-FMM(2)*DC2(MN))
      ERYY(J1I)= ERYY(J1I)- (FMM(1)*DC2(MN)+FMM(2)*DC1(MN))
      ERZZ(J1I)= ERZZ(J1I)- FMM(3)
      J2I= JT2(MN)
      ERXX(J2I)= ERXX(J2I)- (FMM(4)*DC1(MN)-FMM(5)*DC2(MN))
      ERYY(J2I)= ERYY(J2I)- (FMM(4)*DC2(MN)+FMM(5)*DC1(MN))
      ERZZ(J2I)= ERZZ(J2I)- FMM(6)
      DO 4400 I = 1,6
 4400 FOMM(MN,I) = FMM(I)
      RETURN
      END
```

```
      SUBROUTINE DFORCE(NCI,NCT,XLL,XRL,QXL,QYL,QZL,QX,QY,QZ)
      IMPLICIT REAL * 8(A-H,O-Z)
C
C     SUBROUTINE ' DFORCE ' DISTRIBUTED STATIC LOADING AND LINEAR SPRING
C     CONSTANT TO THE STATION IN THE MEMBER
C
      DIMENSION NCI(30),NCT(30),XLL(20),XRL(20),QXL(20),QYL(20),QZL(20),
     1QX(41),QY(41),QZ(41)
      COMMON / T3A / INLOP(30),IPINL(30),IPINR(30),KURVEN(30),ISYMA(30)
      COMMON / SGEN / XM(41),YM(41),DC1M(40),DC2M(40),
     1                XS(41),YS(41),DC1S(40),DC2S(40),DXY
      COMMON / CONST / MN,M,MP1,ZERO,PI
      I1 = NCI(MN)
      I2 = NCT(MN) + I1 - 1
C
C>--->START READING DATA
C
      DO 500 I=I1,I2
      XL=XLL(I)
      XR=XRL(I)
      QXLT=QXL(I)
      QYLT=QYL(I)
      QZLT=QZL(I)
C
C>--->CHECK IF IT IS ONE CARD TYPE INPUT
C
      IF(XL.GE.O.AND.XR.GT.1.0E-10) GC TO 140
C
C>--->CHECK FCR CONTINUOUS TYPE INPUT
C
      IF(XL.GE.0) GO TO 120
C>--->FOR XL=0 ON THE FIRST CARD
      XL=XR
C
C>--->FOR XR=0 ON THE FIRST CARD
C>--->READ DATA FOR RIGHT OF SECTION
  120 IP1=I+1
      IF(IP1.GT.I2) GO TO  500
      TEMP=XLL(IP1)
      XR=XRL(IP1)
      QXRT=QXL(IP1)
      QYRT=QYL(IP1)
      QZRT=QZL(IP1)
      IF(TEMP) 160,500,500
C
C>--->FOR XL AND XR GREATER THAN ZERO
C>--->THEN QL=QR
  140 QXRT=QXLT
      QYRT=QYLT
      QZRT=QZLT
  160 CONTINUE
      IF(DABS(XL-XR).GT.1.0E-10) GO TO 200
C
C>--->CONCENTRATED LOAD XL=XR
C
C>--->DETERMINE ELEMENT NUMBER THAT THE LOAD ACT
      DO 180 J=1, MP1
      IF(XM(J).LT.XL) GO TO 180
      JM1=J-1
      CALL LINCON(XL,ZERO,JM1,QXLT,ZERO,QX,XM)
      CALL LINCON(XL,ZERO,JM1,QYLT,ZERO,QY,XM)
      CALL LINCON(XL,ZERO,JM1,QZLT,ZERO,QZ,XM)
      GO TO 500
  180 CONTINUE
C
C>--->DISTRIBUTED LOAD
C
  200 DO 300 J=1,MP1
      IF(XM(J).LE.XL)  GO TO 300
      JM1 = J - 1
C
C>--->COMPUTE SLOPE OF LINEAR VARIATION
C
  220 DQX=(QXRT-QXLT)/(XR-XL)
      DQY=(QYRT-QYLT)/(XR-XL)
      DQZ=(QZRT-QZLT)/(XR-XL)
      IF(KURVEN(MN).NE.1) GO TO 280
C>--->COMPUTE SLOPE OF LINEAR VARIATICN IN Y DIRECTION WHEN
C>--->MEMBER IS NOT STRAIGHT
C
C>--->CHECK TO MAKE SURE THAT XL AND XR ARE IN THE SAME HALF
      TEMP=XM(MP1)/2.0
      IF(XL.LT.TEMP.AND.XR.GT.TEMP) GO TO 450
C
C>--->DETERMINE Y CO-ORDINATE OF XL
C
      YL=YM(JM1)+((XL-XM(JM1))*(YM(J)-YM(JM1)))/(XM(J)-XM(JM1))
C
C>--->Y COORDINATE OF XR
C
      DO 240 JJ = J,MP1
      IF(XR-XM(JJ)) 260,260,240
  240 CONTINUE
  260 JJM1=JJ-1
      YR=YM(JJM1)+((XR-XM(JJM1))*(YM(JJ)-YM(JJM1)))/(XM(JJ)-XM(JJM1))
C>--->SLOPE
      DQY=(QYRT-QYLT)/(YR-YL)
      CALL LINCON(YL,YM(J),JM1,QYLT,DQY,QY,YM)
  280 CALL LINCON(XL,XM(J),JM1,QXLT,DQX,QX,XM)
      CALL LINCON(XL,XM(J),JM1,QZLT,DQZ,QZ,XM)
      IF(KURVEN(MN).EQ.1) GO TO 320
      CALL LINCON(XL,XM(J),JM1,QYLT,DQY,QY,XM)
      GO TO 320
  300 CONTINUE
C>--->FOR REMAINING ELEMENT(JJ=ELEMENT NUMBER)
  320 DO 400 JJ=J,M
      JJP1=JJ+1
      IF(XM(JJP1).GE.XR) GO TO 420
      QI=QXLT+DQX*(XM(JJ)-XL)
      CALL LINCON(XM(JJ),XM(JJP1),JJ,QI,DQX,QX,XM)
      QI=QZLT+DQZ*(XM(JJ)-XL)
      CALL LINCON(XM(JJ),XM(JJP1),JJ,QI,DQZ,QZ,XM)
      IF(KURVEN(MN).EQ.1) GO TO 340
      QI=QYLT+DQY*(XM(JJ)-XL)
      CALL LINCON(XM(JJ),XM(JJP1),JJ,QI,DQY,QY,XM)
      GO TO 400
```

```
340 QI=QYLT+DQY*(YM(JJ)-YL)
    CALL LINCON(YM(JJ),YM(JJP1),JJ,QI,DQY,QY,YM)
400 CONTINUE
    GO TO 500
420 IF(XR.LE.XM(JJ)) GO TO 500
    QI=QXLT+DQX*(XM(JJ)-XL)
    CALL LINCON(XM(JJ),XR,JJ,QI,DQX,QX,XM)
    QI = QZLT + DQZ * (XM(JJ) - XL)
    CALL LINCON(XM(JJ),XR,JJ,QI,DQZ,QZ,XM)
    IF (KURVEN(MN).EQ.1) GO TO 440
    QI=QYLT+DQY*(XM(JJ)-XL)
    CALL LINCON(XM(JJ),XR,JJ,QI,DQY,QY,XM)
    GO TO 500
440 QI=QYLT+DQY*(YM(JJ)-YL)
    CALL LINCON(YM(JJ),YR,JJ,QI,DQY,QY,YM)
    GO TO 500
450 PRINT 900
900 FORMAT(/,35H     CHECK LOAD IN THE Y DIRECTION      )
500 CONTINUE
    RETURN
    END
```

```
      SUBROUTINE LINCON(XL,XR,I,QL,SL,Q,XN)
      IMPLICIT REAL * 8(A-H,C-Z)
C     SUBROUTINE LINCON DISTRIBUTES LINEAR OR CONCENTRATED LOADSTO THE
C     ADJACENT STATION
C
C     FOR CURVE MEMBER USE YL,YR AND YN INSTEAD OF X WHEN LOAD IN Y AXIS
C     FOR CONCENTRATED LOAD XR MUST BE EQUAL TO ZERO
C     INITIALIZE THE VALUE OF QI FOR CONCENTRATED LOAD
      DIMENSION Q(41),XN(41)
      Z=0
      QI=QL
      IF(XR.LT.1.0E-10) GO TO 100
      QLL=QL+SL*(XR-XL)
      IF((QL+QLL).EQ.0.0) RETURN
      QI=0.5*(XR-XL)*(QL+QLL)
      Z=(2.0*QLL+QL)*(XR-XL)/(3.0*(QL+QLL))
  100 Z=XL-XN(I)+Z
      TH = XN(I+1) - XN(I)
      Q(I)=Q(I)+QI*(TH-Z)/TH
      Q(I+1) = Q(I+1) + QI*Z/TH
      RETURN
      END
```

```
      SUBROUTINE MIDDLE(N,OPJ)
      IMPLICIT REAL * 8(A-H,O-Z)
C
C     SUBROUTINE ' MIDDLE ELEMENT ' COMPUTE THE PROPERTIES OF AREA AND
C     STRESS-STRAIN CURVE AT THE MID-ELEMENT IN A MEMBER ALSO TOTAL AREA
C     AND MAXIMUM WIDTH AT THE MID-ELEMENT WILL BE FOUND
C     LINEAR OPTION MAXIMUM WIDTH EQUAL TO ZERO
C     OPJ = JOINT OPTION
C     OPJ = 0 , N = ELEMENT NUMBER
C     OPJ = 0.5 , N = JOINT NUMBER
C
      COMMON / T3A / INLOP(30),IPINL(30),IPINR(30),KURVEN(30),ISYMA(30)
      COMMON / T3A1 / EL(30),FL1(30),AEL1(30),FL2(30),AEL2(30),NAL(30),
     1                NAR(30)
      COMMON /T3BC / SM(50),EM(50),BI(50),DI(50),YI(50),SAREAI(50),
     1SIGT(5,10),EPST(5,10),NSG(20),NCI3B(20),NSS(50),NPT(5),ISYM(5)
      COMMON / SMID / DB(8),DDP(8),DIY(8),DAREA(8),DSIGL(8,10),
     1DEPSL(8,10),B(8),DP(8),Y(8),SAREA(8),WIDTH,AREAT,AEL,FL,
     2EPSTS(10),SIGTS(10),STRESS(8,19),STRAIN(8,19),NPTS(8),NSEGL
      COMMON / CONST / MN,M,MP1,ZERO,PI
C
C>--->SET INITIAL AREA AND WIDTH EQUAL TO ZERO
C
      AREAT = 0.0
      WIDTH = 0.0
C
C>--->CHECK FOR LINEAR OPTION
C
      IF(INLOP(MN) ) 340,320,120
C>--->NUMBER OF AREA AT LEFT AND RIGHT OF THE MEMBER
  120 J1 = NAL(MN)
      J2 = NAR(MN)
      DENOM = M
      NSEGL= NSG(J1)
      IF(N.GT.1) GO TO 180
C
C>--->CHECK IF NUMBER OF SEGMENT FOR BOTH SIDE OF MEMBER ARE THE SAME
C
      IF(NSEGL.NE.NSG(J2)) GO TO 370
C
C>--->DETERMINE CHANGE IN DIMENSION
C
      DO 160 J = 1,NSEGL
      NCL = NCI3B(J1) + J - 1
      NCR = NCI3B(J2) + J - 1
      DB(J) = (BI(NCR) - BI(NCL)) / DENOM
      DDP(J) = (DI(NCR) - DI(NCL)) / DENOM
      DIY(J)= (YI(NCR) - YI(NCL)) / DENOM
      DAREA(J) = (SAREAI(NCR) - SAREAI(NCL)) / DENOM
      N1 = NSS(NCL)
      N2 = NSS(NCR)
      IF(NPT(N1).NE.NPT(N2)) GO TO 380
      NPTST = NPT(N1)
      DO 140 K = 1,NPTST
      DSIGL(J,K) = (-SIGT(N1,K)*SM(NCL) + SIGT(N2,K)*SM(NCR))/DENOM
      DEPSL(J,K) = (-EPST(N1,K)*EM(NCL) + EPST(N2,K)*EM(NCR))/DENOM
  140 CONTINUE
  160 CONTINUE
```

```
  180 CONTINUE
C
C>--->COMPUTE SECTION PROPERTIES AND STRESS-STRAIN CURVE
C
      ZL = N
      ZL = ZL - 0.5 - OPJ
      DO 300 J = 1,NSEGL
      NCL = NCI3B(J1) + J - 1
      B(J) = BI(NCL) + ZL*DB(J)
      DP(J) = DI(NCL) + ZL*DDP(J)
      Y(J) = YI(NCL) + ZL*DIY(J)
      SAREA(J) = SAREAI(NCL) + ZL*DAREA(J)
      N1 = NSS(NCL)
      NPTST = NPT(N1)
      ISST = ISYM(N1)
      DO 200 K = 1,NPTST
      EPSTS(K) = EPST(N1,K)*EM(NCL) + ZL*DEPSL(J,K)
  200 SIGTS(K) = SIGT(N1,K)*SM(NCL) + ZL*DSIGL(J,K)
C
C>--->COMPLETE STRESS-STRAIN AND NUMBER OF POINTS IN EACH SEGMENT
C
      IF(ISST) 10,10,50
   10 DO 20 I = 1,NPTST
      STRAIN(J,I) = EPSTS(I)
   20 STRESS(J,I) = SIGTS(I)
      NPTS(J) = NPTST
      GO TO 80
   50 STRESS(J,NPTST) = SIGTS(1)
      STRAIN(J,NPTST)  = EPSTS(1)
      DO 70 I = 2,NPTST
      II = I + NPTST - 1
      JJ = NPTST - I + 1
      STRAIN(J,II) = EPSTS(I)
      STRAIN(J,JJ) = -EPSTS(I)
      STRESS(J,II) = SIGTS(I)
   70 STRESS(J,JJ) = -SIGTS(I)
      NPTS(J) = 2*NPTST - 1
   80 CONTINUE
C
C>--->COMPUTE TOTAL AREA AND MAXIMUM WIDTH
C
      IF(SAREA(J).GT.1.0E-10) GO TO 220
C>---> RECTANGULAR SECTION
      AREAT = B(J) *DP(J) + AREAT
      GO TO 280
C>---> AREA
  220 IF(B(J).GT.1.0E-10) GO TO 240
      AREAT = AREAT + SAREA(J)
      GO TO 300
C>---> CIRCULAR AREA
  240 IF(DP(J).GT.1.0E-10) GO TO 260
      AREAT = AREAT + (0.78539816*B(J)*B(J))
      GO TO 280
C>---> THINWALL
  260 AREAT = AREAT + (3.1415926*(B(J) -DP(J)) *DP(J))
  280 IF(B(J).GT.WIDTH) WIDTH = B(J)
  300 CONTINUE
      GO TO 360
C
C>---> LINEAR PART
C
  320 ZL = N
      ZL = ZL - 0.5 - OPJ
      DENOM = M
      AEL = (AEL1(MN) + ZL*(AEL2(MN) - AEL1(MN)))/ DENOM
      FL = (FL1(MN) + ZL*(FL2(MN) - FL1(MN))) / DENOM
      AREAT = AEL / EL(MN)
      GO TO 360
  340 PRINT 11
   11 FORMAT(50H      LINEAR OPTION INLOP CANNOT BE LESS THAN ZERO  )
      GO TO 360
  370 PRINT 21
   21 FORMAT(50H      MEMBER SEGMENT FOR BOTH SIDES ARE NOT EQUAL        )
      GO TO 360
  380 PRINT 30
   30 FORMAT(50H      POINTS IN STRESS-STRAIN CURVES ARE NOT MATCH )
  360 CONTINUE
      RETURN
      END



      SUBROUTINE ELEND(I)
      IMPLICIT REAL * 8(A-H,O-Z)
C
C      SUBROUTINE ' ELEND ' DETERMINE ELEMENT END FORCES FROM THE
C     INTERNAL END FORCES
C
      COMMON / SGEN / XM(41),YM(41),DC1M(40),DC2M(40),
     1                XS(41),YS(41),DC1S(40),DC2S(40),DXY
      COMMON / CONST / MN,M,MP1,ZERO,PI
      COMMON / BLOCK2 / DX( 1,41),DY( 1,41),DZ( 1,41)
      COMMON / BLOCK3 / TT( 1,40),BM1( 1,40),BM2( 1,40)
      COMMON / BLOC10 / U1,V1,W1,U2,V2,W2
      U2= YM(I+1)-YM(I)+DY(MN,I+1)-DY(MN,I)
      V2= XM(I+1)-XM(I)+DX(MN,I+1)-DX(MN,I)
      W2 = DSQRT(U2*U2+V2*V2)
      U1 =-(TT(MN,I)*V2+U2*(BM1(MN,I)+BM2(MN,I))/W2)/W2
      V1 =(-TT(MN,I)*U2+V2*(BM1(MN,I)+BM2(MN,I))/W2)/W2
      W1 = BM1(MN,I)
      U2= -U1
      V2 =-V1
      W2 = BM2(MN,I)
      RETURN
      END
```

```
      SUBROUTINE SSP
      IMPLICIT REAL * 8(A-H,C-Z)
C
C     SUBROUTINE ' SSP ' CALCULATE LINEAR AND NONLINEAR SPRING AND LOAD
C     AT THE STATION
C
      COMMON / T1 / ITYPEL,KEEP4B,KEEP4C,NCD4B,NCD4C,NCD5BT,NCD4AT
      COMMON / BLOCK2 / DX(30,41),DY(30,41),DZ(30,41)
      COMMON / T3A / INLOP(30),IPINL(30),IPINR(30),KURVEN(30),ISYMA(30)
      COMMON/BLOCK4/SX(41),SY(41),SZ(41),SXY(41),SQX(41),SQY(41),SQZ(41)
      COMMON / CONST / MN,M,MP1,ZERO,PI
      COMMON / SGEN / XM(41),YM(41),DC1M(40),DC2M(40),
     1                XS(41),YS(41),DC1S(40),DC2S(40),DXY
      COMMON / SMID / DB(8),DDP(8),DIY(8),DAREA(8),DSIGL(8,10),
     1DEPSL(8,10),B(8),DP(8),Y(8),SAREA(8),WIDTH,AREAT,AEL,FL,
     2EPSTS(10),SIGTS(10),STRESS(8,19),STRAIN(8,19),NPTS(8),NSEGL
      COMMON / T5AB / XLS(20),XRS(20),QXS(20),QYS(20),QZS(20),PEF(20),
     1PET(20),CO(20),GAMA(20),NCI5A(30),NCT5A(30),KEEP5A,NCD5A ,NCD5B,
     2KEEP5B
C
C>--->INITIALIZE SPRING CONSTANT EQUAL TO ZERO WHEN THERE ARE NO LOAD
C
      DO 50 J=1,MP1
      SX(J)=0
      SY(J)=0
      SZ(J)=0
      SXY(J)=0
      SQX(J)=0
      SQY(J)=0
      SQZ(J)=0
   50 CONTINUE
      IF(KEEP5A.EQ.0.AND.NCD5A.EQ.0) GO TO 70
      IF(NCI5A(MN).NE.0.AND.NCT5A(MN).NE.0) GO TO 60
      GO TO 70
C
C>--->LINEAR PART
C
C>--->DETERMINE SPRING CONSTANT AT THE STATIONS
   60 CALL DFORCE(NCI5A,NCT5A,XLS,XRS,QXS,QYS,QZS,SX,SY,SZ)
C
C>--->RESISTIVE SPRING FORCE
C
      DO 65 J=1,MP1
      SQX(J)=-SX(J)*DX(MN,J)
      SQY(J)=-SY(J)*DY(MN,J)
      SQZ(J)=-SZ(J)*DZ(MN,J)
      SXY(J)=0.0
   65 CONTINUE
C>--->CHECK FOR SOIL DATA
C
   70 IF(KEEP5B.EQ.0.AND.NCD5B.EQ.0) GO TO 310
      DO 300 J=1,MP1
      IF(YS(J).GE.0.0) GO TO 300
      IF(KURVEN(MN).EQ.0) GO TO 125
C
C>--->TRANSFORM MEMBER DISPLACEMENT TO NORMAL AND TANGENTIAL
C     COORDINATES FOR CURVE MEMBER ONLY
C
      IF(J-1) 95,100,100
   95 D1=DC1M(1)
      D2=DC2M(1)
      GO TO 120
  100 IF(J-MP1) 110,105,105
  105 D1=DC1M(M)
      D2=DC2M(M)
      GO TO 120
  110 D1=0.5*(DC1M(J-1)+DC1M(J))
      D2=0.5*(DC2M(J-1)+DC2M(J))
  120 DN=D1*DX(MN,J)+D2*DY(MN,J)
      DT=-D2*DX(MN,J)+D1*DY(MN,J)
      GO TO 126
  125 DN=DY(MN,J)
      DT=DX(MN,J)
C>--->DIAMETER OR MAXIMUM WIDTH AT THE STATION J
C
  126 OPJ = 0.5
       CALL MIDDLE(J,OPJ)
C
C>--->GAMA AND SOIL SHEAING STRENGTH FROM DATA READING
C
      DO 140I=1, NCD5BT
      IF(YS(J).LT.PET(I)) GO TO 140
      IF(PEF(I).LT.-1.0E-10) GO TO 130
      TEMP=PEF(I-1)+PET(I-1)
      C=CO(I-1)+(YS(J)-TEMP)*(CO(I)-CO(I-1))/(PET(I)-TEMP)
      GAM=GAMA(I-1)+(YS(J)-TEMP)*(GAMA(I)-GAMA(I-1))/(PET(I)-TEMP)
      GO TO 150
  130 C=CO(I)
      GAM= GAMA(I)
      GO TO 150
  140 CONTINUE
C
C>--->ULTIMATE SHEARING STRENGTH AND SPRING FORCE,TAGENTIAL
C     STIFFNESS IN NORMAL DIRECTION
  150 TEMP=(3.0*C*WIDTH)-(GAM*WIDTH*YS(J))-(C*YS(J)*0.5)
      QULT=9.0*C*WIDTH
      IF(TEMP.LT.QULT)QULT=TEMP
      TEMP=DABS(DN)
      SQYT = DXY*QULT*(5.0*DABS(DN)/WIDTH)**(0.3333333)
      IF(DN.GT.0)SQYT=-SQYT
      SYT = DXY*QULT/(5.4*DN*DN*WIDTH)**(0.3333333)
C>--->TANGENTIAL DIRECTION
      CC=C*DXY*WIDTH
      TP = DABS(DT)
      IF(YS(J).LT.-120.0) GO TO 180
C
C>--->CURVE A
C
      IF(TP  .LT.0.16) GO TO 160
      SQXT=0.51*CC
      SXT=0
      GO TO 280
  160 SQXT=(1100.2*TP**4-465.86*TP**3+52.684*TP*TP+1.913*TP-0.0438)*CC
      SXT=(4400.8*TP**3-1397.58*TP*TP+105.368*TP+1.913)*CC
      GO TO 280
  180 IF(YS(J).LT.-240.0) GO TO 220
```

```
C
C>--->CURVE B
C
      IF(TP  .LT.0.16) GO TO 200
      SQXT=0.82*CC
      SXT=0
      GO TO 280
  200 SQXT=(702.052*TP**4-280.837*TP**3+18.346*TP*TP+6.136*TP+0.0595)*CC
      SXT=(2808.208*TP**3-842.511*TP*TP-36.692*TP+6.136)*CC
      GO TO 280
  220 IF(TP  .GT.0.04) GO TO 240
C
C>--->CURVE C
C
C>--->LINEAR PART
      SQXT=20.0*TP  *CC
      SXT=20.0*CC
      GO TO 280
C
C>--->NONLINEAR PART
C
  240 IF(TP  .GE.0.14) GO TO 260
      SQXT=(-12160.*TP**4+5629.54*TP**3-946.46*TP*TP+69.4*TP-0.764)*CC
      SXT=(48640.*TP**3+16888.62*TP*TP-1928.92*TP+69.4)*CC
      GO TO 280
C
C>--->CONSTANT PART
C
  260 SQXT=0.82*CC
      SXT=0
  280 IF(DT.GT.0) SQXT=-SQXT
      SXYT=0.0
      IF(KURVEN(MN).EQ.0) GO TO 290
C
C>--->TRANSFER BACK TO MEMBER AXIS
C
      TEMP=D1*SQXT-D2*SQYT
      TEMP2=D2*SQXT+D1*SQYT
      SQXT = TEMP
      SQYT=TEMP2
      TEMP=D1*D1*SXT+D2*SYT*D2
      TEMP2=D2*D2*SXT+D1*SYT*D1
      SXYT=(SQXT-SQYT)*D1*D2
      SXT=TEMP
      SYT=TEMP2
  290 SQX(J)=SQX(J)+SQXT
      SQY(J)=SQY(J)+SQYT
      SX(J)=SX(J)+SXT
      SY(J)=SY(J)+SYT
      SXY(J)=SXYT
  300 CONTINUE
  310 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE GRIP2A(RM,RO,W,SL,SU,M)
      IMPLICIT REAL * 8(A-H,C-Z)
C*****************************************************************************
C
C     SOLVE EQUILIBRIUM EQUATIONS
C     CALL FSUB1 TO WHICH CALLS FSUB21 FOR FRAME SOLUTION AND
C     CALLS FSUB22 FOR MEMBER SOLUTIONS
C     NL = TOTAL NUMBER OF EQUATIONS  MUST BE GREATER THAN 2
C     ML = CONTROL CONSTANT
C     J1 = NUMBER OF EQUATION
C     M = (J - 1)/2 WHERE J = BAND WIDTH
C       = 5 FOR MEMBER SOLUTION
C       = 3*MAX. DIFFERENT IN JOINT + 2
C
C*****************************************************************************
      DIMENSION RM(17,126),RO(126),W(126),SL(17),SU(18)
      COMMON / RI / NL,ML,J1
      J1 = 1
      M1 = M - 1
      MP = M + 1
      NLM1 = NL - 1
      NLMM = NL - M
      IZ = 0
      I2 = 1
      I3 = 1
C*****************************************************************************
C                                   CALCULATE RECURSION MULTIPLIERS
C*****************************************************************************
      SL(1) = 0.0
      CALL FSUB1(SU,F,M)
      IF(ML) 210,100,100
  100 RM(M,1) = -1.0/SU(MP)
      DO 150 I = 1,M1
      IB = MP - I
      RM(I,IB) = SU(I + 1)
  150 CONTINUE
      RO(1) = SU(1)
  210 W(1) = RM(M,1) * (-F)
      DO 1000 J = 2,NL
      J1 = J - 1
      IF(J.GT.M) J1 = M1
      DO 250 I = 1,J1
      IB = J1 + 2 - I
      SL(IB) = SL(IB - 1)
  250 CONTINUE
      SL(1) = SU(1)
      J1 = J
      CALL FSUB1(SU,F,M)
      J1 = J - 1
      IF(J.GT.M) J1 = M1
      IF(ML) 750,290,290
  290 IX = J + M1
      IF(IX - NL - 1) 299,295,292
  292 I3 = I3 + 1
  295 IZ = IZ - 1
      I2 = I2 + 1
  299 I1 = IX + IZ
      IE = I3
```

```
      DO 300 I = I2,M
      RM(I,II) = SU(I + 1)
      II = II - 1
  300 CONTINUE
      RO(J) = SU(1)
      DO 400 L = 1,J1
      TEMP = RM(M,J-L)*RM(M-L,J)
      IF((J+M-L).LE.NL) RM(L,M+J-L) = RM(L,M+J-L) + SL(L)*TEMP
      LXX = 1
      IF(IE.GT.1)      LXX = IE
      IF(IE.GT.1)  IE = IE - 1
      LXX = LXX + L
      DO 350 I = LXX,M
      RM(I,J+M-I) = RM(I,J+M-I) + RM(I-L,J+M-I)*TEMP
  350 CONTINUE
  400 CONTINUE
      IF(J.GT.M) RM(M,J) = RM(M,J) + SL(M)*RM(M,J-M)*SL(M)
      RM(M,J) = -1.0/RM(M,J)
C     COMPUTE PRELIMINARY VALUE FOR W(J)
  750 W(J) = 0.0
      DO 800 I = 1,J1
      W(J) = W(J) + RM(M-I,J)*W(J-I)
  800 CONTINUE
      IF(J.GT.M) W(J) = W(J) + RO(J-M)*W(J-M)
      W(J) = RM(M,J)*(W(J) - F)
 1000 CONTINUE
C*******************************************************************************
C                            CALCULATE RECURSION EQUATION
C*******************************************************************************
      K = 0
      DO 3000 L = 1,NLM1
      J = NL - L
      TEMP = W(J)
      W(J) = 0
      K = K + 1
      DO 2100 I = 1,M1
      W(J) = W(J) + RM(M-I,J+I)*W(J+I)
      IF(I.EQ.K) GO TO 2200
 2100 CONTINUE
 2200 IF(J.LE.NLMM) W(J) = W(J) + RO(J)*W(J+M)
      W(J) = RM(M,J)*W(J) + TEMP
 3000 CONTINUE
      RETURN
      END

      SUBROUTINE FSUB1(SU,FF,MM)
      IMPLICIT REAL * 8(A-H,O-Z)
C
C     FSUB1 CALL FSUB21 FOR FRAME SOLUTION AND FSUB22 FORMEMBER SOLUTION
C
      DIMENSION SU(18)
      COMMON / BLK5 / NFSUB,NITF
      IF(NFSUB.EQ.21) CALL FSUB21(SU,FF,MM)
      IF(NFSUB.EQ.22) CALL FSUB22(SU,FF)
      RETURN
      END
```

```
      SUBROUTINE FSUB22(SU,FF)
      IMPLICIT REAL * 8(A-H,O-Z)
C*******************************************************************************
C
C     SUBROUTINE FSUB22 FINISH THE RIGHT SIDE OF SYMMETRIC STIFFNESS
C     MATRIX SU AND LOAD TERM FF TO GRIP2A FOR MEMBER SOLUTION
C     SU IS ONE ROW OF STIFFNESS MATRIX AND FF IS CORRESPONDING LOAD
C     FSUB22 FORMS SEM(3 ROWS OF SU) AND FEM(3 LOADS) EVERY THIRD CALL
C     FROM GRIP2A AND FINISHES SU AND FF FOR EACH CALL
C
C*******************************************************************************
      DIMENSION SU(18),FEM(3),SEMS(3,3),SEM(3,6)
      COMMON / BLOCK8 / ERX(41),ERY(41),ERZ(41)
      COMMON / BLOC11 / SEET(6,6)
      COMMON/BLOCK4/SX(41),SY(41),SZ(41),SXY(41),SQX(41),SQY(41),SQZ(41)
      COMMON / CONST / MN,M,MP1,ZERO,PI
      COMMON / RI / NL,ML,J1
C
C>--->I = STATION NUMBER AND ELEMENT NUMBER
C>--->J1 = EQUATION NUMBER
C
      I = (J1 - 1) / 3 + 1
C
C>--->SKIP FOR EVERY SECOND AND THIRD EQUATION
C
      IF(J1.NE.3*I - 2) GO TO 4000
      IF(ML.EQ.-1) GO TO 2800
      IF(I.NE.1) GO TO 2100
      DO 1600 JJ = 1,3
      DO 1600 KK = 1,3
      SEMS(JJ,KK) = 0.0
 1600 CONTINUE
 2100 CONTINUE
      IF(I.LT.MP1) GO TO 2400
      DO 2300 JJ = 1,6
      DO 2300 KK = 1,6
 2300 SEET(JJ,KK) = 0.0
      GO TO 2500
C
C>--->CALL ELEMST TO OBTAIN 6*6 ELEMENT STIFFNESS MATRIX
C
 2400 CALL ELEMST(I)
 2500 CONTINUE
C
C>--->FORM 3 ROWS OF MEMBER STIFFNESS MATRIX SEM
C
      DO 2600 JJ = 1,3
      DO 2600 KK = 1,3
      SEM(JJ,KK) = SEET(JJ,KK) + SEMS(JJ,KK)
      SEM(JJ,KK+3) = SEET (JJ,KK+3)
      SEMS(JJ,KK) = SEET (JJ+3,KK+3)
 2600 CONTINUE
C
C>--->ADD IN SPRING STIFFNESS
C
      SEM(3,3) = SEM(3,3) + SZ(I)
      SEM(1,1) = SEM(1,1) + SX(I)
      SEM(1,2) = SEM(1,2) + SXY(I)
```

```
      SEM(2,1) = SEM(2,1) + SXY(I)
      SEM(2,2) = SEM(2,2) + SY(I)
 2800 FEM(1) = ERX(I)
      FEM(2) = ERY(I)
      FEM(3) = ERZ(I)
      DO 3600 K = 1,5
 3600 SEM(2,K) = SEM(2,K+1)
      DO 3700 K = 1,4
 3700 SEM(3,K) = SEM(3,K+2)
      SEM(2,6) = 0.0
      SEM(3,6) = 0.0
      SEM(3,5) = 0.0
 4000 CONTINUE
      N123 = J1 - 3*I + 3
      IF (ML.EQ.-1) GO TO 4300
      IC = 6
C
C>--->FORM SU FROM ONE ROW OF SEM
C
      DO 4200 JJ = 1,6
      SU(JJ) = SEM(N123,IC)
 4200 IC = IC - 1
 4300 FF = FEM(N123)
      RETURN
      END
```

```
      SUBROUTINE MATM33 (AA,BB,CC)
      IMPLICIT REAL * 8(A-H,O-Z)
C>--->MULTIPLIES AA(3,3) TIMES BB(3,3) YIELD CC(3,3)
      DIMENSION AA(3,3),BB(3,3),CC(3,3)
      DO 25 I = 1,3
      DO 25 J = 1,3
      CC(I,J) = 0.0
      DO 25 K = 1,3
      CC(I,J) = AA(I,K)*BB(K,J) +CC(I,J)
   25 CONTINUE
      RETURN
      END
      SUBROUTINE MATM31(AA,B,C)
      IMPLICIT REAL * 8(A-H,O-Z)
C>--->MULTIPLIES AA(3,3) TIMES B(3,1) YIELD C(3,1)
      DIMENSION AA(3,3),B(3),C(3)
      DO 25 I = 1,3
      C(I) = 0.0
      DO 25 K = 1,3
      C(I) = AA(I,K)*B(K) + C(I)
   25 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE FSUB21(SU4,FF,IHB)
      IMPLICIT REAL * 8(A-H,O-Z)
C
C     SUBROUTINE ' FSUB21 ' FINISHES RIGHT SIDE OF SYMMETRIC STIFFNESS
C     MATRIX SU4 AND LOAD TERM FF TO GRIP2A AND FRAME SOLUTION
C     SU4 IS ONE ROW OF STIFFNESS MATRIX AND FF IS CORRESPONDING LOAD
C     FSUB21 FORMS SSL(3 ROWS OF SU) AND FDS(3 LOADS)
C     FSUB21 FORMS SSL(3 ROWS OF SU) AND FSS(3 LOADS) EVERY THIRD CALL
C     FROM GRIP2A AND FINISHES SU4 AND FF FOR EACH CALL
C
      COMMON / BLK3 / NM
      COMMON / BLOCK9 / SSL(3,18)
      DIMENSION SU4(18),SMM(3,3),SMS(3,3),DC(3,3),DCT(3,3),T33(3,3),
     1FMM(3),FSS(3),FMS(3)
      COMMON / RI / NL,ML,J1
      COMMON / BLK5 / NFSUB,NITF
      COMMON / T3A2 / DC1(30),DC2(30),JT1(30),JT2(30)
      COMMON / BLOCK5 / FOMM(30,6),SMC(30,21),IMC(30)
      COMMON / T6 / QXX(25),QYY(25),QZZ(25),SXX(25),SYY(25),SZZ(25),
     1              ERXX(25),ERYY(25),ERZZ(25)
      NL4 = NL
      ML4 = ML
      J14 = J1
      IF(J14.NE.1) GO TO 1300
C
C>--->SET CONSTANTS ON FIRST CALL FROM GRIP2A
C
      IHBP1 = IHB + 1
      IHB1 = IHB - 1
      DC(1,3) = 0.0
      DC(2,3) = 0.0
      DC(3,1) = 0.0
      DC(3,2) = 0.0
      DCT(1,3) = 0.0
      DCT(2,3) = 0.0
      DCT(3,1) = 0.0
      DCT(3,2) = 0.0
      DC(3,3) = 1.0
      DCT(3,3) = 1.0
C
C>--->COMPUTE JOINT NUMBER FOR WHICH EQUATION ARE BEING FORMED
C
 1300 JTN = (J14 - 1)/3 + 1
C
C>--->SKIP FOR EVERY SECOND AND THIRD EQUATIONS
C
      IF(J14.NE.3*JTN-2) GO TO 4000
C
C>--->ZERO SSL AND FSS
C
      DO 1400 I = 1,3
      DO 1400 J = 1,IHBP1
 1400 SSL(I,J) = 0.0
      FSS(1) = 0.0
      FSS(2) = 0.0
      FSS(3) = 0.0
C
C>--->DO FOR EACH MEMBER - ADD ITS STIFFNESS MATRIX AND LOAD MATRIX INTO
```

```
C>--->STRUCTURE STIFFNESS MATRIX SSL AND LOAD MATRIX FSS
C
      DO 3500 MN = 1,NM
      IF(JT1(MN).NE.JTN.AND.JT2(MN).NE.JTN) GO TO 3500
C
C>--->FORM TRANSFORMATICN MATRIX ANC ITS TRANSPOSE
C
      DC(1,1) = DC1(MN)
      DC(1,2) = DC2(MN)
      DC(2,1) = -DC(1,2)
      DC(2,2) = DC(1,1)
      DCT(1,1) = DC(1,1)
      DCT(1,2) = DC(2,1)
      DCT(2,1) = DC(1,2)
      DCT(2,2) = DC(2,2)
      IF(JT2(MN).EQ.JTN) GO TO 2300
C
C>--->FORM SMM FOR MEMBER WITH FRCM JOINT AT JOINT JTN
C
      SMM(1,1) = SMC(MN,1)
      SMM(1,2) = SMC(MN,2)
      SMM(1,3) = SMC(MN,3)
      SMM(2,1) = SMC(MN,2)
      SMM(2,2) = SMC(MN,7)
      SMM(2,3) = SMC(MN,8)
      SMM(3,1) = SMC(MN,3)
      SMM(3,2) = SMC(MN,8)
      SMM(3,3) = SMC(MN,12)
C
C>--->FORM FFM FOR MEMBER WITH FRCM JCINT AT JOINT JTN
C
      FMM(1) = FOMM(MN,1)
      FMM(2) = FOMM(MN,2)
      FMM(3) = FOMM(MN,3)
      GO TO 2500
 2300 CONTINUE
C
C>--->FORM SMM FOR MEMBER WITH TO JOINT AT JOINT JTN
C
      SMM(1,1) = SMC(MN,16)
      SMM(1,2) = SMC(MN,17)
      SMM(1,3) = SMC(MN,18)
      SMM(2,1) = SMC(MN,17)
      SMM(2,2) = SMC(MN,19)
      SMM(2,3) = SMC(MN,20)
      SMM(3,1) = SMC(MN,18)
      SMM(3,2) = SMC(MN,20)
      SMM(3,3) = SMC(MN,21)
C
C>--->FORM FMM FROM MEMBER WITH TO JOINT AT JOINT JTN
C
 2350 FMM(1) = FOMM(MN,4)
      FMM(2) = FOMM(MN,5)
      FMM(3) = FOMM(MN,6)
 2500 CONTINUE
C
C>--->TRANSFORM SMM AND FMM TO STRUCTURE COORDINATSS SMS,FMS
C
      CALL MATM33 (DCT,SMM,T33)
      CALL MATM33 (T33,DC,SMS)
 2550 CALL MATM31(DCT,FMM,FMS)
C
C>--->ADD (SUBSTRACT) IN FMS TO STRUCTURE LOAD MATRIX FSS
C
      FSS(1) = FSS(1) - FMS(1)
      FSS(2) = FSS(2) - FMS(2)
      FSS(3) = FSS(3) - FMS(3)
C
C>--->ADD IN SMS TO DIAGONAL SUBMATRIX OF SSL.......SYMMERTICAL TERMS
C
      SSL(1,1) = SSL(1,1) + SMS(1,1)
      SSL(1,2) = SSL(1,2) + SMS(1,2)
      SSL(1,3) = SSL(1,3) + SMS(1,3)
      SSL(2,2) = SSL(2,2) + SMS(2,2)
      SSL(2,3) = SSL(2,3) + SMS(2,3)
      SSL(3,3) = SSL(3,3) + SMS(3,3)
C
C>--->SKIP FOR SMM WHICH ARE TO  LEFT ON DIAGONAL
C
      IF(JTN.GE.JT1(MN).AND.JTN.GE.JT2(MN)) GO TO 3500
      IF(JT2(MN).EQ.JTN) GO TO 2700
C
C>--->FORM SMM FOR MEMBER WITH FORM JOINT AT JOINT JTN
C
      SMM(1,1) = SMC(MN, 4)
      SMM(1,2) = SMC(MN, 5)
      SMM(1,3) = SMC(MN, 6)
      SMM(2,1) = SMC(MN, 9)
      SMM(2,2) = SMC(MN,10)
      SMM(2,3) = SMC(MN,11)
      SMM(3,1) = SMC(MN,13)
      SMM(3,2) = SMC(MN,14)
      SMM(3,3) = SMC(MN,15)
      GO TO 3000
C
C>--->FORM MEMBER WITH TO JOINT AT JOINT JTN
C
 2700 SMM(1,1) = SMC(MN,4)
      SMM(1,2) = SMC(MN,9)
      SMM(1,3) = SMC(MN,13)
      SMM(2,1) = SMC(MN, 5)
      SMM(2,2) = SMC(MN,10)
      SMM(2,3) = SMC(MN,14)
      SMM(3,1) = SMC(MN, 6)
      SMM(3,2) = SMC(MN,11)
      SMM(3,3) = SMC(MN,15)
 3000 CONTINUE
C
C>--->TRANSFORM SMM TO STRUCTURE COORDINATES SMS
C
      CALL MATM33(DCT,SMM,T33)
      CALL MATM33(T33,DC,SMS)
C
C>---> PLACE SMS IN SSL
C
      J21 = JT2(MN) - JT1(MN)
```

```
      J21 = IABS(J21)
      ISTP = 3*J21 + 1
      ISTP1 = ISTP + 1
      ISTP2 = ISTP + 2
      SSL(1,ISTP ) = SMS(1,1)
      SSL(1,ISTP1) = SMS(1,2)
      SSL(1,ISTP2) = SMS(1,3)
      SSL(2,ISTP ) = SMS(2,1)
      SSL(2,ISTP1) = SMS(2,2)
      SSL(2,ISTP2) = SMS(2,3)
      SSL(3,ISTP ) = SMS(3,1)
      SSL(3,ISTP1) = SMS(3,2)
      SSL(3,ISTP2) = SMS(3,3)
 3500 CONTINUE
      FSS(1) = FSS(1) + ERXX(JTN)
      FSS(2) = FSS(2) + ERYY(JTN)
      FSS(3) = FSS(3) + ERZZ(JTN)
C
C>--->ADD IN JOINT RESTRAINTS
C
      SSL(1,1) = SSL(1,1) + SXX(JTN)
      SSL(2,2) = SSL(2,2) + SYY(JTN)
      SSL(3,3) = SSL(3,3) + SZZ(JTN)
C
C>--->SHIFT SLL TO FACILITATE OBTAINING SU FROM 2ND AND 3RD OF SSL
C
      DO 3600 I = 1,IHB
 3600 SSL(2,I) = SSL(2,I+1)
      DO 3700 I = 1,IHB1
 3700 SSL(3,I) = SSL(3,I+2)
      SSL(2,IHBP1) = 0.0
      SSL(3,IHBP1) = 0.0
      SSL(3,IHB) = 0.0
 4000 CONTINUE
      N123 = J14 - 3*JTN + 3
      IC = IHBP1
C
C>--->FORM SU FROM ROW(N123) OF SSL
C
      DO 4300 I = 1,IHBP1
      SU4(I) = SSL(N123,IC)
 4300 IC = IC - 1
 4400 FF = FSS(N123)
 4450 K = IHBP1
      IF(SU4(K).NE.0.0) GO TO 4500
C
C>--->ZERO ON DIAGONAL OF MATRIX - DISPLACEMENT UNDIFINED -
C      SET  DISPLACEMENT EQUAL TO 1.0E40
C
      SU4(K) = 1.0
 4480 FF = 1.0E40
 4500 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE WWF
      IMPLICIT REAL * 8(A-H,O-Z)
C
C       SUBROUTINE WIND AND WAVE FORCES DETERMINE BOTH FORCES IN THE
C      ELEMENT , NO FORCES IN THE HORIZONTAL ELEMENT OR WHEN WIDTH = 0
C
      COMMON / CONST / MN,M,MP1,ZERO,PI
      COMMON / SGEN / XM(41),YM(41),DC1M(40),DC2M(40),
     1                XS(41),YS(41),DC1S(40),DC2S(40),DXY
      COMMON / SMID / DB(8),DDP(8),DIY(8),DAREA(8),DSIGL(8,10),
     1DEPSL(8,10),B(8),DP(8),Y(8),SAREA(8),WIDTH,AREAT,AEL,FL,
     2EPSTS(10),SIGTS(10),STRESS(8,19),STRAIN(8,19),NPTS(8),NSEGL
      COMMON / BLOCK1 / QX(41),QY(41),QZ(41)
      COMMON / T7 / ERR1,ERR2,ER1,ER2,NLINC,LINC,MNITF,MNITM
      COMMON / T4C / AID,BWV,WIK,YSEA,FLD,WAT,WAH,WATT,WAK,WICD(30),
     1               WACD(30),WACM(30)
      TEMP1 = NLINC
      TEMP2 = LINC
      TEMP = TEMP1/TEMP2
      IF(YS(1).LT.0.0.OR.YS(1).EQ.YS(2)) GO TO 200
C>--->DETERMINE WIDTH
      CALL MIDDLE(1,ZERO)
      DO 500 J = 1,MP1
C>--->POINT ALONG WAVE
      THETA = WAK*XS(J)-2.0*PI*WATT
      YWAVE = WAH*0.5*DCOS(THETA)
      IF(YS(J).GT.YWAVE) GO TO 100
C>--->WAVE FORCE
      EKZ = DEXP(WAK*(YS(J)-YSEA))
      VEL = -PI*WAH*EKZ*DCOS(THETA)*DC2S(J)/WAT
      ACC = -2.0*PI*WAH*EKZ*DSIN(THETA)*DC2S(J)/(WAT*WAT)
      QY(J) = QY(J)+TEMP*DXY*(0.5*WACD(MN)*FLD*WIDTH*VEL*DABS(VEL) +
     1FLD*WACM(MN)*0.25*PI*WIDTH*WIDTH*ACC)
      GO TO 500
C>--->WIND FORCE
  100 UZ = BWV*((YS(J)-YSEA)/360.0)*WIK
      QY(J) = QY(J) - TEMP*WICD(MN)*AID*0.5*UZ*UZ*DXY*WIDTH*DC2S(J)
  500 CONTINUE
  200 CONTINUE
      RETURN
      END
```

APPENDIX G

SAMPLE INPUT AND OUTPUT

80/80 LIST

```
      00000000011111111112222222222333333333344444444445555555555666666666677777777778
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
   1  NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
   2  WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC
   3  WWF1     EFFECT OF WIND AND WAVE FORCES AT TIME = 0.0 SEC
   4           1
   5               18   24    6    2              4         6    8    3
   6           1     89.4694   894.694
   7           2     558.5306  894.694
   8           3     60.33468  603.3468
   9           4     587.6532  603.3468
  10           5     31.2      312.0
  11           6     324.0     312.0
  12           7     616.8     312.0
  13           8
  14           9     324.0
  15          10     648.0
  16          11    -35.83124 -358.3124
  17          12     683.83124 -358.3124
  18          13    -77.6129  -776.129
  19          14     725.6129 -776.129
  20          15    -137.315  -1373.15
  21          16     785.315  -1373.15
  22          17    -197.01736-1970.1736
  23          18     845.01736 -1970.1736
  24           1   10    1    1    1         2    1         1
  25           2   10    1    3    1         4    1         1
  26           3   10    1    3    1         1    1         1
  27           4   10    1    4    1         2    1         1
  28           5   10    1    5    1         3    1         1
  29           6   10    1    7    1         4    1         1
  30           7   10    1    5    1         6    1         1
  31           8   10    1    6    1         7    1         1
  32           9   10    1    6    1         3    1         1
  33          10   10    1    6    1         4    1         1
  34          11   10    1    9    1         5    1         1
  35          12   10    1    9    1         7    1         1
  36          13   10    1    8    1         9    1         1
  37          14   10    1    9    1        10    1         1
  38          15   20    1    8    3         5    3         1
  39          16   20    1   10    3         7    3         1
  40          17   20    1   11    3         8    3         1
  41          18   20    1   12    3        10    3         1
  42          19   20    1   13    2        11    2         1
  43          20   20    1   14    2        12    2         1
  44          21   20    1   15    1        13    1         1
  45          22   20    1   16    1        14    1         1
  46          23   20    1   17    1        15    1         1
  47          24   20    1   18    1        16    1         1
  48           1    1
  49           1          1.0 1.000E-03      36.0      0.75                 2.0
  50           2    1
  51           1          1.0 1.000E-03      36.0      1.00                 2.0
  52           3    1
  53           1          1.0 1.000E-03      36.0      1.25                 2.0
  54           1    3    1          40.0 40.0
```

80/80 LIST

```
      00000000011111111112222222222333333333344444444445555555555666666666677777777778
      12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
  55                                1.333 10.0
  56        1.205E-101760.0    0.1       636.0
  57             9.645E-08 7.0        600.0
  58       2.0       1.0       1.0                3    4    5    6    9   10   11   12
  59       2.0       1.0       1.0               15   16
  60                                 1.528E-03 2.604E-05
  61                     -144.0      5.417E-03 2.604E-05
  62                     -432.0      8.611E-03 2.604E-05
  63                    -1308.0      9.861E-03 2.604E-05
  64                    -1800.0      1.042E-02 2.604E-05
  65                    -2040.0      1.042E-02 2.604E-05
  66           1115.0     -400.0
  67           233.0      -400.0
  68           336.0
  69           413.0
  70           521.0
  71           713.0
  72            85.0
  73          105.0
  74           1
  75          20      10.0      100.0
  76          10            .5      5.0
  77
```

80/80 LIST

```
       00000000011111111112222222222333333333344444444445555555555666666666677777777778
       12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
   1   NUNLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
   2   WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC
   3   WWF2     EFFECT OF WIND AND WAVE FORCES AT TIME = 0.88 SEC
   4            1
   5                18   24    6    2              4         6    8    3
   6            1    89.4694   894.694
   7            2    558.5306  894.694
   8            3    60.33468  603.3468
   9            4    587.6532  603.3468
  10            5    31.2      312.0
  11            6    324.0     312.0
  12            7    616.8     312.0
  13            8
  14            9    324.0
  15           10    648.0
  16           11    -35.83124 -358.3124
  17           12    683.83124 -358.3124
  18           13    -77.6129  -776.129
  19           14    725.6129  -776.129
  20           15    -137.315  -1373.15
  21           16    785.315   -1373.15
  22           17    -197.01736-1970.1736
  23           18    845.01736 -1970.1736
  24            1   10    1    1    1         2    1         1
  25            2   10    1    3    1         4    1         1
  26            3   10    1    3    1         1    1         1
  27            4   10    1    4    1         2    1         1
  28            5   10    1    5    1         3    1         1
  29            6   10    1    7    1         4    1         1
  30            7   10    1    5    1         6    1         1
  31            8   10    1    6    1         7    1         1
  32            9   10    1    6    1         3    1         1
  33           10   10    1    6    1         4    1         1
  34           11   10    1    9    1         5    1         1
  35           12   10    1    9    1         7    1         1
  36           13   10    1    8    1         9    1         1
  37           14   10    1    9    1        10    1         1
  38           15   20    1    8    3         5    3         1
  39           16   20    1   10    3         7    3         1
  40           17   20    1   11    3         8    3         1
  41           18   20    1   12    3        10    3         1
  42           19   20    1   13    2        11    2         1
  43           20   20    1   14    2        12    2         1
  44           21   20    1   15    1        13    1         1
  45           22   20    1   16    1        14    1         1
  46           23   20    1   17    1        15    1         1
  47           24   20    1   18    1        16    1         1
  48            1    1
  49            1      1.0 1.000E-03       36.0      0.75                 2.0
  50            2    1
  51            1      1.0 1.000E-03       36.0      1.00                 2.0
  52            3    1
  53            1      1.0 1.000E-03       36.0      1.25                 2.0
  54            1    3    1           40.0 40.0
```

80/80 LIST

```
       00000000011111111112222222222333333333344444444445555555555666666666677777777778
       12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
  55                                 1.333 10.0
  56         1.205E-101760.0    0.1       636.0
  57              9.645E-08 7.0       600.0    0.125
  58        2.0       1.0       1.0                3    4    5    6    9   10   11   12
  59        2.0       1.0       1.0               15   16
  60                                  1.528E-03 2.604E-05
  61                        -144.0      5.417E-03 2.604E-05
  62                        -432.0      8.611E-03 2.604E-05
  63                       -1308.0      9.861E-03 2.604E-05
  64                       -1800.0      1.042E-02 2.604E-05
  65                       -2040.0      1.042E-02 2.604E-05
  66            186.0      -400.0
  67            2106.0     -400.0
  68            324.0
  69            432.0
  70            516.0
  71            719.0
  72            85.0
  73           105.0
  74            1
  75           20      10.0      100.0
  76           10            .5      5.0
  77
```

80/80 LIST

```
     00000000011111111112222222222333333333344444444445555555555666666666677777777778
     12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
   1 NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
   2 WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC
   3 WWF3     EFFECT OF WIND AND WAVE FORCES AT TIME = 1.76 SEC
   4          1
   5             18   24    6    2              4         6    8    3
   6          1     89.4694   894.694
   7          2     558.5306  894.694
   8          3     60.33468  603.3468
   9          4     587.6532  603.3468
  10          5     31.2      312.0
  11          6     324.0     312.0
  12          7     616.8     312.0
  13          8
  14          9     324.0
  15         10     648.0
  16         11     -35.83124 -358.3124
  17         12     683.83124 -358.3124
  18         13     -77.6129  -776.129
  19         14     725.6129  -776.129
  20         15     -137.315  -1373.15
  21         16     785.315   -1373.15
  22         17     -197.01736-1970.1736
  23         18     845.01736 -1970.1736
  24          1   10    1    1    1         2    1         1
  25          2   10    1    3    1         4    1         1
  26          3   10    1    3    1         1    1         1
  27          4   10    1    4    1         2    1         1
  28          5   10    1    5    1         3    1         1
  29          6   10    1    7    1         4    1         1
  30          7   10    1    5    1         6    1         1
  31          8   10    1    6    1         7    1         1
  32          9   10    1    6    1         3    1         1
  33         10   10    1    6    1         4    1         1
  34         11   10    1    9    1         5    1         1
  35         12   10    1    9    1         7    1         1
  36         13   10    1    8    1         9    1         1
  37         14   10    1    9    1        10    1         1
  38         15   20    1    8    3         5    3         1
  39         16   20    1   10    3         7    3         1
  40         17   20    1   11    3         8    3         1
  41         18   20    1   12    3        10    3         1
  42         19   20    1   13    2        11    2         1
  43         20   20    1   14    2        12    2         1
  44         21   20    1   15    1        13    1         1
  45         22   20    1   16    1        14    1         1
  46         23   20    1   17    1        15    1         1
  47         24   20    1   18    1        16    1         1
  48          1    1
  49          1       1.0 1.000E-03      36.0      0.75                 2.0
  50          2    1
  51          1       1.0 1.000E-03      36.0      1.00                 2.0
  52          3    1
  53          1       1.0 1.000E-03      36.0      1.25                 2.0
  54          1    3    1           40.0 40.0
```

80/80 LIST

```
     00000000011111111112222222222333333333344444444445555555555666666666677777777778
     12345678901234567890123456789012345678901234567890123456789012345678901234567890
CARD
  55                               1.333 10.0
  56       1.205E-101760.0    0.1       636.0
  57           9.645E-08 7.0      600.0   0.25
  58      2.0      1.0      1.0                3    4    5    6    9   10   11   12
  59      2.0      1.0      1.0               15   16
  60                                1.528E-03 2.604E-05
  61                    -144.0      5.417E-03 2.604E-05
  62                    -432.0      8.611E-03 2.604E-05
  63                   -1308.0      9.861E-03 2.604E-05
  64                   -1800.0      1.042E-02 2.604E-05
  65                   -2040.0      1.042E-02 2.604E-05
  66          133.0     -400.0
  67          2102.0    -400.0
  68          32.0
  69          432.0
  70          5
  71          710.0
  72          85.0
  73         105.0
  74          1
  75         20      10.0      100.0
  76         10            .5      5.0
  77
```

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NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF1   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.0 SEC

TABLE 1 - PROGRAM CONTROL DATA
PROBLEM TYPE 1

TABLE NUMBER	2	3A	3B	3C	4A	4B	4C	5A	5B	6	7
PRIOR-DATA OPTIONS (1=YES,0=NO)	0	0	0	0	0	0	C	0	0	0	0
NUMBER OF CARDS ADDED FOR THIS PROBLEM	18	24	6	2	0	0	4	0	6	8	3

TABLE 2 - JOINT COORDINATES

JOINT NUMBER	X-COORD	Y-COORD
1	0.895D 02	0.895D 03
2	0.559D 03	0.895D 03
3	0.603D 02	0.603D 03
4	0.588D 03	0.603D 03
5	0.312D 02	0.312D 03
6	0.324D 03	0.312D 03
7	0.617D 03	0.312D 03
8	0.000D 00	0.000D 00
9	0.324D 03	0.000D 00
10	0.648D 03	0.000D 00
11	-0.358D 02	-0.358D 03
12	0.684D 03	-0.358D 03
13	-0.776D 02	-0.776D 03
14	0.726D 03	-0.776D 03
15	-0.137D 03	-0.137D 04
16	0.785D 03	-0.137D 04
17	-0.197D 03	-0.197D 04
18	0.845D 03	-0.197D 04

TABLE 3A - MEMBER PROPERTIES

MEMBER NUMBER	ELEM PER NUMBER	NON LIN	FROM JOINT NO.	FROM JOINT AREA	FROM JOINT PIN	TO JOINT NO.	TO JOINT AREA	TO JOINT PIN
1	10	1	1	1	0	2	1	0
2	10	1	3	1	0	4	1	0
3	10	1	3	1	0	1	1	0
4	10	1	4	1	0	2	1	0
5	10	1	5	1	0	3	1	0
6	10	1	7	1	0	4	1	0
7	10	1	5	1	0	6	1	0
8	10	1	6	1	0	7	1	0
9	10	1	6	1	0	3	1	0
10	10	1	6	1	0	4	1	0
11	10	1	9	1	0	5	1	0
12	10	1	9	1	0	7	1	0
13	10	1	8	1	0	9	1	0
14	10	1	9	1	0	10	1	0
15	20	1	8	3	0	5	3	0
16	20	1	10	3	0	7	3	0
17	20	1	11	3	0	8	3	0
18	20	1	12	3	0	10	3	0
19	20	1	13	2	0	11	2	0
20	20	1	14	2	0	12	2	0
21	20	1	15	1	0	13	1	0
22	20	1	16	1	0	14	1	0
23	20	1	17	1	0	15	1	0
24	20	1	18	1	0	16	1	0

MEMBER NUMBER	MODULUS OF ELASTICITY	FROM JOINT EI	FROM JOINT AE	TO JOINT EI	TO JOINT AE

MEMBER NUMBER	LENGTH	COSINE-X	COSINE-Y	MEMBER TYPE	CENTER-X COORDINATE	CENTER-Y COORDINATE
1	0.469D 03	0.100D 01	0.000D 00	STRAIGHT		
2	0.527D 03	0.100D 01	0.000D 00	STRAIGHT		
3	0.293D 03	0.995D-01	0.995D 00	STRAIGHT		
4	0.293D 03	-0.995D-01	0.995D 00	STRAIGHT		
5	0.293D 03	0.995D-01	0.995D 00	STRAIGHT		
6	0.293D 03	-0.995D-01	0.995D 00	STRAIGHT		
7	0.293D 03	0.100D 01	0.000D 00	STRAIGHT		
8	0.293D 03	0.100D 01	0.000D 00	STRAIGHT		
9	0.393D 03	-0.671D 00	0.741D 00	STRAIGHT		
10	0.393D 03	0.671D 00	0.741D 00	STRAIGHT		
11	0.428D 03	-0.684D 00	0.729D 00	STRAIGHT		
12	0.428D 03	0.684D 00	0.729D 00	STRAIGHT		
13	0.324D 03	0.100D 01	0.000D 00	STRAIGHT		
14	0.324D 03	0.100D 01	0.000D 00	STRAIGHT		
15	0.314D 03	0.995D-01	0.995D 00	STRAIGHT		
16	0.314D 03	-0.995D-01	0.995D 00	STRAIGHT		
17	0.360D 03	0.995D-01	0.995D 00	STRAIGHT		
18	0.360D 03	-0.995D-01	0.995D 00	STRAIGHT		
19	0.420D 03	0.995D-01	0.995D 00	STRAIGHT		
20	0.420D 03	-0.995D-01	0.995D 00	STRAIGHT		
21	0.600D 03	0.995D-01	0.995D 00	STRAIGHT		
22	0.600D 03	-0.995D-01	0.995D 00	STRAIGHT		
23	0.600D 03	0.995D-01	0.995D 00	STRAIGHT		
24	0.600D 03	-0.995D-01	0.995D 00	STRAIGHT		

TABLE 3B - CROSS SECTION PROPERTIES

CROSS SECTION NUMBER = 1
NUMBER OF SEGMENT = 1

SEG NUM	SEG TYPE	CUR NUM	STRESS MULTIPLIER	STRAIN MULTIPLIER	WIDTH OR DIAMETER	DEPTH OR THICKNESS	CENTROIDAL DISTANCE	SEGMENTAL AREA
1	CIRC	1	0.100D 01	0.100D-02	0.360D 02	0.750D 00	0.000D 00	

CROSS SECTION NUMBER = 2
NUMBER OF SEGMENT = 1

SEG NUM	SEG TYPE	CUR NUM	STRESS MULTIPLIER	STRAIN MULTIPLIER	WIDTH OR DIAMETER	DEPTH OR THICKNESS	CENTROIDAL DISTANCE	SEGMENTAL AREA
1	CIRC	1	0.100D 01	0.100D-02	0.360D 02	0.100D 01	0.000D 00	

CROSS SECTION NUMBER = 3
NUMBER OF SEGMENT = 1

SEG NUM	SEG TYPE	CUR NUM	STRESS MULTIPLIER	STRAIN MULTIPLIER	WIDTH OR DIAMETER	DEPTH OR THICKNESS	CENTROIDAL DISTANCE	SEGMENTAL AREA
1	CIRC	1	0.100D 01	0.100D-02	0.360D 02	0.125D 01	0.000D 00	

TABLE 3C - STRESS-STRAIN CURVE

STRESS-STRAIN CURVE NUMBER = 1
NUMBER OF POINTS IN THIS CURVE = 3
CURVE SYMMETRY = YES

SIG 0.000 40.000 40.000

EPS 0.000 1.333 10.000

TABLE 4A - APPLIED MEMBER LOAD

NO DATA IN THE TABLE

TABLE 4B - SELFWEIGHT

WT PER UNIT VOL MEMBER NUMBER

NO DATA IN THE TABLE

TABLE 4C - WIND AND WAVE FORCES

MASS DENSITY OF AIR = 0.121D-09
BASIC WIND VELOCITY = 0.176D 04
WIND CONSTANT = 0.100D 00
MEAN SEA LEVEL = 0.636D 03

DENSITY OF FLUID = 0.964D-07
WAVE PERIOD = 0.700D 01
WAVE HEIGHT = 0.600D 03
TIME/PERIOD = 0.000D 00
TIME INCREMENT/PERIOD = 0.000D 00
NUMBER OF TIME INCREMENT= 0

WIND CD	WAVE CD	WAVE CM	MEMBER NUMBER
0.200D 01	0.100D 01	0.100D 01	3 4 5 6 9 10 11 12
0.200D 01	0.100D 01	0.100D 01	15 16

TABLE 5A - ELASTIC MEMBER RESTRAIN

NO DATA IN THE TABLE

TABLE 5B - SOIL DATA

PENETRATION DISTANCE FROM	TO	SOIL SHEAR STRENGTH	SOIL DENSITY
0.000D 00	0.000D 00	0.153D-02	0.260D-04
0.000D 00	-0.144D 03	0.542D-02	0.260D-04
0.000D 00	-0.432D 03	0.861D-02	0.260D-04
0.000D 00	-0.131D 04	0.936D-02	0.260D-04
0.000D 00	-0.180D 04	0.104D-01	0.260D-04
0.000D 00	-0.204D 04	0.104D-01	0.260D-04

TABLE 6 - JOINT LOADS AND LINEAR SUPPORTS

JOINT	FORCE(X)	FORCE(Y)	MOMENT(Z)	SPRING(X)	SPRING(Y)	SPRING(Z)
1	0.115D 03	-0.400D 03	0.000D 00	0.000D 00	0.000D 00	0.000D 00
2	0.330D 02	-0.400D 03	0.000D 00	0.000D 00	0.000D 00	0.000D 00
3	0.360D 02	0.000D 00	0.000D 00	0.000D 00	0.000D 00	0.000D 00
4	0.130D 02	0.000D 00	0.000D 00	0.000D 00	0.000D 00	0.000D 00
5	0.210D 02	0.000D 00	0.000D 00	0.000D 00	0.000D 00	0.000D 00

7	0.130D 02	0.000D 00	0.000D 00	0.000D 0C	0.000D 00	0.000D 00
8	0.500D 01	0.000D 00	0.000D 00	0.000D 00	0.000D 00	0.000D 00
10	0.500D 01	0.000D 00	0.000D 00	0.000D 0C	0.000D 00	0.000D 00

TABLE 7 - ITERATION CONTROL

NUMBER OF LOAD INCREMENT= 1

FRAME ITERATION

MAXIMUM NUMBER OF ITERATION = 20
FORCE ERROR = 0.100D 02
MOMENT ERROR = 0.100D 03

MEMBER ITERATION

MAXIMUM NUMBER OF ITERATION = 10
FORCE ERROR = 0.500D 00
MOMENT ERROR = 0.500D 01

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PRCB
WWF1   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.0 SEC
TABLE 8 - JOINT DISPLACEMENTS AND REACTIONS

	DISPLACEMENTS			REACTIONS		
JOINT	DISP(X)	DISP(Y)	ROTATION(Z)	REACT(X)	REACT(Y)	REACT(Z)
1	0.194D 01	-0.248D 00	-0.213D-02	-0.000D 00	-0.000D 00	-0.000D 00
2	0.192D 01	-0.159D C0	-0.230D-02	-0.000D 00	-0.000D 00	-0.000D 00
3	0.884D 00	-0.988D-01	-0.158D-02	-0.000D 0C	-0.000D 00	-0.000D 00
4	0.878D 00	-0.205D 00	-0.147D-02	-0.000D 00	-0.000D 00	-0.000D 00
5	0.751D 00	-0.676D-C1	-0.124D-03	-0.000D 00	-0.000D 00	-0.000D 00
6	0.768D 00	-0.153D 00	0.116D-04	-0.000D 0C	-0.000D 00	-0.000D 00
7	0.751D 00	-0.141D 00	0.112D-04	-0.000D 00	-0.000D 00	-0.000D 00
8	0.637D 0C	-0.568D-01	-0.126D-02	-0.000D 0C	-0.000D 00	-0.000D 00
9	0.655D 00	-0.101D 00	0.163D-03	-0.000D 00	-0.000D 00	-0.000D 00
10	0.637D 00	-0.897D-01	-0.123D-02	-0.000D 00	-0.000D 00	-0.000D 00
11	0.158D-01	0.219D-02	-0.582D-03	-0.000D 00	-0.000D 00	-0.000D 00
12	0.221D-01	-0.820D-01	-0.559D-03	-0.000D 00	-0.000D 00	-0.000D 00
13	0.593D-03	0.129D-02	-0.190D-05	-0.000D 00	-0.000D 00	-0.000D 00
14	0.351D-02	-0.302D-C1	-0.255D-05	-0.000D 00	-0.000D 00	-0.000D 00
15	0.231D-04	0.225D-03	0.106D-07	-0.000D 00	-0.000D 00	-0.000D 00
16	0.489D-C3	-0.489D-C2	0.850D-08	-0.000D 00	-0.000D 00	-0.000D 00
17	0.995D-05	0.994D-04	0.203D-09	-0.000D 00	-0.000D 00	-0.000D 00
18	0.143D-03	-0.143D-02	0.205D-09	-0.000D 00	-0.000D 00	-0.000D 00

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PRCB
WWF1   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.0 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 1
GOES FROM JOINT 1 TO JOINT 2
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.194D 01	-0.248D 00	-0.213D-02	-0.983D 02	-0.503D 02	0.117D 05
46.91	0.00	0.194D 01	-0.317D 00	-0.851D-03	-0.983D 02	-0.503D 02	0.932D 04
93.81	0.00	0.194D 01	-0.332D 00	0.145D-03	-0.983D 02	-0.503D 02	0.696D 04
140.72	0.00	0.193D 01	-0.308D 00	0.851D-03	-0.983D 02	-0.503D 02	0.460D 04
187.62	0.00	0.193D 01	-0.257D 00	0.127D-02	-0.983D 02	-0.503D 02	0.223D 04
234.53	0.00	0.193D 01	-0.193D 00	0.140D-02	-0.983D 02	-0.503D 02	-0.138D 03
281.44	0.00	0.193D 01	-0.131D 00	0.123D-02	-0.983D 02	-0.503D 02	-0.251D 04
328.34	0.00	0.193D 01	-0.821D-01	0.784D-03	-0.983D 02	-0.503D 02	-0.487D 04
375.25	0.00	0.192D 01	-0.616D-01	0.436D-04	-0.983D 02	-0.503D 02	-0.724D 04
422.16	0.00	0.192D 01	-0.826D-C1	-0.985D-03	-0.983D 02	-0.503D 02	-0.959D 04
469.06	0.00	0.192D 01	-0.159D 00	-0.230D-02	-0.983D 02	-0.503D 02	-0.119D 05

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PRCB
WWF1   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.0 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 2
GOES FROM JOINT 3 TO JOINT 4
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.0C	0.00	0.884D 00	-0.988D-01	-0.158D-02	-0.279D 02	-0.219D 02	0.584D 04
52.73	0.00	0.883D 00	-0.162D 00	-0.852D-03	-0.279D 02	-0.219D 02	0.469D 04
105.46	0.00	0.883D 00	-0.192D 00	-0.287D-03	-0.279D 02	-0.219D 02	0.354D 04
158.2C	0.C0	0.882D C0	-0.195D 00	0.120D-03	-0.279D 02	-0.219D 02	0.239D 04
210.93	0.00	0.881D 00	-0.182D 00	0.369D-03	-0.279D 02	-0.219D 02	0.123D 04
263.66	0.00	0.881D 00	-0.159D 00	0.459D-03	-0.279D 02	-0.219D 02	0.770D 02
316.39	0.C0	0.88CD 0C	-0.136D 00	0.390D-03	-0.279D 02	-0.219D 02	-0.108D 04
369.12	0.00	0.880D 00	-0.121D 00	0.163D-03	-0.279D 02	-0.219D 02	-0.223D 04
421.85	0.00	0.879D 00	-0.122D 00	-0.223D-03	-0.279D 02	-0.219D 02	-0.338D 04
474.59	0.00	0.878D 0C	-0.147D C0	-0.768D-03	-0.279D 02	-0.219D 02	-0.454D 04
527.32	0.00	0.878D 00	-0.205D 00	-0.147D-02	-0.279D 02	-0.219D 02	-0.569D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF1   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.0 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER   3
GOES FROM JOINT   3 TO JOINT   1
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.104D-01	-0.889D 00	-0.158D-02	-0.346D 03	0.119D 03	-0.160D 05
29.28	0.00	-0.146D-01	-0.952D 00	-0.267D-02	-0.346D 03	0.114D 03	-0.126D 05
58.56	0.00	-0.189D-01	-0.104D 01	-0.350D-02	-0.346D 03	0.111D 03	-0.926D 04
87.84	0.00	-0.232D-01	-0.115D 01	-0.408D-02	-0.346D 03	0.106D 03	-0.604D 04
117.12	0.00	-0.276D-01	-0.128D 01	-0.443D-02	-0.346D 03	0.102D 03	-0.295D 04
146.40	0.00	-0.321D-01	-0.141D 01	-0.454D-02	-0.346D 03	0.961D 02	-0.175D 01
175.68	0.00	-0.365D-01	-0.154D 01	-0.443D-02	-0.346D 03	0.900D 02	0.277D 04
204.96	0.00	-0.409D-01	-0.167D 01	-0.412D-02	-0.346D 03	0.831D 02	0.536D 04
234.24	0.00	-0.453D-01	-0.178D 01	-0.362D-02	-0.346D 03	0.753D 02	0.772D 04
263.52	0.00	-0.496D-01	-0.188D 01	-0.295D-02	-0.346D 03	0.665D 02	0.984D 04
292.80	0.00	-0.538D-01	-0.195D 01	-0.213D-02	-0.346D 03	0.514D 02	0.117D 05

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF1   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.0 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER   4
GOES FROM JOINT   4 TO JOINT   2
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.292D 00	-0.853D 00	-0.147D-02	-0.461D 03	0.915D 02	-0.144D 05
29.28	0.00	-0.297D 00	-0.911D 00	-0.246D-02	-0.461D 03	0.906D 02	-0.117D 05
58.56	0.00	-0.303D 00	-0.995D 00	-0.325D-02	-0.461D 03	0.900D 02	-0.899D 04
87.84	0.00	-0.309D 00	-0.110D 01	-0.384D-02	-0.461D 03	0.892D 02	-0.632D 04
117.12	0.00	-0.314D 00	-0.122D 01	-0.422D-02	-0.461D 03	0.884D 02	-0.366D 04
146.40	0.00	-0.320D 00	-0.134D 01	-0.440D-02	-0.461D 03	0.878D 02	-0.103D 04
175.68	0.00	-0.326D 00	-0.147D 01	-0.438D-02	-0.461D 03	0.875D 02	0.159D 04
204.96	0.00	-0.332D 00	-0.160D 01	-0.415D-02	-0.461D 03	0.871D 02	0.421D 04
234.24	0.00	-0.337D 00	-0.171D 01	-0.373D-02	-0.461D 03	0.868D 02	0.681D 04
263.52	0.00	-0.343D 00	-0.182D 01	-0.312D-02	-0.461D 03	0.864D 02	0.939D 04
292.80	0.00	-0.349D 00	-0.190D 01	-0.230D-02	-0.461D 03	0.859D 02	0.119D 05

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF1   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.0 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER   5
GOES FROM JOINT   5 TO JOINT   3
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.741D-02	-0.754D 00	-0.124D-03	-0.148D 03	-0.134D 02	0.759D 03
29.28	0.00	0.564D-02	-0.757D 00	-0.816D-04	-0.148D 03	-0.148D 02	0.341D 03
58.56	0.00	0.386D-02	-0.759D 00	-0.728D-04	-0.148D 03	-0.160D 02	-0.109D 03
87.84	0.00	0.209D-02	-0.761D 00	-0.996D-04	-0.148D 03	-0.173D 02	-0.594D 03
117.12	0.00	0.314D-03	-0.765D 00	-0.165D-03	-0.148D 03	-0.187D 02	-0.112D 04
146.40	0.00	-0.146D-02	-0.771D 00	-0.272D-03	-0.148D 03	-0.203D 02	-0.169D 04
175.68	0.00	-0.324D-02	-0.781D 00	-0.424D-03	-0.148D 03	-0.222D 02	-0.231D 04
204.96	0.00	-0.502D-02	-0.797D 00	-0.626D-03	-0.148D 03	-0.242D 02	-0.298D 04
234.24	0.00	-0.680D-02	-0.819D 00	-0.882D-03	-0.148D 03	-0.266D 02	-0.372D 04
263.52	0.00	-0.859D-02	-0.849D 00	-0.120D-02	-0.148D 03	-0.292D 02	-0.453D 04
292.80	0.00	-0.104D-01	-0.889D 00	-0.158D-02	-0.148D 03	-0.338D 02	-0.542D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF1   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.0 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER   6
GOES FROM JOINT   7 TO JOINT   4
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.215D 00	-0.733D 00	0.112D-04	-0.644D 03	-0.160D 02	0.517D 03
29.28	0.00	-0.222D 00	-0.732D 00	0.325D-04	-0.644D 03	-0.163D 02	0.422D 02
58.56	0.00	-0.230D 00	-0.731D 00	0.174D-04	-0.644D 03	-0.165D 02	-0.438D 03
87.84	0.00	-0.238D 00	-0.731D 00	-0.346D-04	-0.644D 03	-0.167D 02	-0.925D 03
117.12	0.00	-0.245D 00	-0.734D 00	-0.124D-03	-0.644D 03	-0.170D 02	-0.142D 04
146.40	0.00	-0.253D 00	-0.739D 00	-0.251D-03	-0.644D 03	-0.173D 02	-0.192D 04
175.68	0.00	-0.261D 00	-0.749D 00	-0.416D-03	-0.644D 03	-0.176D 02	-0.242D 04
204.96	0.00	-0.269D 00	-0.764D 00	-0.621D-03	-0.644D 03	-0.180D 02	-0.293D 04
234.24	0.00	-0.276D 00	-0.785D 00	-0.864D-03	-0.644D 03	-0.184D 02	-0.345D 04
263.52	0.00	-0.284D 00	-0.815D 00	-0.115D-02	-0.644D 03	-0.188D 02	-0.397D 04
292.80	0.00	-0.292D 00	-0.853D 00	-0.147D-02	-0.644D 03	-0.196D 02	-0.451D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF1   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.0 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER   7
GOES FROM JOINT   5 TO JOINT   6
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE X	Y	DISPLACEMENTS AXIAL	LATERAL	ROTATIONAL	FORCES AXIAL	SHEAR	MOMENT
0.00	0.00	0.751D 00	-0.676D-01	-0.124D-03	0.143D 03	0.126D 02	-0.167D 04
29.28	0.00	0.752D 00	-0.730D-01	-0.237D-03	0.143D 03	0.126D 02	-0.130D 04
58.56	0.00	0.754D 00	-0.812D-01	-0.322D-03	0.143D 03	0.126D 02	-0.928D 03
87.84	0.00	0.756D 00	-0.915D-01	-0.378D-03	0.143D 03	0.126D 02	-0.560D 03
117.12	0.00	0.758D 00	-0.103D 00	-0.407D-03	0.143D 03	0.126D 02	-0.191D 03
146.40	0.00	0.759D 00	-0.115D 00	-0.408D-03	0.143D 03	0.126D 02	0.177D 03
175.68	0.00	0.761D 00	-0.127D 00	-0.380D-03	0.143D 03	0.126D 02	0.545D 03
204.96	0.00	0.763D 00	-0.137D 00	-0.324D-03	0.143D 03	0.126D 02	0.914D 03
234.24	0.00	0.764D 00	-0.145D 00	-0.241D-03	0.143D 03	0.126D 02	0.128D 04
263.52	0.00	0.766D 00	-0.151D 00	-0.129D-03	0.143D 03	0.126D 02	0.165D 04
292.80	0.00	0.768D 00	-0.153D 00	0.116D-04	0.143D 03	0.126D 02	0.202D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF1   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.0 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER   8
GOES FROM JOINT   6 TO JOINT   7
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE X	Y	DISPLACEMENTS AXIAL	LATERAL	ROTATIONAL	FORCES AXIAL	SHEAR	MOMENT
0.00	0.00	0.768D 00	-0.153D 00	0.116D-04	-0.145D 03	-0.159D 01	0.233D 03
29.28	0.00	0.766D 00	-0.152D 00	0.276D-04	-0.145D 03	-0.159D 01	0.186D 03
58.56	0.00	0.764D 00	-0.151D 00	0.401D-04	-0.145D 03	-0.159D 01	0.140D 03
87.84	0.00	0.763D 00	-0.150D 00	0.489D-04	-0.145D 03	-0.159D 01	0.929D 02
117.12	0.00	0.761D 00	-0.148D 00	0.542D-04	-0.145D 03	-0.159D 01	0.462D 02
146.40	0.00	0.759D 00	-0.147D 00	0.560D-04	-0.145D 03	-0.159D 01	-0.591D 00
175.68	0.00	0.757D 00	-0.145D 00	0.541D-04	-0.145D 03	-0.159D 01	-0.473D 02
204.96	0.00	0.756D 00	-0.143D 00	0.488D-04	-0.145D 03	-0.159D 01	-0.941D 02
234.24	0.00	0.754D 00	-0.142D 00	0.398D-04	-0.145D 03	-0.159D 01	-0.141D 03
263.52	0.00	0.752D 00	-0.141D 00	0.273D-04	-0.145D 03	-0.159D 01	-0.187D 03
292.80	0.00	0.751D 00	-0.141D 00	0.112D-04	-0.145D 03	-0.159D 01	-0.234D 03

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF1   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.0 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER   9
GOES FROM JOINT   6 TO JOINT   3
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE X	Y	DISPLACEMENTS AXIAL	LATERAL	ROTATIONAL	FORCES AXIAL	SHEAR	MOMENT
0.00	0.00	-0.628D 00	-0.467D 00	0.116D-04	-0.236D 03	-0.950D 01	0.886D 03
39.29	0.00	-0.632D 00	-0.465D 00	0.823D-04	-0.236D 03	-0.103D 02	0.493D 03
78.59	0.00	-0.636D 00	-0.461D 00	0.111D-03	-0.236D 03	-0.109D 02	0.762D 02
117.88	0.00	-0.640D 00	-0.457D 00	0.965D-04	-0.236D 03	-0.117D 02	-0.368D 03
157.18	0.00	-0.644D 00	-0.454D 00	0.343D-04	-0.236D 03	-0.126D 02	-0.845D 03
196.47	0.00	-0.647D 00	-0.455D 00	-0.786D-04	-0.236D 03	-0.137D 02	-0.136D 04
235.76	0.00	-0.651D 00	-0.461D 00	-0.246D-03	-0.236D 03	-0.149D 02	-0.192D 04
275.06	0.00	-0.655D 00	-0.475D 00	-0.474D-03	-0.236D 03	-0.164D 02	-0.253D 04
314.35	0.00	-0.659D 00	-0.499D 00	-0.767D-03	-0.236D 03	-0.180D 02	-0.320D 04
353.65	0.00	-0.663D 00	-0.536D 00	-0.113D-02	-0.236D 03	-0.200D 02	-0.393D 04
392.94	0.00	-0.666D 00	-0.589D 00	-0.158D-02	-0.236D 03	-0.234D 02	-0.474D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF1   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.0 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER   10
GOES FROM JOINT   6 TO JOINT   4
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE X	Y	DISPLACEMENTS AXIAL	LATERAL	ROTATIONAL	FORCES AXIAL	SHEAR	MOMENT
0.00	0.00	0.402D 00	-0.672D 00	0.116D-04	0.216D 03	-0.993D 01	0.903D 03
39.29	0.00	0.406D 00	-0.670D 00	0.832D-04	0.216D 03	-0.107D 02	0.494D 03
78.59	0.00	0.409D 00	-0.666D 00	0.112D-03	0.216D 03	-0.112D 02	0.647D 02
117.88	0.00	0.412D 00	-0.662D 00	0.953D-04	0.216D 03	-0.117D 02	-0.385D 03
157.17	0.00	0.416D 00	-0.659D 00	0.317D-04	0.216D 03	-0.123D 02	-0.857D 03
196.47	0.00	0.419D 00	-0.660D 00	-0.813D-04	0.216D 03	-0.128D 02	-0.135D 04
235.76	0.00	0.423D 00	-0.666D 00	-0.246D-03	0.216D 03	-0.134D 02	-0.187D 04
275.05	0.00	0.426D 00	-0.680D 00	-0.465D-03	0.216D 03	-0.139D 02	-0.241D 04
314.35	0.00	0.430D 00	-0.703D 00	-0.741D-03	0.216D 03	-0.145D 02	-0.297D 04
353.64	0.00	0.433D 00	-0.739D 00	-0.107D-02	0.216D 03	-0.150D 02	-0.356D 04
392.93	0.00	0.437D 00	-0.789D 00	-0.147D-02	0.216D 03	-0.157D 02	-0.417D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF1 EFFECT OF WIND AND WAVE FORCES AT TIME = 0.0 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 11
GOES FROM JOINT 9 TO JOINT 5
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.522D 00	-0.408D 00	0.163D-03	-0.232D 03	0.464D 01	-0.164D 04
42.79	0.00	-0.526D 00	-0.405D 00	-0.291D-05	-0.236D 03	0.710D 01	-0.133D 04
85.57	0.00	-0.530D 00	-0.408D 00	-0.135D-03	-0.236D 03	0.689D 01	-0.103D 04
128.36	0.00	-0.534D 00	-0.416D 00	-0.234D-03	-0.236D 03	0.665D 01	-0.740D 03
171.15	0.00	-0.538D 00	-0.428D 00	-0.300D-03	-0.236D 03	0.636D 01	-0.459D 03
213.94	0.00	-0.542D 00	-0.441D 00	-0.337D-03	-0.236D 03	0.602D 01	-0.190D 03
256.72	0.00	-0.547D 00	-0.456D 00	-0.344D-03	-0.236D 03	0.563D 01	0.633D 02
299.51	0.00	-0.551D 00	-0.470D 00	-0.324D-03	-0.236D 03	0.517D 01	0.298D 03
342.30	0.00	-0.555D 00	-0.483D 00	-0.278D-03	-0.236D 03	0.464D 01	0.512D 03
385.09	0.00	-0.559D 00	-0.494D 00	-0.211D-03	-0.236D 03	0.403D 01	0.701D 03
427.87	0.00	-0.563D 00	-0.501D 00	-0.124D-03	-0.236D 03	0.297D 01	0.861D 03

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF1 EFFECT OF WIND AND WAVE FORCES AT TIME = 0.0 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 12
GOES FROM JOINT 9 TO JOINT 7
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.374D 00	-0.547D 00	0.163D-03	0.205D 03	0.592D 01	-0.189D 04
42.79	0.00	0.378D 00	-0.544D 00	-0.271D-04	0.209D 03	0.866D 01	-0.151D 04
85.57	0.00	0.382D 00	-0.548D 00	-0.176D-03	0.209D 03	0.849D 01	-0.115D 04
128.36	0.00	0.385D 00	-0.558D 00	-0.284D-03	0.209D 03	0.831D 01	-0.791D 03
171.15	0.00	0.389D 00	-0.572D 00	-0.353D-03	0.209D 03	0.813D 01	-0.442D 03
213.94	0.00	0.393D 00	-0.588D 00	-0.383D-03	0.209D 03	0.794D 01	-0.102D 03
256.72	0.00	0.396D 00	-0.604D 00	-0.376D-03	0.209D 03	0.775D 01	0.231D 03
299.51	0.00	0.400D 00	-0.620D 00	-0.332D-03	0.209D 03	0.756D 01	0.555D 03
342.30	0.00	0.404D 00	-0.632D 00	-0.252D-03	0.209D 03	0.738D 01	0.872D 03
385.09	0.00	0.407D 00	-0.641D 00	-0.138D-03	0.209D 03	0.720D 01	0.118D 04
427.87	0.00	0.411D 00	-0.643D 00	0.112D-04	0.209D 03	0.694D 01	0.149D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF1 EFFECT OF WIND AND WAVE FORCES AT TIME = 0.0 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 13
GOES FROM JOINT 8 TO JOINT 9
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.637D 00	-0.568D-01	-0.126D-02	0.122D 03	-0.253D 02	0.499D 04
32.40	0.00	0.638D 00	-0.912D-01	-0.873D-03	0.127D 03	-0.236D 02	0.421D 04
64.80	0.00	0.640D 00	-0.114D 00	-0.549D-03	0.130D 03	-0.223D 02	0.346D 04
97.20	0.00	0.642D 00	-0.127D 00	-0.287D-03	0.132D 03	-0.209D 02	0.276D 04
129.60	0.00	0.643D 00	-0.133D 00	-0.818D-04	0.135D 03	-0.195D 02	0.210D 04
162.00	0.00	0.645D 00	-0.133D 00	0.699D-04	0.138D 03	-0.181D 02	0.149D 04
194.40	0.00	0.647D 00	-0.129D 00	0.172D-03	0.141D 03	-0.167D 02	0.929D 03
226.80	0.00	0.649D 00	-0.123D 00	0.229D-03	0.144D 03	-0.153D 02	0.412D 03
259.20	0.00	0.651D 00	-0.115D 00	0.244D-03	0.147D 03	-0.139D 02	-0.603D 02
291.60	0.00	0.653D 00	-0.107D 00	0.220D-03	0.150D 03	-0.126D 02	-0.489D 03
324.00	0.00	0.655D 00	-0.101D 00	0.163D-03	0.154D 03	-0.107D 02	-0.875D 03

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF1 EFFECT OF WIND AND WAVE FORCES AT TIME = 0.0 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 14
GOES FROM JOINT 9 TO JOINT 10
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.655D 00	-0.101D 00	0.163D-03	-0.148D 03	-0.310D 02	0.266D 04
32.40	0.00	0.653D 00	-0.925D-01	0.347D-03	-0.144D 03	-0.291D 02	0.170D 04
64.80	0.00	0.651D 00	-0.794D-01	0.451D-03	-0.141D 03	-0.279D 02	0.772D 03
97.20	0.00	0.649D 00	-0.641D-01	0.479D-03	-0.138D 03	-0.267D 02	-0.113D 03
129.60	0.00	0.647D 00	-0.492D-01	0.433D-03	-0.135D 03	-0.257D 02	-0.963D 03
162.00	0.00	0.646D 00	-0.368D-01	0.318D-03	-0.133D 03	-0.247D 02	-0.176D 04
194.40	0.00	0.644D 00	-0.293D-01	0.134D-03	-0.130D 03	-0.238D 02	-0.257D 04
226.80	0.00	0.642D 00	-0.288D-01	-0.115D-03	-0.127D 03	-0.230D 02	-0.332D 04
259.20	0.00	0.641D 00	-0.374D-01	-0.426D-03	-0.124D 03	-0.221D 02	-0.405D 04
291.60	0.00	0.639D 00	-0.571D-01	-0.798D-03	-0.121D 03	-0.211D 02	-0.475D 04
324.00	0.00	0.637D 00	-0.897D-01	-0.123D-02	-0.117D 03	-0.193D 02	-0.541D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF1   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.0 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER   15
GOES FROM JOINT   8 TO JOINT   5
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE X	Y	DISPLACEMENTS AXIAL	DISPLACEMENTS LATERAL	DISPLACEMENTS ROTATIONAL	FORCES AXIAL	FORCES SHEAR	FORCES MOMENT
0.00	0.00	0.681D-02	-0.639D 00	-0.126D-02	0.820D 01	-0.234D 02	0.593D 04
15.68	0.00	0.683D-02	-0.658D 00	-0.111D-02	0.832D 01	-0.225D 02	0.558D 04
31.36	0.00	0.685D-02	-0.674D 00	-0.976D-03	0.832D 01	-0.226D 02	0.522D 04
47.03	0.00	0.688D-02	-0.688D 00	-0.847D-03	0.832D 01	-0.228D 02	0.487D 04
62.71	0.00	0.691D-02	-0.701D 00	-0.727D-03	0.832D 01	-0.230D 02	0.451D 04
78.39	0.00	0.693D-02	-0.711D 00	-0.616D-03	0.832D 01	-0.231D 02	0.415D 04
94.07	0.00	0.696D-02	-0.720D 00	-0.514D-03	0.832D 01	-0.233D 02	0.378D 04
109.74	0.00	0.699D-02	-0.727D 00	-0.422D-03	0.832D 01	-0.235D 02	0.342D 04
125.42	0.00	0.703D-02	-0.733D 00	-0.340D-03	0.832D 01	-0.238D 02	0.305D 04
141.10	0.00	0.706D-02	-0.738D 00	-0.266D-03	0.832D 01	-0.240D 02	0.267D 04
156.78	0.00	0.709D-02	-0.742D 00	-0.203D-03	0.832D 01	-0.243D 02	0.229D 04
172.46	0.00	0.712D-02	-0.744D 00	-0.149D-03	0.832D 01	-0.245D 02	0.191D 04
188.13	0.00	0.715D-02	-0.746D 00	-0.105D-03	0.832D 01	-0.248D 02	0.152D 04
203.81	0.00	0.719D-02	-0.748D 00	-0.711D-04	0.832D 01	-0.251D 02	0.113D 04
219.49	0.00	0.722D-02	-0.749D 00	-0.472D-04	0.832D 01	-0.255D 02	0.736D 03
235.17	0.00	0.725D-02	-0.749D 00	-0.335D-04	0.832D 01	-0.258D 02	0.334D 03
250.84	0.00	0.728D-02	-0.750D 00	-0.302D-04	0.832D 01	-0.262D 02	-0.733D 02
266.52	0.00	0.732D-02	-0.750D 00	-0.374D-04	0.832D 01	-0.266D 02	-0.487D 03
282.20	0.00	0.735D-02	-0.751D 00	-0.552D-04	0.832D 01	-0.270D 02	-0.907D 03
297.88	0.00	0.738D-02	-0.752D 00	-0.839D-04	0.832D 01	-0.275D 02	-0.133D 04
313.56	0.00	0.741D-02	-0.754D 00	-0.124D-03	0.832D 01	-0.282D 02	-0.177D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF1   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.0 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER   16
GOES FROM JOINT   10 TO JOINT   7
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE X	Y	DISPLACEMENTS AXIAL	DISPLACEMENTS LATERAL	DISPLACEMENTS ROTATIONAL	FORCES AXIAL	FORCES SHEAR	FORCES MOMENT
0.00	0.00	-0.153D 00	-0.625D 00	-0.123D-02	-0.792D 03	-0.207D 02	0.546D 04
15.68	0.00	-0.156D 00	-0.643D 00	-0.109D-02	-0.793D 03	-0.196D 02	0.517D 04
31.36	0.00	-0.159D 00	-0.659D 00	-0.962D-03	-0.793D 03	-0.196D 02	0.487D 04
47.03	0.00	-0.162D 00	-0.674D 00	-0.841D-03	-0.793D 03	-0.196D 02	0.458D 04
62.71	0.00	-0.165D 00	-0.666D 00	-0.728D-03	-0.793D 03	-0.197D 02	0.428D 04
78.39	0.00	-0.168D 00	-0.696D 00	-0.622D-03	-0.793D 03	-0.197D 02	0.398D 04
94.07	0.00	-0.171D 00	-0.705D 00	-0.524D-03	-0.793D 03	-0.198D 02	0.368D 04
109.74	0.00	-0.174D 00	-0.713D 00	-0.434D-03	-0.793D 03	-0.198D 02	0.337D 04
125.42	0.00	-0.177D 00	-0.719D 00	-0.352D-03	-0.793D 03	-0.199D 02	0.307D 04
141.10	0.00	-0.181D 00	-0.724D 00	-0.277D-03	-0.793D 03	-0.199D 02	0.276D 04
156.78	0.00	-0.184D 00	-0.728D 00	-0.211D-03	-0.793D 03	-0.200D 02	0.245D 04
172.46	0.00	-0.187D 00	-0.731D 00	-0.152D-03	-0.793D 03	-0.200D 02	0.214D 04
188.13	0.00	-0.190D 00	-0.733D 00	-0.102D-03	-0.793D 03	-0.201D 02	0.182D 04
203.81	0.00	-0.193D 00	-0.734D 00	-0.590D-04	-0.793D 03	-0.202D 02	0.151D 04
219.49	0.00	-0.196D 00	-0.734D 00	-0.245D-04	-0.793D 03	-0.202D 02	0.119D 04
235.17	0.00	-0.199D 00	-0.735D 00	0.195D-05	-0.793D 03	-0.203D 02	0.874D 03
250.84	0.00	-0.202D 00	-0.734D 00	0.202D-04	-0.793D 03	-0.204D 02	0.555D 03
266.52	0.00	-0.205D 00	-0.734D 00	0.303D-04	-0.793D 03	-0.205D 02	0.234D 03
282.20	0.00	-0.208D 00	-0.734D 00	0.322D-04	-0.793D 03	-0.206D 02	-0.874D 02
297.88	0.00	-0.212D 00	-0.733D 00	0.258D-04	-0.793D 03	-0.206D 02	-0.411D 03
313.56	0.00	-0.215D 00	-0.733D 00	0.112D-04	-0.793D 03	-0.208D 02	-0.735D 03

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF1   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.0 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 17
GOES FROM JOINT 11 TO JOINT 8
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.375D-02	-0.155D-01	-0.582D-03	0.304D 02	-0.327D 02	-0.488D 04
18.00	0.00	0.389D-02	-0.273D-01	-0.732D-03	0.322D 02	-0.234D 02	-0.536D 04
36.01	0.00	0.403D-02	-0.419D-01	-0.895D-03	0.334D 02	-0.162D 02	-0.572D 04
54.01	0.00	0.417D-02	-0.596D-01	-0.107D-02	0.346D 02	-0.858D 01	-0.594D 04
72.02	0.00	0.432D-02	-0.804D-01	-0.124D-02	0.358D 02	-0.566D 00	-0.603D 04
90.02	0.00	0.447D-02	-0.104D 00	-0.142D-02	0.370D 02	0.769D 01	-0.597D 04
108.03	0.00	0.462D-02	-0.131D 00	-0.159D-02	0.383D 02	0.161D 02	-0.575D 04
126.03	0.00	0.476D-02	-0.162D 00	-0.175D-02	0.393D 02	0.245D 02	-0.539D 04
144.04	0.00	0.491D-02	-0.195D 00	-0.191D-02	0.400D 02	0.328D 02	-0.488D 04
162.04	0.00	0.506D-02	-0.230D 00	-0.204D-02	0.408D 02	0.411D 02	-0.421D 04
180.05	0.00	0.520D-02	-0.268D 00	-0.215D-02	0.416D 02	0.491D 02	-0.340D 04
198.05	0.00	0.535D-02	-0.307D 00	-0.224D-02	0.423D 02	0.568D 02	-0.245D 04
216.06	0.00	0.549D-02	-0.348D 00	-0.229D-02	0.431D 02	0.643D 02	-0.136D 04
234.06	0.00	0.564D-02	-0.390D 00	-0.231D-02	0.438D 02	0.712D 02	-0.135D 03
252.07	0.00	0.579D-02	-0.431D 00	-0.230D-02	0.443D 02	0.773D 02	0.120D 04
270.07	0.00	0.595D-02	-0.472D 00	-0.224D-02	0.446D 02	0.827D 02	0.264D 04
288.08	0.00	0.610D-02	-0.512D 00	-0.214D-02	0.450D 02	0.873D 02	0.418D 04
306.08	0.00	0.627D-02	-0.549D 00	-0.200D-02	0.452D 02	0.911D 02	0.578D 04
324.09	0.00	0.644D-02	-0.583D 00	-0.180D-02	0.455D 02	0.942D 02	0.745D 04
342.09	0.00	0.662D-02	-0.614D 00	-0.156D-02	0.457D 02	0.965D 02	0.917D 04
360.10	0.00	0.681D-02	-0.639D 00	-0.126D-02	0.459D 02	0.989D 02	0.109D 05

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF1   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.0 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 18
GOES FROM JOINT 12 TO JOINT 10
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.837D-01	-0.138D-01	-0.559D-03	-0.632D 03	-0.332D 02	-0.480D 04
18.00	0.00	-0.867D-01	-0.252D-01	-0.708D-03	-0.658D 03	-0.242D 02	-0.529D 04
36.01	0.00	-0.896D-01	-0.393D-01	-0.869D-03	-0.676D 03	-0.173D 02	-0.566D 04
54.01	0.00	-0.927D-01	-0.565D-01	-0.104D-02	-0.692D 03	-0.974D 01	-0.589D 04
72.02	0.00	-0.959D-01	-0.768D-01	-0.121D-02	-0.709D 03	-0.186D 01	-0.598D 04
90.02	0.00	-0.991D-01	-0.100D 00	-0.139D-02	-0.725D 03	0.627D 01	-0.593D 04
108.03	0.00	-0.102D 00	-0.127D 00	-0.156D-02	-0.741D 03	0.145D 02	-0.572D 04
126.03	0.00	-0.106D 00	-0.156D 00	-0.172D-02	-0.753D 03	0.229D 02	-0.536D 04
144.04	0.00	-0.109D 00	-0.189D 00	-0.187D-02	-0.761D 03	0.311D 02	-0.485D 04
162.04	0.00	-0.113D 00	-0.223D 00	-0.200D-02	-0.770D 03	0.393D 02	-0.419D 04
180.05	0.00	-0.116D 00	-0.261D 00	-0.212D-02	-0.778D 03	0.472D 02	-0.338D 04
198.05	0.00	-0.120D 00	-0.299D 00	-0.220D-02	-0.787D 03	0.549D 02	-0.243D 04
216.06	0.00	-0.123D 00	-0.340D 00	-0.226D-02	-0.795D 03	0.623D 02	-0.134D 04
234.06	0.00	-0.127D 00	-0.381D 00	-0.228D-02	-0.802D 03	0.691D 02	-0.122D 03
252.07	0.00	-0.131D 00	-0.421D 00	-0.226D-02	-0.808D 03	0.752D 02	0.121D 04
270.07	0.00	-0.134D 00	-0.462D 00	-0.220D-02	-0.811D 03	0.805D 02	0.265D 04
288.08	0.00	-0.138D 00	-0.501D 00	-0.210D-02	-0.814D 03	0.851D 02	0.418D 04
306.08	0.00	-0.142D 00	-0.537D 00	-0.196D-02	-0.817D 03	0.889D 02	0.578D 04
324.09	0.00	-0.145D 00	-0.571D 00	-0.176D-02	-0.819D 03	0.920D 02	0.743D 04
342.09	0.00	-0.149D 00	-0.600D 00	-0.152D-02	-0.821D 03	0.943D 02	0.914D 04
360.10	0.00	-0.153D 00	-0.625D 00	-0.123D-02	-0.823D 03	0.966D 02	0.109D 05

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF1 EFFECT OF WIND AND WAVE FORCES AT TIME = 0.0 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 19
GOES FROM JOINT 13 TO JOINT 11
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.135D-02	-0.462D-03	-0.190D-05	0.101D 02	0.136D 00	0.937D 02
21.00	0.00	0.142D-02	-0.459D-03	0.214D-05	0.110D 02	0.295D 00	0.988D 02
41.99	0.00	0.149D-02	-0.370D-03	0.644D-05	0.116D 02	0.390D 00	0.106D 03
62.99	0.00	0.157D-02	-0.187D-03	0.111D-04	0.123D 02	0.454D 00	0.115D 03
83.98	0.00	0.165D-02	0.980D-04	0.161D-04	0.130D 02	0.464D 00	0.125D 03
104.98	0.00	0.173D-02	0.493D-03	0.216D-04	0.137D 02	0.397D 00	0.135D 03
125.97	0.00	0.183D-02	0.101D-02	0.274D-04	0.144D 02	0.228D 00	0.142D 03
146.97	0.00	0.192D-02	0.164D-02	0.334D-04	0.152D 02	-0.704D-01	0.144D 03
167.96	0.00	0.202D-02	0.241D-02	0.393D-04	0.161D 02	-0.525D 00	0.139D 03
188.96	0.00	0.213D-02	0.329D-02	0.448D-04	0.169D 02	-0.116D 01	0.122D 03
209.95	0.00	0.224D-02	0.428D-02	0.492D-04	0.178D 02	-0.201D 01	0.902D 02
230.95	0.00	0.236D-02	0.535D-02	0.519D-04	0.188D 02	-0.308D 01	0.381D 02
251.94	0.00	0.249D-02	0.644D-02	0.519D-04	0.198D 02	-0.663D 01	-0.390D 02
272.94	0.00	0.262D-02	0.748D-02	0.460D-04	0.209D 02	-0.127D 02	-0.240D 03
293.93	0.00	0.276D-02	0.830D-02	0.290D-04	0.220D 02	-0.189D 02	-0.571D 03
314.93	0.00	0.290D-02	0.859D-02	-0.458D-05	0.231D 02	-0.252D 02	-0.103D 04
335.92	0.00	0.306D-02	0.795D-02	-0.604D-04	0.244D 02	-0.314D 02	-0.163D 04
356.92	0.00	0.322D-02	0.586D-02	-0.144D-03	0.256D 02	-0.351D 02	-0.235D 04
377.91	0.00	0.339D-02	0.169D-02	-0.258D-03	0.270D 02	-0.359D 02	-0.310D 04
398.91	0.00	0.357D-02	-0.521D-02	-0.404D-03	0.283D 02	-0.356D 02	-0.386D 04
419.90	0.00	0.375D-02	-0.155D-01	-0.582D-03	0.304D 02	-0.282D 02	-0.460D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF1 EFFECT OF WIND AND WAVE FORCES AT TIME = 0.0 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 20
GOES FROM JOINT 14 TO JOINT 12
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.304D-01	-0.491D-03	-0.255D-05	-0.228D 03	0.139D 00	0.904D 02
21.00	0.00	-0.319D-01	-0.504D-03	0.135D-05	-0.248D 03	0.310D 00	0.957D 02
41.99	0.00	-0.336D-01	-0.432D-03	0.552D-05	-0.262D 03	0.417D 00	0.103D 03
62.99	0.00	-0.353D-01	-0.269D-03	0.101D-04	-0.277D 03	0.497D 00	0.113D 03
83.98	0.00	-0.372D-01	-0.671D-05	0.150D-04	-0.293D 03	0.528D 00	0.124D 03
104.98	0.00	-0.391D-01	0.365D-03	0.205D-04	-0.309D 03	0.488D 00	0.135D 03
125.97	0.00	-0.412D-01	0.856D-03	0.263D-04	-0.326D 03	0.350D 00	0.144D 03
146.97	0.00	-0.434D-01	0.147D-02	0.325D-04	-0.345D 03	0.876D-01	0.149D 03
167.96	0.00	-0.457D-01	0.222D-02	0.387D-04	-0.364D 03	-0.327D 00	0.148D 03
188.96	0.00	-0.481D-01	0.310D-02	0.446D-04	-0.383D 03	-0.922D 00	0.135D 03
209.95	0.00	-0.506D-01	0.409D-02	0.497D-04	-0.403D 03	-0.172D 01	-0.108D 03
230.95	0.00	-0.533D-01	0.517D-02	0.533D-04	-0.424D 03	-0.275D 01	0.620D 02
251.94	0.00	-0.561D-01	0.631D-02	0.544D-04	-0.445D 03	-0.627D 01	-0.836D 01
272.94	0.00	-0.591D-01	0.742D-02	0.500D-04	-0.466D 03	-0.123D 02	-0.202D 03
293.93	0.00	-0.622D-01	0.833D-02	0.348D-04	-0.488D 03	-0.185D 02	-0.525D 03
314.93	0.00	-0.654D-01	0.877D-02	0.324D-05	-0.510D 03	-0.248D 02	-0.980D 03
335.92	0.00	-0.688D-01	0.832D-02	-0.502D-04	-0.532D 03	-0.311D 02	-0.157D 04
356.92	0.00	-0.723D-01	0.647D-02	-0.131D-03	-0.555D 03	-0.349D 02	-0.229D 04
377.91	0.00	-0.760D-01	0.260D-02	-0.242D-03	-0.577D 03	-0.359D 02	-0.303D 04
398.91	0.00	-0.798D-01	-0.393D-02	-0.385D-03	-0.598D 03	-0.358D 02	-0.379D 04
419.90	0.00	-0.837D-01	-0.138D-01	-0.559D-03	-0.630D 03	-0.288D 02	-0.452D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PRCB
WWF1 EFFECT OF WIND AND WAVE FORCES AT TIME = 0.0 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 21
GOES FROM JOINT 15 TO JOINT 13
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE X	Y	DISPLACEMENTS AXIAL	LATERAL	ROTATIONAL	FORCES AXIAL	SHEAR	MOMENT
0.00	0.00	0.226D-03	-0.593D-06	0.106D-07	0.156D 01	0.158D-02	0.117D 00
30.00	0.00	0.247D-03	-0.116D-06	0.219D-07	0.180D 01	0.181D-02	0.171D 00
60.00	0.00	0.271D-03	0.762D-06	0.374D-07	0.197D 01	0.170D-02	0.226D 00
90.00	0.00	0.296D-03	0.217D-05	0.568D-07	0.216D 01	0.118D-02	0.273D 00
120.00	0.00	0.323D-03	0.420D-05	0.791D-07	0.236D 01	0.501D-04	0.296D 00
150.00	0.00	0.354D-03	0.691D-05	0.101D-06	0.259D 01	-0.191D-02	0.276D 00
180.00	0.00	0.387D-03	0.102D-04	0.119D-06	0.283D 01	-0.492D-02	0.182D 00
210.00	0.00	0.423D-03	0.140D-04	0.126D-06	0.310D 01	-0.915D-02	-0.198D-01
240.00	0.00	0.463D-03	0.176D-04	0.111D-06	0.339D 01	-0.146D-01	-0.367D 00
270.00	0.00	0.506D-03	0.202D-04	0.610D-07	0.370D 01	-0.212D-01	-0.898D 00
300.00	0.00	0.554D-03	0.207D-04	-0.382D-07	0.405D 01	-0.283D-01	-0.164D 01
330.00	0.00	0.606D-03	0.173D-04	-0.204D-06	0.442D 01	-0.348D-01	-0.259D 01
360.00	0.00	0.662D-03	0.769D-05	-0.451D-06	0.483D 01	-0.391D-01	-0.373D 01
390.00	0.00	0.724D-03	-0.107D-04	-0.790D-06	0.527D 01	-0.386D-01	-0.494D 01
420.00	0.00	0.792D-03	-0.406D-04	-0.122D-05	0.575D 01	-0.299D-01	-0.604D 01
450.00	0.00	0.865D-03	-0.845D-04	-0.172D-05	0.628D 01	-0.881D-02	-0.673D 01
480.00	0.00	0.946D-03	-0.144D-03	-0.224D-05	0.685D 01	0.295D-01	-0.657D 01
510.00	0.00	0.103D-02	-0.218D-03	-0.269D-05	0.747D 01	0.901D-01	-0.496D 01
540.00	0.00	0.113D-02	-0.303D-03	-0.293D-05	0.815D 01	0.177D 00	-0.117D 01
570.00	0.00	0.123D-02	-0.390D-03	-0.275D-05	0.888D 01	0.292D 00	0.564D 01
600.00	0.00	0.135D-02	-0.462D-03	-0.190D-05	0.101D 02	0.508D 00	0.163D 02

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PRCB
WWF1 EFFECT OF WIND AND WAVE FORCES AT TIME = 0.0 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 22
GOES FROM JOINT 16 TO JOINT 14
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE X	Y	DISPLACEMENTS AXIAL	LATERAL	ROTATIONAL	FORCES AXIAL	SHEAR	MOMENT
0.00	0.00	-0.491D-02	-0.758D-06	0.850D-08	-0.368D 02	0.168D-02	0.111D 00
30.00	0.00	-0.540D-02	-0.349D-06	0.195D-07	-0.419D 02	0.201D-02	0.170D 00
60.00	0.00	-0.594D-02	0.459D-06	0.352D-07	-0.457D 02	0.199D-02	0.232D 00
90.00	0.00	-0.652D-02	0.181D-05	0.556D-07	-0.499D 02	0.159D-02	0.289D 00
120.00	0.00	-0.716D-02	0.383D-05	0.797D-07	-0.544D 02	0.588D-03	0.327D 00
150.00	0.00	-0.786D-02	0.660D-05	0.105D-06	-0.594D 02	-0.125D-02	0.324D 00
180.00	0.00	-0.862D-02	0.101D-04	0.128D-06	-0.648D 02	-0.419D-02	0.252D 00
210.00	0.00	-0.945D-02	0.142D-04	0.140D-06	-0.708D 02	-0.843D-02	0.725D-01
240.00	0.00	-0.104D-01	0.183D-04	0.133D-06	-0.772D 02	-0.141D-01	-0.255D 00
270.00	0.00	-0.113D-01	0.218D-04	0.930D-07	-0.843D 02	-0.210D-01	-0.773D 00
300.00	0.00	-0.124D-01	0.234D-04	0.344D-08	-0.920D 02	-0.288D-01	-0.152D 01
330.00	0.00	-0.136D-01	0.214D-04	-0.154D-06	-0.100D 03	-0.365D-01	-0.250D 01
360.00	0.00	-0.149D-01	0.133D-04	-0.397D-06	-0.110D 03	-0.425D-01	-0.371D 01
390.00	0.00	-0.163D-01	-0.344D-05	-0.739D-06	-0.120D 03	-0.442D-01	-0.505D 01
420.00	0.00	-0.178D-01	-0.320D-04	-0.118D-05	-0.130D 03	-0.382D-01	-0.635D 01
450.00	0.00	-0.195D-01	-0.754D-04	-0.172D-05	-0.142D 03	-0.200D-01	-0.733D 01
480.00	0.00	-0.213D-01	-0.136D-03	-0.230D-05	-0.155D 03	0.154D-01	-0.754D 01
510.00	0.00	-0.233D-01	-0.213D-03	-0.285D-05	-0.169D 03	0.737D-01	-0.638D 01
540.00	0.00	-0.255D-01	-0.305D-03	-0.322D-05	-0.184D 03	0.160D 00	-0.309D 01
570.00	0.00	-0.278D-01	-0.402D-03	-0.321D-05	-0.201D 03	0.277D 00	0.324D 01
600.00	0.00	-0.304D-01	-0.491D-03	-0.255D-05	-0.228D 03	0.505D 00	0.136D 02

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF1   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.0 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER   23
GOES FROM JOINT   17 TO JOINT   15
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.999D-04	-0.636D-08	0.203D-09	-0.209D 00	-0.210D-09	0.277D-07
30.00	0.00	0.974D-04	-0.252D-09	0.206D-09	-0.174D 00	0.244D-05	0.719D-04
60.00	0.00	0.957D-04	0.603D-08	0.214D-09	-0.106D 00	0.136D-05	0.147D-03
90.00	0.00	0.948D-04	0.126D-07	0.226D-09	-0.388D-01	-0.216D-05	0.153D-03
120.00	0.00	0.947D-04	0.195D-07	0.232D-09	0.282D-01	-0.821D-05	0.173D-04
150.00	0.00	0.955D-04	0.264D-07	0.220D-09	0.955D-01	-0.169D-04	-0.339D-03
180.00	0.00	0.971D-04	0.323D-07	0.168D-09	0.164D 00	-0.279D-04	-0.994D-03
210.00	0.00	0.995D-04	0.358D-07	0.501D-10	0.233D 00	-0.407D-04	-0.201D-02
240.00	0.00	0.103D-03	0.344D-07	-0.163D-09	0.304D 00	-0.538D-04	-0.344D-02
270.00	0.00	0.107D-03	0.248D-07	-0.502D-09	0.377D 00	-0.649D-04	-0.524D-02
300.00	0.00	0.112D-03	0.271D-08	-0.994D-09	0.454D 00	-0.700D-04	-0.733D-02
330.00	0.00	0.118D-03	-0.365D-07	-0.165D-08	0.534D 00	-0.637D-04	-0.944D-02
360.00	0.00	0.125D-03	-0.978D-07	-0.245D-08	0.618D 00	-0.389D-04	-0.112D-01
390.00	0.00	0.133D-03	-0.185D-06	-0.335D-08	0.708D 00	0.131D-04	-0.118D-01
420.00	0.00	0.142D-03	-0.299D-06	-0.422D-08	0.803D 00	0.102D-03	-0.104D-01
450.00	0.00	0.153D-03	-0.435D-06	-0.484D-08	0.904D 00	0.236D-03	-0.568D-02
480.00	0.00	0.165D-03	-0.584D-06	-0.492D-08	0.101D 01	0.422D-03	0.379D-02
510.00	0.00	0.178D-03	-0.721D-06	-0.400D-08	0.113D 01	0.659D-03	0.196D-01
540.00	0.00	0.192D-03	-0.808D-06	-0.154D-08	0.126D 01	0.936D-03	0.433D-01
570.00	0.00	0.209D-03	-0.791D-06	0.311D-08	0.139D 01	0.122D-02	0.758D-01
600.00	0.00	0.226D-03	-0.593D-06	0.106D-07	0.161D 01	0.158D-02	0.117D 00

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF1   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.0 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER   24
GOES FROM JOINT   18 TO JOINT   16
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.144D-02	-0.746D-08	0.205D-09	-0.409D-05	0.615D-08	-0.680D-06
30.00	0.00	-0.145D-02	-0.128D-08	0.208D-09	-0.153D 01	0.306D-05	0.838D-04
60.00	0.00	-0.148D-02	0.509D-08	0.218D-09	-0.257D 01	0.234D-05	0.183D-03
90.00	0.00	-0.151D-02	0.119D-07	0.234D-09	-0.362D 01	-0.857D-06	0.224D-03
120.00	0.00	-0.157D-02	0.191D-07	0.248D-09	-0.471D 01	-0.670D-05	0.131D-03
150.00	0.00	-0.163D-02	0.266D-07	0.246D-09	-0.584D 01	-0.153D-04	-0.178D-03
180.00	0.00	-0.171D-02	0.336D-07	0.209D-09	-0.702D 01	-0.266D-04	-0.788D-03
210.00	0.00	-0.180D-02	0.385D-07	0.109D-09	-0.826D 01	-0.402D-04	-0.178D-02
240.00	0.00	-0.191D-02	0.391D-07	-0.860D-10	-0.957D 01	-0.547D-04	-0.320D-02
270.00	0.00	-0.204D-02	0.321D-07	-0.409D-09	-0.109D 02	-0.680D-04	-0.506D-02
300.00	0.00	-0.218D-02	0.130D-07	-0.891D-09	-0.124D 02	-0.764D-04	-0.728D-02
330.00	0.00	-0.234D-02	-0.232D-07	-0.155D-08	-0.140D 02	-0.745D-04	-0.964D-02
360.00	0.00	-0.252D-02	-0.819D-07	-0.239D-08	-0.157D 02	-0.551D-04	-0.118D-01
390.00	0.00	-0.273D-02	-0.168D-06	-0.336D-08	-0.175D 02	-0.911D-05	-0.130D-01
420.00	0.00	-0.295D-02	-0.283D-06	-0.434D-08	-0.195D 02	0.737D-04	-0.123D-01
450.00	0.00	-0.320D-02	-0.427D-06	-0.516D-08	-0.216D 02	0.204D-03	-0.853D-02
480.00	0.00	-0.348D-02	-0.588D-06	-0.549D-08	-0.239D 02	0.389D-03	-0.821D-04
510.00	0.00	-0.379D-02	-0.747D-06	-0.492D-08	-0.263D 02	0.631D-03	0.148D-01
540.00	0.00	-0.413D-02	-0.868D-06	-0.286D-08	-0.290D 02	0.924D-03	0.378D-01
570.00	0.00	-0.450D-02	-0.897D-06	0.136D-08	-0.319D 02	0.124D-02	0.702D-01
600.00	0.00	-0.491D-02	-0.758D-06	0.850D-08	-0.368D 02	0.168D-02	0.112D 00

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PRC2
WWF2   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.88 SEC

TABLE 1 - PROGRAM CONTROL DATA
PROBLEM TYPE   1

TABLE NUMBER	2	3A	3B	3C	4A	4B	4C	5A	5B	6	7
PRIOR-DATA OPTIONS (1=YES,0=NO)	0	0	0	0	0	0	0	0	0	0	0
NUMBER OF CARDS ADDED FOR THIS PROBLEM	18	24	6	2	0	0	4	0	6	8	3

TABLE 2 - JOINT COORDINATES

JOINT NUMBER	X-COORD	Y-COORD
1	0.895D 02	0.895D 03
2	0.559D 03	0.895D 03
3	0.603D 02	0.603D 03
4	0.538D 03	0.603D 03
5	0.312D 02	0.312D 03
6	0.324D 03	0.312D 03
7	0.617D 03	0.312D 03
8	0.000D 00	0.000D 00
9	0.324D 03	0.000D 00
10	0.648D 03	0.000D 00
11	-0.358D 02	-0.358D 03
12	0.684D 03	-0.358D 03
13	-0.776D 02	-0.776D 03
14	0.726D 03	-0.776D 03
15	-0.137D 03	-0.137D 04
16	0.785D 03	-0.137D 04
17	-0.197D 03	-0.197D 04
18	0.845D 03	-0.197D 04

TABLE 3A - MEMBER PROPERTIES

MEMBER NUMBER	ELEM PER NUMBER	NON LIN	FROM JOINT NO.	AREA	PIN	TO JOINT NO.	AREA	PIN
1	10	1	1	1	0	2	1	0
2	10	1	3	1	0	4	1	0
3	10	1	3	1	0	1	1	0
4	10	1	4	1	0	2	1	0
5	10	1	5	1	0	3	1	0
6	10	1	7	1	0	4	1	0
7	10	1	5	1	0	6	1	0
8	10	1	6	1	0	7	1	0
9	10	1	6	1	0	3	1	0
10	10	1	6	1	0	4	1	0
11	10	1	9	1	0	5	1	0
12	10	1	9	1	0	7	1	0
13	10	1	8	1	0	9	1	0
14	10	1	9	1	0	10	1	0
15	20	1	8	3	0	5	3	0
16	20	1	10	3	0	7	3	0
17	20	1	11	3	0	8	3	0
18	20	1	12	3	0	10	3	0
19	20	1	13	2	0	11	2	0
20	20	1	14	2	0	12	2	0
21	20	1	15	1	0	13	1	0
22	20	1	16	1	0	14	1	0
23	20	1	17	1	0	15	1	0
24	20	1	18	1	0	16	1	0

MEMBER NUMBER	MODULUS OF ELASTICITY	FROM JOINT EI	AE	TO JOINT EI	AE

MEMBER NUMBER	LENGTH	COSINE-X	COSINE-Y	MEMBER TYPE	CENTER-X COORDINATE	CENTER-Y COORDINATE
1	0.469D 03	0.100D 01	0.000D 00	STRAIGHT		
2	0.527D 03	0.100D 01	0.000D 00	STRAIGHT		
3	0.293D 03	0.995D-01	0.995D 00	STRAIGHT		
4	0.293D 03	-0.995D-01	0.995D 00	STRAIGHT		
5	0.293D 03	0.995D-01	0.995D 00	STRAIGHT		
6	0.293D 03	-0.995D-01	0.995D 00	STRAIGHT		
7	0.293D 03	0.100D 01	0.000D 00	STRAIGHT		
8	0.293D 03	0.100D 01	0.000D 00	STRAIGHT		
9	0.393D 03	-0.671D 00	0.741D 00	STRAIGHT		
10	0.393D 03	0.671D 00	0.741D 00	STRAIGHT		
11	0.428D 03	-0.684D 00	0.729D 00	STRAIGHT		
12	0.428D 03	0.684D 00	0.729D 00	STRAIGHT		
13	0.324D 03	0.100D 01	0.000D 00	STRAIGHT		
14	0.324D 03	0.100D 01	0.000D 00	STRAIGHT		
15	0.314D 03	0.995D-01	0.995D 00	STRAIGHT		
16	0.314D 03	-0.995D-01	0.995D 00	STRAIGHT		
17	0.360D 03	0.995D-01	0.995D 00	STRAIGHT		
18	0.360D 03	-0.995D-01	0.995D 00	STRAIGHT		
19	0.420D 03	0.995D-01	0.995D 00	STRAIGHT		
20	0.420D 03	-0.995D-01	0.995D 00	STRAIGHT		
21	0.600D 03	0.995D-01	0.995D 00	STRAIGHT		
22	0.600D 03	-0.995D-01	0.995D 00	STRAIGHT		
23	0.600D 03	0.995D-01	0.995D 00	STRAIGHT		
24	0.600D 03	-0.995D-01	0.995D 00	STRAIGHT		

TABLE 3B - CROSS SECTION PROPERTIES

CROSS SECTION NUMBER = 1
NUMBER OF SEGMENT = 1

SEG NUM	SEG TYPE	CUR NUM	STRESS MULTIPLIER	STRAIN MULTIPLIER	WIDTH OR DIAMETER	DEPTH OR THICKNESS	CENTROIDAL DISTANCE	SEGMENTAL AREA
1	CIRC	1	0.100D 01	0.100D-02	0.360D 02	0.750D 00	0.000D 00	

CROSS SECTION NUMBER = 2
NUMBER OF SEGMENT = 1

SEG NUM	SEG TYPE	CUR NUM	STRESS MULTIPLIER	STRAIN MULTIPLIER	WIDTH OR DIAMETER	DEPTH OR THICKNESS	CENTROIDAL DISTANCE	SEGMENTAL AREA
1	CIRC	1	0.100D 01	0.100D-02	0.360D 02	0.100D 01	0.000D 00	

CROSS SECTION NUMBER = 3
NUMBER OF SEGMENT = 1

SEG NUM	SEG TYPE	CUR NUM	STRESS MULTIPLIER	STRAIN MULTIPLIER	WIDTH OR DIAMETER	DEPTH OR THICKNESS	CENTROIDAL DISTANCE	SEGMENTAL AREA
1	CIRC	1	0.100D 01	0.100D-02	0.360D 02	0.125D 01	0.000D 00	

TABLE 3C - STRESS-STRAIN CURVE

STRESS-STRAIN CURVE NUMBER = 1
NUMBER OF POINTS IN THIS CURVE = 3
CURVE SYMMETRY = YES

SIG 0.000 40.000 40.000

EPS 0.000 1.333 10.000

TABLE 4A - APPLIED MEMBER LOAD

NO DATA IN THE TABLE

TABLE 4B - SELFWEIGHT

WT PER UNIT VOL MEMBER NUMBER

NO DATA IN THE TABLE

TABLE 4C - WIND AND WAVE FORCES

MASS DENSITY OF AIR = 0.121D-09
BASIC WIND VELOCITY = 0.176D 04
WIND CONSTANT = 0.100D 00
MEAN SEA LEVEL = 0.636D 03

DENSITY OF FLUID = 0.964D-07
WAVE PERIOD = 0.700D 01
WAVE HEIGHT = 0.600D 03
TIME/PERIOD = 0.125D 00
TIME INCREMENT/PERIOD = 0.000D 00
NUMBER OF TIME INCREMENT= 0

WIND CD	WAVE CD	WAVE CM	MEMBER NUMBER
0.200D 01	0.100D 01	0.100D 01	3 4 5 6 9 10 11 12
0.200D 01	0.100D 01	0.100D 01	15 16

TABLE 5A - ELASTIC MEMBER RESTRAIN

NO DATA IN THE TABLE

TABLE 5B - SOIL DATA

PENETRATION DISTANCE FROM	TO	SOIL SHEAR STRENGTH	SOIL DENSITY
0.000D 00	0.000D 00	0.153D-02	0.260D-04
0.000D 00	-0.144D 03	0.542D-02	0.260D-04
0.000D 00	-0.432D 03	0.861D-02	0.260D-04
0.000D 00	-0.131D 04	0.986D-02	0.260D-04
0.000D 00	-0.180D 04	0.104D-01	0.260D-04
0.000D 00	-0.204D 04	0.104D-01	0.260D-04

TABLE 6 - JOINT LOADS AND LINEAR SUPPORTS

JOINT	FORCE(X)	FORCE(Y)	MOMENT(Z)	SPRING(X)	SPRING(Y)	SPRING(Z)
1	0.860D 02	-0.400D 03	0.000D 00	0.000D 00	0.000D 00	0.000D 00
2	0.106D 03	-0.400D 03	0.000D 00	0.000D 00	0.000D 00	0.000D 00
3	0.240D 02	0.000D 00	0.000D 00	0.000D 00	0.000D 00	0.000D 00
4	0.320D 02	0.000D 00	0.000D 00	0.000D 00	0.000D 00	0.000D 00
5	0.160D 02	0.000D 00	0.000D 00	0.000D 00	0.000D 00	0.000D 00

7	0.190D 02	0.000D 00	0.000D 00	0.000D 00	0.000D 00	0.000D 00
8	0.500D 01	0.000D 00	0.000D 00	0.000D 00	0.000D 00	0.000D 00
10	0.500D 01	0.000D 00	0.000D 00	0.000D 00	0.000D 00	0.000D 00

TABLE 7 - ITERATION CONTROL

NUMBER OF LOAD INCREMENT= 1

FRAME ITERATION

MAXIMUM NUMBER OF ITERATION = 20
FORCE ERROR = 0.100D 02
MOMENT ERROR = 0.100D 03

MEMBER ITERATION

MAXIMUM NUMBER OF ITERATION = 10
FORCE ERROR = 0.500D 00
MOMENT ERROR = 0.500D 01

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PRCB
WWF2 EFFECT OF WIND AND WAVE FORCES AT TIME = 0.88 SEC
TABLE 8 - JOINT DISPLACEMENTS AND REACTIONS

	DISPLACEMENTS			REACTIONS		
JOINT	DISP(X)	DISP(Y)	ROTATION(Z)	REACT(X)	REACT(Y)	REACT(Z)
1	0.258D 01	-0.274D 00	-0.290D-02	-0.000D 00	-0.000D 00	-0.000D 00
2	0.257D 01	-0.142D 00	-0.278D-02	-0.000D 00	-0.000D 00	-0.000D 00
3	0.122D 01	-0.953D-01	-0.195D-02	-0.000D 00	-0.000D 00	-0.000D 00
4	0.122D 01	-0.217D 00	-0.195D-02	-0.000D 00	-0.000D 00	-0.000D 00
5	0.106D 01	-0.701D-01	-0.863D-04	-0.000D 00	-0.000D 00	-0.000D 00
6	0.108D 01	-0.153D 00	0.421D-04	-0.000D 00	-0.000D 00	-0.000D 00
7	0.106D 01	-0.147D 00	0.366D-04	-0.000D 00	-0.000D 00	-0.000D 00
8	0.927D 00	-0.657D-01	-0.165D-02	-0.000D 00	-0.000D 00	-0.000D 00
9	0.950D 00	-0.104D 00	0.254D-03	-0.000D 00	-0.000D 00	-0.000D 00
10	0.928D 00	-0.899D-01	-0.163D-02	-0.000D 00	-0.000D 00	-0.000D 00
11	0.402D-01	0.104D-01	-0.105D-02	-0.000D 00	-0.000D 00	-0.000D 00
12	0.455D-01	-0.983D-01	-0.101D-02	-0.000D 00	-0.000D 00	-0.000D 00
13	0.134D-02	0.504D-02	-0.188D-05	-0.000D 00	-0.000D 00	-0.000D 00
14	0.466D-02	-0.375D-01	-0.304D-05	-0.000D 00	-0.000D 00	-0.000D 00
15	0.835D-04	0.828D-03	0.272D-07	-0.000D 00	-0.000D 00	-0.000D 00
16	0.609D-03	-0.608D-02	0.244D-07	-0.000D 00	-0.000D 00	-0.000D 00
17	0.243D-04	0.243D-03	0.398D-09	-0.000D 00	-0.000D 00	-0.000D 00
18	0.178D-03	-0.178D-02	0.415D-09	-0.000D 00	-0.000D 00	-0.000D 00

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PRCB
WWF2 EFFECT OF WIND AND WAVE FORCES AT TIME = 0.88 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 1
GOES FROM JOINT 1 TO JOINT 2
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.258D 01	-0.274D 00	-0.290D-02	-0.214D 02	-0.653D 02	0.154D 05
46.91	0.00	0.258D 01	-0.369D 00	-0.121D-02	-0.214D 02	-0.653D 02	0.124D 05
93.81	0.00	0.258D 01	-0.393D 00	0.118D-03	-0.214D 02	-0.653D 02	0.929D 04
140.72	0.00	0.258D 01	-0.363D 00	0.107D-02	-0.214D 02	-0.653D 02	0.623D 04
187.62	0.00	0.258D 01	-0.299D 00	0.164D-02	-0.214D 02	-0.653D 02	0.317D 04
234.53	0.00	0.258D 01	-0.215D 00	0.184D-02	-0.214D 02	-0.653D 02	0.103D 03
281.44	0.00	0.258D 01	-0.132D 00	0.167D-02	-0.214D 02	-0.653D 02	-0.296D 04
328.34	0.00	0.258D 01	-0.650D-01	0.112D-02	-0.214D 02	-0.653D 02	-0.602D 04
375.25	0.00	0.257D 01	-0.328D-01	0.193D-03	-0.214D 02	-0.653D 02	-0.909D 04
422.16	0.00	0.257D 01	-0.527D-01	-0.110D-02	-0.214D 02	-0.653D 02	-0.121D 05
469.06	0.00	0.257D 01	-0.142D 00	-0.278D-02	-0.214D 02	-0.653D 02	-0.152D 05

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PRCB
WWF2 EFFECT OF WIND AND WAVE FORCES AT TIME = 0.88 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 2
GOES FROM JOINT 3 TO JOINT 4
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.122D 01	-0.953D-01	-0.195D-02	0.145D 02	-0.285D 02	0.751D 04
52.73	0.00	0.122D 01	-0.173D 00	-0.102D-02	0.145D 02	-0.285D 02	0.601D 04
105.46	0.00	0.122D 01	-0.207D 00	-0.298D-03	0.145D 02	-0.285D 02	0.451D 04
158.20	0.00	0.122D 01	-0.208D 00	0.218D-03	0.145D 02	-0.285D 02	0.300D 04
210.93	0.00	0.122D 01	-0.187D 00	0.527D-03	0.145D 02	-0.285D 02	0.150D 04
263.66	0.00	0.122D 01	-0.156D 00	0.630D-03	0.145D 02	-0.285D 02	-0.346D 01
316.39	0.00	0.122D 01	-0.124D 00	0.526D-03	0.145D 02	-0.285D 02	-0.151D 04
369.12	0.00	0.122D 01	-0.104D 00	0.216D-03	0.145D 02	-0.285D 02	-0.301D 04
421.85	0.00	0.122D 01	-0.105D 00	-0.301D-03	0.145D 02	-0.285D 02	-0.451D 04
474.59	0.00	0.122D 01	-0.139D 00	-0.102D-02	0.145D 02	-0.285D 02	-0.602D 04
527.32	0.00	0.122D 01	-0.217D 00	-0.195D-02	0.145D 02	-0.285D 02	-0.752D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF2   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.88 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 3
GOES FROM JOINT 3 TO JOINT 1
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.265D-01	-0.122D 01	-0.195D-02	-0.327D 03	0.135D 03	-0.197D 05
29.28	0.00	0.225D-01	-0.130D 01	-0.331D-02	-0.327D 03	0.132D 03	-0.158D 05
58.56	0.00	0.183D-01	-0.141D 01	-0.437D-02	-0.327D 03	0.130D 03	-0.120D 05
87.84	0.00	0.141D-01	-0.155D 01	-0.514D-02	-0.327D 03	0.127D 03	-0.815D 04
117.12	0.00	0.977D-02	-0.171D 01	-0.561D-02	-0.327D 03	0.124D 03	-0.442D 04
146.40	0.00	0.539D-02	-0.183D 01	-0.581D-02	-0.327D 03	0.121D 03	-0.782D 03
175.68	0.00	0.993D-03	-0.205D 01	-0.574D-02	-0.327D 03	0.117D 03	0.275D 04
204.96	0.00	-0.337D-02	-0.221D 01	-0.540D-02	-0.327D 03	0.112D 03	0.615D 04
234.24	0.00	-0.765D-02	-0.236D 01	-0.480D-02	-0.327D 03	0.107D 03	0.942D 04
263.52	0.00	-0.118D-01	-0.249D 01	-0.397D-02	-0.327D 03	0.101D 03	0.125D 05
292.80	0.00	-0.159D-01	-0.259D 01	-0.290D-02	-0.327D 03	0.976D 02	0.154D 05

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF2   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.88 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 4
GOES FROM JOINT 4 TO JOINT 2
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.337D 00	-0.119D 01	-0.195D-02	-0.476D 03	0.140D 03	-0.199D 05
29.28	0.00	-0.343D 00	-0.127D 01	-0.332D-02	-0.476D 03	0.136D 03	-0.158D 05
58.56	0.00	-0.349D 00	-0.139D 01	-0.437D-02	-0.476D 03	0.133D 03	-0.118D 05
87.84	0.00	-0.355D 00	-0.153D 01	-0.512D-02	-0.476D 03	0.129D 03	-0.791D 04
117.12	0.00	-0.361D 00	-0.168D 01	-0.558D-02	-0.476D 03	0.125D 03	-0.411D 04
146.40	0.00	-0.367D 00	-0.185D 01	-0.575D-02	-0.476D 03	0.120D 03	-0.442D 03
175.68	0.00	-0.374D 00	-0.202D 01	-0.565D-02	-0.476D 03	0.115D 03	0.308D 04
204.96	0.00	-0.380D 00	-0.213D 01	-0.529D-02	-0.476D 03	0.109D 03	0.644D 04
234.24	0.00	-0.386D 00	-0.232D 01	-0.468D-02	-0.476D 03	0.102D 03	0.959D 04
263.52	0.00	-0.392D 00	-0.245D 01	-0.384D-02	-0.476D 03	0.940D 02	0.125D 05
292.80	0.00	-0.398D 00	-0.255D 01	-0.278D-02	-0.476D 03	0.805D 02	0.152D 05

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF2   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.88 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 5
GOES FROM JOINT 5 TO JOINT 3
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.358D-01	-0.106D 01	-0.863D-04	-0.775D 02	-0.215D 02	0.107D 04
29.28	0.00	0.349D-01	-0.106D 01	-0.290D-04	-0.775D 02	-0.222D 02	0.429D 03
58.56	0.00	0.340D-01	-0.107D 01	-0.214D-04	-0.775D 02	-0.228D 02	-0.230D 03
87.84	0.00	0.330D-01	-0.107D 01	-0.648D-04	-0.775D 02	-0.235D 02	-0.907D 03
117.12	0.00	0.321D-01	-0.107D 01	-0.161D-03	-0.775D 02	-0.242D 02	-0.160D 04
146.40	0.00	0.312D-01	-0.108D 01	-0.311D-03	-0.775D 02	-0.251D 02	-0.232D 04
175.68	0.00	0.303D-01	-0.109D 01	-0.517D-03	-0.775D 02	-0.261D 02	-0.307D 04
204.96	0.00	0.293D-01	-0.111D 01	-0.781D-03	-0.775D 02	-0.273D 02	-0.385D 04
234.24	0.00	0.284D-01	-0.113D 01	-0.111D-02	-0.775D 02	-0.286D 02	-0.467D 04
263.52	0.00	0.274D-01	-0.117D 01	-0.149D-02	-0.775D 02	-0.301D 02	-0.552D 04
292.80	0.00	0.265D-01	-0.122D 01	-0.195D-02	-0.775D 02	-0.328D 02	-0.642D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF2   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.88 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 6
GOES FROM JOINT 7 TO JOINT 4
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.252D 00	-0.104D 01	0.366D-04	-0.713D 03	-0.180D 02	0.593D 03
29.28	0.00	-0.261D 00	-0.104D 01	0.608D-04	-0.713D 03	-0.192D 02	0.422D 02
58.56	0.00	-0.269D 00	-0.104D 01	0.421D-04	-0.713D 03	-0.202D 02	-0.535D 03
87.84	0.00	-0.278D 00	-0.104D 01	-0.218D-04	-0.713D 03	-0.212D 02	-0.114D 04
117.12	0.00	-0.286D 00	-0.104D 01	-0.133D-03	-0.713D 03	-0.224D 02	-0.177D 04
146.40	0.00	-0.295D 00	-0.105D 01	-0.294D-03	-0.713D 03	-0.238D 02	-0.244D 04
175.68	0.00	-0.303D 00	-0.105D 01	-0.507D-03	-0.713D 03	-0.253D 02	-0.315D 04
204.96	0.00	-0.312D 00	-0.103D 01	-0.777D-03	-0.713D 03	-0.270D 02	-0.390D 04
234.24	0.00	-0.320D 00	-0.111D 01	-0.110D-02	-0.713D 03	-0.290D 02	-0.470D 04
263.52	0.00	-0.329D 00	-0.114D 01	-0.150D-02	-0.713D 03	-0.312D 02	-0.555D 04
292.80	0.00	-0.336D 00	-0.119D 01	-0.195D-02	-0.713D 03	-0.351D 02	-0.647D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF2   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.88 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 7
GOES FROM JOINT 5 TO JOINT 6
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.106D 01	-0.701D-01	-0.863D-04	0.195D 03	0.141D 02	-0.188D 04
29.28	0.00	0.106D 01	-0.746D-01	-0.214D-03	0.195D 03	0.141D 02	-0.147D 04
58.56	0.00	0.107D 01	-0.824D-01	-0.311D-03	0.195D 03	0.141D 02	-0.106D 04
87.84	0.00	0.107D 01	-0.925D-01	-0.376D-03	0.195D 03	0.141D 02	-0.651D 03
117.12	0.00	0.107D 01	-0.104D 00	-0.410D-03	0.195D 03	0.141D 02	-0.241D 03
146.40	0.00	0.107D 01	-0.116D 00	-0.413D-03	0.195D 03	0.141D 02	0.168D 03
175.68	0.00	0.108D 01	-0.128D 00	-0.384D-03	0.195D 03	0.141D 02	0.577D 03
204.96	0.00	0.108D 01	-0.138D 00	-0.325D-03	0.195D 03	0.141D 02	0.987D 03
234.24	0.00	0.108D 01	-0.147D 00	-0.234D-03	0.195D 03	0.141D 02	0.140D 04
263.52	0.00	0.108D 01	-0.152D 00	-0.112D-03	0.195D 03	0.141D 02	0.181D 04
292.80	0.00	0.108D 01	-0.153D 00	0.421D-04	0.195D 03	0.141D 02	0.222D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF2   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.88 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 8
GOES FROM JOINT 6 TO JOINT 7
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.108D 01	-0.153D 00	0.421D-04	-0.173D 03	0.103D 01	-0.157D 03
29.28	0.00	0.108D 01	-0.152D 00	0.312D-04	-0.173D 03	0.103D 01	-0.128D 03
58.56	0.00	0.108D 01	-0.151D 00	0.226D-04	-0.173D 03	0.103D 01	-0.975D 02
87.84	0.00	0.108D 01	-0.150D 00	0.163D-04	-0.173D 03	0.103D 01	-0.674D 02
117.12	0.00	0.108D 01	-0.150D 00	0.124D-04	-0.173D 03	0.103D 01	-0.373D 02
146.40	0.00	0.107D 01	-0.150D 00	0.107D-04	-0.173D 03	0.103D 01	-0.721D 01
175.68	0.00	0.107D 01	-0.149D 00	0.112D-04	-0.173D 03	0.103D 01	0.229D 02
204.96	0.00	0.107D 01	-0.149D 00	0.141D-04	-0.173D 03	0.103D 01	0.530D 02
234.24	0.00	0.107D 01	-0.149D 00	0.193D-04	-0.173D 03	0.103D 01	0.831D 02
263.52	0.00	0.107D 01	-0.148D 00	0.268D-04	-0.173D 03	0.103D 01	0.113D 03
292.80	0.00	0.106D 01	-0.147D 00	0.366D-04	-0.173D 03	0.103D 01	0.143D 03

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF2   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.88 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 9
GOES FROM JOINT 6 TO JOINT 3
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.841D 00	-0.702D 00	0.421D-04	-0.296D 03	-0.132D 02	0.127D 04
39.29	0.00	-0.846D 00	-0.698D 00	0.145D-03	-0.296D 03	-0.142D 02	0.728D 03
78.59	0.00	-0.851D 00	-0.691D 00	0.190D-03	-0.296D 03	-0.150D 02	0.152D 03
117.88	0.00	-0.855D 00	-0.684D 00	0.174D-03	-0.296D 03	-0.159D 02	-0.456D 03
157.18	0.00	-0.860D 00	-0.678D 00	0.945D-04	-0.296D 03	-0.168D 02	-0.110D 04
196.47	0.00	-0.865D 00	-0.677D 00	-0.528D-04	-0.296D 03	-0.178D 02	-0.178D 04
235.76	0.00	-0.870D 00	-0.683D 00	-0.272D-03	-0.296D 03	-0.189D 02	-0.250D 04
275.06	0.00	-0.874D 00	-0.699D 00	-0.567D-03	-0.296D 03	-0.201D 02	-0.326D 04
314.35	0.00	-0.879D 00	-0.729D 00	-0.942D-03	-0.296D 03	-0.213D 02	-0.406D 04
353.65	0.00	-0.884D 00	-0.775D 00	-0.140D-02	-0.296D 03	-0.226D 02	-0.491D 04
392.94	0.00	-0.889D 00	-0.840D 00	-0.195D-02	-0.296D 03	-0.246D 02	-0.581D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF2   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.88 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 10
GOES FROM JOINT 6 TO JOINT 4
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.614D 00	-0.907D 00	0.421D-04	0.280D 03	-0.120D 02	0.110D 04
39.29	0.00	0.619D 00	-0.903D 00	0.130D-03	0.280D 03	-0.130D 02	0.607D 03
78.59	0.00	0.623D 00	-0.897D 00	0.165D-03	0.280D 03	-0.139D 02	0.819D 02
117.88	0.00	0.628D 00	-0.891D 00	0.145D-03	0.280D 03	-0.148D 02	-0.479D 03
157.17	0.00	0.632D 00	-0.887D 00	0.649D-04	0.280D 03	-0.159D 02	-0.108D 04
196.47	0.00	0.637D 00	-0.887D 00	-0.788D-04	0.280D 03	-0.171D 02	-0.173D 04
235.76	0.00	0.641D 00	-0.894D 00	-0.291D-03	0.280D 03	-0.184D 02	-0.243D 04
275.05	0.00	0.646D 00	-0.911D 00	-0.579D-03	0.280D 03	-0.199D 02	-0.318D 04
314.35	0.00	0.650D 00	-0.940D 00	-0.947D-03	0.280D 03	-0.216D 02	-0.401D 04
353.64	0.00	0.655D 00	-0.986D 00	-0.140D-02	0.280D 03	-0.234D 02	-0.490D 04
392.93	0.00	0.659D 00	-0.105D 01	-0.195D-02	0.280D 03	-0.263D 02	-0.587D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF2 EFFECT OF WIND AND WAVE FORCES AT TIME = 0.88 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 11
GOES FROM JOINT 9 TO JOINT 5
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.726D 00	-0.622D 00	0.254D-03	-0.288D 03	0.636D 01	-0.215D 04
42.79	0.00	-0.731D 00	-0.616D 00	0.358D-04	-0.292D 03	0.918D 01	-0.176D 04
85.57	0.00	-0.737D 00	-0.618D 00	-0.139D-03	-0.292D 03	0.896D 01	-0.137D 04
128.36	0.00	-0.742D 00	-0.627D 00	-0.270D-03	-0.292D 03	0.872D 01	-0.988D 03
171.15	0.00	-0.747D 00	-0.640D 00	-0.359D-03	-0.292D 03	0.847D 01	-0.616D 03
213.94	0.00	-0.752D 00	-0.657D 00	-0.408D-03	-0.292D 03	0.819D 01	-0.255D 03
256.72	0.00	-0.757D 00	-0.675D 00	-0.417D-03	-0.292D 03	0.789D 01	0.944D 02
299.51	0.00	-0.762D 00	-0.692D 00	-0.388D-03	-0.292D 03	0.758D 01	0.431D 03
342.30	0.00	-0.767D 00	-0.707D 00	-0.322D-03	-0.292D 03	0.726D 01	0.753D 03
385.09	0.00	-0.772D 00	-0.719D 00	-0.221D-03	-0.292D 03	0.693D 01	0.106D 04
427.87	0.00	-0.777D 00	-0.726D 00	-0.863D-04	-0.292D 03	0.642D 01	0.135D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF2 EFFECT OF WIND AND WAVE FORCES AT TIME = 0.88 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 12
GOES FROM JOINT 9 TO JOINT 7
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.574D 00	-0.764D 00	0.254D-03	0.262D 03	0.860D 01	-0.251D 04
42.79	0.00	0.579D 00	-0.759D 00	0.174D-05	0.266D 03	0.116D 02	-0.201D 04
85.57	0.00	0.584D 00	-0.763D 00	-0.195D-03	0.266D 03	0.114D 02	-0.152D 04
128.36	0.00	0.588D 00	-0.775D 00	-0.337D-03	0.266D 03	0.111D 02	-0.104D 04
171.15	0.00	0.593D 00	-0.791D 00	-0.427D-03	0.266D 03	0.108D 02	-0.573D 03
213.94	0.00	0.598D 00	-0.811D 00	-0.466D-03	0.266D 03	0.104D 02	-0.124D 03
256.72	0.00	0.602D 00	-0.831D 00	-0.456D-03	0.266D 03	0.100D 02	0.309D 03
299.51	0.00	0.607D 00	-0.849D 00	-0.398D-03	0.266D 03	0.957D 01	0.724D 03
342.30	0.00	0.612D 00	-0.864D 00	-0.295D-03	0.266D 03	0.907D 01	0.112D 04
385.09	0.00	0.616D 00	-0.874D 00	-0.150D-03	0.266D 03	0.851D 01	0.149D 04
427.87	0.00	0.621D 00	-0.876D 00	0.366D-04	0.266D 03	0.761D 01	0.184D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF2 EFFECT OF WIND AND WAVE FORCES AT TIME = 0.88 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 13
GOES FROM JOINT 6 TO JOINT 9
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.927D 00	-0.657D-01	-0.165D-02	0.162D 03	-0.329D 02	0.675D 04
32.40	0.00	0.929D 00	-0.110D 00	-0.112D-02	0.166D 03	-0.311D 02	0.572D 04
64.80	0.00	0.931D 00	-0.139D 00	-0.679D-03	0.169D 03	-0.298D 02	0.472D 04
97.20	0.00	0.933D 00	-0.155D 00	-0.320D-03	0.172D 03	-0.283D 02	0.378D 04
129.60	0.00	0.936D 00	-0.161D 00	-0.385D-04	0.175D 03	-0.268D 02	0.289D 04
162.00	0.00	0.938D 00	-0.158D 00	0.170D-03	0.178D 03	-0.253D 02	0.204D 04
194.40	0.00	0.940D 00	-0.151D 00	0.309D-03	0.180D 03	-0.238D 02	0.125D 04
226.80	0.00	0.943D 00	-0.139D 00	0.383D-03	0.183D 03	-0.224D 02	0.503D 03
259.20	0.00	0.945D 00	-0.126D 00	0.396D-03	0.186D 03	-0.209D 02	-0.196D 03
291.60	0.00	0.948D 00	-0.114D 00	0.351D-03	0.189D 03	-0.196D 02	-0.849D 03
324.00	0.00	0.950D 00	-0.104D 00	0.254D-03	0.193D 03	-0.176D 02	-0.146D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF2 EFFECT OF WIND AND WAVE FORCES AT TIME = 0.88 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 14
GOES FROM JOINT 9 TO JOINT 10
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.950D 00	-0.104D 00	0.254D-03	-0.184D 03	-0.378D 02	0.322D 04
32.40	0.00	0.948D 00	-0.921D-01	0.476D-03	-0.180D 03	-0.359D 02	0.203D 04
64.80	0.00	0.946D 00	-0.745D-01	0.599D-03	-0.177D 03	-0.347D 02	0.886D 03
97.20	0.00	0.943D 00	-0.544D-01	0.627D-03	-0.174D 03	-0.336D 02	-0.223D 03
129.60	0.00	0.941D 00	-0.349D-01	0.562D-03	-0.172D 03	-0.326D 02	-0.130D 04
162.00	0.00	0.939D 00	-0.189D-01	0.409D-03	-0.169D 03	-0.318D 02	-0.234D 04
194.40	0.00	0.936D 00	-0.932D-02	0.168D-03	-0.166D 03	-0.311D 02	-0.336D 04
226.80	0.00	0.934D 00	-0.894D-02	-0.158D-03	-0.163D 03	-0.305D 02	-0.436D 04
259.20	0.00	0.932D 00	-0.205D-01	-0.568D-03	-0.160D 03	-0.299D 02	-0.534D 04
291.60	0.00	0.930D 00	-0.466D-01	-0.106D-02	-0.157D 03	-0.290D 02	-0.629D 04
324.00	0.00	0.928D 00	-0.899D-01	-0.163D-02	-0.153D 03	-0.273D 02	-0.721D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF2   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.88 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER   15
GOES FROM JOINT   8 TO JOINT   5
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.268D-01	-0.929D 00	-0.165D-02	0.116D 03	-0.332D 02	0.814D 04
15.68	0.00	0.272D-01	-0.953D 00	-0.144D-02	0.116D 03	-0.320D 02	0.764D 04
31.36	0.00	0.277D-01	-0.974D 00	-0.126D-02	0.116D 03	-0.320D 02	0.714D 04
47.03	0.00	0.281D-01	-0.992D 00	-0.108D-02	0.116D 03	-0.321D 02	0.663D 04
62.71	0.00	0.286D-01	-0.101D 01	-0.916D-03	0.116D 03	-0.321D 02	0.613D 04
78.39	0.00	0.290D-01	-0.102D 01	-0.766D-03	0.116D 03	-0.322D 02	0.562D 04
94.07	0.00	0.295D-01	-0.103D 01	-0.628D-03	0.116D 03	-0.323D 02	0.511D 04
109.74	0.00	0.299D-01	-0.104D 01	-0.504D-03	0.116D 03	-0.324D 02	0.461D 04
125.42	0.00	0.304D-01	-0.105D 01	-0.393D-03	0.116D 03	-0.324D 02	0.410D 04
141.10	0.00	0.308D-01	-0.105D 01	-0.294D-03	0.116D 03	-0.325D 02	0.359D 04
156.78	0.00	0.313D-01	-0.106D 01	-0.209D-03	0.116D 03	-0.327D 02	0.308D 04
172.46	0.00	0.317D-01	-0.106D 01	-0.137D-03	0.116D 03	-0.328D 02	0.256D 04
188.13	0.00	0.322D-01	-0.106D 01	-0.779D-04	0.116D 03	-0.329D 02	0.205D 04
203.81	0.00	0.326D-01	-0.106D 01	-0.321D-04	0.116D 03	-0.330D 02	0.153D 04
219.49	0.00	0.331D-01	-0.106D 01	0.443D-06	0.116D 03	-0.332D 02	0.101D 04
235.17	0.00	0.336D-01	-0.106D 01	0.197D-04	0.116D 03	-0.333D 02	0.490D 03
250.84	0.00	0.340D-01	-0.106D 01	0.255D-04	0.116D 03	-0.335D 02	-0.335D 02
266.52	0.00	0.345D-01	-0.106D 01	0.179D-04	0.116D 03	-0.337D 02	-0.560D 03
282.20	0.00	0.349D-01	-0.106D 01	-0.321D-05	0.116D 03	-0.339D 02	-0.109D 04
297.88	0.00	0.354D-01	-0.106D 01	-0.379D-04	0.116D 03	-0.341D 02	-0.162D 04
313.56	0.00	0.358D-01	-0.106D 01	-0.863D-04	0.116D 03	-0.345D 02	-0.216D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF2   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.88 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER   16
GOES FROM JOINT   10 TO JOINT   7
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.182D 00	-0.914D 00	-0.163D-02	-0.899D 03	-0.285D 02	0.759D 04
15.68	0.00	-0.185D 00	-0.938D 00	-0.144D-02	-0.900D 03	-0.273D 02	0.719D 04
31.36	0.00	-0.189D 00	-0.960D 00	-0.126D-02	-0.900D 03	-0.275D 02	0.678D 04
47.03	0.00	-0.192D 00	-0.978D 00	-0.109D-02	-0.900D 03	-0.276D 02	0.636D 04
62.71	0.00	-0.196D 00	-0.994D 00	-0.936D-03	-0.900D 03	-0.277D 02	0.594D 04
78.39	0.00	-0.199D 00	-0.101D 01	-0.789D-03	-0.900D 03	-0.279D 02	0.552D 04
94.07	0.00	-0.203D 00	-0.102D 01	-0.653D-03	-0.900D 03	-0.280D 02	0.509D 04
109.74	0.00	-0.206D 00	-0.103D 01	-0.529D-03	-0.900D 03	-0.282D 02	0.466D 04
125.42	0.00	-0.210D 00	-0.104D 01	-0.415D-03	-0.900D 03	-0.284D 02	0.422D 04
141.10	0.00	-0.213D 00	-0.104D 01	-0.313D-03	-0.900D 03	-0.286D 02	0.378D 04
156.78	0.00	-0.217D 00	-0.105D 01	-0.222D-03	-0.900D 03	-0.288D 02	0.333D 04
172.46	0.00	-0.221D 00	-0.105D 01	-0.142D-03	-0.900D 03	-0.290D 02	0.288D 04
188.13	0.00	-0.224D 00	-0.105D 01	-0.746D-04	-0.900D 03	-0.293D 02	0.243D 04
203.81	0.00	-0.228D 00	-0.105D 01	-0.184D-04	-0.900D 03	-0.295D 02	0.197D 04
219.49	0.00	-0.231D 00	-0.105D 01	0.260D-04	-0.900D 03	-0.298D 02	0.150D 04
235.17	0.00	-0.235D 00	-0.105D 01	0.584D-04	-0.900D 03	-0.301D 02	0.103D 04
250.84	0.00	-0.238D 00	-0.105D 01	0.787D-04	-0.900D 03	-0.304D 02	0.557D 03
266.52	0.00	-0.242D 00	-0.105D 01	0.869D-04	-0.900D 03	-0.307D 02	0.776D 02
282.20	0.00	-0.245D 00	-0.105D 01	0.826D-04	-0.900D 03	-0.311D 02	-0.408D 03
297.88	0.00	-0.249D 00	-0.104D 01	0.659D-04	-0.900D 03	-0.314D 02	-0.898D 03
313.56	0.00	-0.252D 00	-0.104D 01	0.366D-04	-0.900D 03	-0.320D 02	-0.139D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF2 EFFECT OF WIND AND WAVE FORCES AT TIME = 0.88 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 17
GOES FROM JOINT 11 TO JOINT 8
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.144D-01	-0.390D-01	-0.105D-02	0.116D 03	-0.317D 02	-0.710D 04
18.00	0.00	0.149D-01	-0.597D-01	-0.126D-02	0.123D 03	-0.193D 02	-0.753D 04
36.01	0.00	0.154D-01	-0.844D-01	-0.149D-02	0.128D 03	-0.102D 02	-0.780D 04
54.01	0.00	0.160D-01	-0.113D 00	-0.172D-02	0.132D 03	-0.636D 00	-0.790D 04
72.02	0.00	0.166D-01	-0.146D 00	-0.195D-02	0.137D 03	0.922D 01	-0.783D 04
90.02	0.00	0.171D-01	-0.183D 00	-0.218D-02	0.142D 03	0.192D 02	-0.758D 04
108.03	0.00	0.177D-01	-0.225D 00	-0.239D-02	0.147D 03	0.293D 02	-0.715D 04
126.03	0.00	0.184D-01	-0.269D 00	-0.259D-02	0.150D 03	0.393D 02	-0.654D 04
144.04	0.00	0.190D-01	-0.318D 00	-0.277D-02	0.152D 03	0.492D 02	-0.575D 04
162.04	0.00	0.196D-01	-0.369D 00	-0.293D-02	0.155D 03	0.589D 02	-0.478D 04
180.05	0.00	0.202D-01	-0.423D 00	-0.305D-02	0.157D 03	0.682D 02	-0.364D 04
198.05	0.00	0.208D-01	-0.479D 00	-0.314D-02	0.159D 03	0.772D 02	-0.234D 04
216.06	0.00	0.215D-01	-0.536D 00	-0.319D-02	0.161D 03	0.858D 02	-0.880D 03
234.06	0.00	0.221D-01	-0.593D 00	-0.319D-02	0.163D 03	0.938D 02	0.732D 03
252.07	0.00	0.227D-01	-0.650D 00	-0.314D-02	0.164D 03	0.101D 03	0.248D 04
270.07	0.00	0.234D-01	-0.706D 00	-0.304D-02	0.165D 03	0.107D 03	0.434D 04
288.08	0.00	0.240D-01	-0.760D 00	-0.288D-02	0.165D 03	0.112D 03	0.631D 04
306.08	0.00	0.247D-01	-0.810D 00	-0.267D-02	0.165D 03	0.117D 03	0.837D 04
324.09	0.00	0.254D-01	-0.855D 00	-0.239D-02	0.165D 03	0.120D 03	0.105D 05
342.09	0.00	0.261D-01	-0.895D 00	-0.205D-02	0.165D 03	0.123D 03	0.127D 05
360.10	0.00	0.268D-01	-0.929D 00	-0.165D-02	0.166D 03	0.125D 03	0.149D 05

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF2 EFFECT OF WIND AND WAVE FORCES AT TIME = 0.88 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 18
GOES FROM JOINT 12 TO JOINT 10
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.102D 00	-0.355D-01	-0.101D-02	-0.739D 03	-0.334D 02	-0.704D 04
13.00	0.00	-0.106D 00	-0.556D-01	-0.123D-02	-0.766D 03	-0.213D 02	-0.749D 04
36.01	0.00	-0.109D 00	-0.797D-01	-0.145D-02	-0.783D 03	-0.124D 02	-0.778D 04
54.01	0.00	-0.113D 00	-0.108D 00	-0.168D-02	-0.800D 03	-0.300D 01	-0.789D 04
72.02	0.00	-0.116D 00	-0.140D 00	-0.191D-02	-0.817D 03	0.671D 01	-0.784D 04
90.02	0.00	-0.120D 00	-0.177D 00	-0.214D-02	-0.833D 03	0.166D 02	-0.760D 04
108.03	0.00	-0.124D 00	-0.217D 00	-0.236D-02	-0.849D 03	0.265D 02	-0.717D 04
126.03	0.00	-0.128D 00	-0.262D 00	-0.256D-02	-0.861D 03	0.365D 02	-0.657D 04
144.04	0.00	-0.132D 00	-0.309D 00	-0.274D-02	-0.871D 03	0.462D 02	-0.578D 04
162.04	0.00	-0.136D 00	-0.360D 00	-0.290D-02	-0.880D 03	0.558D 02	-0.482D 04
180.05	0.00	-0.140D 00	-0.413D 00	-0.302D-02	-0.890D 03	0.651D 02	-0.368D 04
198.05	0.00	-0.144D 00	-0.469D 00	-0.311D-02	-0.899D 03	0.741D 02	-0.238D 04
216.06	0.00	-0.148D 00	-0.525D 00	-0.316D-02	-0.907D 03	0.826D 02	-0.914D 03
234.06	0.00	-0.152D 00	-0.582D 00	-0.316D-02	-0.916D 03	0.905D 02	0.699D 03
252.07	0.00	-0.156D 00	-0.639D 00	-0.311D-02	-0.922D 03	0.975D 02	0.245D 04
270.07	0.00	-0.161D 00	-0.694D 00	-0.302D-02	-0.926D 03	0.104D 03	0.431D 04
288.08	0.00	-0.165D 00	-0.747D 00	-0.286D-02	-0.930D 03	0.109D 03	0.628D 04
306.08	0.00	-0.169D 00	-0.796D 00	-0.265D-02	-0.933D 03	0.113D 03	0.832D 04
324.09	0.00	-0.173D 00	-0.842D 00	-0.237D-02	-0.936D 03	0.117D 03	0.104D 05
342.09	0.00	-0.178D 00	-0.881D 00	-0.203D-02	-0.938D 03	0.119D 03	0.126D 05
360.10	0.00	-0.182D 00	-0.914D 00	-0.163D-02	-0.941D 03	0.122D 03	0.148D 05

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF2   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.88 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 19
GOES FROM JOINT 13 TO JOINT 11
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.0C	0.00	0.515D-02	-0.829D-03	-0.188D-05	0.387D 02	0.102D 01	0.389D 02
21.00	0.00	0.541D-02	-0.848D-03	0.284D-06	0.421D 02	0.131D 01	0.644D 02
41.99	0.00	0.569D-02	-0.809D-03	0.360D-05	0.445D 02	0.150D 01	0.939D 02
62.99	0.00	0.599D-02	-0.687D-03	0.824D-05	0.470D 02	0.167D 01	0.127D 03
83.98	0.00	0.630D-02	-0.453D-03	0.143D-04	0.496D 02	0.180D 01	0.164D 03
104.98	0.00	0.663D-02	-0.738D-04	0.220D-04	0.523D 02	0.186D 01	0.203D 03
125.97	0.00	0.698D-02	0.484D-03	0.314D-04	0.552D 02	0.181D 01	0.242D 03
146.97	0.00	0.735D-02	0.125D-02	0.423D-04	0.583D 02	0.162D 01	0.279D 03
167.96	0.00	0.774D-02	0.227D-02	0.546D-04	0.614D 02	0.122D 01	0.310D 03
188.96	0.00	0.815D-C2	0.356D-02	0.681D-04	0.648D 02	-0.171D 01	0.330D 03
209.95	0.00	0.858D-02	0.512D-02	0.800D-04	0.683D 02	-0.729D 01	0.239D 03
230.95	0.00	0.903D-02	0.687D-02	0.855D-04	0.719D 02	-0.133D 02	0.248D 02
251.94	0.00	0.951D-02	0.863D-02	0.793D-04	0.758D 02	-0.197D 02	-0.320D 03
272.94	0.00	0.100D-01	0.101D-01	0.558D-04	0.799D 02	-0.264D 02	-0.803D 03
293.93	0.00	0.105D-01	0.108D-01	0.897D-05	0.841D 02	-0.333D 02	-0.143D 04
314.93	0.00	0.111D-01	0.103D-01	-0.671D-04	0.886D 02	-0.401D 02	-0.220D 04
335.92	0.00	0.117D-01	0.774D-02	-0.179D-03	0.932D 02	-0.465D 02	-0.311D 04
356.92	0.00	0.123D-01	0.247D-02	-0.331D-03	0.981D 02	-0.498D 02	-0.416D 04
377.91	0.00	0.130D-01	-0.647D-02	-0.527D-03	0.103D 03	-0.494D 02	-0.521D 04
398.91	0.00	0.136D-01	-0.200D-01	-0.767D-03	0.108D 03	-0.449D 02	-0.623D 04
419.90	0.00	0.144D-01	-0.390D-01	-0.1C5D-02	0.116D 03	-0.318D 02	-0.710D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF2   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.88 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 20
GOES FROM JOINT 14 TO JOINT 12
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.378D-01	-0.907D-03	-0.3C4D-05	-0.285D 03	0.126D 00	0.149D 03
21.00	0.00	-0.397D-01	-0.904D-03	0.336D-05	-0.310D 03	0.439D 00	0.156D 03
41.99	0.00	-0.418D-01	-0.763D-03	0.1C1D-04	-0.328D 03	0.630D 00	0.168D 03
62.99	0.00	-0.440D-01	-0.474D-03	0.175D-04	-0.347D 03	0.771D 00	0.182D 03
83.98	0.00	-0.463D-01	-0.245D-04	0.255D-04	-0.366D 03	0.828D 00	0.200D 03
104.98	0.00	-0.487D-01	0.601D-03	0.342D-04	-0.386D 03	0.763D 00	0.217D 03
125.97	0.00	-0.513D-01	0.142D-02	0.436D-04	-0.406D 03	0.535D 00	0.231D 03
146.97	0.C0	-0.540D-01	0.243D-02	0.534D-04	-0.428D 03	0.101D 00	0.239D 03
167.96	0.00	-0.569D-01	0.366D-02	0.634D-04	-0.449D 03	-0.583D 00	0.234D 03
188.96	0.00	-0.598D-01	0.5C9D-02	0.727D-04	-0.471D 03	-0.156D 01	0.213D 03
209.95	0.00	-0.630D-01	0.671D-02	0.8C7D-04	-0.493D 03	-0.515D 01	0.167D 03
230.95	0.00	-0.662D-01	0.845D-02	0.841D-04	-0.516D 03	-0.114D 02	-0.508D 01
251.94	0.00	-0.696D-C1	0.102D-01	0.774D-04	-0.538D 03	-0.180D 02	-0.313D 03
272.94	0.00	-0.732D-01	0.116D-01	0.549D-04	-0.561D 03	-0.249D 02	-0.763D 03
293.93	0.00	-0.769D-01	0.123D-01	0.104D-04	-0.584D 03	-0.320D 02	-0.136D 04
314.93	0.00	-0.808D-01	0.118D-01	-0.622D-04	-0.607D 03	-0.390D 02	-0.211D 04
335.92	0.00	-0.848D-01	0.946D-02	-0.169D-03	-0.630D 03	-0.458D 02	-0.300D 04
356.92	0.00	-0.889D-01	0.444D-02	-0.316D-03	-0.653D 03	-0.495D 02	-0.402D 04
377.91	0.00	-0.932D-01	-0.412D-02	-0.507D-03	-0.675D 03	-0.495D 02	-0.507D 04
398.91	0.00	-0.977D-01	-0.171D-01	-0.741D-03	-0.697D 03	-0.455D 02	-0.609D 04
419.90	0.00	-0.102D 00	-0.355D-01	-0.101D-02	-0.728D 03	-0.328D 02	-0.695D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF2   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.88 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 21
GOES FROM JOINT 15 TO JOINT 13
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE X	Y	DISPLACEMENTS AXIAL	LATERAL	ROTATIONAL	FORCES AXIAL	SHEAR	MOMENT
0.00	0.00	0.832D-03	-0.720D-06	0.272D-07	0.623D 01	0.288D-02	0.245D 00
30.00	0.00	0.916D-03	0.419D-06	0.500D-07	0.710D 01	0.306D-02	0.339D 00
60.00	0.00	0.101D-02	0.235D-05	0.800D-07	0.775D 01	0.257D-02	0.428D 00
90.00	0.00	0.111D-02	0.528D-05	0.116D-06	0.845D 01	0.121D-02	0.493D 00
120.00	0.00	0.121D-02	0.934D-05	0.155D-06	0.922D 01	-0.138D-02	0.501D 00
150.00	0.00	0.133D-02	0.145D-04	0.190D-06	0.101D 02	-0.559D-02	0.410D 00
180.00	0.00	0.146D-02	0.206D-04	0.213D-06	0.110D 02	-0.118D-01	0.166D 00
210.00	0.00	0.160D-02	0.270D-04	0.208D-06	0.120D 02	-0.201D-01	-0.296D 00
240.00	0.00	0.175D-02	0.326D-04	0.156D-06	0.131D 02	-0.305D-01	-0.104D 01
270.00	0.00	0.192D-02	0.357D-04	0.319D-07	0.143D 02	-0.423D-01	-0.213D 01
300.00	0.00	0.211D-02	0.336D-04	-0.191D-06	0.156D 02	-0.543D-01	-0.358D 01
330.00	0.00	0.230D-02	0.229D-04	-0.542D-06	0.170D 02	-0.640D-01	-0.538D 01
360.00	0.00	0.252D-02	-0.435D-06	-0.104D-05	0.186D 02	-0.679D-01	-0.742D 01
390.00	0.00	0.276D-02	-0.412D-04	-0.170D-05	0.203D 02	-0.608D-01	-0.945D 01
420.00	0.00	0.302D-02	-0.104D-03	-0.250D-05	0.221D 02	-0.362D-01	-0.111D 02
450.00	0.00	0.330D-02	-0.192D-03	-0.339D-05	0.241D 02	0.137D-01	-0.116D 02
480.00	0.00	0.361D-02	-0.307D-03	-0.425D-05	0.263D 02	0.976D-01	-0.102D 02
510.00	0.00	0.395D-02	-0.445D-03	-0.487D-05	0.286D 02	0.223D 00	-0.578D 01
540.00	0.00	0.431D-02	-0.594D-03	-0.498D-05	0.312D 02	0.396D 00	0.314D 01
570.00	0.00	0.471D-02	-0.734D-03	-0.415D-05	0.340D 02	0.616D 00	0.180D 02
600.00	0.00	0.515D-02	-0.829D-03	-0.188D-05	0.387D 02	0.101D 01	0.401D 02

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF2   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.88 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 22
GOES FROM JOINT 16 TO JOINT 14
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE X	Y	DISPLACEMENTS AXIAL	LATERAL	ROTATIONAL	FORCES AXIAL	SHEAR	MOMENT
0.00	0.00	-0.611D-02	-0.103D-05	0.244D-07	-0.458D 02	0.313D-02	0.245D 00
30.00	0.00	-0.672D-02	0.341D-07	0.477D-07	-0.521D 02	0.350D-02	0.350D 00
60.00	0.00	-0.739D-02	0.192D-05	0.792D-07	-0.569D 02	0.315D-02	0.455D 00
90.00	0.00	-0.812D-02	0.486D-05	0.118D-06	-0.621D 02	0.194D-02	0.539D 00
120.00	0.00	-0.891D-02	0.904D-05	0.161D-06	-0.677D 02	-0.520D-03	0.571D 00
150.00	0.00	-0.978D-02	0.145D-04	0.204D-06	-0.739D 02	-0.468D-02	0.507D 00
180.00	0.00	-0.107D-01	0.212D-04	0.235D-06	-0.807D 02	-0.109D-01	0.290D 00
210.00	0.00	-0.118D-01	0.284D-04	0.240D-06	-0.880D 02	-0.193D-01	-0.151D 00
240.00	0.00	-0.129D-01	0.351D-04	0.200D-06	-0.961D 02	-0.306D-01	-0.888D 00
270.00	0.00	-0.141D-01	0.396D-04	0.871D-07	-0.105D 03	-0.436D-01	-0.199D 01
300.00	0.00	-0.155D-01	0.393D-04	-0.128D-06	-0.114D 03	-0.572D-01	-0.350D 01
330.00	0.00	-0.169D-01	0.306D-04	-0.477D-06	-0.125D 03	-0.692D-01	-0.542D 01
360.00	0.00	-0.185D-01	0.909D-05	-0.988D-06	-0.136D 03	-0.760D-01	-0.765D 01
390.00	0.00	-0.203D-01	-0.304D-04	-0.168D-05	-0.149D 03	-0.724D-01	-0.997D 01
420.00	0.00	-0.222D-01	-0.937D-04	-0.254D-05	-0.162D 03	-0.515D-01	-0.120D 02
450.00	0.00	-0.242D-01	-0.184D-03	-0.351D-05	-0.177D 03	-0.475D-02	-0.130D 02
480.00	0.00	-0.265D-01	-0.304D-03	-0.450D-05	-0.193D 03	0.772D-01	-0.122D 02
510.00	0.00	-0.290D-01	-0.452D-03	-0.531D-05	-0.210D 03	0.204D 00	-0.836D 01
540.00	0.00	-0.317D-01	-0.618D-03	-0.563D-05	-0.229D 03	0.381D 00	0.473D-01
570.00	0.00	-0.346D-01	-0.781D-03	-0.506D-05	-0.250D 03	0.613D 00	0.146D 02
600.00	0.00	-0.378D-01	-0.907D-03	-0.304D-05	-0.284D 03	0.104D 01	0.369D 02

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF2   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.88 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER   23
GOES FROM JOINT   17 TO JOINT   15
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.244D-03	-0.960D-08	0.398D-09	-0.145D-07	0.229D-09	-0.220D-07
30.00	0.00	0.246D-03	0.238D-08	0.402D-09	0.259D 00	0.317D-05	0.108D-03
60.00	0.00	0.250D-03	0.146D-07	0.414D-09	0.435D 00	-0.301D-07	0.190D-03
90.00	0.00	0.257D-03	0.272D-07	0.426D-09	0.614D 00	-0.791D-05	0.107D-03
120.00	0.00	0.265D-03	0.400D-07	0.419D-09	0.799D 00	-0.206D-04	-0.284D-03
150.00	0.00	0.276D-03	0.518D-07	0.363D-09	0.990D 00	-0.378D-04	-0.113D-02
180.00	0.00	0.290D-03	0.609D-07	0.219D-09	0.119D 01	-0.591D-04	-0.255D-02
210.00	0.00	0.305D-03	0.636D-07	-0.630D-10	0.140D 01	-0.824D-04	-0.467D-02
240.00	0.00	0.324D-03	0.552D-07	-0.539D-09	0.162D 01	-0.105D-03	-0.750D-02
270.00	0.00	0.345D-03	0.283D-07	-0.126D-08	0.186D 01	-0.120D-03	-0.110D-01
300.00	0.00	0.369D-03	-0.233D-07	-0.226D-08	0.210D 01	-0.121D-03	-0.147D-01
330.00	0.00	0.397D-03	-0.110D-06	-0.355D-08	0.237D 01	-0.968D-04	-0.182D-01
360.00	0.00	0.428D-03	-0.239D-06	-0.507D-08	0.266D 01	-0.324D-04	-0.205D-01
390.00	0.00	0.462D-03	-0.415D-06	-0.666D-08	0.296D 01	0.879D-04	-0.202D-01
420.00	0.00	0.500D-03	-0.636D-06	-0.805D-08	0.330D 01	0.281D-03	-0.153D-01
450.00	0.00	0.543D-03	-0.891D-06	-0.877D-08	0.365D 01	0.560D-03	-0.334D-02
480.00	0.00	0.590D-03	-0.115D-05	-0.819D-08	0.404D 01	0.932D-03	0.183D-01
510.00	0.00	0.642D-03	-0.136D-05	-0.541D-08	0.446D 01	0.139D-02	0.526D-01
540.00	0.00	0.699D-03	-0.144D-05	0.616D-09	0.492D 01	0.190D-02	0.102D 00
570.00	0.00	0.763D-03	-0.128D-05	0.111D-07	0.541D 01	0.239D-02	0.166D 00
600.00	0.00	0.832D-03	-0.720D-06	0.272D-07	0.623D 01	0.288D-02	0.245D 00

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF2   EFFECT OF WIND AND WAVE FORCES AT TIME = 0.88 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER   24
GOES FROM JOINT   18 TO JOINT   16
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.179D-02	-0.118D-07	0.415D-09	-0.874D-06	-0.905D-09	0.895D-07
30.00	0.00	-0.181D-02	0.684D-09	0.420D-09	-0.190D 01	0.432D-05	0.133D-03
60.00	0.00	-0.184D-02	0.135D-07	0.435D-09	-0.319D 01	0.165D-05	0.259D-03
90.00	0.00	-0.188D-02	0.263D-07	0.454D-09	-0.451D 01	-0.594D-05	0.232D-03
120.00	0.00	-0.195D-02	0.406D-07	0.460D-09	-0.586D 01	-0.186D-04	-0.976D-04
150.00	0.00	-0.203D-02	0.540D-07	0.421D-09	-0.727D 01	-0.365D-04	-0.887D-03
180.00	0.00	-0.213D-02	0.650D-07	0.297D-09	-0.874D 01	-0.589D-04	-0.229D-02
210.00	0.00	-0.224D-02	0.704D-07	0.351D-10	-0.103D 02	-0.843D-04	-0.442D-02
240.00	0.00	-0.238D-02	0.652D-07	-0.425D-09	-0.119D 02	-0.110D-03	-0.734D-02
270.00	0.00	-0.253D-02	0.424D-07	-0.114D-08	-0.136D 02	-0.130D-03	-0.110D-01
300.00	0.00	-0.271D-02	-0.640D-08	-0.216D-08	-0.155D 02	-0.136D-03	-0.151D-01
330.00	0.00	-0.291D-02	-0.906D-07	-0.350D-08	-0.174D 02	-0.118D-03	-0.192D-01
360.00	0.00	-0.314D-02	-0.219D-06	-0.512D-08	-0.195D 02	-0.612D-04	-0.222D-01
390.00	0.00	-0.339D-02	-0.400D-06	-0.689D-08	-0.218D 02	0.528D-04	-0.229D-01
420.00	0.00	-0.367D-02	-0.631D-06	-0.853D-08	-0.242D 02	0.242D-03	-0.191D-01
450.00	0.00	-0.399D-02	-0.905D-06	-0.960D-08	-0.268D 02	0.523D-03	-0.333D-02
480.00	0.00	-0.433D-02	-0.120D-05	-0.944D-08	-0.297D 02	0.906D-03	0.123D-01
510.00	0.00	-0.471D-02	-0.145D-05	-0.716D-08	-0.328D 02	0.139D-02	0.460D-01
540.00	0.00	-0.514D-02	-0.159D-05	-0.163D-08	-0.361D 02	0.194D-02	0.955D-01
570.00	0.00	-0.560D-02	-0.150D-05	0.845D-08	-0.398D 02	0.250D-02	0.162D 00
600.00	0.00	-0.611D-02	-0.103D-05	0.244D-07	-0.456D 02	0.314D-02	0.245D 00

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF3   EFFECT OF WIND AND WAVE FORCES AT TIME = 1.76 SEC

TABLE 1 – PROGRAM CONTROL DATA
PROBLEM TYPE 1

TABLE NUMBER	2	3A	3B	3C	4A	4B	4C	5A	5B	6	7
PRIOR-DATA OPTIONS (1=YES,0=NO)	0	0	0	0	0	0	0	0	0	0	0
NUMBER OF CARDS ADDED FOR THIS PROBLEM	18	24	6	2	0	0	4	0	6	8	3

TABLE 2 – JOINT COORDINATES

JOINT NUMBER	X-COORD	Y-COORD
1	0.895D 02	0.895D 03
2	0.559D 03	0.895D 03
3	0.603D 02	0.603D 03
4	0.588D 03	0.603D 03
5	0.312D 02	0.312D 03
6	0.324D 03	0.312D 03
7	0.617D 03	0.312D 03
8	0.000D 00	0.000D 00
9	0.324D 03	0.000D 00
10	0.648D 03	0.000D 00
11	-0.358D 02	-0.358D 03
12	0.684D 03	-0.358D 03
13	-0.776D 02	-0.776D 03
14	0.726D 03	-0.776D 03
15	-0.137D 03	-0.137D 04
16	0.785D 03	-0.137D 04
17	-0.197D 03	-0.197D 04
18	0.845D 03	-0.197D 04

TABLE 3A – MEMBER PROPERTIES

MEMBER NUMBER	ELEM PER NUMBER	NON LIN	FROM JOINT NO.	FROM JOINT AREA	FROM JOINT PIN	TO JOINT NO.	TO JOINT AREA	TO JOINT PIN
1	10	1	1	1	0	2	1	0
2	10	1	3	1	0	4	1	0
3	10	1	3	1	0	1	1	0
4	10	1	4	1	0	2	1	0
5	10	1	5	1	0	3	1	0
6	10	1	7	1	0	4	1	0
7	10	1	5	1	0	6	1	0
8	10	1	6	1	0	7	1	0
9	10	1	6	1	0	3	1	0
10	10	1	6	1	0	4	1	0
11	10	1	9	1	0	5	1	0
12	10	1	9	1	0	7	1	0
13	10	1	8	1	0	9	1	0
14	10	1	9	1	0	10	1	0
15	20	1	8	3	0	5	3	0
16	20	1	10	3	0	7	3	0
17	20	1	11	3	0	8	3	0
18	20	1	12	3	0	10	3	0
19	20	1	13	2	0	11	2	0
20	20	1	14	2	0	12	2	0
21	20	1	15	1	0	13	1	0
22	20	1	16	1	0	14	1	0
23	20	1	17	1	0	15	1	0
24	20	1	18	1	0	16	1	0

MEMBER NUMBER	MODULUS OF ELASTICITY	FROM JOINT EI	FROM JOINT AE	TO JOINT EI	TO JOINT AE

MEMBER NUMBER	LENGTH	COSINE-X	COSINE-Y	MEMBER TYPE	CENTER-X COORDINATE	CENTER-Y COORDINATE
1	0.469D 03	0.100D 01	0.000D 00	STRAIGHT		
2	0.527D 03	0.100D 01	0.000D 00	STRAIGHT		
3	0.293D 03	0.995D-01	0.995D 00	STRAIGHT		
4	0.293D 03	-0.995D-01	0.995D 00	STRAIGHT		
5	0.293D 03	0.995D-01	0.995D 00	STRAIGHT		
6	0.293D 03	-0.995D-01	0.995D 00	STRAIGHT		
7	0.293D 03	0.100D 01	0.000D 00	STRAIGHT		
8	0.293D 03	0.100D 01	0.000D 00	STRAIGHT		
9	0.393D 03	-0.671D 00	0.741D 00	STRAIGHT		
10	0.393D 03	0.671D 00	0.741D 00	STRAIGHT		
11	0.428D 03	-0.684D 00	0.729D 00	STRAIGHT		
12	0.428D 03	0.684D 00	0.729D 00	STRAIGHT		
13	0.324D 03	0.100D 01	0.000D 00	STRAIGHT		
14	0.324D 03	0.100D 01	0.000D 00	STRAIGHT		
15	0.314D 03	0.995D-01	0.995D 00	STRAIGHT		
16	0.314D 03	-0.995D-01	0.995D 00	STRAIGHT		
17	0.360D 03	0.995D-01	0.995D 00	STRAIGHT		
18	0.360D 03	-0.995D-01	0.995D 00	STRAIGHT		
19	0.420D 03	0.995D-01	0.995D 00	STRAIGHT		
20	0.420D 03	-0.995D-01	0.995D 00	STRAIGHT		
21	0.600D 03	0.995D-01	0.995D 00	STRAIGHT		
22	0.600D 03	-0.995D-01	0.995D 00	STRAIGHT		
23	0.600D 03	0.995D-01	0.995D 00	STRAIGHT		
24	0.600D 03	-0.995D-01	0.995D 00	STRAIGHT		

TABLE 3B - CROSS SECTION PROPERTIES

CROSS SECTION NUMBER = 1
NUMBER OF SEGMENT = 1

SEG NUM	SEG TYPE	CUR NUM	STRESS MULTIPLIER	STRAIN MULTIPLIER	WIDTH OR DIAMETER	DEPTH OR THICKNESS	CENTROIDAL DISTANCE	SEGMENTAL AREA
1	CIRC	1	0.100D 01	0.100D-02	0.360D 02	0.750D 00	0.000D 00	

CROSS SECTION NUMBER = 2
NUMBER OF SEGMENT = 1

SEG NUM	SEG TYPE	CUR NUM	STRESS MULTIPLIER	STRAIN MULTIPLIER	WIDTH OR DIAMETER	DEPTH OR THICKNESS	CENTROIDAL DISTANCE	SEGMENTAL AREA
1	CIRC	1	0.100D 01	0.100D-02	0.360D 02	0.100D 01	0.000D 00	

CROSS SECTION NUMBER = 3
NUMBER OF SEGMENT = 1

SEG NUM	SEG TYPE	CUR NUM	STRESS MULTIPLIER	STRAIN MULTIPLIER	WIDTH OR DIAMETER	DEPTH OR THICKNESS	CENTROIDAL DISTANCE	SEGMENTAL AREA
1	CIRC	1	0.100D 01	0.100D-02	0.360D 02	0.125D 01	0.000D 00	

TABLE 3C - STRESS-STRAIN CURVE

STRESS-STRAIN CURVE NUMBER = 1
NUMBER OF POINTS IN THIS CURVE = 3
CURVE SYMMETRY = YES

SIG 0.000 40.000 40.000

EPS 0.000 1.333 10.000

TABLE 4A - APPLIED MEMBER LOAD

NO DATA IN THE TABLE

TABLE 4B - SELFWEIGHT

WT PER UNIT VOL MEMBER NUMBER

NO DATA IN THE TABLE

TABLE 4C - WIND AND WAVE FORCES

MASS DENSITY OF AIR = 0.121D-09
BASIC WIND VELOCITY = 0.176D 04
WIND CONSTANT = 0.100D 00
MEAN SEA LEVEL = 0.636D 03

DENSITY OF FLUID = 0.964D-07
WAVE PERIOD = 0.700D 01
WAVE HEIGHT = 0.600D 03
TIME/PERIOD = 0.250D 00
TIME INCREMENT/PERIOD = 0.000D 00
NUMBER OF TIME INCREMENT= 0

WIND CD	WAVE CD	WAVE CM	MEMBER NUMBER
0.200D 01	0.100D 01	0.100D 01	3 4 5 6 9 10 11 12
0.200D 01	0.100D 01	0.100D 01	15 16

TABLE 5A - ELASTIC MEMBER RESTRAIN

NO DATA IN THE TABLE

TABLE 5B - SOIL DATA

PENETRATION DISTANCE FROM	TO	SOIL SHEAR STRENGTH	SOIL DENSITY
0.000D 00	0.000D 00	0.153D-02	0.260D-04
0.000D 00	-0.144D 03	0.542D-02	0.260D-04
0.000D 00	-0.432D 03	0.861D-02	0.260D-04
0.000D 00	-0.131D 04	0.986D-02	0.260D-04
0.000D 00	-0.180D 04	0.104D-01	0.260D-04
0.000D 00	-0.204D 04	0.104D-01	0.260D-04

TABLE 6 - JOINT LOADS AND LINEAR SUPPORTS

JOINT	FORCE(X)	FORCE(Y)	MOMENT(Z)	SPRING(X)	SPRING(Y)	SPRING(Z)
1	0.330D 02	-0.400D 03	0.000D 00	0.000D 00	0.000D 00	0.000D 00
2	0.102D 03	-0.400D 03	0.000D 00	0.000D 00	0.000D 00	0.000D 00
3	0.200D 01	0.000D 00	0.000D 00	0.000D 00	0.000D 00	0.000D 00
4	0.320D 02	0.000D 00	0.000D 00	0.000D 00	0.000D 00	0.000D 00
5	0.000D 00	0.000D 00	0.000D 00	0.000D 00	0.000D 00	0.000D 00

7	0.100D 02	0.000D 00	0.000D 00	0.000D 00	0.000D 00	0.000D 00
8	0.500D 01	0.000D 00	0.000D 00	0.000D 00	0.000D 00	0.000D 00
10	0.500D 01	0.000D 00	0.000D 00	0.000D 00	0.000D 00	0.000D 00

TABLE 7 - ITERATION CONTROL

NUMBER OF LOAD INCREMENT= 1

FRAME ITERATION

MAXIMUM NUMBER OF ITERATION = 20
FORCE ERROR = 0.100D 02
MOMENT ERROR = 0.100D 03

MEMBER ITERATION

MAXIMUM NUMBER OF ITERATION = 10
FORCE ERROR = 0.500D 00
MOMENT ERROR = 0.500D 01

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PRCB
WWF3 EFFECT OF WIND AND WAVE FORCES AT TIME = 1.76 SEC
TABLE 8 - JOINT DISPLACEMENTS AND REACTIONS

	DISPLACEMENTS			REACTIONS		
JOINT	DISP(X)	DISP(Y)	ROTATION(Z)	REACT(X)	REACT(Y)	REACT(Z)
1	0.154D 01	-0.231D 00	-0.217D-02	-0.000D 00	-0.000D 00	-0.000D 00
2	0.154D 01	-0.164D 00	-0.189D-02	-0.000D 00	-0.000D 00	-0.000D 00
3	0.581D 00	-0.923D-01	-0.137D-02	-0.000D 00	-0.000D 00	-0.000D 00
4	0.589D 00	-0.203D 00	-0.142D-02	-0.000D 00	-0.000D 00	-0.000D 00
5	0.461D 00	-0.584D-01	-0.158D-03	-0.000D 00	-0.000D 00	-0.000D 00
6	0.478D 00	-0.142D 00	0.127D-05	-0.000D 00	-0.000D 00	-0.000D 00
7	0.466D 00	-0.142D 00	-0.483D-04	-0.000D 00	-0.000D 00	-0.000D 00
8	0.364D 00	-0.434D-01	-0.854D-03	-0.000D 00	-0.000D 00	-0.000D 00
9	0.377D 00	-0.952D-01	0.493D-04	-0.000D 00	-0.000D 00	-0.000D 00
10	0.366D 00	-0.959D-01	-0.837D-03	-0.000D 00	-0.000D 00	-0.000D 00
11	-0.305D-02	-0.311D-02	-0.262D-03	-0.000D 00	-0.000D 00	-0.000D 00
12	0.341D-02	-0.708D-01	-0.243D-03	-0.000D 00	-0.000D 00	-0.000D 00
13	0.313D-03	-0.126D-02	0.345D-05	-0.000D 00	-0.000D 00	-0.000D 00
14	0.298D-02	-0.253D-01	0.296D-05	-0.000D 00	-0.000D 00	-0.000D 00
15	-0.215D-04	-0.208D-03	0.377D-07	-0.000D 00	-0.000D 00	-0.000D 00
16	0.409D-03	-0.410D-02	0.355D-07	-0.000D 00	-0.000D 00	-0.000D 00
17	-0.108D-04	-0.108D-03	0.309D-09	-0.000D 00	-0.000D 00	-0.000D 00
18	0.120D-03	-0.120D-02	0.303D-09	-0.000D 00	-0.000D 00	-0.000D 00

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PRCB
WWF3 EFFECT OF WIND AND WAVE FORCES AT TIME = 1.76 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 1
GOES FROM JOINT 1 TO JOINT 2
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.0C	0.00	0.154D 01	-0.231D 00	-0.217D-02	0.110D 02	-0.454D 02	0.109D 05
46.91	0.00	0.154D 01	-0.304D 00	-0.967D-03	0.110D 02	-0.454D 02	0.875D 04
93.81	0.00	0.154D 01	-0.326D 00	-0.273D-04	0.110D 02	-0.454D 02	0.662D 04
140.72	0.00	0.154D 01	-0.311D 00	0.652D-03	0.110D 02	-0.454D 02	0.449D 04
187.62	0.00	0.154D 01	-0.269D 00	0.107D-02	0.110D 02	-0.454D 02	0.236D 04
234.53	0.00	0.154D 01	-0.214D 00	0.123D-02	0.110D 02	-0.454D 02	0.229D 03
281.44	0.00	0.154D 01	-0.158D 00	0.113D-02	0.110D 02	-0.454D 02	-0.190D 04
328.34	0.00	0.154D 01	-0.113D 00	0.764D-03	0.110D 02	-0.454D 02	-0.403D 04
375.25	0.00	0.154D 01	-0.904D-01	0.140D-03	0.110D 02	-0.454D 02	-0.616D 04
422.16	0.00	0.154D 01	-0.104D 00	-0.743D-03	0.110D 02	-0.454D 02	-0.830D 04
469.06	0.00	0.154D 01	-0.164D 00	-0.189D-02	0.110D 02	-0.454D 02	-0.104D 05

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PRCB
WWF3 EFFECT OF WIND AND WAVE FORCES AT TIME = 1.76 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 2
GOES FROM JOINT 3 TO JOINT 4
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.581D 00	-0.923D-01	-0.137D-02	0.408D 02	-0.196D 02	0.514D 04
52.73	0.00	0.581D 00	-0.147D 00	-0.732D-03	0.408D 02	-0.196D 02	0.410D 04
105.46	0.00	0.582D 00	-0.172D 00	-0.240D-03	0.408D 02	-0.196D 02	0.306D 04
158.2C	0.00	0.583D 00	-0.175D 00	0.110D-03	0.408D 02	-0.196D 02	0.203D 04
210.93	0.00	0.584D 00	-0.163D 00	0.317D-03	0.408D 02	-0.196D 02	0.992D 03
263.66	0.00	0.585D 00	-0.144D 00	0.383D-03	0.408D 02	-0.196D 02	-0.421D 02
316.39	0.00	0.586D 00	-0.125D 00	0.306D-03	0.408D 02	-0.196D 02	-0.108D 04
369.12	0.00	0.587D 00	-0.114D 00	0.867D-04	0.408D 02	-0.196D 02	-0.211D 04
421.85	0.00	0.588D 00	-0.118D 00	-0.275D-03	0.408D 02	-0.196D 02	-0.315D 04
474.59	0.00	0.588D 00	-0.146D 00	-0.778D-03	0.408D 02	-0.196D 02	-0.418D 04
527.32	0.00	0.589D 00	-0.203D 00	-0.142D-02	0.408D 02	-0.196D 02	-0.522D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF3   EFFECT OF WIND AND WAVE FORCES AT TIME = 1.76 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 3
GOES FROM JOINT 3 TO JOINT 1
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

		DISPLACEMENTS			FORCES		
DISTANCE X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.341D-01	-0.587D 00	-0.137D-02	-0.348D 03	0.812D 02	-0.131D 05
29.28	0.00	-0.383D-01	-0.641D 00	-0.227D-02	-0.348D 03	0.814D 02	-0.107D 05
58.56	0.00	-0.426D-01	-0.718D 00	-0.300D-02	-0.348D 03	0.816D 02	-0.828D 04
87.84	0.00	-0.469D-01	-0.814D 00	-0.354D-02	-0.348D 03	0.815D 02	-0.585D 04
117.12	0.00	-0.513D-01	-0.924D 00	-0.389D-02	-0.348D 03	0.812D 02	-0.343D 04
146.40	0.00	-0.557D-01	-0.104D 01	-0.406D-02	-0.348D 03	0.809D 02	-0.102D 04
175.68	0.00	-0.601D-01	-0.116D 01	-0.405D-02	-0.348D 03	0.806D 02	0.139D 04
204.96	0.00	-0.645D-01	-0.128D 01	-0.385D-02	-0.348D 03	0.803D 02	0.378D 04
234.24	0.00	-0.688D-01	-0.138D 01	-0.347D-02	-0.348D 03	0.799D 02	0.617D 04
263.52	0.00	-0.732D-01	-0.148D 01	-0.291D-02	-0.348D 03	0.796D 02	0.853D 04
292.80	0.00	-0.774D-01	-0.155D 01	-0.217D-02	-0.348D 03	0.790D 02	0.109D 05

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF3   EFFECT OF WIND AND WAVE FORCES AT TIME = 1.76 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 4
GOES FROM JOINT 4 TO JOINT 2
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

		DISPLACEMENTS			FORCES		
DISTANCE X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.261D 00	-0.566D 00	-0.142D-02	-0.452D 03	0.105D 03	-0.141D 05
29.28	0.00	-0.266D 00	-0.623D 00	-0.239D-02	-0.452D 03	0.101D 03	-0.111D 05
58.56	0.00	-0.272D 00	-0.704D 00	-0.312D-02	-0.452D 03	0.974D 02	-0.817D 04
87.84	0.00	-0.277D 00	-0.803D 00	-0.364D-02	-0.452D 03	0.937D 02	-0.532D 04
117.12	0.00	-0.283D 00	-0.915D 00	-0.394D-02	-0.452D 03	0.895D 02	-0.259D 04
146.40	0.00	-0.288D 00	-0.103D 01	-0.404D-02	-0.452D 03	0.848D 02	0.239D 02
175.68	0.00	-0.294D 00	-0.115D 01	-0.394D-02	-0.452D 03	0.795D 02	0.249D 04
204.96	0.00	-0.300D 00	-0.126D 01	-0.366D-02	-0.452D 03	0.735D 02	0.478D 04
234.24	0.00	-0.305D 00	-0.136D 01	-0.322D-02	-0.452D 03	0.668D 02	0.689D 04
263.52	0.00	-0.311D 00	-0.145D 01	-0.262D-02	-0.452D 03	0.593D 02	0.878D 04
292.80	0.00	-0.316D 00	-0.151D 01	-0.189D-02	-0.452D 03	0.463D 02	0.104D 05

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF3   EFFECT OF WIND AND WAVE FORCES AT TIME = 1.76 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 5
GOES FROM JOINT 5 TO JOINT 3
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

		DISPLACEMENTS			FORCES		
DISTANCE X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.122D-01	-0.465D 00	-0.158D-03	-0.182D 03	-0.193D 02	0.116D 04
29.28	0.00	-0.144D-01	-0.468D 00	-0.902D-04	-0.182D 03	-0.191D 02	0.603D 03
58.56	0.00	-0.166D-01	-0.470D 00	-0.654D-04	-0.182D 03	-0.190D 02	0.455D 02
87.84	0.00	-0.188D-01	-0.473D 00	-0.831D-04	-0.182D 03	-0.189D 02	-0.508D 03
117.12	0.00	-0.210D-01	-0.476D 00	-0.143D-03	-0.182D 03	-0.187D 02	-0.106D 04
146.40	0.00	-0.231D-01	-0.481D 00	-0.244D-03	-0.182D 03	-0.186D 02	-0.160D 04
175.68	0.00	-0.253D-01	-0.490D 00	-0.388D-03	-0.182D 03	-0.185D 02	-0.215D 04
204.96	0.00	-0.275D-01	-0.504D 00	-0.572D-03	-0.182D 03	-0.183D 02	-0.268D 04
234.24	0.00	-0.297D-01	-0.524D 00	-0.797D-03	-0.182D 03	-0.182D 02	-0.321D 04
263.52	0.00	-0.319D-01	-0.551D 00	-0.106D-02	-0.182D 03	-0.180D 02	-0.374D 04
292.80	0.00	-0.341D-01	-0.587D 00	-0.137D-02	-0.182D 03	-0.178D 02	-0.426D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF3   EFFECT OF WIND AND WAVE FORCES AT TIME = 1.76 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 6
GOES FROM JOINT 7 TO JOINT 4
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

		DISPLACEMENTS			FORCES		
DISTANCE X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.188D 00	-0.449D 00	-0.483D-04	-0.609D 03	-0.117D 02	0.519D 03
29.28	0.00	-0.195D 00	-0.450D 00	-0.227D-04	-0.609D 03	-0.130D 02	0.153D 03
58.56	0.00	-0.202D 00	-0.451D 00	-0.260D-04	-0.609D 03	-0.140D 02	-0.241D 03
87.84	0.00	-0.210D 00	-0.452D 00	-0.606D-04	-0.609D 03	-0.151D 02	-0.666D 03
117.12	0.00	-0.217D 00	-0.455D 00	-0.129D-03	-0.609D 03	-0.164D 02	-0.112D 04
146.40	0.00	-0.224D 00	-0.460D 00	-0.234D-03	-0.609D 03	-0.178D 02	-0.162D 04
175.68	0.00	-0.232D 00	-0.469D 00	-0.378D-03	-0.609D 03	-0.195D 02	-0.216D 04
204.96	0.00	-0.239D 00	-0.482D 00	-0.565D-03	-0.609D 03	-0.213D 02	-0.275D 04
234.24	0.00	-0.246D 00	-0.502D 00	-0.799D-03	-0.609D 03	-0.233D 02	-0.339D 04
263.52	0.00	-0.253D 00	-0.530D 00	-0.108D-02	-0.609D 03	-0.257D 02	-0.408D 04
292.80	0.00	-0.261D 00	-0.566D 00	-0.142D-02	-0.609D 03	-0.296D 02	-0.485D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF3 EFFECT OF WIND AND WAVE FORCES AT TIME = 1.76 SEC
TABLE 9 – MEMBER RESULTS

MEMBER NUMBER 7
GOES FROM JOINT 5 TO JOINT 6
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.461D 00	-0.584D-01	-0.158D-03	0.139D 03	0.112D 02	-0.142D 04
29.28	0.00	0.463D 00	-0.645D-01	-0.254D-03	0.139D 03	0.112D 02	-0.110D 04
58.56	0.00	0.465D 00	-0.730D-01	-0.325D-03	0.139D 03	0.112D 02	-0.771D 03
87.84	0.00	0.466D 00	-0.833D-01	-0.371D-03	0.139D 03	0.112D 02	-0.445D 03
117.12	0.00	0.468D 00	-0.945D-01	-0.393D-03	0.139D 03	0.112D 02	-0.118D 03
146.40	0.00	0.470D 00	-0.106D 00	-0.389D-03	0.139D 03	0.112D 02	0.208D 03
175.68	0.00	0.471D 00	-0.117D 00	-0.361D-03	0.139D 03	0.112D 02	0.534D 03
204.96	0.00	0.473D 00	-0.127D 00	-0.308D-03	0.139D 03	0.112D 02	0.860D 03
234.24	0.00	0.475D 00	-0.135D 00	-0.230D-03	0.139D 03	0.112D 02	0.119D 04
263.52	0.00	0.476D 00	-0.140D 00	-0.127D-03	0.139D 03	0.112D 02	0.151D 04
292.80	0.00	0.478D 00	-0.142D 00	0.127D-05	0.139D 03	0.112D 02	0.184D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF3 EFFECT OF WIND AND WAVE FORCES AT TIME = 1.76 SEC
TABLE 9 – MEMBER RESULTS

MEMBER NUMBER 8
GOES FROM JOINT 6 TO JOINT 7
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.478D 00	-0.142D 00	0.127D-05	-0.103D 03	-0.125D 01	0.118D 03
29.28	0.00	0.477D 00	-0.142D 00	0.887D-05	-0.103D 03	-0.125D 01	0.813D 02
58.56	0.00	0.475D 00	-0.142D 00	0.137D-04	-0.103D 03	-0.125D 01	0.447D 02
87.84	0.00	0.474D 00	-0.141D 00	0.157D-04	-0.103D 03	-0.125D 01	0.815D 01
117.12	0.00	0.473D 00	-0.141D 00	0.149D-04	-0.103D 03	-0.125D 01	-0.284D 02
146.40	0.00	0.472D 00	-0.140D 00	0.114D-04	-0.103D 03	-0.125D 01	-0.650D 02
175.68	0.00	0.471D 00	-0.140D 00	0.500D-05	-0.103D 03	-0.125D 01	-0.102D 03
204.96	0.00	0.469D 00	-0.140D 00	-0.414D-05	-0.103D 03	-0.125D 01	-0.138D 03
234.24	0.00	0.468D 00	-0.140D 00	-0.161D-04	-0.103D 03	-0.125D 01	-0.175D 03
263.52	0.00	0.467D 00	-0.141D 00	-0.308D-04	-0.103D 03	-0.125D 01	-0.211D 03
292.80	0.00	0.466D 00	-0.142D 00	-0.483D-04	-0.103D 03	-0.125D 01	-0.248D 03

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF3 EFFECT OF WIND AND WAVE FORCES AT TIME = 1.76 SEC
TABLE 9 – MEMBER RESULTS

MEMBER NUMBER 9
GOES FROM JOINT 6 TO JOINT 3
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.426D 00	-0.259D 00	0.127D-05	-0.199D 03	-0.114D 02	0.101D 04
39.29	0.00	-0.429D 00	-0.257D 00	0.813D-04	-0.199D 03	-0.117D 02	0.553D 03
78.59	0.00	-0.432D 00	-0.253D 00	0.114D-03	-0.199D 03	-0.119D 02	0.895D 02
117.88	0.00	-0.436D 00	-0.249D 00	0.993D-04	-0.199D 03	-0.120D 02	-0.380D 03
157.18	0.00	-0.439D 00	-0.246D 00	0.361D-04	-0.199D 03	-0.121D 02	-0.854D 03
196.47	0.00	-0.442D 00	-0.247D 00	-0.758D-04	-0.199D 03	-0.122D 02	-0.133D 04
235.76	0.00	-0.445D 00	-0.253D 00	-0.237D-03	-0.199D 03	-0.122D 02	-0.181D 04
275.06	0.00	-0.448D 00	-0.266D 00	-0.447D-03	-0.199D 03	-0.122D 02	-0.229D 04
314.35	0.00	-0.452D 00	-0.288D 00	-0.705D-03	-0.199D 03	-0.122D 02	-0.276D 04
353.65	0.00	-0.455D 00	-0.322D 00	-0.101D-02	-0.199D 03	-0.121D 02	-0.323D 04
392.94	0.00	-0.458D 00	-0.369D 00	-0.137D-02	-0.199D 03	-0.118D 02	-0.369D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF3 EFFECT OF WIND AND WAVE FORCES AT TIME = 1.76 SEC
TABLE 9 – MEMBER RESULTS

MEMBER NUMBER 10
GOES FROM JOINT 6 TO JOINT 4
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.215D 00	-0.450D 00	0.127D-05	0.184D 03	-0.909D 01	0.714D 03
39.29	0.00	0.218D 00	-0.448D 00	0.558D-04	0.184D 03	-0.941D 01	0.350D 03
78.59	0.00	0.221D 00	-0.446D 00	0.724D-04	0.184D 03	-0.973D 01	-0.248D 02
117.88	0.00	0.224D 00	-0.443D 00	0.500D-04	0.184D 03	-0.101D 02	-0.414D 03
157.17	0.00	0.227D 00	-0.442D 00	-0.133D-04	0.184D 03	-0.107D 02	-0.821D 03
196.47	0.00	0.230D 00	-0.445D 00	-0.120D-03	0.184D 03	-0.114D 02	-0.125D 04
235.76	0.00	0.233D 00	-0.452D 00	-0.272D-03	0.184D 03	-0.122D 02	-0.172D 04
275.05	0.00	0.236D 00	-0.467D 00	-0.473D-03	0.184D 03	-0.133D 02	-0.222D 04
314.35	0.00	0.239D 00	-0.490D 00	-0.729D-03	0.184D 03	-0.146D 02	-0.277D 04
353.64	0.00	0.242D 00	-0.525D 00	-0.104D-02	0.184D 03	-0.162D 02	-0.338D 04
392.93	0.00	0.245D 00	-0.573D 00	-0.142D-02	0.184D 03	-0.191D 02	-0.406D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF3   EFFECT OF WIND AND WAVE FORCES AT TIME = 1.76 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 11
GOES FROM JOINT 9 TO JOINT 5
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.328D 00	-0.210D 00	0.493D-04	-0.171D 03	0.150D 01	-0.972D 03
42.79	0.00	-0.331D 00	-0.210D 00	-0.503D-04	-0.175D 03	0.363D 01	-0.816D 03
85.57	0.00	-0.334D 00	-0.214D 00	-0.133D-03	-0.175D 03	0.361D 01	-0.660D 03
128.36	0.00	-0.337D 00	-0.221D 00	-0.198D-03	-0.175D 03	0.361D 01	-0.505D 03
171.15	0.00	-0.340D 00	-0.231D 00	-0.245D-03	-0.175D 03	0.361D 01	-0.349D 03
213.94	0.00	-0.343D 00	-0.242D 00	-0.275D-03	-0.175D 03	0.364D 01	-0.192D 03
256.72	0.00	-0.346D 00	-0.254D 00	-0.288D-03	-0.175D 03	0.367D 01	-0.336D 02
299.51	0.00	-0.349D 00	-0.266D 00	-0.283D-03	-0.175D 03	0.373D 01	0.127D 03
342.30	0.00	-0.352D 00	-0.273D 00	-0.259D-03	-0.175D 03	0.380D 01	0.290D 03
385.09	0.00	-0.355D 00	-0.283D 00	-0.218D-03	-0.175D 03	0.390D 01	0.456D 03
427.87	0.00	-0.358D 00	-0.296D 00	-0.158D-03	-0.175D 03	0.406D 01	0.626D 03

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF3   EFFECT OF WIND AND WAVE FORCES AT TIME = 1.76 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 12
GOES FROM JOINT 9 TO JOINT 7
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.189D 00	-0.340D 00	0.493D-04	0.145D 03	0.387D 01	-0.137D 04
42.79	0.00	0.191D 00	-0.341D 00	-0.881D-04	0.149D 03	0.637D 01	-0.110D 04
85.57	0.00	0.194D 00	-0.347D 00	-0.195D-03	0.149D 03	0.630D 01	-0.825D 03
128.36	0.00	0.197D 00	-0.358D 00	-0.272D-03	0.149D 03	0.620D 01	-0.559D 03
171.15	0.00	0.199D 00	-0.370D 00	-0.320D-03	0.149D 03	0.605D 01	-0.299D 03
213.94	0.00	0.202D 00	-0.385D 00	-0.340D-03	0.149D 03	0.586D 01	-0.454D 02
256.72	0.00	0.204D 00	-0.399D 00	-0.331D-03	0.149D 03	0.561D 01	0.198D 03
299.51	0.00	0.207D 00	-0.413D 00	-0.296D-03	0.149D 03	0.529D 01	0.430D 03
342.30	0.00	0.210D 00	-0.424D 00	-0.236D-03	0.149D 03	0.489D 01	0.648D 03
385.09	0.00	0.212D 00	-0.432D 00	-0.153D-03	0.149D 03	0.441D 01	0.846D 03
427.87	0.00	0.215D 00	-0.437D 00	-0.483D-04	0.149D 03	0.349D 01	0.102D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF3   EFFECT OF WIND AND WAVE FORCES AT TIME = 1.76 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 13
GOES FROM JOINT 8 TO JOINT 9
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.364D 00	-0.434D-01	-0.854D-03	0.824D 02	-0.171D 02	0.313D 04
32.40	0.00	0.366D 00	-0.670D-01	-0.612D-03	0.867D 02	-0.156D 02	0.260D 04
64.80	0.00	0.367D 00	-0.835D-01	-0.413D-03	0.896D 02	-0.144D 02	0.212D 04
97.20	0.00	0.368D 00	-0.942D-01	-0.253D-03	0.924D 02	-0.132D 02	0.167D 04
129.60	0.00	0.369D 00	-0.100D 00	-0.129D-03	0.953D 02	-0.119D 02	0.126D 04
162.00	0.00	0.370D 00	-0.103D 00	-0.387D-04	0.981D 02	-0.106D 02	0.892D 03
194.40	0.00	0.372D 00	-0.103D 00	0.230D-04	0.101D 03	-0.935D 01	0.568D 03
226.80	0.00	0.373D 00	-0.102D 00	0.591D-04	0.104D 03	-0.805D 01	0.286D 03
259.20	0.00	0.375D 00	-0.995D-01	0.731D-04	0.107D 03	-0.676D 01	0.468D 02
291.60	0.00	0.376D 00	-0.972D-01	0.687D-04	0.110D 03	-0.546D 01	-0.151D 03
324.00	0.00	0.377D 00	-0.952D-01	0.493D-04	0.114D 03	-0.358D 01	-0.308D 03

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF3   EFFECT OF WIND AND WAVE FORCES AT TIME = 1.76 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 14
GOES FROM JOINT 9 TO JOINT 10
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.377D 00	-0.952D-01	0.493D-04	-0.105D 03	-0.236D 02	0.204D 04
32.40	0.00	0.376D 00	-0.912D-01	0.191D-03	-0.100D 03	-0.217D 02	0.131D 04
64.80	0.00	0.375D 00	-0.835D-01	0.272D-03	-0.976D 02	-0.205D 02	0.626D 03
97.20	0.00	0.373D 00	-0.741D-01	0.298D-03	-0.948D 02	-0.193D 02	-0.203D 02
129.60	0.00	0.372D 00	-0.648D-01	0.271D-03	-0.919D 02	-0.182D 02	-0.629D 03
162.00	0.00	0.371D 00	-0.571D-01	0.193D-03	-0.891D 02	-0.171D 02	-0.120D 04
194.40	0.00	0.370D 00	-0.528D-01	0.692D-04	-0.862D 02	-0.160D 02	-0.174D 04
226.80	0.00	0.369D 00	-0.531D-01	-0.987D-04	-0.834D 02	-0.150D 02	-0.224D 04
259.20	0.00	0.368D 00	-0.596D-01	-0.308D-03	-0.805D 02	-0.139D 02	-0.271D 04
291.60	0.00	0.367D 00	-0.735D-01	-0.555D-03	-0.776D 02	-0.128D 02	-0.314D 04
324.00	0.00	0.366D 00	-0.959D-01	-0.837D-03	-0.734D 02	-0.110D 02	-0.354D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF3   EFFECT OF WIND AND WAVE FORCES AT TIME = 1.76 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 15
GOES FROM JOINT 8 TO JOINT 5
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.691D-02	-0.367D 00	-0.854D-03	-0.678D 02	-0.159D 02	0.365D 04
15.68	0.00	-0.718D-02	-0.380D 00	-0.764D-03	-0.679D 02	-0.149D 02	0.342D 04
31.36	0.00	-0.745D-02	-0.391D 00	-0.679D-03	-0.679D 02	-0.148D 02	0.319D 04
47.03	0.00	-0.772D-02	-0.401D 00	-0.600D-03	-0.679D 02	-0.148D 02	0.296D 04
62.71	0.00	-0.799D-02	-0.410D 00	-0.528D-03	-0.679D 02	-0.148D 02	0.273D 04
78.39	0.00	-0.825D-02	-0.418D 00	-0.461D-03	-0.679D 02	-0.147D 02	0.249D 04
94.07	0.00	-0.852D-02	-0.424D 00	-0.400D-03	-0.679D 02	-0.147D 02	0.226D 04
109.74	0.00	-0.879D-02	-0.430D 00	-0.345D-03	-0.679D 02	-0.146D 02	0.204D 04
125.42	0.00	-0.905D-02	-0.435D 00	-0.296D-03	-0.679D 02	-0.146D 02	0.181D 04
141.10	0.00	-0.932D-02	-0.439D 00	-0.253D-03	-0.679D 02	-0.146D 02	0.158D 04
156.78	0.00	-0.958D-02	-0.443D 00	-0.215D-03	-0.679D 02	-0.145D 02	0.135D 04
172.46	0.00	-0.985D-02	-0.446D 00	-0.183D-03	-0.679D 02	-0.145D 02	0.112D 04
188.13	0.00	-0.101D-01	-0.449D 00	-0.158D-03	-0.679D 02	-0.144D 02	0.897D 03
203.81	0.00	-0.104D-01	-0.451D 00	-0.138D-03	-0.679D 02	-0.144D 02	0.671D 03
219.49	0.00	-0.106D-01	-0.453D 00	-0.123D-03	-0.679D 02	-0.143D 02	0.446D 03
235.17	0.00	-0.109D-01	-0.455D C0	-0.115D-03	-0.679D 02	-0.143D 02	0.222D 03
250.84	0.00	-0.112D-01	-0.457D 00	-0.112D-03	-0.679D 02	-0.142D 02	-0.173D 01
266.52	0.00	-0.114D-01	-0.459D 00	-0.115D-03	-0.679D 02	-0.142D 02	-0.224D 03
282.20	0.00	-0.117D-01	-0.460D 00	-0.123D-03	-0.679D 02	-0.141D 02	-0.446D 03
297.88	0.00	-0.120D-01	-0.462D 00	-0.138D-03	-0.679D 02	-0.141D 02	-0.667D 03
313.56	0.00	-0.122D-01	-0.465D 00	-0.158D-03	-0.679D 02	-0.140D 02	-0.887D 03

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF3   EFFECT OF WIND AND WAVE FORCES AT TIME = 1.76 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 16
GOES FROM JOINT 10 TO JOINT 7
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.132D 00	-0.354D 00	-0.837D-03	-0.716D 03	-0.967D 01	0.305D 04
15.68	0.00	-0.135D 00	-0.367D 00	-0.760D-03	-0.717D 03	-0.891D 01	0.292D 04
31.36	0.00	-0.137D 00	-0.378D 00	-0.687D-03	-0.717D 03	-0.905D 01	0.279D 04
47.03	0.00	-0.140D 00	-0.388D 00	-0.618D-03	-0.717D 03	-0.919D 01	0.266D 04
62.71	0.00	-0.143D 00	-0.397D 00	-0.552D-03	-0.717D 03	-0.935D 01	0.252D 04
78.39	0.00	-0.146D 00	-0.406D 00	-0.489D-03	-0.717D 03	-0.951D 01	0.237D 04
94.07	0.00	-0.149D 00	-0.413D 00	-0.430D-03	-0.717D 03	-0.969D 01	0.223D 04
109.74	0.00	-0.151D 00	-0.419D 00	-0.375D-03	-0.717D 03	-0.987D 01	0.208D 04
125.42	0.00	-0.154D 00	-0.425D 00	-0.324D-03	-0.717D 03	-0.101D 02	0.193D 04
141.10	0.00	-0.157D 0C	-0.429D 00	-0.276D-C3	-0.717D 03	-0.103D 02	0.177D 04
156.78	0.00	-0.160D 00	-0.433D 00	-0.233D-03	-0.717D 03	-0.105D 02	0.161D 04
172.46	0.00	-0.163D 00	-0.437D C0	-0.194D-03	-0.717D 03	-0.108D 02	0.145D 04
188.13	0.00	-0.165D 00	-0.439D 00	-0.159D-03	-0.717D 03	-0.110D 02	0.128D 04
203.81	0.00	-0.168D 00	-0.442D 00	-0.126D-03	-0.717D 03	-0.113D 02	0.111D 04
219.49	0.00	-0.171D 00	-0.443D 00	-0.102D-03	-0.717D 03	-0.116D 02	0.928D 03
235.17	0.00	-0.174D 00	-0.445D 00	-0.811D-04	-0.717D 03	-0.119D 02	0.745D 03
250.84	0.00	-0.177D 00	-0.446D 00	-0.644D-04	-0.717D 03	-0.122D 02	0.556D 03
266.52	0.00	-0.179D 00	-0.447D 00	-0.527D-04	-0.717D 03	-0.126D 02	0.362D 03
282.20	0.00	-0.182D 00	-0.448D 00	-0.460D-04	-0.717D 03	-0.130D 02	0.162D 03
297.88	0.00	-0.185D 00	-0.448D 00	-0.445D-04	-0.717D 03	-0.134D 02	-0.437D 02
313.56	0.00	-0.188D 0C	-0.449D 00	-0.483D-04	-0.717D 03	-0.140D 02	-0.256D 03

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF3   EFFECT OF WIND AND WAVE FORCES AT TIME = 1.76 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 17
GOES FROM JOINT 11 TO JOINT 8
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.340D-02	0.273D-02	-0.262D-03	-0.275D 02	-0.222D 02	-0.242D 04
18.00	0.00	-0.353D-02	-0.266D-02	-0.339D-03	-0.291D 02	-0.224D 02	-0.283D 04
36.01	0.00	-0.366D-02	-0.955D-02	-0.428D-03	-0.302D 02	-0.199D 02	-0.323D 04
54.01	0.00	-0.380D-02	-0.181D-01	-0.527D-03	-0.313D 02	-0.149D 02	-0.354D 04
72.02	0.00	-0.395D-02	-0.286D-01	-0.635D-03	-0.324D 02	-0.939D 01	-0.376D 04
90.02	0.00	-0.410D-02	-0.410D-01	-0.747D-03	-0.335D 02	-0.344D 01	-0.388D 04
108.03	0.00	-0.426D-02	-0.555D-01	-0.861D-03	-0.347D 02	0.278D 01	-0.389D 04
126.03	0.00	-0.442D-02	-0.720D-01	-0.974D-03	-0.356D 02	0.915D 01	-0.378D 04
144.04	0.00	-0.459D-02	-0.905D-01	-0.108D-02	-0.363D 02	0.156D 02	-0.356D 04
162.04	0.00	-0.477D-02	-0.111D 00	-0.118D-02	-0.370D 02	0.220D 02	-0.322D 04
180.05	0.00	-0.495D-02	-0.133D 00	-0.127D-02	-0.377D 02	0.283D 02	-0.276D 04
198.05	0.00	-0.514D-02	-0.157D 00	-0.134D-02	-0.385D 02	0.345D 02	-0.220D 04
216.06	0.00	-0.533D-02	-0.181D 00	-0.140D-02	-0.392D 02	0.404D 02	-0.152D 04
234.06	0.00	-0.552D-02	-0.207D 00	-0.143D-02	-0.399D 02	0.460D 02	-0.737D 03
252.07	0.00	-0.572D-02	-0.233D 00	-0.144D-02	-0.404D 02	0.510D 02	0.140D 03
270.07	0.00	-0.592D-02	-0.258D 00	-0.142D-02	-0.407D 02	0.553D 02	0.110D 04
288.08	0.00	-0.612D-02	-0.283D 00	-0.137D-02	-0.411D 02	0.591D 02	0.213D 04
306.08	0.00	-0.632D-02	-0.308D 00	-0.129D-02	-0.413D 02	0.623D 02	0.323D 04
324.09	0.00	-0.652D-02	-0.330D 00	-0.118D-02	-0.416D 02	0.648D 02	0.438D 04
342.09	0.00	-0.672D-02	-0.350D 00	-0.104D-02	-0.418D 02	0.668D 02	0.557D 04
360.10	0.00	-0.691D-02	-0.367D 00	-0.854D-03	-0.420D 02	0.687D 02	0.678D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES   WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PROB
WWF3   EFFECT OF WIND AND WAVE FORCES AT TIME = 1.76 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 18
GOES FROM JOINT 12 TO JOINT 10
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.708D-01	0.365D-02	-0.243D-03	-0.552D 03	-0.220D 02	-0.232D 04
18.00	0.00	-0.734D-01	-0.137D-02	-0.317D-03	-0.578D 03	-0.225D 02	-0.273D 04
36.01	0.00	-0.760D-01	-0.784D-02	-0.403D-03	-0.595D 03	-0.203D 02	-0.313D 04
54.01	0.00	-0.787D-01	-0.160D-01	-0.500D-03	-0.611D 03	-0.155D 02	-0.345D 04
72.02	0.00	-0.815D-01	-0.259D-01	-0.605D-03	-0.628D 03	-0.102D 02	-0.368D 04
90.02	0.00	-0.843D-01	-0.378D-01	-0.714D-03	-0.643D 03	-0.441D 01	-0.380D 04
108.03	0.00	-0.373D-01	-0.516D-01	-0.826D-03	-0.659D 03	0.165D 01	-0.382D 04
126.03	0.00	-0.903D-01	-0.675D-01	-0.937D-03	-0.670D 03	0.787D 01	-0.372D 04
144.04	0.00	-0.933D-01	-0.853D-01	-0.104D-02	-0.678D 03	0.142D 02	-0.351D 04
162.04	0.00	-0.963D-01	-0.105D 00	-0.114D-02	-0.686D 03	0.205D 02	-0.319D 04
180.05	0.00	-0.994D-01	-0.126D 00	-0.123D-02	-0.693D 03	0.267D 02	-0.275D 04
198.05	0.00	-0.103D 00	-0.149D 00	-0.130D-02	-0.701D 03	0.327D 02	-0.220D 04
216.06	0.00	-0.106D 00	-0.173D 00	-0.136D-02	-0.708D 03	0.386D 02	-0.154D 04
234.06	0.00	-0.109D 00	-0.198D 00	-0.139D-02	-0.715D 03	0.441D 02	-0.771D 03
252.07	0.00	-0.112D 00	-0.223D 00	-0.140D-02	-0.720D 03	0.490D 02	0.874D 02
270.07	0.00	-0.115D 00	-0.248D 00	-0.138D-02	-0.723D 03	0.533D 02	0.103D 04
288.08	0.00	-0.119D 00	-0.273D 00	-0.134D-02	-0.726D 03	0.570D 02	0.204D 04
306.08	0.00	-0.122D 00	-0.296D 00	-0.126D-02	-0.729D 03	0.601D 02	0.312D 04
324.09	0.00	-0.125D 00	-0.318D 00	-0.115D-02	-0.731D 03	0.627D 02	0.424D 04
342.09	0.00	-0.129D 00	-0.338D 00	-0.101D-02	-0.732D 03	0.646D 02	0.540D 04
360.10	0.00	-0.132D 00	-0.354D 00	-0.837D-03	-0.734D 03	0.665D 02	0.659D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PRCB
WWF3 EFFECT OF WIND AND WAVE FORCES AT TIME = 1.76 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 19
GOES FROM JOINT 13 TO JOINT 11
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.122D-02	-0.437D-03	0.345D-05	-0.913D 01	0.778D 00	-0.490D 01
21.00	0.00	-0.128D-02	-0.364D-03	0.363D-05	-0.993D 01	0.920D 00	0.135D 02
41.99	0.00	-0.135D-02	-0.278D-03	0.463D-05	-0.105D 02	0.994D 00	0.337D 02
62.99	0.00	-0.142D-02	-0.163D-03	0.649D-05	-0.111D 02	0.104D 01	0.553D 02
83.98	0.00	-0.149D-02	0.730D-06	0.928D-05	-0.117D 02	0.106D 01	0.776D 02
104.98	0.00	-0.157D-02	0.233D-03	0.130D-04	-0.124D 02	0.104D 01	0.999D 02
125.97	0.00	-0.165D-02	0.553D-03	0.176D-04	-0.130D 02	0.948D 00	0.121D 03
146.97	0.00	-0.174D-02	0.979D-03	0.231D-04	-0.138D 02	0.775D 00	0.140D 03
167.96	0.00	-0.183D-02	0.153D-02	0.292D-04	-0.145D 02	0.494D 00	0.154D 03
188.96	0.00	-0.193D-02	0.221D-02	0.358D-04	-0.153D 02	0.754D-01	0.160D 03
209.95	0.00	-0.203D-02	0.303D-02	0.425D-04	-0.161D 02	-0.509D 00	0.157D 03
230.95	0.00	-0.214D-02	0.399D-02	0.487D-04	-0.170D 02	-0.129D 01	0.139D 03
251.94	0.00	-0.225D-02	0.507D-02	0.537D-04	-0.179D 02	-0.229D 01	0.103D 03
272.94	0.00	-0.237D-02	0.623D-02	0.568D-04	-0.189D 02	-0.354D 01	0.426D 02
293.93	0.00	-0.249D-02	0.743D-02	0.567D-04	-0.199D 02	-0.725D 01	-0.461D 02
314.93	0.00	-0.263D-02	0.857D-02	0.503D-04	-0.209D 02	-0.134D 02	-0.262D 03
335.92	0.00	-0.277D-02	0.946D-02	0.320D-04	-0.220D 02	-0.198D 02	-0.610D 03
356.92	0.00	-0.291D-02	0.979D-02	-0.372D-05	-0.232D 02	-0.262D 02	-0.109D 04
377.91	0.00	-0.307D-02	0.914D-02	-0.625D-04	-0.244D 02	-0.304D 02	-0.171D 04
398.91	0.00	-0.323D-02	0.698D-02	-0.148D-03	-0.256D 02	-0.321D 02	-0.237D 04
419.90	0.00	-0.340D-02	0.273D-02	-0.262D-03	-0.275D 02	-0.333D 02	-0.306D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PRCB
WWF3 EFFECT OF WIND AND WAVE FORCES AT TIME = 1.76 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 20
GOES FROM JOINT 14 TO JOINT 12
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.255D-01	-0.446D-03	0.296D-05	-0.191D 03	0.739D 00	-0.979D 01
21.00	0.00	-0.268D-01	-0.385D-03	0.292D-05	-0.208D 03	0.886D 00	0.786D 01
41.99	0.00	-0.282D-01	-0.316D-03	0.366D-05	-0.220D 03	0.966D 00	0.274D 02
62.99	0.00	-0.296D-01	-0.226D-03	0.524D-05	-0.232D 03	0.103D 01	0.484D 02
83.98	0.00	-0.312D-01	-0.911D-04	0.774D-05	-0.245D 03	0.106D 01	0.705D 02
104.98	0.00	-0.328D-01	0.106D-03	0.112D-04	-0.259D 03	0.106D 01	0.930D 02
125.97	0.00	-0.345D-01	0.384D-03	0.155D-04	-0.273D 03	0.101D 01	0.115D 03
146.97	0.00	-0.364D-01	0.764D-03	0.208D-04	-0.288D 03	0.878D 00	0.135D 03
167.96	0.00	-0.383D-01	0.126D-02	0.268D-04	-0.304D 03	0.651D 00	0.152D 03
188.96	0.00	-0.403D-01	0.189D-02	0.333D-04	-0.321D 03	0.298D 00	0.162D 03
209.95	0.00	-0.424D-01	0.266D-02	0.402D-04	-0.339D 03	-0.210D 00	0.164D 03
230.95	0.00	-0.447D-01	0.358D-02	0.468D-04	-0.357D 03	-0.904D 00	0.153D 03
251.94	0.00	-0.471D-01	0.462D-02	0.526D-04	-0.376D 03	-0.181D 01	0.125D 03
272.94	0.00	-0.496D-01	0.578D-02	0.568D-04	-0.396D 03	-0.296D 01	0.758D 02
293.93	0.00	-0.522D-01	0.699D-02	0.584D-04	-0.416D 03	-0.657D 01	-0.217D 00
314.93	0.00	-0.550D-01	0.819D-02	0.542D-04	-0.437D 03	-0.126D 02	-0.201D 03
335.92	0.00	-0.579D-01	0.919D-02	0.388D-04	-0.458D 03	-0.190D 02	-0.532D 03
356.92	0.00	-0.609D-01	0.970D-02	0.678D-05	-0.479D 03	-0.254D 02	-0.997D 03
377.91	0.00	-0.641D-01	0.932D-02	-0.476D-04	-0.500D 03	-0.316D 02	-0.160D 04
398.91	0.00	-0.674D-01	0.751D-02	-0.130D-03	-0.521D 03	-0.354D 02	-0.232D 04
419.90	0.00	-0.708D-01	0.365D-02	-0.243D-03	-0.552D 03	-0.369D 02	-0.308D 04

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PRCB
WWF3 EFFECT OF WIND AND WAVE FORCES AT TIME = 1.76 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 21
GOES FROM JOINT 15 TO JOINT 13
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	RCTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.209D-03	0.620D-06	0.377D-07	-0.138D 01	0.163D-02	0.231D 00
30.00	0.00	-0.228D-03	0.204D-05	0.575D-07	-0.159D 01	0.104D-02	0.274D 00
60.00	0.00	-0.249D-03	0.409D-05	0.797D-07	-0.175D 01	-0.517D-04	0.294D 00
90.00	0.00	-0.271D-03	0.682D-05	0.102D-06	-0.193D 01	-0.199D-02	0.270D 00
120.00	0.00	-0.296D-03	0.101D-04	0.119D-06	-0.212D 01	-0.500D-02	0.174D 00
150.00	0.00	-0.323D-03	0.138D-04	0.125D-06	-0.232D 01	-0.923D-02	-0.295D-01
180.00	0.00	-0.353D-03	0.174D-04	0.109D-06	-0.254D 01	-0.147D-01	-0.380D 00
210.00	0.00	-0.385D-03	0.200D-04	0.583D-07	-0.279D 01	-0.213D-01	-0.913D 00
240.00	0.00	-0.421D-03	0.204D-04	-0.422D-07	-0.305D 01	-0.283D-01	-0.166D 01
270.00	0.00	-0.460D-03	0.168D-04	-0.209D-06	-0.334D 01	-0.348D-01	-0.261D 01
300.00	0.00	-0.503D-03	0.706D-05	-0.457D-06	-0.365D 01	-0.389D-01	-0.374D 01
330.00	0.00	-0.550D-03	-0.115D-04	-0.797D-06	-0.399D 01	-0.381D-01	-0.495D 01
360.00	0.00	-0.601D-03	-0.417D-04	-0.123D-05	-0.436D 01	-0.291D-01	-0.603D 01
390.00	0.00	-0.657D-03	-0.858D-04	-0.172D-05	-0.476D 01	-0.737D-02	-0.669D 01
420.00	0.00	-0.717D-03	-0.145D-03	-0.224D-05	-0.520D 01	0.318D-01	-0.647D 01
450.00	0.00	-0.784D-03	-0.219D-03	-0.268D-05	-0.567D 01	0.933D-01	-0.478D 01
480.00	0.00	-0.857D-03	-0.304D-03	-0.290D-05	-0.619D 01	0.181D 00	-0.875D 00
510.00	0.00	-0.936D-03	-0.389D-03	-0.270D-05	-0.675D 01	0.297D 00	0.608D 01
540.00	0.00	-0.102D-02	-0.458D-03	-0.180D-05	-0.736D 01	0.438D 00	0.169D 02
570.00	0.00	-0.112D-02	-0.486D-03	0.132D-06	-0.803D 01	0.594D 00	0.324D 02
600.00	0.00	-0.122D-02	-0.437D-03	0.345D-05	-0.913D 01	0.818D 00	0.526D 02

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PRCB
WWF3 EFFECT OF WIND AND WAVE FORCES AT TIME = 1.76 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 22
GOES FROM JOINT 16 TO JOINT 14
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.412D-02	0.503D-06	0.355D-07	-0.308D 02	0.166D-02	0.223D 00
30.00	0.00	-0.453D-02	0.185D-05	0.547D-07	-0.351D 02	0.115D-02	0.268D 00
60.00	0.00	-0.498D-02	0.381D-05	0.766D-07	-0.383D 02	0.138D-03	0.292D 00
90.00	0.00	-0.547D-02	0.645D-05	0.988D-07	-0.418D 02	-0.169D-02	0.276D 00
120.00	0.00	-0.601D-02	0.970D-05	0.117D-06	-0.456D 02	-0.455D-02	0.191D 00
150.00	0.00	-0.659D-02	0.134D-04	0.125D-06	-0.498D 02	-0.862D-02	0.249D-02
180.00	0.00	-0.723D-02	0.170D-04	0.112D-06	-0.544D 02	-0.139D-01	-0.327D 00
210.00	0.00	-0.792D-02	0.197D-04	0.665D-07	-0.593D 02	-0.204D-01	-0.834D 00
240.00	0.00	-0.868D-02	0.205D-04	-0.267D-07	-0.648D 02	-0.274D-01	-0.155D 01
270.00	0.00	-0.951D-02	0.175D-04	-0.184D-06	-0.707D 02	-0.340D-01	-0.248D 01
300.00	0.00	-0.104D-01	0.864D-05	-0.421D-06	-0.771D 02	-0.385D-01	-0.358D 01
330.00	0.00	-0.114D-01	-0.866D-05	-0.748D-06	-0.842D 02	-0.385D-01	-0.478D 01
360.00	0.00	-0.125D-01	-0.371D-04	-0.117D-05	-0.919D 02	-0.306D-01	-0.589D 01
390.00	0.00	-0.137D-01	-0.793D-04	-0.165D-05	-0.100D 03	-0.108D-01	-0.661D 01
420.00	0.00	-0.149D-01	-0.137D-03	-0.217D-05	-0.109D 03	0.258D-01	-0.653D 01
450.00	0.00	-0.163D-01	-0.209D-03	-0.262D-05	-0.119D 03	0.840D-01	-0.505D 01
480.00	0.00	-0.179D-01	-0.292D-03	-0.288D-05	-0.130D 03	0.168D 00	-0.147D 01
510.00	0.00	-0.195D-01	-0.377D-03	-0.274D-05	-0.142D 03	0.280D 00	0.505D 01
540.00	0.00	-0.213D-01	-0.449D-03	-0.194D-05	-0.154D 03	0.418D 00	0.153D 02
570.00	0.00	-0.233D-01	-0.464D-03	-0.160D-06	-0.168D 03	0.572D 00	0.301D 02
600.00	0.00	-0.255D-01	-0.446D-03	0.296D-05	-0.191D 03	0.799D 00	0.497D 02

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PRCB
WWF3 EFFECT OF WIND AND WAVE FORCES AT TIME = 1.76 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 23
GOES FROM JOINT 17 TO JOINT 15
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.109D-03	0.216D-09	0.309D-09	0.688D-01	0.564D-10	0.139D-07
30.00	0.00	-0.109D-03	0.948D-08	0.309D-09	-0.245D-01	-0.187D-05	-0.243D-05
60.00	0.00	-0.109D-03	0.187D-07	0.304D-09	-0.556D-01	-0.717D-05	-0.112D-03
90.00	0.00	-0.110D-03	0.276D-07	0.283D-09	-0.841D-01	-0.159D-04	-0.433D-03
120.00	0.00	-0.111D-03	0.353D-07	0.224D-09	-0.110D 00	-0.277D-04	-0.107D-02
150.00	0.00	-0.113D-03	0.404D-07	0.101D-09	-0.135D 00	-0.420D-04	-0.210D-02
180.00	0.00	-0.115D-03	0.404D-07	-0.121D-09	-0.157D 00	-0.572D-04	-0.358D-02
210.00	0.00	-0.117D-03	0.318D-07	-0.477D-09	-0.179D 00	-0.707D-04	-0.553D-02
240.00	0.00	-0.119D-03	0.100D-07	-0.999D-09	-0.199D 00	-0.785D-04	-0.783D-02
270.00	0.00	-0.122D-03	-0.301D-07	-0.171D-08	-0.219D 00	-0.748D-04	-0.102D-01
300.00	0.00	-0.125D-03	-0.940D-07	-0.259D-08	-0.237D 00	-0.518D-04	-0.123D-01
330.00	0.00	-0.128D-03	-0.187D-06	-0.359D-08	-0.291D 00	0.229D-06	-0.133D-01
360.00	0.00	-0.132D-03	-0.309D-06	-0.459D-08	-0.381D 00	0.918D-04	-0.123D-01
390.00	0.00	-0.137D-03	-0.460D-06	-0.538D-08	-0.473D 00	0.234D-03	-0.783D-02
420.00	0.00	-0.143D-03	-0.627D-06	-0.562D-08	-0.570D 00	0.433D-03	0.171D-02
450.00	0.00	-0.151D-03	-0.787D-06	-0.484D-08	-0.671D 00	0.692D-03	0.181D-01
480.00	0.00	-0.160D-03	-0.901D-06	-0.245D-08	-0.777D 00	0.999D-03	0.432D-01
510.00	0.00	-0.170D-03	-0.910D-06	0.230D-08	-0.890D 00	0.133D-02	0.781D-01
540.00	0.00	-0.182D-03	-0.732D-06	0.102D-07	-0.101D 01	0.163D-02	0.123D 00
570.00	0.00	-0.195D-03	-0.263D-06	0.218D-07	-0.114D 01	0.181D-02	0.176D 00
600.00	0.00	-0.209D-03	0.620D-06	0.377D-07	-0.134D 01	0.163D-02	0.231D 00

NONLINEAR ANALYSIS OF PILE SUPPORTED FRAME WITH SUBJECTED TO
WIND AND WAVE FORCES WAVE HEIGHT = 50 FT, WAVE PERIOD = 7 SEC

PRCB
WWF3 EFFECT OF WIND AND WAVE FORCES AT TIME = 1.76 SEC
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 24
GOES FROM JOINT 18 TO JOINT 16
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.121D-02	-0.468D-09	0.303D-09	-0.359D-06	-0.128D-08	0.384D-06
30.00	0.00	-0.122D-02	0.862D-08	0.303D-09	-0.128D 01	-0.145D-05	0.563D-05
60.00	0.00	-0.124D-02	0.177D-07	0.300D-09	-0.215D 01	-0.640D-05	-0.865D-04
90.00	0.00	-0.127D-02	0.265D-07	0.282D-09	-0.304D 01	-0.147D-04	-0.378D-03
120.00	0.00	-0.131D-02	0.342D-07	0.229D-09	-0.395D 01	-0.261D-04	-0.969D-03
150.00	0.00	-0.137D-02	0.396D-07	0.115D-09	-0.490D 01	-0.400D-04	-0.195D-02
180.00	0.00	-0.143D-02	0.402D-07	-0.930D-10	-0.589D 01	-0.551D-04	-0.337D-02
210.00	0.00	-0.151D-02	0.327D-07	-0.430D-09	-0.693D 01	-0.687D-04	-0.525D-02
240.00	0.00	-0.160D-02	0.128D-07	-0.928D-09	-0.802D 01	-0.773D-04	-0.750D-02
270.00	0.00	-0.171D-02	-0.248D-07	-0.161D-08	-0.918D 01	-0.750D-04	-0.989D-02
300.00	0.00	-0.183D-02	-0.855D-07	-0.246D-08	-0.104D 02	-0.545D-04	-0.120D-01
330.00	0.00	-0.196D-02	-0.174D-06	-0.345D-08	-0.117D 02	-0.647D-05	-0.132D-01
360.00	0.00	-0.212D-02	-0.292D-06	-0.445D-08	-0.131D 02	0.797D-04	-0.124D-01
390.00	0.00	-0.229D-02	-0.439D-06	-0.526D-08	-0.147D 02	0.214D-03	-0.837D-02
420.00	0.00	-0.248D-02	-0.603D-06	-0.557D-08	-0.163D 02	0.405D-03	0.475D-03
450.00	0.00	-0.269D-02	-0.763D-06	-0.492D-08	-0.181D 02	0.655D-03	0.160D-01
480.00	0.00	-0.292D-02	-0.883D-06	-0.274D-08	-0.200D 02	0.955D-03	0.398D-01
510.00	0.00	-0.318D-02	-0.905D-06	0.168D-08	-0.221D 02	0.128D-02	0.733D-01
540.00	0.00	-0.346D-02	-0.752D-06	0.910D-08	-0.243D 02	0.158D-02	0.117D 00
570.00	0.00	-0.377D-02	-0.322D-06	0.202D-07	-0.266D 02	0.177D-02	0.168D 00
600.00	0.00	-0.412D-02	0.503D-06	0.355D-07	-0.308D 02	0.165D-02	0.223D 00

ANALYSIS OF STRAIGHT AND CURVED PILE LOADED IN PLANE OF CURVATURE
LATERAL LOAD = 12.0 KIPS

PROB
ST1 STRAIGHT PILE

TABLE 1 - PROGRAM CONTROL DATA
PROBLEM TYPE 1

TABLE NUMBER	2	3A	3B	3C	4A	4B	4C	5A	5B	6	7
PRIOR-DATA OPTIONS (1=YES,0=NO)	0	0	0	0	0	0	0	0	0	0	0
NUMBER OF CARDS ADDED FOR THIS PROBLEM	2	1	2	2	0	0	0	0	3	1	3

TABLE 2 - JOINT COORDINATES

JOINT NUMBER	X-COORD	Y-COORD
1	0.000D 00	0.000D 00
2	0.000D 00	-0.960D 03

TABLE 3A - MEMBER PROPERTIES

MEMBER NUMBER	ELEM NUMBER	PER LIN	NON	FROM JOINT NO.	FROM JOINT AREA	FROM JOINT PIN	TO JOINT NO.	TO JOINT AREA	TO JOINT PIN
1	40	1		1	1	0	2	1	0

MEMBER NUMBER	MODULUS OF ELASTICITY	FROM JOINT EI	FROM JOINT AE	TO JOINT EI	TO JOINT AE

MEMBER NUMBER	LENGTH	COSINE-X	COSINE-Y	MEMBER TYPE	CENTER-X COORDINATE	CENTER-Y COORDINATE
1	0.960D 03	0.000D 00	-0.100D 01	STRAIGHT		

TABLE 3B - CROSS SECTION PROPERTIES

CROSS SECTION NUMBER = 1
NUMBER OF SEGMENT = 1

SEG NUM	SEG TYPE	CUR NUM	STRESS MULTIPLIER	STRAIN MULTIPLIER	WIDTH OR DIAMETER	DEPTH OR THICKNESS	CENTROIDAL DISTANCE	SEGMENTAL AREA
1	CIRC	1	0.100D 01	0.100D-02	0.128D 02	0.500D 00	0.000D 00	

TABLE 3C - STRESS-STRAIN CURVE

STRESS-STRAIN CURVE NUMBER = 1
NUMBER OF POINTS IN THIS CURVE = 3
CURVE SYMMETRY = YES

SIG 0.000 40.000 40.000

EPS 0.000 1.333 10.000

TABLE 4A - APPLIED MEMBER LOAD

NO DATA IN THE TABLE

TABLE 4B - SELFWEIGHT

WT PER UNIT VOL MEMBER NUMBER

NO DATA IN THE TABLE

TABLE 4C - WIND AND WAVE FORCES

NO DATA IN THE TABLE

TABLE 5A - ELASTIC MEMBER RESTRAIN

NO DATA IN THE TABLE

TABLE 5B - SOIL DATA

PENETRATION DISTANCE FROM	TO	SOIL SHEAR STRENGTH	SOIL DENSITY
0.0000 00	0.000D 00	0.208D-02	0.347D-04
0.0000 00	-0.120D 03	0.208D-02	0.347D-04
0.0000 00	-0.960D 03	0.694D-02	0.347D-04

TABLE 6 - JOINT LOADS AND LINEAR SUPPORTS

JOINT	FORCE(X)	FORCE(Y)	MOMENT(Z)	SPRING(X)	SPRING(Y)	SPRING(Z)
1	0.120D 02	0.000D 00	0.000D 00	0.000D 00	0.000D 00	0.000D 00

TABLE 7 - ITERATION CONTROL

NUMBER OF LOAD INCREMENT= 1

FRAME ITERATION

MAXIMUM NUMBER OF ITERATION = 4
FORCE ERROR = 0.500D 00
MOMENT ERROR = 0.100D 02

MEMBER ITERATION

MAXIMUM NUMBER OF ITERATION = 4
FORCE ERROR = 0.500D-01
MOMENT ERROR = 0.100D 01

ANALYSIS OF STRAIGHT AND CURVED PILE LOADED IN PLANE OF CURVATURE
LATERAL LOAD = 12.0 KIPS

PROB
ST1 STRAIGHT PILE
TABLE 8 - JOINT DISPLACEMENTS AND REACTIONS

	DISPLACEMENTS			REACTIONS		
JOINT	DISP(X)	DISP(Y)	ROTATION(Z)	REACT(X)	REACT(Y)	REACT(Z)
1	0.123D 01	-0.456D-02	-0.104D-01	-0.000D 00	-0.000D 00	-0.000D 00
2	-0.341D-06	0.776D-04	-0.724D-08	-0.000D 00	-0.000D 00	-0.000D 00

ANALYSIS OF STRAIGHT AND CURVED PILE LOADED IN PLANE OF CURVATURE
LATERAL LOAD = 12.0 KIPS

PROB
ST1 STRAIGHT PILE
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 1
GOES FROM JOINT 1 TO JOINT 2
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.456D-02	0.123D 01	-0.104D-01	-0.533D-01	0.119D 02	0.929D 01
24.00	0.00	0.330D-02	0.983D 00	-0.101D-01	0.321D-01	0.939D 01	0.259D 03
48.00	0.00	0.217D-02	0.750D 00	-0.928D-02	0.698D-01	0.718D 01	0.460D 03
72.00	0.00	0.127D-02	0.541D 00	-0.808D-02	0.935D-01	0.464D 01	0.604D 03
96.00	0.00	0.621D-03	0.363D 00	-0.664D-02	0.106D 00	0.192D 01	0.683D 03
120.00	0.00	0.213D-03	0.223D 00	-0.510D-02	0.112D 00	-0.747D 00	0.696D 03
144.00	0.00	-0.830D-05	0.119D 00	-0.359D-02	0.114D 00	-0.312D 01	0.647D 03
168.00	0.00	-0.105D-03	0.489D-01	-0.225D-02	0.113D 00	-0.509D 01	0.546D 03
192.00	0.00	-0.135D-03	0.829D-02	-0.119D-02	0.109D 00	-0.611D 01	0.403D 03
216.00	0.00	-0.138D-03	-0.107D-01	-0.452D-03	0.105D 00	-0.567D 01	0.253D 03
240.00	0.00	-0.135D-03	-0.159D-01	-0.226D-04	0.101D 00	-0.436D 01	0.131D 03
264.00	0.00	-0.130D-03	-0.137D-01	0.172D-03	0.949D-01	-0.294D 01	0.431D 02
288.00	0.00	-0.127D-03	-0.886D-02	0.209D-03	0.871D-01	-0.156D 01	-0.103D 02
312.00	0.00	-0.124D-03	-0.431D-02	0.162D-03	0.799D-01	-0.320D 00	-0.318D 02
336.00	0.00	-0.121D-03	-0.123D-02	0.974D-04	0.729D-01	0.286D 00	-0.257D 02
360.00	0.00	-0.118D-03	0.483D-03	0.483D-04	0.653D-01	0.304D 00	-0.181D 02
384.00	0.00	-0.115D-03	0.122D-02	0.156D-04	0.570D-01	0.260D 00	-0.111D 02
408.00	0.00	-0.113D-03	0.134D-02	-0.321D-05	0.520D-01	0.191D 00	-0.563D 01
432.00	0.00	-0.111D-03	0.115D-02	-0.117D-04	0.506D-01	0.123D 00	-0.191D 01
456.00	0.00	-0.109D-03	0.835D-03	-0.135D-04	0.493D-01	0.661D-01	0.259D 00
480.00	0.00	-0.107D-03	0.526D-03	-0.118D-04	0.479D-01	0.259D-01	0.126D 01
504.00	0.00	-0.105D-03	0.279D-03	-0.871D-05	0.465D-01	0.132D-02	0.150D 01
528.00	0.00	-0.103D-03	0.109D-03	-0.554D-05	0.451D-01	-0.109D-01	0.133D 01
552.00	0.00	-0.101D-03	0.836D-05	-0.295D-05	0.435D-01	-0.146D-01	0.980D 00
576.00	0.00	-0.993D-04	-0.394D-04	-0.116D-05	0.420D-01	-0.136D-01	0.622D 00
600.00	0.00	-0.975D-04	-0.530D-04	-0.898D-07	0.404D-01	-0.104D-01	0.329D 00
624.00	0.00	-0.958D-04	-0.481D-04	0.419D-06	0.388D-01	-0.676D-02	0.125D 00
648.00	0.00	-0.942D-04	-0.358D-04	0.564D-06	0.372D-01	-0.368D-02	0.462D-02
672.00	0.00	-0.927D-04	-0.226D-04	0.512D-06	0.358D-01	-0.149D-02	-0.518D-01
696.00	0.00	-0.912D-04	-0.119D-04	0.379D-06	0.344D-01	-0.156D-03	-0.667D-01
720.00	0.00	-0.898D-04	-0.451D-05	0.237D-06	0.331D-01	0.491D-03	-0.592D-01
744.00	0.00	-0.884D-04	-0.262D-06	0.123D-06	0.320D-01	0.683D-03	-0.431D-01
768.00	0.00	-0.871D-04	0.167D-05	0.447D-07	0.309D-01	0.624D-03	-0.264D-01
792.00	0.00	-0.858D-04	0.215D-05	0.319D-09	0.300D-01	0.460D-03	-0.132D-01
816.00	0.00	-0.845D-04	0.189D-05	-0.193D-07	0.291D-01	0.283D-03	-0.436D-02
840.00	0.00	-0.833D-04	0.135D-05	-0.237D-07	0.284D-01	0.139D-03	0.445D-03
864.00	0.00	-0.821D-04	0.807D-06	-0.206D-07	0.277D-01	0.407D-04	0.232D-02
888.00	0.00	-0.810D-04	0.376D-06	-0.153D-07	0.272D-01	-0.144D-04	0.240D-02
912.00	0.00	-0.798D-04	0.658D-07	-0.108D-07	0.268D-01	-0.353D-04	0.163D-02
936.00	0.00	-0.787D-04	-0.158D-06	-0.820D-08	0.265D-01	-0.307D-04	0.702D-03
960.00	0.00	-0.776D-04	-0.341D-06	-0.724D-08	0.265D-01	0.113D-04	0.152D-03

ANALYSIS OF STRAIGHT AND CURVED PILE LOADED IN PLANE OF CURVATURE
LATERAL LOAD = 12.0 KIPS

PROB
CP1 CURVED PILE

TABLE 1 - PROGRAM CONTROL DATA
PROBLEM TYPE 1

TABLE NUMBER	2	3A	3B	3C	4A	4B	4C	5A	5B	6	7
PRIOR-DATA OPTIONS (1=YES,0=NO)	0	0	0	0	0	0	0	0	0	0	0
NUMBER OF CARDS ADDED FOR THIS PROBLEM	2	1	2	2	0	0	0	0	3	1	3

TABLE 2 - JOINT COORDINATES

JOINT NUMBER	X-COORD	Y-COORD
1	0.000D 00	0.000D 00
2	0.100D 03	-0.953D 03

TABLE 3A - MEMBER PROPERTIES

MEMBER NUMBER	ELEM PER NUMBER	NON LIN	FROM JOINT NO.	FROM JOINT AREA	FROM JOINT PIN	TO JOINT NO.	TO JOINT AREA	TO JOINT PIN
1	40	1	1	1	0	2	1	0

MEMBER NUMBER	MODULUS OF ELASTICITY	FROM JOINT EI	FROM JOINT AE	TO JOINT EI	TO JOINT AE

MEMBER NUMBER	LENGTH	COSINE-X	COSINE-Y	MEMBER TYPE	CENTER-X COORDINATE	CENTER-Y COORDINATE
1	0.958D 03	0.104D 00	-0.995D 00	CURVE	0.459D 04	0.000D 00

TABLE 3B - CROSS SECTION PROPERTIES

CROSS SECTION NUMBER = 1
NUMBER OF SEGMENT = 1

SEG NUM	SEG TYPE	CUR NUM	STRESS MULTIPLIER	STRAIN MULTIPLIER	WIDTH OR DIAMETER	DEPTH OR THICKNESS	CENTROIDAL DISTANCE	SEGMENTAL AREA
1	CIRC	1	0.100D 01	0.100D-02	0.128D 02	0.500D 00	0.000D 00	

TABLE 3C - STRESS-STRAIN CURVE

STRESS-STRAIN CURVE NUMBER = 1
NUMBER OF POINTS IN THIS CURVE = 3
CURVE SYMMETRY = YES

SIG 0.000 40.000 40.000

EPS 0.000 1.333 10.000

TABLE 4A - APPLIED MEMBER LOAD

NO DATA IN THE TABLE

TABLE 4B - SELFWEIGHT

WT PER UNIT VOL MEMBER NUMBER

NO DATA IN THE TABLE

TABLE 4C - WIND AND WAVE FORCES

NO DATA IN THE TABLE

TABLE 5A - ELASTIC MEMBER RESTRAIN

NO DATA IN THE TABLE

TABLE 5B - SOIL DATA

PENETRATION DISTANCE FROM	TO	SOIL SHEAR STRENGTH	SOIL DENSITY
0.000D 00	0.000D 00	0.208D-02	0.347D-04
0.000D 00	-0.120D 03	0.208D-02	0.347D-04
0.000D 00	-0.960D 03	0.694D-02	0.347D-04

TABLE 6 - JOINT LOADS AND LINEAR SUPPORTS

JOINT	FORCE(X)	FORCE(Y)	MOMENT(Z)	SPRING(X)	SPRING(Y)	SPRING(Z)
1	0.120D 02	0.000D 00	0.000D 00	0.000D 00	0.000D 00	0.000D 00

TABLE 7 - ITERATION CONTROL

NUMBER OF LOAD INCREMENT= 1

FRAME ITERATION

MAXIMUM NUMBER OF ITERATION = 4
FORCE ERROR = 0.500D 00
MOMENT ERROR = 0.100D 02

MEMBER ITERATION

MAXIMUM NUMBER OF ITERATION = 4
FORCE ERROR = 0.500D-01
MOMENT ERROR = 0.100D 01

ANALYSIS OF STRAIGHT AND CURVED PILE LOADED IN PLANE OF CURVATURE
LATERAL LOAD = 12.0 KIPS

PROB
CP1 CURVED PILE
TABLE 8 - JOINT DISPLACEMENTS AND REACTIONS

	DISPLACEMENTS			REACTIONS		
JOINT	DISP(X)	DISP(Y)	ROTATION(Z)	REACT(X)	REACT(Y)	REACT(Z)
1	0.123D 01	0.142D-01	-0.104D-01	-0.000D 00	-0.000D 00	-0.000D 00
2	0.154D-05	0.168D-04	-0.508D-07	-0.000D 00	-0.000D 00	-0.000D 00

ANALYSIS OF STRAIGHT AND CURVED PILE LOADED IN PLANE OF CURVATURE
LATERAL LOAD = 12.0 KIPS

PROB
CP1 CURVED PILE
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 1
GOES FROM JOINT 1 TO JOINT 2
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.110D-01	0.123D 01	-0.104D-01	-0.219D 01	0.118D 02	0.279D 00
23.87	-2.44	-0.969D-02	0.987D 00	-0.101D-01	-0.170D 01	0.933D 01	0.252D 03
47.76	-4.76	-0.626D-02	0.754D 00	-0.929D-02	-0.134D 01	0.714D 01	0.455D 03
71.66	-6.95	-0.376D-02	0.545D 00	-0.811D-02	-0.909D 00	0.463D 01	0.600D 03
95.57	-9.02	-0.206D-02	0.367D 00	-0.667D-02	-0.461D 00	0.193D 01	0.682D 03
119.49	-10.96	-0.937D-03	0.225D 00	-0.512D-02	-0.451D-01	-0.707D 00	0.696D 03
143.42	-12.78	-0.268D-03	0.121D 00	-0.362D-02	0.299D 00	-0.307D 01	0.649D 03
167.36	-14.47	0.702D-04	0.505D-01	-0.227D-02	0.560D 00	-0.504D 01	0.548D 03
191.31	-16.04	0.186D-03	0.937D-02	-0.120D-02	0.673D 00	-0.608D 01	0.405D 03
215.27	-17.46	0.173D-03	-0.999D-02	-0.464D-03	0.598D 00	-0.566D 01	0.255D 03
239.23	-18.80	0.105D-03	-0.154D-01	-0.308D-04	0.437D 00	-0.437D 01	0.132D 03
263.20	-19.99	0.294D-04	-0.134D-01	0.167D-03	0.289D 00	-0.294D 01	0.440D 02
287.18	-21.05	-0.275D-04	-0.865D-02	0.205D-03	0.169D 00	-0.156D 01	-0.977D 01
311.16	-21.99	-0.595D-04	-0.418D-02	0.159D-03	0.734D-01	-0.319D 00	-0.315D 02
335.14	-22.81	-0.715D-04	-0.116D-02	0.952D-04	0.323D-01	0.289D 00	-0.253D 02
359.13	-23.50	-0.712D-04	0.513D-03	0.469D-04	0.303D-01	0.303D 00	-0.178D 02
383.13	-24.06	-0.648D-04	0.122D-02	0.146D-04	0.305D-01	0.258D 00	-0.109D 02
407.12	-24.50	-0.565D-04	0.133D-02	-0.353D-05	0.299D-01	0.189D 00	-0.547D 01
431.12	-24.82	-0.486D-04	0.113D-02	-0.117D-04	0.264D-01	0.121D 00	-0.182D 01
455.12	-25.01	-0.423D-04	0.824D-03	-0.134D-04	0.262D-01	0.647D-01	0.295D 00
479.12	-25.07	-0.377D-04	0.518D-03	-0.117D-04	0.234D-01	0.249D-01	0.127D 01
503.12	-25.01	-0.347D-04	0.274D-03	-0.858D-05	0.205D-01	0.702D-03	0.149D 01
527.11	-24.62	-0.329D-04	0.107D-03	-0.544D-05	0.175D-01	-0.113D-01	0.131D 01
551.11	-24.50	-0.319D-04	0.912D-05	-0.288D-05	0.146D-01	-0.150D-01	0.966D 00
575.11	-24.06	-0.314D-04	-0.370D-04	-0.111D-05	0.118D-01	-0.139D-01	0.615D 00
599.10	-23.50	-0.312D-04	-0.495D-04	-0.519D-07	0.908D-02	-0.107D-01	0.327D 00
623.09	-22.81	-0.311D-04	-0.435D-04	0.456D-06	0.632D-02	-0.706D-02	0.127D 00
647.08	-21.99	-0.310D-04	-0.301D-04	0.606D-06	0.349D-02	-0.402D-02	0.718D-02
671.06	-21.05	-0.311D-04	-0.157D-04	0.554D-06	0.517D-02	-0.207D-02	-0.537D-01
695.03	-19.99	-0.307D-04	-0.386D-05	0.415D-06	0.111D-01	-0.127D-02	-0.707D-01
719.00	-18.80	-0.302D-04	0.441D-05	0.264D-06	0.163D-01	-0.123D-02	-0.639D-01
742.97	-17.46	-0.293D-04	0.932D-05	0.139D-06	0.209D-01	-0.172D-02	-0.476D-01
766.92	-16.04	-0.283D-04	0.117D-04	0.511D-07	0.249D-01	-0.250D-02	-0.305D-01
790.37	-14.47	-0.271D-04	0.123D-04	-0.213D-08	0.284D-01	-0.341D-02	-0.170D-01
814.81	-12.78	-0.257D-04	0.121D-04	-0.304D-07	0.313D-01	-0.434D-02	-0.822D-02
838.74	-10.96	-0.243D-04	0.113D-04	-0.439D-07	0.337D-01	-0.521D-02	-0.388D-02
862.66	-9.02	-0.227D-04	0.102D-04	-0.512D-07	0.356D-01	-0.598D-02	-0.259D-02
886.57	-6.95	-0.211D-04	0.907D-05	-0.571D-07	0.370D-01	-0.664D-02	-0.266D-02
910.47	-4.76	-0.195D-04	0.773D-05	-0.624D-07	0.380D-01	-0.716D-02	-0.210D-02
934.36	-2.44	-0.176D-04	0.631D-05	-0.633D-07	0.386D-01	-0.751D-02	0.129D-02
958.23	0.00	-0.161D-04	0.495D-05	-0.508D-07	0.387D-01	-0.813D-02	0.937D-02

ANALYSIS OF STRAIGHT AND CURVED PILE LOADED IN PLANE OF CURVATURE
LATERAL LOAD = 21.0 KIPS

PROB
ST2 STRAIGHT PILE
TABLE 8 - JOINT DISPLACEMENTS AND REACTIONS

	DISPLACEMENTS			REACTIONS		
JOINT	DISP(X)	DISP(Y)	ROTATION(Z)	REACT(X)	REACT(Y)	REACT(Z)
1	0.363D 01	-0.344D-01	-0.260D-01	-0.000D 00	-0.000D 00	-0.000D 00
2	-0.258D-06	0.125D-03	-0.487D-07	-0.000D 00	-0.000D 00	-0.000D 00

ANALYSIS OF STRAIGHT AND CURVED PILE LOADED IN PLANE OF CURVATURE
LATERAL LOAD = 21.0 KIPS

PRCB
ST2 STRAIGHT PILE
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 1
GOES FROM JOINT 1 TO JOINT 2
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.344D-01	0.363D 01	-0.260D-01	0.289D 00	0.210D 02	0.140D 01
24.00	0.00	0.264D-01	0.301D 01	-0.255D-01	0.458D 00	0.177D 02	0.459D 03
48.00	0.00	0.191D-01	0.242D 01	-0.240D-01	0.503D 00	0.145D 02	0.849D 03
72.00	0.00	0.128D-01	0.187D 01	-0.218D-01	0.500D 00	0.107D 02	0.115D 04
96.00	0.00	0.785D-02	0.138D 01	-0.189D-01	0.542D 00	0.654D 01	0.136D 04
120.00	0.00	0.426D-02	0.962D 00	-0.158D-01	0.625D 00	0.229D 01	0.147D 04
144.00	0.00	0.190D-02	0.623D 00	-0.125D-01	0.680D 00	-0.169D 01	0.147D 04
168.00	0.00	0.524D-03	0.363D 00	-0.924D-02	0.712D 00	-0.531D 01	0.139D 04
192.00	0.00	-0.169D-03	0.178D 00	-0.632D-02	0.717D 00	-0.842D 01	0.122D 04
216.00	0.00	-0.445D-03	0.566D-01	-0.385D-02	0.707D 00	-0.109D 02	0.982D 03
240.00	0.00	-0.515D-03	-0.120D-01	-0.197D-02	0.692D 00	-0.112D 02	0.697D 03
264.00	0.00	-0.506D-03	-0.427D-01	-0.689D-03	0.669D 00	-0.957D 01	0.443D 03
288.00	0.00	-0.480D-03	-0.492D-01	0.735D-04	0.641D 00	-0.741D 01	0.238D 03
312.00	0.00	-0.454D-03	-0.424D-01	0.437D-03	0.613D 00	-0.516D 01	0.868D 02
336.00	0.00	-0.431D-03	-0.304D-01	0.523D-03	0.585D 00	-0.299D 01	-0.102D 02
360.00	0.00	-0.410D-03	-0.186D-01	0.448D-03	0.558D 00	-0.102D 01	-0.568D 02
384.0C	0.00	-0.389D-03	-0.935D-02	0.318D-03	0.530D 00	0.155D 00	-0.589D 02
408.00	0.00	-0.368D-03	-0.321D-02	0.197D-03	0.504D 00	0.486D 00	-0.493D 02
432.00	0.00	-0.347D-03	0.311D-03	0.102D-03	0.477D 00	0.565D 00	-0.356D 02
456.0C	0.00	-0.328D-03	0.191D-02	0.368D-04	0.452D 00	0.500D 00	-0.222D 02
480.00	0.00	-0.309D-03	0.229D-02	-0.118D-05	0.427D 00	0.375D 00	-0.116D 02
504.00	0.00	-0.292D-03	0.202D-02	-0.189D-04	0.402D 00	0.243D 00	-0.423D 01
528.00	0.00	-0.275D-03	0.149D-02	-0.235D-04	0.378D 00	0.133D 00	0.105D 00
552.00	0.00	-0.260D-03	0.944D-03	-0.210D-04	0.355D 00	0.536D-01	0.214D 01
576.00	0.00	-0.245D-03	0.502D-03	-0.156D-04	0.333D 00	0.511D-02	0.268D 01
600.00	0.00	-0.231D-03	0.197D-03	-0.992D-05	0.311D 00	-0.190D-01	0.239D 01
624.00	0.00	-0.219D-03	0.177D-04	-0.527D-05	0.289D 00	-0.266D-01	0.177D 01
648.00	0.00	-0.207D-03	-0.670D-04	-0.204D-05	0.269D 00	-0.247D-01	0.111D 01
672.00	0.00	-0.196D-03	-0.908D-04	-0.142D-06	0.249D 00	-0.187D-01	0.579D 00
696.00	0.00	-0.186D-03	-0.819D-04	0.747D-06	0.229D 00	-0.121D-01	0.213D 00
720.00	0.00	-0.177D-03	-0.601D-04	0.986D-06	0.210D 00	-0.643D-02	0.527D-03
744.00	0.00	-0.168D-03	-0.373D-04	0.879D-06	0.191D 00	-0.248D-02	-0.958D-01
768.00	0.00	-0.160D-03	-0.190D-04	0.639D-06	0.173D 00	-0.138D-03	-0.118D 00
792.00	0.00	-0.153D-03	-0.668D-05	0.392D-06	0.155D 00	0.951D-03	-0.102D 00
816.00	0.00	-0.147D-03	0.236D-06	0.195D-06	0.138D 00	0.123D-02	-0.727D-01
840.00	0.00	-0.142D-03	0.323D-05	0.651D-07	0.121D 00	0.107D-02	-0.434D-01
864.00	0.00	-0.137D-03	0.382D-05	-0.739D-08	0.104D 00	0.749D-03	-0.212D-01
888.00	0.00	-0.133D-03	0.320D-05	-0.395D-07	0.869D-01	0.421D-03	-0.747D-02
912.00	0.00	-0.130D-03	0.211D-05	-0.490D-07	0.703D-01	0.169D-03	-0.985D-03
936.00	0.00	-0.127D-03	0.917D-06	-0.494D-07	0.536D-01	0.218D-04	0.622D-03
960.00	0.00	-0.125D-03	-0.258D-06	-0.487D-07	0.286D-01	0.259D-05	0.623D-04

ANALYSIS OF STRAIGHT AND CURVED PILE LOADED IN PLANE OF CURVATURE
LATERAL LOAD = 21.0 KIPS

PROB
CP2 CURVED PILE
TABLE 8 - JOINT DISPLACEMENTS AND REACTIONS

	DISPLACEMENTS			REACTIONS		
JOINT	DISP(X)	DISP(Y)	ROTATION(Z)	REACT(X)	REACT(Y)	REACT(Z)
1	0.363D 01	0.300D-01	-0.260D-01	-0.000D 00	-0.000D 00	-0.000D 00
2	0.838D-05	-0.402D-06	-0.157D-06	-0.000D 00	-0.000D 00	-0.000D 00

ANALYSIS OF STRAIGHT AND CURVED PILE LOADED IN PLANE OF CURVATURE
LATERAL LOAD = 21.0 KIPS

PROB
CP2 CURVED PILE
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 1
GOES FROM JOINT 1 TO JOINT 2
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	-0.205D-01	0.363D 01	-0.260D-01	-0.413D 01	0.206D 02	0.127D 01
23.87	-2.44	-0.206D-01	0.301D 01	-0.255D-01	-0.345D 01	0.173D 02	0.459D 03
47.76	-4.76	-0.138D-01	0.242D 01	-0.240D-01	-0.276D 01	0.143D 02	0.850D 03
71.66	-6.95	-0.887D-02	0.187D 01	-0.218D-01	-0.204D 01	0.105D 02	0.116D 04
95.57	-9.02	-0.538D-02	0.138D 01	-0.189D-01	-0.136D 01	0.639D 01	0.136D 04
119.49	-10.96	-0.290D-02	0.961D 00	-0.157D-01	-0.704D 00	0.220D 01	0.147D 04
143.42	-12.78	-0.116D-02	0.622D 00	-0.124D-01	-0.125D 00	-0.175D 01	0.147D 04
167.36	-14.47	-0.825D-05	0.363D 00	-0.923D-02	0.360D 00	-0.532D 01	0.139D 04
191.31	-16.04	0.666D-03	0.177D 00	-0.631D-02	0.746D 00	-0.841D 01	0.122D 04
215.27	-17.48	0.957D-03	0.561D-01	-0.384D-02	0.102D 01	-0.108D 02	0.982D 03
239.23	-18.80	0.965D-03	-0.123D-01	-0.196D-02	0.103D 01	-0.112D 02	0.696D 03
263.20	-19.99	0.797D-03	-0.429D-01	-0.683D-03	0.850D 00	-0.953D 01	0.442D 03
287.18	-21.05	0.555D-03	-0.492D-01	0.781D-04	0.649D 00	-0.739D 01	0.237D 03
311.16	-21.99	0.317D-03	-0.423D-01	0.441D-03	0.461D 00	-0.514D 01	0.861D 02
335.14	-22.81	0.129D-03	-0.303D-01	0.525D-03	0.300D 00	-0.298D 01	-0.109D 02
359.13	-23.50	0.335D-05	-0.184D-01	0.448D-03	0.174D 00	-0.999D 00	-0.575D 02
383.13	-24.06	-0.655D-04	-0.922D-02	0.317D-03	0.111D 00	0.173D 00	-0.592D 02
407.12	-24.50	-0.937D-04	-0.311D-02	0.196D-03	0.932D-01	0.497D 00	-0.494D 02
431.12	-24.82	-0.967D-04	0.381D-03	0.100D-03	0.861D-01	0.570D 00	-0.355D 02
455.12	-25.01	-0.868D-04	0.196D-02	0.358D-04	0.824D-01	0.502D 00	-0.221D 02
479.12	-25.07	-0.721D-04	0.232D-02	-0.184D-05	0.788D-01	0.375D 00	-0.114D 02
503.12	-25.01	-0.576D-04	0.203D-02	-0.193D-04	0.743D-01	0.241D 00	-0.413D 01
527.11	-24.82	-0.454D-04	0.149D-02	-0.237D-04	0.692D-01	0.130D 00	0.177D 00
551.11	-24.50	-0.364D-04	0.947D-03	-0.211D-04	0.641D-01	0.506D-01	0.219D 01
575.11	-24.06	-0.300D-04	0.505D-03	-0.156D-04	0.594D-01	0.189D-02	0.270D 01
599.10	-23.50	-0.257D-04	0.200D-03	-0.990D-05	0.556D-01	-0.224D-01	0.240D 01
623.09	-22.81	-0.228D-04	0.212D-04	-0.523D-05	0.527D-01	-0.302D-01	0.177D 01
647.08	-21.99	-0.206D-04	-0.627D-04	-0.201D-05	0.505D-01	-0.286D-01	0.111D 01
671.06	-21.05	-0.188D-04	-0.858D-04	-0.122D-06	0.488D-01	-0.229D-01	0.575D 00
695.03	-19.99	-0.171D-04	-0.764D-04	0.759D-06	0.474D-01	-0.165D-01	0.210D 00
719.00	-18.80	-0.155D-04	-0.543D-04	0.992D-06	0.462D-01	-0.112D-01	-0.150D-02
742.97	-17.48	-0.137D-04	-0.313D-04	0.883D-06	0.450D-01	-0.762D-02	-0.963D-01
766.92	-16.04	-0.119D-04	-0.129D-04	0.643D-06	0.438D-01	-0.559D-02	-0.117D 00
790.87	-14.47	-0.101D-04	-0.360D-06	0.400D-06	0.426D-01	-0.480D-02	-0.996D-01
814.81	-12.78	-0.834D-05	0.689D-05	0.212D-06	0.415D-01	-0.484D-02	-0.685D-01
838.74	-10.96	-0.655D-05	0.104D-04	0.913D-07	0.405D-01	-0.534D-02	-0.387D-01
862.66	-9.02	-0.477D-05	0.118D-04	0.280D-07	0.397D-01	-0.607D-02	-0.178D-01
886.57	-6.95	-0.303D-05	0.121D-04	-0.174D-08	0.390D-01	-0.689D-02	-0.870D-02
910.47	-4.76	-0.129D-05	0.118D-04	-0.251D-07	0.385D-01	-0.773D-02	-0.121D-01
934.36	-2.44	0.424D-06	0.107D-04	-0.692D-07	0.383D-01	-0.854D-02	-0.272D-01
958.23	0.00	0.211D-C5	0.812D-05	-0.157D-06	0.380D-01	-0.971D-02	-0.514D-01

ANALYSIS OF STRAIGHT AND CURVED PILE LOADED IN PLANE OF CURVATURE
LATERAL LOAD = 25.0 KIPS

PROB
ST3 STRAIGHT PILE
TABLE 8 - JOINT DISPLACEMENTS AND REACTIONS

	DISPLACEMENTS			REACTIONS		
JOINT	DISP(X)	DISP(Y)	ROTATION(Z)	REACT(X)	REACT(Y)	REACT(Z)
1	0.544D 01	-0.727D-01	-0.365D-01	-0.000D 00	-0.000D 00	-0.000D 00
2	-0.244D-06	0.293D-03	-0.102D-06	-0.000D 00	-0.000D 00	-0.000D 00

ANALYSIS OF STRAIGHT AND CURVED PILE LOADED IN PLANE OF CURVATURE
LATERAL LOAD = 25.0 KIPS

PROB
ST3 STRAIGHT PILE
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 1
GOES FROM JOINT 1 TO JOINT 2
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.727D-01	0.544D 01	-0.365D-01	0.163D 00	0.250D 02	0.360D 00
24.00	0.00	0.569D-01	0.457D 01	-0.359D-01	0.776D 00	0.217D 02	0.554D 03
48.00	0.00	0.422D-01	0.373D 01	-0.341D-01	0.104D 01	0.185D 02	0.104D 04
72.00	0.00	0.294D-01	0.294D 01	-0.313D-01	0.118D 01	0.145D 02	0.144D 04
96.00	0.00	0.190D-01	0.223D 01	-0.277D-01	0.124D 01	0.967D 01	0.173D 04
120.00	0.00	0.111D-01	0.161D 01	-0.236D-01	0.123D 01	0.466D 01	0.190D 04
144.00	0.00	0.565D-02	0.110D 01	-0.193D-01	0.129D 01	-0.111D 00	0.195D 04
168.00	0.00	0.220D-02	0.687D 00	-0.149D-01	0.139D 01	-0.452D 01	0.190D 04
192.00	0.00	0.272D-03	0.379D 00	-0.108D-01	0.143D 01	-0.845D 01	0.174D 04
216.00	0.00	-0.637D-03	0.164D 00	-0.720D-02	0.142D 01	-0.117D 02	0.149D 04
240.00	0.00	-0.964D-03	0.281D-01	-0.422D-02	0.140D 01	-0.140D 02	0.117D 04
264.00	0.00	-0.102D-02	-0.447D-01	-0.198D-02	0.135D 01	-0.138D 02	0.816D 03
288.00	0.00	-0.979D-03	-0.732D-01	-0.499D-03	0.129D 01	-0.115D 02	0.509D 03
312.00	0.00	-0.925D-03	-0.736D-01	0.367D-03	0.124D 01	-0.887D 01	0.264D 03
336.00	0.00	-0.878D-03	-0.594D-01	0.757D-03	0.118D 01	-0.621D 01	0.833D 02
360.00	0.00	-0.837D-03	-0.400D-01	0.812D-03	0.112D 01	-0.370D 01	-0.341D 02
384.00	0.00	-0.798D-03	-0.220D-01	0.668D-03	0.107D 01	-0.148D 01	-0.941D 02
408.00	0.00	-0.757D-03	-0.858D-02	0.445D-03	0.101D 01	0.338D 00	-0.105D 03
432.00	0.00	-0.717D-03	-0.481D-03	0.240D-03	0.960D 00	0.114D 01	-0.779D 02
456.00	0.00	-0.678D-03	0.343D-02	0.963D-04	0.907D 00	0.105D 01	-0.502D 02
480.00	0.00	-0.640D-03	0.460D-02	0.949D-05	0.855D 00	0.815D 00	-0.273D 02
504.00	0.00	-0.605D-03	0.424D-02	-0.335D-04	0.804D 00	0.545D 00	-0.110D 02
528.00	0.00	-0.572D-03	0.322D-02	-0.471D-04	0.754D 00	0.309D 00	-0.112D 01
552.00	0.00	-0.542D-03	0.211D-02	-0.441D-04	0.706D 00	0.135D 00	0.380D 01
576.00	0.00	-0.513D-03	0.117D-02	-0.338D-04	0.659D 00	0.254D-01	0.537D 01
600.00	0.00	-0.486D-03	0.497D-03	-0.222D-04	0.613D 00	-0.319D-01	0.502D 01
624.00	0.00	-0.461D-03	0.891D-04	-0.122D-04	0.568D 00	-0.526D-01	0.383D 01
648.00	0.00	-0.438D-03	-0.114D-03	-0.515D-05	0.524D 00	-0.516D-01	0.249D 01
672.00	0.00	-0.417D-03	-0.180D-03	-0.841D-06	0.481D 00	-0.405D-01	0.135D 01
696.00	0.00	-0.397D-03	-0.171D-03	0.129D-05	0.439D 00	-0.269D-01	0.546D 00
720.00	0.00	-0.379D-03	-0.130D-03	0.197D-05	0.399D 00	-0.149D-01	0.618D-01
744.00	0.00	-0.363D-03	-0.834D-04	0.185D-05	0.358D 00	-0.625D-02	-0.171D 00
768.00	0.00	-0.349D-03	-0.443D-04	0.139D-05	0.319D 00	-0.947D-03	-0.238D 00
792.00	0.00	-0.336D-03	-0.172D-04	0.878D-06	0.280D 00	0.166D-02	-0.216D 00
816.00	0.00	-0.325D-03	-0.139D-05	0.458D-06	0.242D 00	0.247D-02	-0.159D 00
840.00	0.00	-0.316D-03	0.587D-05	0.170D-06	0.204D 00	0.226D-02	-0.979D-01
864.00	0.00	-0.308D-03	0.775D-05	0.441D-08	0.166D 00	0.164D-02	-0.499D-01
888.00	0.00	-0.302D-03	0.678D-05	-0.731D-07	0.128D 00	0.959D-03	-0.192D-01
912.00	0.00	-0.297D-03	0.465D-05	-0.990D-07	0.898D-01	0.414D-03	-0.389D-02
936.00	0.00	-0.294D-03	0.221D-05	-0.103D-06	0.515D-01	0.806D-04	0.653D-03
960.00	0.00	-0.293D-03	-0.244D-06	-0.102D-06	-0.682D-02	-0.367D-05	-0.242D-04

ANALYSIS OF STRAIGHT AND CURVED PILE LOADED IN PLANE OF CURVATURE
LATERAL LOAD = 29.0 KIPS

PROB
ST4 STRAIGHT PILE
TABLE 8 - JOINT DISPLACEMENTS AND REACTIONS

	DISPLACEMENTS			REACTIONS		
JOINT	DISP(X)	DISP(Y)	ROTATION(Z)	REACT(X)	REACT(Y)	REACT(Z)
1	0.801D 01	-0.148D 00	-0.503D-01	-0.000D 00	-0.000D 00	-0.000D 00
2	0.262D-05	0.683D-03	-0.132D-06	-0.000D 00	-0.000D 00	-0.000D 00

ANALYSIS OF STRAIGHT AND CURVED PILE LOADED IN PLANE OF CURVATURE
LATERAL LOAD = 29.0 KIPS

PROB
ST4 STRAIGHT PILE
TABLE 9 - MEMBER RESULTS

MEMBER NUMBER 1
GOES FROM JOINT 1 TO JOINT 2
ALL OUTPUT FORCES AND DISPLACEMENTS ARE IN NORMAL AND TANGENTIAL AXES

DISTANCE		DISPLACEMENTS			FORCES		
X	Y	AXIAL	LATERAL	ROTATIONAL	AXIAL	SHEAR	MOMENT
0.00	0.00	0.148D 00	0.801D 01	-0.503D-01	-0.232D 00	0.289D 02	0.856D 01
24.00	0.00	0.118D 00	0.681D 01	-0.496D-01	0.954D 00	0.256D 02	0.655D 03
48.00	0.00	0.896D-01	0.564D 01	-0.475D-01	0.160D 01	0.224D 02	0.123D 04
72.00	0.00	0.644D-01	0.454D 01	-0.441D-01	0.208D 01	0.184D 02	0.173D 04
96.00	0.00	0.433D-01	0.353D 01	-0.398D-01	0.238D 01	0.135D 02	0.211D 04
120.00	0.00	0.268D-01	0.264D 01	-0.347D-01	0.252D 01	0.791D 01	0.237D 04
144.00	0.00	0.147D-01	0.187D 01	-0.290D-01	0.272D 01	0.229D 01	0.249D 04
168.00	0.00	0.670D-02	0.125D 01	-0.232D-01	0.298D 01	-0.300D 01	0.247D 04
192.00	0.00	0.187D-02	0.760D 00	-0.176D-01	0.310D 01	-0.785D 01	0.234D 04
216.00	0.00	-0.686D-03	0.401D 00	-0.125D-01	0.312D 01	-0.121D 02	0.209D 04
240.00	0.00	-0.181D-02	0.156D 00	-0.811D-02	0.308D 01	-0.156D 02	0.175D 04
264.00	0.00	-0.217D-02	0.495D-02	-0.463D-02	0.299D 01	-0.172D 02	0.134D 04
288.00	0.00	-0.217D-02	-0.737D-01	-0.208D-02	0.286D 01	-0.160D 02	0.928D 03
312.00	0.00	-0.207D-02	-0.102D 00	-0.395D-03	0.273D 01	-0.132D 02	0.574D 03
336.00	0.00	-0.196D-02	-0.983D-01	0.578D-03	0.261D 01	-0.102D 02	0.293D 03
360.00	0.00	-0.186D-02	-0.784D-01	0.100D-02	0.248D 01	-0.712D 01	0.864D 02
384.00	0.00	-0.177D-02	-0.532D-01	0.105D-02	0.236D 01	-0.425D 01	-0.485D 02
408.00	0.00	-0.168D-02	-0.300D-01	0.860D-03	0.224D 01	-0.171D 01	-0.118D 03
432.00	0.00	-0.160D-02	-0.127D-01	0.582D-03	0.212D 01	0.380D 00	-0.130D 03
456.00	0.00	-0.151D-02	-0.196D-02	0.324D-03	0.200D 01	0.135D 01	-0.993D 02
480.00	0.00	-0.143D-02	0.345D-02	0.139D-03	0.188D 01	0.130D 01	-0.655D 02
504.00	0.00	-0.135D-02	0.530D-02	0.249D-04	0.177D 01	0.104D 01	-0.366D 02
528.00	0.00	-0.128D-02	0.510D-02	-0.339D-04	0.166D 01	0.706D 00	-0.158D 02
552.00	0.00	-0.121D-02	0.398D-02	-0.546D-04	0.155D 01	0.411D 00	-0.274D 01
576.00	0.00	-0.115D-02	0.265D-02	-0.533D-04	0.145D 01	0.188D 00	0.395D 01
600.00	0.00	-0.109D-02	0.150D-02	-0.418D-04	0.134D 01	0.448D-01	0.629D 01
624.00	0.00	-0.104D-02	0.665D-03	-0.279D-04	0.124D 01	-0.321D-01	0.610D 01
648.00	0.00	-0.986D-03	0.148D-03	-0.157D-04	0.114D 01	-0.617D-01	0.475D 01
672.00	0.00	-0.940D-03	-0.115D-03	-0.687D-05	0.105D 01	-0.628D-01	0.314D 01
696.00	0.00	-0.897D-03	-0.208D-03	-0.141D-05	0.952D 00	-0.502D-01	0.174D 01
720.00	0.00	-0.859D-03	-0.204D-03	0.136D-05	0.859D 00	-0.338D-01	0.727D 00
744.00	0.00	-0.825D-03	-0.158D-03	0.230D-05	0.768D 00	-0.191D-01	0.113D 00
768.00	0.00	-0.794D-03	-0.102D-03	0.221D-05	0.679D 00	-0.823D-02	-0.188D 00
792.00	0.00	-0.767D-03	-0.551D-04	0.169D-05	0.590D 00	-0.152D-02	-0.281D 00
816.00	0.00	-0.744D-03	-0.220D-04	0.108D-05	0.502D 00	0.184D-02	-0.261D 00
840.00	0.00	-0.725D-03	-0.249D-05	0.571D-06	0.415D 00	0.292D-02	-0.193D 00
864.00	0.00	-0.709D-03	0.667D-05	0.219D-06	0.328D 00	0.272D-02	-0.120D 00
888.00	0.00	-0.697D-03	0.922D-05	0.144D-07	0.241D 00	0.198D-02	-0.624D-01
912.00	0.00	-0.688D-03	0.822D-05	-0.841D-07	0.153D 00	0.115D-02	-0.254D-01
936.00	0.00	-0.684D-03	0.568D-05	-0.121D-06	0.642D-01	0.471D-03	-0.736D-02
960.00	0.00	-0.683D-03	0.262D-05	-0.132D-06	-0.717D-01	-0.721D-04	-0.277D-02

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