FOR REFERENCE

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THREE DIMENSIONAL ANALYSIS OF POINT-BEARING PILE GROUPS





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THREE DIMENSIONAL ANALYSIS OF POINT-BEARING PILE GROUPS

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THREE DIMENSIONAL ANALYSIS OF POINT-BEARING PILE GROUPS -ABSTRACT-

Piles in the foundation of structures like bridge piers, quays, retaining walls and the like are usually installed in groups resulting in a group reaction. This brings about the problem of determining the distribution of this reaction among individual piles in the group. Especially, if a group of piles consists of both vertical and battered piles, if there are both horizontal and vertical loads or if the loads on the group are eccentric with respect to the pile group, the question of what load is carried by each pile in the group naturally arises. This study attempts to develop a computer program providing the three dimensional analysis of such systems. Here it is assumed that external loads from the superstructure are transferred to the piles through an infinitely rigid pile cap, and piles reach the bearing strata. Each pile is idealized as a beam having a uniformly distributed linearly elastic spring reaction in the lateral direction. Thus; shears, axial forces and moments acting on the piles within the group are determined. The displacements and rotations of each single pile are also calculated. The results of the analysis are checked against the solutions of some particular examples given in the literature.

SAĞLAM ZEMİNDE OTURAN KAZIK GRUPLARININ ÜÇ BOYUTLU ANALİZİ - ÖZET -

Köprü tabliyeleri, rıhtım ve istinat duvarları ve benzeri yapıların temellerinde, kazıklar genellikle gruplar halinde kullanılmakta bu da grup reaksiyonunun doğmasına neden olmaktadır. Ayrıca ortaya çıkan grup reaksiyonunun kazıklar arasındaki dağılımının belirlenmesi problemi de ortaya çıkmaktadır. Özellikle, eğer kazık grubu düşey ve eğik kazıklardan meydana gelmişse ve bu grub yatay ve düşey yükler etkisi altındaysa, veya bu yükler eksantrik olarak etkiyorsa; her kazığın ne kadar yük taşıdığı sorusu daha da önem kazanmaktadır. Çalışmada bu tip sistemlerin üç boyutlu analizi ele alınmıştır. Üstyapıdan etkiyen dış yüklerin sonsuz rijit bir tabliye tarafından kazıklara aktarıldığı ve kazıkların sağlam zemine ulaştıkları varsayılmıştır. Her kazık yatay yönde eşit sayılı lineer elastik yay reaksiyonlarıyla desteklenmiş bir kiriş olarak idealize edilmiştir. Böylelikle gruptaki her bir kazığa etkiyen kesme ve eksenel kuvvetlerle momentler bulunmuştur. Ayrıca yükler altında ortaya çıkan deplasman ve dönmeler de hesaplanmıştır. Literatürden verilen bazı örnekler geliştirilen programdan elde edilen neticelerle karsılaştırılmıştır.

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LIST OF SYMBOLS

| A | : | Cross sectional area (L ²) |
|---------------------------|-------|--|
| A _{ij} | : | Elements of the stiffness matrice |
| A _i | : | Transformation matrice |
| a _i | : | Pile head location matrice |
| α. | : | Torsional factor (L ⁴) |
| b _{ij} | : | Coefficients of the second side (elements |
| | - | of the loading matrice) |
| BG | : | Width of the band matrice |
| C | : | Coefficient of subgrade reaction |
| c_1, c_2, c_3 and c_4 | : | Integration constants |
| C(I) | : | Sequence of soil modulus (Coefficient |
| | • | of subgrade reaction) |
| CO(I) | : | Sequence of direction cosines |
| d _o | | Pile head displacements matrice in the |
| | · · · | 'global axis |
| d | : | Pile head displacements matrice in pile axis |
| E | : | Modulus of elasticity of the pile material |
| | | (F.L ⁻²) |

ce

| EL(I) | : Sequence for lengths of pile elements (L) |
|--|---|
| ER _i | : Element stiffness matrice |
| EX | : Stiffness against moment in x direction |
| | for each pile element |
| EY | : Stiffness against moment in y direction |
| | for each pile element |
| G S S S S S S S S S S S S S S S S S S S | : Shear modulus of elasticity of the pile material (F.L ⁻²) |
| Ŷ | : Pile stiffness factor = $\left(\frac{cb}{4EI}\right) * * 0.25$ |
| ĢJ | : Stiffness against torsion for each pile |
| | element |
| GL(I) | : Sequence for Gamma (L) for each element |
| H | : Horizontal force (F) |
| I | : Moment of inertia of the section of the |
| | pile (L ⁴) |
| 1 | : Identity matrice |
| IDKR i | : Gaussian-eliminated and re-arranged pile |
| | head stiffness matrice |
| IDKRT | : Equivalent pile group stiffness matrice |
| ikr _i | : Re-arranged pile stiffness matrice |
| ITS | : Number of columns on the second side of |
| | the equation (number of loadings) |
| i | : Row number in the element stiffness matri |

| j : | Column number in the element stiffness |
|--|---|
| $\frac{1}{2} \sum_{i=1}^{n} \frac{1}{i} \sum_{i=1}^{n} \frac{1}$ | matrice |
| KS (i,j) : | Function that transfers two dimensional |
| | matrice into one dimensional one. |
| 1 : | Length of the pile element (L) |
| M : | Moment (F.L) |
| ND : | Total number of node number in one |
| | pile element |
| NI : | Node number |
| NIKR i : | New-order pile stiffness matrice |
| NLOAD : | Total number of loadings |
| NPILE : | Total number of piles in a group |
| p : | Lateral subgrade reaction at any point |
| | (F.L ⁻¹) |
| $P_1, P_2, P_3, P_4, P_5, and P_6$ | :Elements of the loading matrice |
| POC _i : | Pile head reactions matrice |
| Q : | Axial force (F) |
| q ₀ : | External pile head loading matrice in |
| | the global axis |
| q _i : | Pile head reactions matrices in the |
| | pile axis |
| R : | Resultant force (F) |
| T ₁ ₁ : | Translation matrice |

| $ \mathtt{T}_2 _{\mathtt{i}}$ | : | Rotation matrice |
|-------------------------------|---|---------------------------------|
| V | : | Vertical force (F) |
| W | : | Lateral deflection of pile (L) |
| X(I) | : | Sequence of x, y, z coordinates |
| YBG | : | Width of the half-band matrice |

I. INTRODUCTION

Design and analysis of pile foundations has become an important area of research and several approaches have been developed to tackle them. Its importance arises not only because pile foundations constitute a large proportion of substructures but a better understanding of their behaviour helps the analysis of superstructures as well.

Due to the complex nature of the problem, with variation of subgrade reaction from one site to another, and along the length of the pile, and also diversity of pile group arrangements a definitive general solution is not possible. Modelling the problem mathematically is difficult. Rather than developing a mathematical model for a direct solution experimental studies have been carried out for single piles with different soil properties. As a result of these, charts have been developed giving the individual pile stresses for different soil properties. After Broms, many charts have been developed determining subgrade reaction and resultant pile stresses for single piles under vertical and horizontal. forces and bending moments (4). Although engineering codes and specifications specify capacities for single piles, no assistance is provided for determining the reaction capacity of different piles located in the same group (1). Yet pile configuration in a group influences the magnitude and distribution of indivudual pile reactions.

With the help of microcomputers representative models for pile groups can be analized to determine individual pile stresses within the group (5). A recent study including the previous works of three-dimensional analysis has been done by Bowles and a computer program has been developed. A successive approximation analysis may be performed by this method if the soil data are sufficiently reliable. This method of pile group analysis makes the following assumptions.

 The load carried by any pile is proportional to the displacement of the pile head. The displacement consists of an axial, transverse and rotational component,

2. The footing (pile cap) in infinitly rigid,

3. The footing undergoes only small displacements,

4. The pile heads are pinned to the pile cap. Although these assumptions do not strictly represent the true situation, they do not introduce serious errors. The program analyzes the group under vertical and a horizontal loads and for any pile the axial and transverse forces are computed. However it is not possible to compute either settlements of the pile groups or the bending and torsional moments exerted in each single pile. Inorder to overcome all these difficulties, another approach is adopted in this study by modelling the piles as an elastically supported beam in the lateral direction. This implies that the objective of this study is to present the three dimensional analysis of pile groups giving the forces and displacements developed in individual piles in each of the six-degrees of freedom in space as shown in figure 1.1. A program is developed considering point-bearing piles only. The skin friction acting on the piles is ignored. It is assumed that load effects from the superstructure are transferred to the individual piles by a rigid pile cap. In practice piles groups of this type constitute a significant proportion of total number of piled foundations. It is also assumed that subgrade reaction is proportional to the lateral displacement at any point along the pile based on "Winkler hypothesis" (7). Any other model than the Winkler's can easily be used in the program if desired.

Inorder to serve the needs of engineering design offices a simple data input is formulated, and effort is made to use a minimum number of memory locations. In the program, piles may individually be defined by the user as vertical or inclined. The subgrade reaction may be defined along the pile length to simulate actual soil properties encountered at the site of the foundation. The program

analyzes the group and determines displacements and rotations as well as axial forces, shears and moments generated in each pile.

Once the analysis is complete, it will be necessary to establish the acceptability of the individual pile stresses and displacements both from structural and geotechnical view point. The overall group reaction capacity should also be investigated.

Finally, solutions of some particular examples given in the literature are compared to the ones obtained from the proposed method and computer outputs of these study.



FIGURE 1.1 - Three dimensional modelling of point-bearing pile groups and the external forces and moments applied from the superstructure.

II. ANALYSIS OF PILE GROUPS

2.1. ANALYSIS OF PILES VERSUS PILE GROUPS

Piles are seldom used singly; generally a foundation is made up of a group of piles installed under a cap distributing the load. Where the cap is cast on the ground the system is called a pilled foundation. Where the cap is formed above the ground it is called a free-standing group.

The settlement of a group of vertical piles subjected to a given average load per pile may be very different from the settlement of a comparable single pile. Similarly, the ultimate load that can be carried by a group of piles is not necessarily the ultimate load of a single pile multiplied by the number of piles in the group. This behaviour and the mechanism which causes it, is usually referred to as "group action". It is important in the case of friction piles in clay, not quite so important with point-bearing piles in dense or gravel and generally unimportant where piles are driven to rock. Pile groups of this type are object of this study. The pile ends are assumed to reach the hard bearing strata and interference among adjacent piles in neglected. In such a case the bearing capacity should be calculated as the load per pile multiplied by the number of piles in the group. The settlement of the foundation is usually little more than the elastic shortening of the pile under load.

Another aspect of the study for piled foundaitons is the resistance of such foundations against horizontal forces. In many applications these forces are small enough to be neglected, but with large buildings and bridges to resist to wind forces, and in earthquake areas the resistance to horizontal forces caused by shocks are of considerable importance. In the case of a bridge the forces due to traffic acceleration, breaking and turning may also be important. For the design of retaining walls, quays and dolphins horizontal forces form a major part of the loading system.

When a vertical pile is deflected from its initial position by a horizontal force applied to the pile head, the deflected form of the pile depends on the head conditions, the pile length, and the stiffness of both pile and the soil. The differential equation for the flexure of a uniform pile embedded in the soil is

$$EI \frac{d^{4}W}{dx^{4}} + p = 0$$
 (2.1)

where,

- W = The deflection of the pile at any point
- X = The depth of that point from the soil surface
- P = Lateral subgrade reaction per unit length at any point.
- E = The modulus of elasticity of the pile material

I = The moment of inertia of the section of the pile In uniform clay it is often assumed that c, the coefficient of lateral reaction is constant, so that p=cw. For granular soils c is usually considered to vary linearly with depth, so that $c=n_hx$, and therefore $p=n_hxw$ where n_h is the constant of horizontal subgrade reaction, as defined by Terzaghi (4). Palmer and Brown (5) examined the case where the value of c varies according to the equation $c=c_1(x/L)^n$, where c_1 is the value of c at the depth L, L being the pile length. They found that values of the parameter n in the range 0 < n < 1 agreed best with test results.

For the case where p=cw and for a pile with no head restraint, and with a horizontal force P applied at the ground level.

$$W = \frac{H}{2 \text{ EIB}^{3}} e^{-\beta x} \cos \beta x \qquad (2.2)$$
$$M = -\frac{H}{\beta} e^{-\beta x} \sin \beta x \qquad (2.3)$$

where M = the moment on the pile at depth x

$$\beta = (c/4EI)^{1/4}$$

$$W = \frac{H}{4 \text{EI } \beta^3} e^{-\beta x} (\cos \beta x + \sin \beta x)$$
(2.4)

$$M = \frac{\pi}{2\beta} e^{-\beta X} (\sin \beta x - \cos \beta x)$$
(2.5)

Although there are many approaches of calculation for laterally loaded single piles, the application of the theoretical solutions to practical design is handicapped by the difficulty of obtaining the value of c. However the value assigned to the parameter c is considerable importance. It is known to vary with the type of soil, the confining pressures, the width of the face, the amount of deflection and the duration of loading.

2.2 GROUPS OF VERTICAL PILES

The following approximate methods are commonly used for groups of identical piles subjected forces and moments for practical design purposes. The pile cap is assumed to be rigid and the reaction of any pile is assumed to be proportional to the displacement of the pile head.

If the vertical load V is applied at the centre of gravity of the pile group, the displacement of the head of each pile will be the same and load distribution is therefore assumed to be equal. Thus V = nQ where Q is the load per pile and n the number of piles :

$$Q_1/x_1 = Q_2/x_2 = \dots = Q_n/x_n$$
 (2.6)

so that

$$Q_1 = Q_1 x_1/x_1, Q_2 = Q_1 x_2/x_1, \dots = Q_n = Q_1 x_n/x_1(2.7)$$

It is obvious that

$$M = Q_1 x_1 + Q_2 x_2 + \dots + Q_n x_n$$
 (2.8)

Thus,

$$M = Q_1 x_1^2 / x_1 + Q_1 x_2 / x_1 + \dots + Q_n x_n^2 / x_1$$
(2.9)

Therefore

$$\Omega_1 = Mx_1 / \sum_{i=1}^{n} x_i^2$$
 (2.10a)

Similarly

$$Q_2 = Mx_2 / \sum_{i=1}^{n} x_i^2 \dots Q_n = Mx_n / \sum_{i=1}^{n} x^2$$
 (2.10b)

Thus the total load Q on pile 1 due to a vertical force and a moment applied at the center of gravity is.

$$Q_1 = V/n + M x_1 / \sum_{i=1}^{n} x^2$$
 (2.11)

If a rectangular group of piles is subjected to moments about both axes xx and yy through the centre of gravity of the group as well as a vertical force acting at the centre

of gravity, then

$$Q_1 = V/n + Myy x_1 / \sum_{i=1}^{n} x^2 + Mxx Y / \sum_{i=1}^{n} y^2$$
 (2.12)

The sign of the second term will be positive for piles to the left of yy and the third term will be positive for piles above xx for the moment directions in right-handed coordinate system.

2.3 GROUPS WITH VERTICAL AND INCLINED PILES

When a piled foundation is subjected to a horizontal force or a moment as well as a vertical force, it is usual for some of the piles to be inclined in order that the resultant of the external forces will be appliced approximately axially to some of the piles. The calculation of the forces and moments transmitted to the each pile in the group is an extremely complicated problem for which no true solution exists. The usual approach to the subject has been made from the direction of structural engineering, in which the piles are treated as members of a frame, the cap is assumed to be rigid. There is a high order of indeterminancy and various simplifications are introduced to make a solution possible.

Mostly piles are regarded as hignes at their upper ands and carry axial loads to hignes on rigid bearings





FIGURE 2.1. A pile group subjected to bending moments in two direction.

at their points. The axial displacement of piles due to compression of soil and the effect each pile has on its neighbours are ignored in all case.

As an example a repeating pattern of retaining wall piles is considered. The foundation is of such a length that it is only necessary to determine the forces for a width b as shown in figure 2.2

The magnitude and line of action of the external forces R is assumed to be known and R intersects the base of the pile cap at X, at a distance a from the center of gravity o. V and are the vertical and horizontal components of R at the point X.

The effect at the pile heads of a vertical force V at X is equivalent to a vertical force V at o plus a moment Va. It is also assumed that H is taken only by the horizontal component of the axial force in the inclined piles and the vertical piles do not offer any resistance to horizontal forces.

2.4 GRAPHICAL METHOD FOR PILES IN THREE DIRECTION

If the piles in a group are inclined not more than three different directions, a graphical solution may be used. The cap on the piles is assumed to be rigid and all the piles and the applied forces are assumed to act in the same plane. The resultant R of the forces is known in magnitude, direction and position. Lines P, Q and S are drawn representing the lines of action of the rows of piles inclined in the same direction through the centers of gravity of their respective rows.

The direction of R meets line P in X. Lines Q and S meet in Y. Using Bow's notation as shown in figure 2.3 the forces on the lines XY and P are first determined from these the forces on lines Q and S are calculated. It is also assumed that the force in each of the three directions is equally shared among the piles inclined in that direction.

2.5 METHODS BASED ON ELASTIC THEORY

The method proposed by Vetter (1939) provides a means of estimating pile loads when there are more than three rows or when piles are fixed headed. It is confined to two dimensional systems and the following assumptions are made(11).

- 1. The pile cap is rigid
- 2. The piles are elastic
- 3. The whole load is carried by the piles

4. The resistance of a pile is concentrated at its base in the case of an end-bearing pile and at one-third of the length of the pile up from the base in friction piles.

5. The soil provides rigid axial bearing but gives no other support.

The methods proposed by Asplund and Francis introduced the lateral resistance of the soil to the calculations to approximate to reality in a better way although they require the knowledge of pile soil interaction.

However all the methods put forward ignore the displacement of the supporting soil, the influence of individual pile on its neighbours and the effect of pile cap when it is flexible or exerts a vertical pressure on the ground. It is assumed that all the piles act independently in all the methods, but if they are closely spaced they do influence each other. Jampel (1949) and Francis (1964) suggest to reduce the value of c for groups of closely spaced piles and group action can be as important in any given instance for horizontal as well as for vertical forces (11).

In the design of retaining walls, bridge abutments or quays, the use of complex design method does not seem to be easily applicable because of the uncertanties involved regarding c coefficient.

III. PROGRAMMING

Inorder to analyze pile groups each pile is assumed to act as a beam elastically supported in the lateral direction. The related stiffness matrix is produced out of the mathematical model obtained using "Winkler hypothesis" (7).

3.1 FORMATION OF THE ELEMENT STIFFNESS MATRICE :

It is assumed that the reaction force for a unit length is directly proportional to the displacements for each element. Thus, the horizontal reaction p, is equal to a constant times horizontal displacement.

p(x) = cbw(x), c > 0

(3.1)

where, b is the width of the element.

The degrees of freedom and resultant reactions for an element is shown in figure 3.1



FIGURE 3.1. A schematic representation for forces and displacement of a pile element.

The elastic curve for a span of *l* is governed by the differential equation

$$\frac{d^4 w}{dx^4} = - \frac{P(x)}{EI} = - \frac{cb}{EI} \quad w(x)$$
(3.2)

For a homogenous solution;

 $W = C_1 \cosh \gamma x \cdot \cos \gamma x + C_2 \sinh \gamma x \cos \gamma x + C_3 \cosh \gamma x$ sin $\gamma x + C_4 \sinh \gamma x \cdot \sin \gamma x$

Where C_1 , C_2 , C_3 and C_4 are integration constrants and

$$= \frac{1}{4EI}$$

Moments and shear forces can be written out of the solution

for displacements as

$$M(x) = -\frac{d^2 w}{dx^2}$$
(3.4)

and

$$T(x) = -EI \frac{d^3 w}{dx^3}$$
 (3.5)

Therefore the reactive forces will be

$$P_{1} = M(0) = EI \frac{d^{2}w(0)}{dx^{2}}$$
(3.6)

$$P_2 = M(\ell) = - EI \frac{d^3 w(\ell)}{dx^2}$$
(3.7)

$$P_{\iota} = T(\ell) = - EI \frac{d^{3}w(\ell)}{dx^{3}}$$
(3.8)

$$P_{6} = T (0) = -EI \frac{d^{3}w(0)}{dx^{3}}$$
(3.9)

and the related displacements are

dx

$$D_{1} = -\frac{dw}{dx} (0)$$
(3.10)
$$D_{2} = \frac{dw}{dx} (1)$$
(3.11)

$$D_{\mu} = W(\ell)$$

$$D_{e} = -w(0)$$

Betti's reciprocal theorem is also applicable for this case therefore the, flexibility matrice should be symmetrical to its diagonal. Thus some elements of the flexibility matrice will be,

$$f_{11} = f_{22}, f_{66} = f_{44}, f_{24} = f_{16}, f_{26} = f_{62} = f_{14} (3.14)$$

Furthermore, considering that the pile is a straight prismatic beam, it can be stated that

$$f_{13} = f_{24} = f_{34} = f_{36} = 0, \quad f_{33} = \frac{\ell}{E\Delta}$$
(3.15)

where

l is the length of the element

A is the cross-sectional area

Inorder to determine the other elements of the flexibility matrice two different loadings are made on the beam.

For $P_1 = P_3 = P_4 = P_6 = 0$ and $P_2 = 1$ integration constants C_1 , C_2 , C_3 and C_4 are determined using equations 3.6 through 3.9 By definition,

 $D_1 = f_{12}$, $D_2 = f_{22} = f_{11}$, $D_4 = f_{42} = f_{16}$, $D_6 = f_{62} = f_{14}$ which leads to

(3.13)

$$f_{11} = \frac{\ell}{EI} \cdot \frac{1}{\gamma \ell} \cdot \frac{\sinh \gamma \ell \cdot \cosh \gamma \ell + \sin \gamma \ell \cdot \cos \gamma \ell}{\sinh^2 \gamma \ell - \sin^2 \gamma \ell}$$
(3.17)

$$f_{12} = \frac{\ell}{EI} \cdot \frac{1}{\gamma_{\ell}} \cdot \frac{\sinh\gamma\ell \cdot \cos\gamma\ell + \cosh\gamma\ell \cdot \sin\gamma\ell}{\sinh^{2}\gamma_{\ell} - \sin^{2}\gamma_{\ell}}$$
(3.18)

$$f_{14} = \frac{\ell^2}{EI} \cdot \frac{1}{(\gamma \ell)^2} \frac{\sinh \gamma \ell \cdot \sin \gamma \ell}{\sinh^2 \gamma \ell - \sin^2 \gamma \ell}$$
(3.19)

$$f_{16} = \frac{\ell^2}{EI} \cdot \frac{1}{2(\gamma \ell)^2} \frac{\sinh^2 \gamma \ell - \sin^2 \gamma \ell}{\sinh^2 \gamma \ell - \sin^2 \gamma \ell}$$
(3.20)

In a second loading for P_1 , = P_2 , = P_3 , = P_6 , and P_4 = 1 the integration constants are determined using equations 3.6 through 3.9 Consequently, $D_4 = f_{44}$ and $D_6 = f_{46}$ are obtained.

$$f_{44} = \frac{\ell^3}{EI} \cdot \frac{1}{2(\gamma \ell)^3} \frac{\sinh\gamma\ell \cdot \cosh\gamma\ell - \sin\gamma\ell \cdot \cos\gamma\ell}{\sinh^2\gamma\ell - \sin^2\gamma\ell} (3.21)$$

$$f_{46} = \frac{3}{EI} \frac{1}{2(\gamma \ell)^3} \frac{\sinh \gamma \ell \cdot \cos \gamma \ell - \cosh \gamma \ell \cdot \sin \gamma \ell}{\sinh^2 \gamma \ell - \sin^2 \gamma \ell}$$
(3.22)

By definition stiffness matrix is the inverse of the flexibility matrice so the elements of the stiffness matrice are the reciprocals of the flexibilty elements. Thus,

$$k_{11} = \frac{EI}{\ell} \cdot 2\gamma\ell \cdot \frac{\sin\gamma\ell \cdot \cosh\gamma\ell - \sin\gamma\ell \cosh\gamma\ell}{\sinh^2\gamma\ell - \sin^2\gamma\ell}$$
(3.23)

$$k_{12} = \frac{EI}{\ell} \cdot 2\gamma\ell \cdot \frac{\sin\gamma\ell \cdot \sin\gamma\ell - \sin\gamma\ell \cos\gamma\ell}{\sinh^2\gamma\ell - \sin\gamma\ell}$$
(3.24)

$$k_{14} = \frac{EI}{\ell^2} 4(\gamma \ell)^2 \frac{\sinh \gamma \ell \sin \gamma \ell}{\sinh^2 \gamma \ell - \sin^2 \gamma \ell}$$
(3.25)

$$k_{16} = \frac{EI}{\ell^2} 2(\gamma \ell)^2 \frac{\sinh^2 \gamma \ell + \sin^2 \gamma \ell}{\sinh^2 \gamma \ell - \sin^2 \gamma \ell}$$
(3.26)

$$k_{44} = \frac{EI}{\ell^2} 4(\gamma \ell)^3 \frac{\sinh \gamma \ell \cosh \gamma \ell + \sin \gamma \ell \cos \gamma \ell}{\sinh^2 \gamma \ell - \sin^2 \gamma \ell}$$
(3.27)

$$k_{46} = \frac{EI}{\ell^3} 4(\gamma \ell)^3 \frac{\cosh \gamma \ell \sin \gamma \ell + \sinh \gamma \ell \cosh \gamma \ell}{\sinh^2 \gamma \ell - \sin^2 \gamma \ell}$$
(3.28)

and the resulting stiffness matrix will be as shown in figure 3.2

| | 1 | 2 | 3 | 4 | 5=3 | 6 | |
|-------|------|------|------|------|------|------|-----|
| | K 11 | K 12 | 0 | K 14 | 0 | K 16 | 1 |
| | K 21 | K 11 | 0 | K16 | 0 | K 14 | 2 |
| | 0 | 0 | EA/L | 0 | EA/I | 0 | 3 |
| [n] - | K 14 | K16 | 0 | K44 | 0 | K 46 | 4 |
| | 0 | 0 | EA/1 | 0 | EA/I | 0 | 5=3 |
| | K 16 | K 14 | 0 | K46 | 0 | K 44 | 6 |

FIGURE 3.2 Stiffness matrice of a pile element

A subroutine is introduced to the program for the calculation of element stiffness matrix element. The subroutine is executed twice for each element. One for the reactions in the plane of the beam and the other for the reactions perpendicular to the plane of the beam. In the second execution the torsional stiffness Ga is substituted
for the axial stiffness EA, where

G is Shear modulus of elasticity

 α is the torsional factor

Some of the magnitudes are calculated at the beginning for the reasons of simplicity. By introducing some intermediate values stiffness matrice elements can easily be obtained. The calculation procedure is,

 $GL = L^* (C^*B/(4^*E^*I)) **0.25$

The magnitudes that are to be calculated once,

CH = $\cosh \gamma \ell$ C ϕ = $\cos \gamma \ell$ SH = $\sinh \gamma \ell$ SI = $\sin \gamma \ell$ SHCH = $\sin \gamma \ell * \cosh \gamma \ell$ CHSI = $\cosh \gamma \ell * \sin \gamma \ell$ SHC ϕ = $\sinh \gamma \ell * \sinh \gamma \ell$ SIC ϕ = $\sinh \gamma \ell * \cosh \gamma \ell$ PYD = $\sinh^2 \gamma \ell - \sin^2 \gamma \ell$ PYDT = 1/PYD

The coefficients calculated according to this magnitudes are

L11 = $(CHCH - SIC\phi) * PYDT$ L44 = $(SHCH - SIC\phi) * PYDT$ L12 = $(CHSI - SHC\phi) * PYDT$ L46 = (SHSI + SHC ϕ) * PYDT L14 = SH * SI * PYDT L16 = (SH * SH + SI * SI) * PYDT EI = E*I GJ = G* α CK1 = (EI * GL * 2)/L CK2 = CK1 * GL * 2/L CK3 = CK2 * GL/L

Hence the elements of the stiffness matrice are,

K11 = CK1 * L11
K12 = CK1 * L12
K14 = CK2 * L14
K16 = CK2 * 0.5 * L16
K44 = CK3 * L44
K46 = CK3 * L44

It is also possible to re-arrange matrice inorder to put the degrees of freedom of one node on the side and the second one on the other. Thus the new-order of the element stiffness matrice will be as given in figure 3.3

×

[K]

| - | | 5 | 6 | 2 | 3 | 4 | |
|---|------|------|-----|-----|------|-----|-----|
| | K 11 | 0 | K16 | K12 | 0 | K14 | 1 |
| | 0 | EA/I | 0 | 0 | EA/I | 0 | 5 |
| _ | K16 | 0 | K44 | K14 | 0 | K46 | 6 |
| - | K12 | 0 | K14 | K11 | 0 | K16 | 2 |
| | 0 | EA/I | 0 | 0 | EA/I | 0 | 3 |
| | K14 | 0 | K46 | K16 | 0 | K44 |] 4 |

FIGURE 3.3 Re-arranged stiffness matrice of a pile element

A further attempt is made to form the two dimensional stiffness matrice in a dimensional one. Using the property of symmetry the unnecessary elements are eliminated. A function transfers the row and column number into the related array number of the one-dimensional sequence as shown in figure 3.4.



FIGURE 3.4 One dimensional order of element stiffness matrice

The one dimensional |ER| sequence is formed for each element and kept in a file. The same procedure is repeated for the degrees of freedom perpendicular to the plane of the element. A record is reserved for each element and twenty-one elements are kept in each record as shown in figure 3.5

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FIGURE 3.5 Location of the one dimensional element stiffness

matrice in a file.

3.2 FORMATION OF PILE STIFFNESS MATRICE :

The node numbers are chosen consecutively from the bearing strata to the pile cap for each pile. Since the node numbers are consecutive; the pile stiffness matrix can be easily formed by the superposition of element stifnesses. Pile stiffness matrix is also formed in one dimensional sequence and kept in a file. For a pile having five elements and six node numbers the one-dimensional pilestiffness matrice is shown in figure 3.6.



→ KS = (18 - 13) #18 - (18 - 13 - 1) # (18 - 13) / 2 + 13 = 93

FIGURE 3.6 One dimensional order of pile stiffness matrice

The corresponding row number of the one-dimensional pile stiffnes matrice is calculated by a function, once the row and column numbers are determined. The function is

KS(IS, JS) = (JS-IS) * ND*3 - (JS-IS-1)*(XS-IS)/2+IS (3.28)

and

IS = (NI-1) * 3+IJS = (NI-1) * 3+J (3.29)

(3.30)

ND is the total number of node number in the pile, NI is the node number,

I is the row number in the element stiffness matrice,

J is the column number in the element stiffness matrice.

In the formulation of the pile stiffness matrice, the elements corresponding to the ith node of the ith element is added to the jth note of the (i-1)th element.

3.3 GAUSSIAN-ELIMINATION OF THE PILE STIFFNESS MATRICES

A subroutine is introduced to the program for the gaussian-elimination of symmetrical band matrices. An iterative method is carried out for a given half-band width. The iteration taken are shown illustratively on an example having N numbers of unknowns and ITS number of columns on the second side of the equation. It is obvious that the property of symmetry is preserved in each step. A graphical representation is shown in figure 3.7

where,

- BG = Width of the band matrice
- YBG = Width of the half band matrice = BG/2+1
- ITS = Number of columns on the second side of the equation.

and BG, YBG and ITS being integers



FIGURE 3.7 Gaussian-elimination of symmetrical matrices



The gaussian-eliminated elements of the element stiffness matrice will be calculated as shown in equations 3.31 and 3.32 and the iteration will proceeduntil the row number I reaches to the value N-YBG+1 Elimination will be applied until I reaches the value N-1. For I less than N-YBG+1, JS is the last iteration number of J indice whereas for the values between N-YBG+1 and N-1, JS equals N.

The elimination of the second side is also handled in a similar way.

$$\vec{b}_{21} = b_{21} - \frac{a_{12}}{a_{11}} * b_{11}$$

$$\vec{b}_{22} = b_{22} - \frac{a_{12}}{a_{11}} * b_{12}$$

$$J = 1, ITS$$

$$(3.33)$$

It is easily proved that the eliminated band matrice will be symmetrical as well. As an example,

$$\overline{a}_{32} = a_{32} - \frac{a_{31}}{a_{11}} + a_{12} = a_{23} - \frac{a_{12}}{a_{11}} + a_{13} = \overline{a}_{23}$$

3.4 CALCULATION OF DIRECTION COSINES:

A right-handed global coordinate system is choosen for each group which has an origin at the force of application with z-axis showing the vertical direction. The nodal coordinates of each pile is given to the program as input values. The axial direction of the pile is taken to be the axis of the pile coordinate system and the related direction cosines are calculated. Also direction cosines of the local y direction have to be given as an input value to the program. The direction cosines of the local z axis is found out from the other pre-determined direction cosines by the formula

(3.35) C_{ϕ} (7) = C_{ϕ} (2) * C_{ϕ} (6) - C_{ϕ} (3) * C_{ϕ} (5) (3.36)

 C_{ϕ} (8) = C_{ϕ} (3) * C_{ϕ} (4) - C_{ϕ} (1) * C_{ϕ} (6)

 C_{ϕ} (9) = C_{ϕ} (1) * C_{ϕ} (5) - C_{ϕ} (2) * C_{ϕ} (4) (3.37)

where

| x | = | Cφ | (1) | <u>i</u> + | Cφ | (2) | j | + | Cφ | (3) | <u>k</u> | (3.38) |
|---|---|----|-----|------------|----|-----|---|---|----|-----|----------|--------|
| У | = | Cφ | (4) | <u>i</u> + | Cφ | (5) | j | + | Cφ | (6) | <u>k</u> | (3.39) |
| z | = | Cφ | (7) | i + | Cφ | (8) | j | + | Cφ | (9) | <u>k</u> | (3.40) |

and $C\phi$ is the sequence of direction cosines. Direction cosines of a vertical pile and an inclined pile are given in figures 3.8 and 3.9 respectively.









3.5 FORMATION OF TRANSLATION MATRICE :

The translation matrice will be denoted as $|T_1|$. If two coordinate system is parallel to each other having different origin points, translation matrice is used transfer displacements and forces from one to another,

$$[T_{1}] = \begin{bmatrix} |I| & |a|_{i} \\ |0| & |I| \end{bmatrix} \qquad [a]_{i} = \begin{bmatrix} 0 & z & -y \\ -z & 0 & j \\ y & -x & 0 \end{bmatrix}_{i}$$

where x,y and z are the coordinates of the each pile head according to the global axis. By definition it can be stated that,

$$\begin{bmatrix} \mathbf{T}_1 \end{bmatrix} \cdot \begin{bmatrix} \mathbf{T}_1 \end{bmatrix}^{-1} = \begin{bmatrix} \mathbf{I} \end{bmatrix} \rightarrow \begin{bmatrix} \mathbf{T}_1 \end{bmatrix}^{-1} = \begin{bmatrix} \mathbf{T}_1 \end{bmatrix}^{\mathrm{T}}$$
(3.41)
$$\begin{bmatrix} \mathbf{T}_1 \end{bmatrix} \cdot \begin{bmatrix} \mathbf{q}_0 \end{bmatrix} = \begin{bmatrix} \mathbf{q}_1 \end{bmatrix}$$
(3.42)
$$\begin{bmatrix} \mathbf{T}_1 \end{bmatrix} \cdot \begin{bmatrix} \mathbf{d}_0 \end{bmatrix} = \begin{bmatrix} \mathbf{d}_1 \end{bmatrix}$$
(3.43)

where

- [d] is the matrice for displacements and rotations in
 global axis,
- [d] i is the matrice for displacements and rotations in
 pile axis,

 $[q]_0$ is the matrice of external forces in global axis, $[q]_1$ is the matrice of external forces in pile axis. To write it in explicit from,

$$\begin{bmatrix} 1 & 0 & 0 & 0 & z & -y \\ 0 & 1 & 0 & -z & 0 & x \\ 0 & 0 & 1 & y & -x & 0 \\ 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} U_X \\ U_Y \\ U_Z \\ W_X \\ W_Y \\ W_Z \end{bmatrix} = \begin{bmatrix} U_X \\ U_Y \\ U_Z \\ W_X \\ W_Y \\ W_Z \end{bmatrix}_{I_1}$$

thus,

 $(Ux) i = (Ux)_{0} + Z (Wy)_{0} -y (Wz)_{0}$ $(Uy) i = (Uy)_{0} + -z (Wx)_{0} + x (Wz)_{0}$ $(Uz) i = (Uz)_{0} + y (Wx)_{0} - x (Wy)_{0}$ $(Wx) i = (Wx)_{0}$ $(Wy) i = (Wy)_{0}$ $(Wz) i = (Wz)_{0}$

3.6 FORMATION OF THE ROTATION MATRICE :

The rotation matrice will be denoted as $[T_2]$. If two different coordinate axis having the same origin are considered, rotation matrice transfers reactions and displacements from one coordinate axis to the other.



where λ_i is

| | C¢(1) | C¢(2) | C¢(3) | |
|-----|-------|--------|-------|--|
| : = | C¢(4) | C¢ (5) | C¢(6) | |
| | C¢(7) | C¢(8) | C¢(9) | |

and

 $C\phi(1)$, $C\phi(2)$, $C\phi(3)$ are the direction cosines of the x axis $C\phi(4)$, $C\phi(5)$, $C\phi(6)$ are the direction cosines of the y axis $C\phi(7)$, $C\phi(8)$, $C\phi(9)$ are the direction cosines of the z axis

It can be easily established that

$$\begin{bmatrix} \mathbf{T}_{2} \end{bmatrix} \cdot \begin{bmatrix} \mathbf{T}_{2} \end{bmatrix}^{1} = \begin{bmatrix} \mathbf{I} \end{bmatrix} \Rightarrow \begin{bmatrix} \mathbf{T}_{2} \end{bmatrix}^{-1} = \begin{bmatrix} \mathbf{T}_{2} \end{bmatrix}^{T}$$
(3.44)
$$\begin{bmatrix} \mathbf{T}_{2} \end{bmatrix} \cdot \begin{bmatrix} \mathbf{d}_{0} \end{bmatrix} = \begin{bmatrix} \mathbf{d}_{1} \end{bmatrix}$$
(3.45)
$$\begin{bmatrix} \mathbf{T}_{2} \end{bmatrix} \cdot \begin{bmatrix} \mathbf{d}_{0} \end{bmatrix} = \begin{bmatrix} \mathbf{d}_{1} \end{bmatrix}$$
(3.46)

In the explicit form,

| C¢(1) | C¢(2) | C¢(3) | 0 | 0 | 0 | Ux | Ux |
|-------|-------|-------|-------|-------|-------|-----------------|----------|
| C¢(4) | C¢(5) | C¢(6) | 0 | 0 | 0 | Uy | Uy |
| C¢(7) | C¢(8) | C¢(9) | 0 | 0 | 0 | Uz _ | Uz |
| | | | 1 | | | No allo and and | |
| 0 | 0 | 0 | C¢(1) | C¢(2) | C¢(3) | Wx | Wx |
| 0 | 0 | 0 | C¢(4) | C¢(5) | C¢(6) | Wy | Wy |
| 0 | 0 | 0 | C¢(7) | C¢(8) | C¢(9) | Wz | Wz |
| | | | | | | | <u> </u> |

thus,

 $(Ux) i = C\phi(1) * Ux_{0} + C\phi(4) * Uy_{0} + C\phi(7) * Uz_{0}$ $(Uy) i = C\phi(2) * Ux_{0} + C\phi(5) * Uy_{0} + C\phi(8) * Uz_{0}$ $(Uz) i = C\phi(3) * Ux_{0} + C\phi(6) * Uy_{0} + C\phi(9) * Uz_{0}$ $(Wx) i = C\phi(1) * Wx_{0} + C\phi(4) * Wy_{0} + C\phi(7) * Wz_{0}$ $(Wy) i = C\phi(2) * Wx_{0} + C\phi(5) * Wy_{0} + C\phi(8) * Wz_{0}$ $(Wz) i = C\phi(3) * Wx_{0} + C\phi(6) * Wy_{0} + C\phi(9) * Wz_{0}$

3.7 FORMATION OF THE TRANSFORMATION MATRICE

Transformation matrice will be denoted as |A|. Its a combination of rotation and translation matrices and obtained by multiplication of them.

It enables the transformation of displacements and reactions from one coordinate system to another having different direction cosines and origin points.Further, it can be stated that.

| $ \mathbf{A} = \mathbf{T}_2 \cdot \mathbf{T}_1 $ | (3.47) |
|--|--------|
| $ A ^{T}$. $ q_{0} = q_{1} $ | (3.48) |
| $ A \cdot d_0 = d_1 $ | (3.49) |

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3.8 FORMATION OF THE GAUSSIAN-ELIMINATED PILE HEAD STIFFNESS MATRICE

A new subrouting "KURIKR" is introduced to the program, and elements corresponding to the head node of the gaussian -eliminated pile stiffness matrice are obtained inorder to form the pile head stiffness matrice. The execution is carried twice. One for the degrees of freedom in the plane of the beam and one for the degrees of freedom perpendicular to the plane of the beam.

Furthermore, the pile head stiffness matrices are re-arranged to make transformations to the force of application possible. Both matrices are sketched in figure 3.10 and 3.11.

| | 1.317 | 6 | 1 | 2 | 5 | 4 | 3 | • |
|-------|-------|---------------|---------------|---------------|---------------------------|----------------|-----------------|-------------------------------------|
| funci | 6 | (1, 1) | 34 k (1,2) | ⑤ k(1.3) | 0 | 0 | 0 | |
| | 1 | 33 k (2,1) | k (2,2) | (2,3) | -0 | 0 | 0 | Influences in the plane of the beam |
| | 2 | ⑤] k (3.1) | (3,2) | 18 k (3,3) | 0 | 0 | 0 | First execution |
| [IVK] | - 5 | 0 | 0 | 0 | 16 k(4,4) | 34 k (4,5) | (5) k (4,6) | Influences perpen- |
| | 4 | 0 | 0 | 0 | 34 k (5,4) | ⑦ k (5,5) | (5,6) | of the beam Second execution |
| | 3 | 0 | 0 | 0 | 5) [*] k(6,4) | (6,5) (6,5) | (18) k (6,6) | |

FIGURE 3.10 Gaussian-eliminated pile head stiffness matrice

| | | 1 · | 2 | 3 | 4 | 5 | 6 |
|------------|---|---------|---------|---------|---------|---------|---------|
| | 1 | k (2,2) | k(2,3) | 0 | 0 | 0 | k (2,1) |
| | 2 | k (3,2) | k (3,3) | 0 | 0 | 0 | k (3.1) |
| [[] | 3 | 0 | 0 | k (6,6) | k (6,5) | k(6,4) | 0 |
| [נאורערק]- | 4 | 0 | 0 | k(5,6) | k (5,5) | k (5.4) | 0 |
| | 5 | 0 | 0 | k (4,6) | k (4,5) | k (4,4) | 0 |
| | 6 | k (1,2) | k (1,3) | 0 | 0 | 0 | k (1,1) |

FIGURE 3.11 Re-arrangement of pile head stiffness matrice.

3.9 FORMULATION OF THE EQUIVALENT PILE-GROUP STIFFNESS MATRICE :

The Gaussian-eliminated and re-arranged pile head stiffness matrices are rotated and translated to the point of application of forces from the superstructure. It will be denoted as |IDKR|_i. By definition,

$$IDKR|_{i} = |A|_{i} |NIKR|_{i} |A|_{i}^{T}$$
(3.50)

 $= |T_{1}|_{i}^{T} |T_{2}|_{i} |NIKR|_{i} |T_{2}|_{i}^{T} |T_{1}|_{i}$ (3.51)

| [[1] [[0]] [[\lambda] |] [0] | k(2,2) k(3,2) 0 | k(2,3) k(3,3) O | 0 0 k(6,6) | 0 0 k(6,5) | 0 0 k(6,4) | k(21) k(3,1) O | [[_{\label{intermation}}] | [0] | | (1) | (ai) | |
|-----------------------|-------|-----------------------|-----------------------|------------------|------------------|------------------|----------------------|-------------------------------------|-------------------|---|-----|------|---|
| | | 0 | 0 | 145,6) | 15,5) | H(5,4) | 0 | | | Π | | | |
| [[ai]] [1] [0 |] [Ŋ] | 0 14(1,2) | 0 K(1,3) | ₩4,6) 0 | k(4,5) 0 | 1444) 0 | 0 k0,1); | [0] | [λ _j] | | [0] | (I) | i |

The equivalent pile group stiffness matrice is determined by the summation of each individual transformed and gaussian-eliminated pile head stiffness matrices.

n pile $|IDKRT| = \Sigma |IDKR|_i$ i=1

(3.52)

3.10 SOLUTION FOR THE DISPLACEMENTS OF THE EQUIVALENT PILE

Once the equivalent pile stiffness matrice is formed, the relation between the external force and related displacements is established by,

i=npile
T

$$\Sigma$$
 $|T_1|_i |T_2|_i |NIKR|_i |T_2|_i |T_1|_i)|d_0| = |q_0|$ (3.53)
i=1

where the loading matrice, and the resulting displacements can be explicity stated as

$$q_{0} = \begin{bmatrix} Qx_{0} \\ Qy_{0} \\ Qz_{0} \\ Mx_{0} \\ My_{0} \\ Mz_{0} \end{bmatrix} \qquad d_{0} = \begin{bmatrix} Ux_{0} \\ Uy_{0} \\ Uz_{0} \\ Wx_{0} \\ Wy_{0} \\ Wz_{0} \end{bmatrix}$$

Six equations for six unknowns are solved for each loading and the displacement and rotations at the force of application of the infinitely rigid pile cap are obtained. For each loading six different loads can be applied, three forces and three moments in space. The loads and corresponding displacements are kept in a file.

3.11 DETERMINATION OF PILE HEAD REACTIONS AND DISPLACEMENTS :

The previously calculated $|A|_i$ and $|NIKR|_i$ matrices are taken back to the memory from the file and by transforming the original displacements pile head displacements and reactions are determined. Therefore it can be stated that ;

$$|\mathbf{d}|_{\mathbf{i}} = |\mathbf{T}_2|_{\mathbf{i}}^{\mathbf{T}} |\mathbf{T}_1|_{\mathbf{i}} |\mathbf{d}|_{\mathbf{o}}$$

$$= |A|^{T} |d|_{o}$$
(3.55)
|POC|_{i} = |NIKR|_{i} |d|_{i} (3.56)

where

|d|_i = Pile head displacements matrice

 $|A|^{T}$ = Transpose of the translation matrice

|POC| = Pile head reactions matrice

(3.54)

3.12 DETERMINATION OF NODAL DISPLACEMENTS AND REACTIONS :

The pile element stiffness matrices which have been kept in a file are taken back to memory for superposition and displacements and reactions are found out for each element in an iterative solution. Once the displacements of the jth node the top-most pile element is calculated; the reactions caused in the ith node due to these displacements can easily be obtained. Then the displacements exerted in the ith node due to the reactions in ith node of the some pile element are determined which are also the reactions of the jth node of (ND-1)th pile element. In an iterative solution; from nodal displacements the nodal reactions and from nodal reaction the nodal displacements are successively obtained until the ith node of the first pile element.In figure 3.12the relation between element stiffness matrices and nodal points are schematically shown.



FIGURE 3.12 A schematical representation of the relation between element stiffness matrices and node numbers.

IV. COMPARISON BY OTHER CALCULATION METHODS

IV.a Example from "Grundbau Taschenbuch"

A pile group of fifteen piles is subjected to a vertical load of 300 t as well as bending moments of 50 tm and 60 tm in x and y directions respectively as shown in figure 4.1. The pile material properties are assumed to be equal. All the piles are assumed to reach the hard-bearing strata. The axial reactions arised due to these external loads are given by the formula 2.12

Hence,

$$Q_{i} = \frac{300}{15} + \frac{50}{90} Y_{i} - \frac{60}{270} X_{i}$$

The resulting axial forces are indicated in table 4.1

| ile No | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|--------------------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| x (m) | -6 | -3 | 0 | +3 | +6 | -6 | -3 | 0 | +3 | +6 | -6 |
| y (m) | +3 | +3 | +3 | +3 | +3 | 0 | 0 | 0 | 0 | 0 | -3 |
| Q ₁ (t) | 23.00 | 22.33 | 21.67 | 21.00 | 20.33 | 21.33 | 20.67 | 20.00 | 19.33 | 18.67 | 19.67 |

| Pile No | 12 | 13 | 14 | 15 |
|--------------------|-------|-------|-------|-------|
| x (m) | -3 | 0 | +3 | +6 |
| y (m) | -3 | -3 | -3 | -3 |
| Q _i (t) | 19.00 | 18.33 | 17.67 | 17.00 |

TABLE 4.1 The axial reactions of the piles for the example from "Grundbau Taschenbuch"

The same pile group is also solved by the developed programme and the resulting pile head axial reactions as well as shears, bending moments, torsional moments, displacement and rotations are obtained for each pile. The outputs are reasonably close to the results obtained by the rough calculation method as shown in table 4.2.

| Pile Number | Axial forces com- puted by the rough calculation method | Axial forces com- puted by the deve- loped programme |
|----------------|---|--|
| 1 | 23.00 | 22.960 |
| 2 | 22.33 | 22.297 |
| 3 | 21.67 | 21.635 |
| 4 | 21.00 | 20.973 |
| 5 | 20.33 | 20.310 |
| 6 | 21.33 | 21.325 |
| 7 | 20.67 | 20.662 |
| 8 | 20.00 | 20.000 |
| 9 | 19.33 | 19.338 |
| 10 | 18.67 | 18.675 |
| 11 | 19.67 | 19.690 |
| 12 | 19.00 | 19.027 |
| 13 | 18.33 | 18.365 |
| 14 | 17.67 | 17.703 |
| 15 | 17.00 | 17.040 |

TABLE 4.2 The axial and lateral reactions of the piles given in the example by Bowles (Foundation Analysis and Design) for three different interference ratios.



FIGURE 4.1 Example from "Grundbau Taschenbuch"

| AMPLE F | 'rom "grundeau 1 | TASCHENBUCH" (C=5 | 500t/m3) | | | | 17 |
|----------|------------------|-------------------|-------------|-----------|-----------|------------|-------------|
| DAL LOA | DS | 10.512 | | | | | 47 |
| NO NO: | | P1 | P2 | 82 | | _ | |
| 1 | | 0.00 | | FJ | P4 | 13 | . P6 |
| 1 | | 0.00 | 0.00 | 300.00 | 50.00 | 60.00 | 0.00 |
| ile head | DISPLACEMENTS | | esta - | | | 119 | |
| DAD NO: | PILE NO: | D1 . | D2 | D3 | D4 | D5 | . 06 |
| 1 | 1 | -0.974E-04 | 0.441E-04 | 0.179E-04 | 0.000E+00 | -0.937E-06 | -0.231E-05 |
| 1 | 2 | -0.946E-04 | 0.441E-04 | 0.179E-04 | 0.000E+00 | -0.937E-06 | -0.231E-05 |
| 1 | 3 | -0.918E-04 | 0.441E-04 | 0.179E-04 | 0.000E+00 | -0.937E-06 | -0.231E-05 |
| 1 | 4 | -0.890E-04 | ° 0.441E-04 | 0.179E-04 | 0.000E+00 | -0.937E-06 | -0.231E-05 |
| 1 | 5 | -0.862E-04 | 0.441E-04 | 0.179E-04 | 0.000E+00 | -0.937E-06 | -0.231E-05 |
| 1 | 6 | -0.905E-04 | 0.441E-04 | 0.179E-04 | 0.000E+00 | -0.937E-06 | -0.231E-05 |
| 1 | 7 | -0.877E-04 | 0.441E-04 | 0.179E-04 | 0.000E+00 | -0.937E-06 | -0.231E-05 |
| 1 | . 8 | -0.849E-04 | 0.441E-04 | 0.179E-04 | 0.000E+00 | -0.937E-06 | -0.231E-05 |
| 1 | 9 | -0.821E-04 | 0.441E-04 | 0.179E-04 | 0.000E+00 | -0.937E-06 | -0.231E-05 |
| 1 | 10 | -0.793E-04 | 0.441E-04 | 0.179E-04 | 0.000E+00 | -0.937E-06 | -0.231E-05 |
| 1 | 11 | -0.836E-04 | 0.441E-04 | 0.179E-04 | 0.000E+00 | -0.937E-06 | -0.231E-05 |
| 1 | 12 | -0.808E-04 | 0.441E-04 | 0.179E-04 | 0.000E+00 | -0.937E-06 | -0.231E-05 |
| 1 | 13 | -0.779E-04 | 0.441E-04 | 0.179E-04 | 0.000E+00 | -0.937E-06 | -0.231E-05 |
| 1 | 14 | -0.751E-04 | 0.441E-04 | 0.179E-04 | 0.000E+00 | -0.937E-06 | -0.231E-05 |
| 1 | 15 | -0.723E-04 | 0.441E-04 | 0.179E-04 | 0.000E+00 | -0.937E-06 | -0.231E-05 |
| ile head | REACTIONS | | | ; | | | |
| OAD NO: | PILE NO: | TX | ΤΥ | TZ | МΧ | MY | HZ |
| 1 | • 1 | -22.960 | 0.131 | 0.053 | 0.000 | 0.143 | 0.353 |
| 1 | 2 | -22.297 | 0.131 | 0.053 | 0.000 | 0.143 | 0.353 |
| 1 | 3 | -21.635 | 0.131 | 0.053 | 0.000 | 0.143 | 0.353 |
| 1 | 4 | -20.973 | 0.131 | 0.053 | 0.000 | 0.143 | 0.353 |
| 1 | 5 | -20.310 | 0.131 | 0.053 | 0.000 | 0.143 | 0.353 |
| 1 | 6 | -21.325 | 0.131 | 0.053 | 0.000 | 0.143 | 0.353 |
| | | | | | | | |

| 1 | 7 | -20.662 | 0.131 | 0.053 | 0.000 | 0.143 | 0.353 |
|---|----|---------|-------|-------|-------|-------|-------|
| 1 | 8 | -20.000 | 0.131 | 0.053 | 0.000 | 0.143 | 0.353 |
| 1 | 9 | -19.338 | 0.131 | 0.053 | 0.000 | 0.143 | 0.353 |
| 1 | 10 | -18.675 | 0.131 | 0.053 | 0.000 | 0.143 | 0.353 |
| 1 | 11 | -19.690 | 0.131 | 0.053 | 0.000 | 0.143 | 0.353 |
| 1 | 12 | -19.027 | 0.131 | 0.053 | 0.000 | 0.143 | 0.353 |
| 1 | 13 | -18.365 | 0.131 | 0.053 | 0.000 | 0.143 | 0.353 |
| 1 | 14 | -17.703 | 0.131 | 0.053 | 0.000 | 0.143 | 0.353 |
| 1 | 15 | -17.040 | 0.131 | 0.053 | 0.000 | 0.143 | 0.353 |
| | | | | | | | |

read line change is a big forge according to as interfaces.

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IV.b Example From "Foundation Analysis an Design, Bowles"

As a second example another pile group is solved by the developed programme. The group consists of thirteen vertical and batter piles and is subjected to a vertical force of 1000 kips as well as a horizontal load of 150 kips as shown in figure 4.2.

According to the results given by Bowles, three different solutions are possible depending on the interference ratio, r. The stiffness matrix elements and resultant axial and lateral forces are indicated in table 4.3. Although the reactions change in a big range according to the interference ratio, they are compatible to the ones obtained from the developed programme.

| Matrix | :000 | | | So | lution | n (-indic | ates comp | ression) | |
|--------|---------|---------|----------|----------|----------|------------|--------------------|----------------------|---------------------|
| For r | ratio = | = 0.226 | 16 | | 0.000 | Pile No | TX (K (axial fo | ips) TZ orce) (la | (Kips) teral for |
| -3.249 | 0.000 | 0.000 | 0.000 | 7.003 | 0.000 | 1 | -64.81 | 17.65 | |
| 0.000 | -3.559 | 0.000 | -11.956 | 0.000 | 0.000 | 2 | -74.09 | 13.70 | |
| 0.000 | 0.000 | -12.071 | 0.000 | 0.000 | 0.000 | 3 | -86.12 | 10.84 | |
| 0.000 | -11.956 | 0.000 | -388.569 | 0.000 | 0.000 | 4 | -89.41 | 10.84 | |
| 7.003 | 0.000 | 0.000 | 0.000 | -408.379 | 0.000 | 5 | -82.84 | 10.84 | |
| 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -202.641 | 6 | -79.55 | 10.84 | |
| | | | | | | 7 | -83.86 | 7.71 | |
| | | | | | | 8 | -76.26 | 10.84 | |
| | | | | | | 9 | -79.55 | 10.84 | |
| | | | | | | 10 | -83.36 | 7.71 | |
| | | | | | | 11 | -74.09 | 13.70 | |
| | | | | | | 12 | -86.12 | 10.84 | |
| | | | | | | 13 | -64.81 | 17.65 | |
| | | | | | | 13 | -64.81 | 17.65 | |

| | | | | | Contraction of the second | 1 million and and | | | |
|---|--|--|---|---|---|---|--|---|--------------|
| For r | ratio = | 0.0056 | 0 | | | Pile No | TX (Kips) (axial force) | TZ (Kips))(lateral f | force) |
| -0.470 | 0.000 | 0.000 | 0.000 | 9.000 | 0.000 | 1 | 10.88 | 3.32 | |
| 0.000 | -0.868 | 0.000 | -15.364 | 0.000 | 0.000 | 2 | -75.75 | 3.36 | |
| 0.000 | 0.000 | -11.806 | 0.000 | 0.000 | 0.000 | 3 | -135.69 | 3.15 | |
| 0.000 | -15.364 | 0.000 | -371.630 | 0.000 | 0.000 | 4 | -186.68 | 3.15 | |
| 9.000 | 0.000 | 0.000 | 0.000 | -397.087 | 0.000 | 5 | -84.69 | 3.15 | |
| 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | -5.026 | 6 | -33.70 | 3.15 | |
| | | | | | | 7 | -162.40 | 3.02 | |
| | | | | | | 8 | 17.29 | 3.15 | |
| | | | | | | 9 | -33.70 | 3.15 | |
| | | | | | | 10 | -162.40 | 3.02 | |
| | | | | - 64.620 | | 11 | -75.75 | 3.16 | |
| | | | | | | 12 | -135.69 | 3.15 | |
| | | | | | Les and Les | 13 | 10.88 | 3.32 | |
| | | | | | | | | | |
| | | | | | | | | | |
| For | r ratio | = 0.000 | , | -118 2146 | F | Pile No | TX(Kips) (axial force | TZ(Kij) (lateral | ps) force |
| For | r ratio | = 0.000 |) | | F | Pile No | TX(Kips) (axial force | TZ (Kij) (lateral | ps) force |
| For -0.400 | r ratio | = 0.000 | 0.000 | 9.050 | P 0.000 | Pile No 1 | TX(Kips) (axial force 82.82 | TZ(Kij) (lateral 0.0 | ps) force |
| For -0.400 | r ratio 0.000 0.8.800 | = 0.000 0.000 0.000 | 0.000 | 9.050 0.000 | e 0.000 0.000 | Pile No 1 2 | TX(Kips) (axial force 82.82 -21.87 | TZ(Kij) (lateral 0.0 0.0 | ps) force |
| For -0.400 0.000 | r ratio 0.000 0.8.800 0.000 | = 0.000 0.000 0.000 -11.800 | 0.000 -15.450 0.000 | 9.050 0.000 0.000 | 0.000 0.000 0.000 0.000 | Pile No 1 2 3 | TX(Kips) (axial force 82.82 -21.87 -197.15 | TZ(Kij) (lateral 0.0 0.0 0.0 | ps) force |
| For -0.400 0.000 0.000 | r ratio 0 0.000 0 -8.800 0 0.000 0 -15.450 | = 0.000 0.000 0.000 -11.800 0.000 | 0.000 -15.450 0.000 -371.200 | 9.050 0.000 0.000 0.000 | 0.000 0.000 0.000 0.000 0.000 | Pile No 1 2 3 4 | TX(Kips) (axial force 82.82 -21.87 -197.15 -274.67 | TZ(Kij) (lateral 0.0 0.0 0.0 0.0 | ps) force |
| For -0.400 0.000 0.000 0.000 9.050 | r ratio 0 0.000 0 -8.800 0 0.000 0 -15.450 0 0.000 | = 0.000 0.000 0.000 -11.800 0.000 0.000 | 0.000 -15.450 0.000 -371.200 0.000 | 9.050 0.000 0.000 0.000 -396.800 | 0.000 0.000 0.000 0.000 0.000 | 2 No 1 2 3 4 5 | TX(Kips) (axial force 82.82 -21.87 -197.15 -274.67 -133.25 | TZ(Kij) (lateral 0.0 0.0 0.0 0.0 0.0 0.0 | os) force |
| For -0.400 0.000 0.000 9.050 0.000 | r ratio 0 0.000 0 -8.800 0 0.000 0 -15.450 0 0.000 0 0.000 | = 0.000 0.000 -11.800 0.000 0.000 0.000 | 0.000 -15.450 0.000 -371.200 0.000 0.000 | 9.050 0.000 0.000 0.000 -396.800 0.000 | E 0.000 0.000 0.000 0.000 0.000 0.000 | Pile No 1 2 3 4 5 6 | TX (Kips) (axial force 82.82 -21.87 -197.15 -274.67 -133.25 -55.73 | TZ(Kij) (lateral 0.0 0.0 0.0 0.0 0.0 0.0 0.0 | os) force |
| For -0.400 0.000 0.000 9.050 0.000 | r ratio 0 0.000 0 -8.800 0 0.000 0 -15.450 0 0.000 0 0.000 | = 0.000 0.000 -11.800 0.000 0.000 0.000 | 0.000 -15.450 0.000 -371.200 0.000 0.000 | 9.050 0.000 0.000 0.000 -396.800 0.000 | 0.000 0.000 0.000 0.000 0.000 0.000 | Pile No 1 2 3 4 5 6 7 | TX (Kips) (axial force 82.82 -21.87 -197.15 -274.67 -133.25 -55.73 -106.12 | TZ(Kij) (lateral 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 | ps) force |
| For -0.400 0.000 0.000 9.050 0.000 | r ratio 0 0.000 0 -8.800 0 0.000 0 -15.450 0 0.000 0 0.000 | = 0.000 0.000 -11.800 0.000 0.000 0.000 | 0.000 -15.450 0.000 -371.200 0.000 0.000 | 9.050 0.000 0.000 0.000 -396.800 0.000 | 0.000 0.000 0.000 0.000 0.000 0.000 | 2 No 1 2 3 4 5 6 7 8 | TX (Kips) (axial force 82.82 -21.87 -197.15 -274.67 -133.25 -55.73 -106.12 8.16 | TZ(Kij) (lateral 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 | os) force |
| For -0.400 0.000 0.000 9.050 0.000 | r ratio 0 0.000 0 -8.800 0 0.000 0 -15.450 0 0.000 0 0.000 | = 0.000 0.000 -11.800 0.000 0.000 0.000 | 0.000 -15.450 0.000 -371.200 0.000 0.000 | 9.050 0.000 0.000 0.000 -396.800 0.000 | 0.000 0.000 0.000 0.000 0.000 0.000 | Pile No 1 2 3 4 5 6 7 8 9 | TX (Kips) (axial force 82.82 -21.87 -197.15 -274.67 -133.25 -55.73 -106.12 8.16 -69.35 | TZ(Kij) (lateral 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0. | os) force |
| For -0.400 0.000 0.000 9.050 0.000 | r ratio 0 0.000 0 -8.800 0 0.000 0 -15.450 0 0.000 | = 0.000 0.000 -11.800 0.000 0.000 0.000 | 0.000 -15.450 0.000 -371.200 0.000 0.000 | 9.050 0.000 0.000 0.000 -396.800 0.000 | 0.000 0.000 0.000 0.000 0.000 0.000 | Pile No 1 2 3 4 5 6 7 8 9 10 | TX (Kips) (axial force 82.82 -21.87 -197.15 -274.67 -133.25 -55.73 -106.12 8.16 -69.35 -128.34 | TZ(Kij) (lateral 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0. | os) force |
| For -0.400 0.000 0.000 9.050 0.000 | r ratio 0 0.000 0 -8.800 0 0.000 0 -15.450 0 0.000 0 0.000 | = 0.000 0.000 -11.800 0.000 0.000 0.000 | 0.000 -15.450 0.000 -371.200 0.000 0.000 | 9.050 0.000 0.000 -396.800 0.000 | 0.000 0.000 0.000 0.000 0.000 | Pile No 1 2 3 4 5 6 7 8 9 10 11 | TX (Kips) (axial force 82.82 -21.87 -197.15 -274.67 -133.25 -55.73 -106.12 8.16 -69.35 -128.34 -58.64 | TZ(Kij) (lateral 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0. | os) force |
| For -0.400 0.000 0.000 9.050 0.000 | r ratio 0 0.000 0 -8.800 0 0.000 0 -15.450 0 0.000 0 0.000 | = 0.000 0.000 -11.800 0.000 0.000 0.000 | 0.000 -15.450 0.000 -371.200 0.000 0.000 | 9.050 0.000 0.000 -396.800 0.000 | E 0.000 0.000 0.000 0.000 0.000 | Pile No 1 2 3 4 5 6 7 8 9 10 11 12 | TX (Kips) (axial force 82.82 -21.87 -197.15 -274.67 -133.25 -55.73 -106.12 8.16 -69.35 -128.34 -58.64 -210.77 | TZ(Kij) (lateral 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0. | os) force |
| For -0.400 0.000 0.000 9.050 0.000 | r ratio 0 0.000 0 -8.800 0 0.000 0 -15.450 0 0.000 0 0.000 | = 0.000 0.000 -11.800 0.000 0.000 0.000 | 0.000 -15.450 0.000 -371.200 0.000 0.000 | 9.050 0.000 0.000 -396.800 0.000 | 0.000 0.000 0.000 0.000 0.000 | Pile No 1 2 3 4 5 6 7 8 9 10 11 12 13 | TX (Kips) (axial force 82.82 -21.87 -197.15 -274.67 -133.25 -55.73 -106.12 8.16 -69.35 -128.34 -58.64 -210.77 157.04 | TZ(Kij) (lateral 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0. | os) force |

TABLE 4.3 The axial and lateral forces computed by the programme developed by Bowles

| Pile | TX (Kips | TZ (Kips) |
|------|---------------|-----------------|
| No | (Axial Force) | (Lateral force) |
| 1 | 132.838 | 21.927 |
| 2 | - 3.554 | 21.295 |
| 3 | - 36.627 | 20.924 |
| 4 | - 69.699 | 20.618 |
| 5 | -113.922 | 20.618 |
| 6 | - 80.850 | 20.924 |
| 7 | -212.960 | 22.330 |
| 8 | -158.146 | 20.618 |
| 9 | -191.218 | 20.312 |
| 10 | - 3.965 | 20.006 |
| 11 | 224.270 | 20.633 |
| 12 | -146.995 | 20.312 |
| 13 | 218.623 | 21.105 |

TABLE 4.4 The axial and lateral forces computed by the developed programme.



FIGURE 4.2 Example from "Foundation Analysis and Design" (Bowles)

HPLE FROM "FOUNDATION ANALYSIS AND DESIGN, BOWLES" (C=43201b/ft3)

OAL LOADS

| HD NO: | | P1 | P2 | P3 | P4 | P5 | P6 |
|----------|-----------------|------------|-------------|-----------|------------|------------|-----------|
| 1 | | -150.00 | 0.00 | 1000.00 | 0.00 | 0.00 | 0.00 |
| ile head |) displacements | | | | • | 170.774 | hair |
| OAD NO: | PILE NO: | D1 - | D2 | D3 | D4 | 05 | .06 |
| 1 | 1 | 0.979E-05 | 0.555E-05 | 0.191E-03 | -0.673E-06 | 0.279E-06 | 0.106E-05 |
| 1 | 2 | -0.262E-06 | 0.164E-04 | 0.190E-03 | -0.673E-06 | -0.277E-06 | 0.106E-05 |
| 1 | 3 | -0.270E-05 | -0.101E-04 | 0.188E-03 | -0.673E-06 | -0.407E-06 | 0.102E-05 |
| 1 | 4 | -0.513E-05 | '-0.128E-04 | 0.185E-03 | -0.673E-06 | -0.407E-06 | 0.102E-05 |
| 1 | 5 | -0.839E-05 | -0.744E-05 | 0.185E-03 | -0.673E-06 | -0.407E-06 | 0.102E-05 |
| 1 | 6 | -0.596E-05 | -0.474E-05 | 0.188E-03 | -0.673E-06 | -0.407E-06 | 0.102E-05 |
| 1 | 7 | -0.1575-04 | 0.205E-04 | 0.189E-03 | 0.866E-07 | 0.836E-06 | 0.1062-05 |
| 1 | 8 | -0.117E-04 | -0.205E-05 | 0.185E-03 | -0.6732-06 | -0.407E-06 | 0.102E-05 |
| 1 | 9 | -0.141E-04 | -0.474E-05 | 0.182E-03 | -0.673E-06 | -0.407E-06 | 0.102E-05 |
| 1 | 10 | -0.292E-06 | -0.283E-04 | 0.179E-03 | 0.673E-06 | -0.279E-06 | 0.106E-05 |
| 1 | 11 | 0.165E-04 | -0.151E-04 | 0.179E-03 | 0.6732-06 | 0.277E-06 | 0.106E-05 |
| 1 | 12 | -0.108E-04 | -0.101E-04 | 0.182E-03 | -0.673E-06 | -0.407E-06 | 0.102E-05 |
| 1 | 13 | 0.161E-04 | 0.266E-05 | 0.180E-03 | 0.279E-06 | 0.673E-06 | 0.106E-05 |
| PILE HEA | D REACTIONS | | | | | | |
| LOAD NO: | PILE NO: | TX | TY | TZ | MX | HY | MZ |
| 1 | 1 | 132.838 | 1.685 | 21.927 | -0.917 | 194.565 | 23.994 |
| 1 | 2 | -3.554 | 2.920 | 21.295 | -0.918 | 184.182 | 34.819 |
| 1 | 3 | -36.627 | -0.139 | 20.924 | -0.918 | 179.792 | 7.643 |
| 1 | 4 | -69.699 | -0.445 | 20.618 | -0.918 | 177.112 | 4.963 |
| 1 | 5 | -113.922 | 0.167 | 20.618 | -0.918 | 177.112 | 10.323 |
| 1 | 6 | -80.850 | 0.473 | 20.924 | -0.918 | 179.792 | 13.003 |
| 1 | 7 | -212.960 | 3.385 | 22.330 | 0.118 | 202.947 | 38.892 |
| 1 | 8 | -158.146 | 0.779 | 20.618 | -0.918 | 177.112 | 15.683 |
| | | | | | | | |

| • | | | | | | | |
|---|----|----------|--------|--------|--------|---------|--------|
| 1 | 9 | -191.218 | 0.473 | 20.312 | -0.918 | 174.432 | 13.003 |
| 1 | 10 | -3.965 | -2.157 | 20.006 | 0.917 | 172.863 | -9.673 |
| 1 | 11 | 224.270 | -0.659 | 20.633 | 0.918 | 183.209 | 3.457 |
| 1 | 12 | -146.995 | -0.139 | 20.312 | -0.918 | 174.432 | 7.643 |
| 1 | 13 | 218.623 | 1.356 | 21.105 | 0.381 | 190.791 | 21.113 |
| | | | | | | | |

gater in the differencere by the proposed model with dehige

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it can be stilled that a suitable proge

V. CONCLUSION AND REMARKS

Calculation of the compressive and tensile forces on a group of raking piles or combined vertical and raking piles under inclined loading is very complex, and there is no established procedure with any sound theoretical basis, since a piled foundation is a three-dimensional structure with a high degree of indeterminancy. Inorder to tackle the problem some analytical methods are proposed in the literature. However an exact solution is not available. This study is adopted elastic beam model for piles as a better approach for the group analysis of point-bearing piles. Comparison of some numerical examples given in the literature by the proposed model with other calculation methods has proved that the results obtained are in reasonable limits.

In conclusion, it can be stated that a suitable programme has been developed for the design of end-bearing pile groups which will turn tedious calculation into a practical and efficient aid to the needs of engineering design offices.

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The computed axial, shear forces as well as bending and torsional moments for each single pile is also useful in the structural design of the piles. The cross-section of piles should be chosen in accordance with the reactive forces to which it is subjected to.

Another importance of the study is that the settlements of the piled foundation under the forces from superstructure can also be obtained, which gives the designer reliable information to make sure that the movements are within acceptable limits provided the pile is founded on a hard yielding strata.

The numerical computations with the developed programme has shown that the subgrade coefficient, c, does not effect the reactive forces and moments if the group consists of only vertical piles. However if the group includes or consists of battered piles the computed reactive forces and moments vary considerably due to the change in subgrade coefficient. Therefore if can be concluded that reliable subsoil properties are necessary for the threedimensional analysis of pile groups including raking piles, but not so adequate if the group consists of only vertical piles.

The analysis giving the maximum pile head reactions and moments is also useful for the design of pile cap.

Another important aspect of the study is the calculation of settlements and movements if detailed subsoil data is available. Since the study is confined to point-

bearing piles only, it is found out that the vertical settlements are little more than the elastic shortening of piles. The computation of movements approaching to exactness will enable the designer, to check the previously calculated support reactions which had been done assuming vertical and horizontal movements to be zero. If the movements are not within the acceptable limits, a modification of support reactions can be achieved by modelling fixed support as an elastic support undergoing the calculated amount of displacements.

The dynamic analysis of the pile groups or introduction of friction piles can be accepted as a continuation of research subjects to improve this programme for a complete analysis. The matrix methods used for this study is also very efficient in these research areas of pile group analysis.

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VII. APPENDIX

APPENDIX 1 - LIST OF THE PROGRAM

POP-11 FORTRAN-77 V5.0-0 11:01:25

30-Nov-85

| PILFON.FTN;1 | | /F77/OP/TR:BLOCKS/WR | |
|--------------|-------|--|------|
| 0001 | | PROGRAM PILFON | |
| | C**** | *************************************** | Ht. |
| | C | PILE :NUMBER OF PILES | * |
| | С | NLOAD :NUMBER OF LOADINGS | * |
| | С | (1) :SEQUENCE OF X.Y.Z COORDINATES OF A SINGLE PILE | * |
| | C | C(1) :SEQUENCE OF SOIL MODULUS FOR VARIOUS DEPTHS FOR EACH PILL | Et . |
| | C | E :ELASTICITY MODULUS FOR EACH GIVEN PILE | * |
| | C | W :POISSION'S RATIO FOR EACH PILE | * |
| | C | G :ELASTICITY MODILUS FOR TORSION: G=E/(1+2+EMU) | * |
| | c | EL(I) SEQUENCE FOR THE LENGTHS OF FACH ELEMENT FOR FACH PILE | * |
| | C | GL(1) :SEQUENCE FOR GAMMA(L) FOR EACH PILE | * |
| | C | EX STIFFNESS AGANIST MOMENT IN X DIRECTION FOR EACH PILE | * |
| | c | EY STIFFNESS AGANIST MOMENT IN Y DIRECTION FOR EACH PILE | * |
| | C | GI STIFFNESS AGANIST TORSION FOR FACH PILE | * |
| | C | P(1.J) SEDUENCE OF LOADING MATRICE | * |
| | CHAN | | ** |
| 0002 | | COMMON/RINCK1/SR(200) TRR ISS NO TKR/S S) | |
| 0002 | | COMMON/REOCK2/FR(21) PN | |
| 0003 | | COMMON/RIOCK2/ NELLE NICAD | |
| 0005 | | COMMON/DIOCKA/ID IDEC COE | |
| 0005 | | DIMENCION ATDANCIE EN DEDIE 10) DIE 10) DEDDDIE 10) DOCIE 10) | |
| 0000 | | PEAI + A TKP NIKP(C C) TOKPM(C C) TOKPT(C C) | |
| 0007 | | PEAI + 4 COE(C C) DIG(C 10) DOE(C 10) | |
| 0000 | | INTEGED DN DOLLC | |
| 0010 | | CHAPACTER+A RAC(17) | |
| 0010 | | NATA DALIS 1 2 5 4 2/ | |
| 0012 | | OPEN/INIT- 1 CILC-/CLOWIT/ ACCESS-/DIDECT/ DECI-21 TYDE-/SCOATCU | 1 |
| 0012 | | OPEN(INIT= 2 FILE= 2011 ACCESS= DIRECT ARCH-21, TIPE= SCRATCH | 1 |
| 0013 | | OPEN(INIT= 2 FILE= TILE ,ACCESS= DIRECT, RECE-SO,TTLE SCRATCH | 1 |
| 0015 | | OPEN(INIT- 7 EILE- MINHS , ACCESS- DIACCI , RECE-SO, TITE- SCRATCH | 1 |
| 0015 | | DENIMIT- 9 EILE- MIAN , HOLESS- DIACUT, ACCESS, MICH | 1 |
| 0017 | | ADEN(INIT-10 EILE- DEION ACCESS- DIRECT RECE-00,THE- SCRICH | 1 |
| 0019 | | OPEN(INIT-11 FILE- FORCES , ACCESS- DIRECT , RECE-00, TIPE- SCRATCH | 1 |
| 0019 | | OPEN(INIT-12 FILE- DISF ,HULESS- DIRECT, REUL-SO, TIFE- SUMICH | 1 |
| 0015 | C | OPEN CATT-IE, FILE- FREAC , HOLESS- DIRECT , RECE-SU, I, IFE- SCRATCH | , |
| | c | A DEGRAM FOR THE CALCULATION OF CROUP CARACITY OF BUILD | |
| | c | A FROMAN FOR THE CALCOCATION OF BROUF CAPACITY OF FILES | |
| 0020 | | NTI -1 | |
| 0020 | 75(| READ (A ((A) 1704) (D)D-(50) TOD DAG | |
| 0021 | 731 | IE(TOP NE 104) CO TO 750 | |
| 0022 | | | |
| 8024 | | UDITE(C //10V 1704)/) 000 | |
| 0025 | | PEAD (A (1515)() NOTIC NI OAD NO ITO NTO | |
| 0025 | | $\frac{1}{10} \frac{1}{10} |
| 0020 | 11 | PCAD(A //CC10 0)/)/P(I I) I-1 C) | |
| 0027 | 1 | ON-1 | |
| 0020 | | | |
| 0020 | | | |
| 0030 | | | |
| 0031 | 1. | | |
| 0032 | | | |
| 0033 | | 10K0T/1 1)-0 | |
| 0034 | 1 | | |
| 0035 | | DU 13 IPIL=1,NPILE | |
| 0036 | | REAU(2, KEU=1P1L)((10KKM(1,J),J=1,6),I=1,6) | |
| 003/ | | DU 13 1=1,6 | |

| PUP-11 FURINA | N-11 V3.0-0 11:01:23 30-Nov-83 Page 2 |
|---------------|---|
| PILFON.FTN;1 | /F77/OP/TR:BLOCKS/WR |
| 0028 | 00 13 J=1 6 |
| 12 0000 | IDKOL(I T)=IOKOL(I T)TIOKOM(I T) |
| 0035 13 | CALL SOLUE/S NI OAD LOKET D OCDY |
| 0041 | $\frac{1}{1}$ |
| 0042 | UPITE/6 //// 10V 2000 MATION OF DUE OTIEDUECE MATRICEC.)// |
| 0042 | WRITE(0, (//, 10X, 30H30HTHITUN UP FILE STIFFNESS MRIKICES:)) |
| 0043 | MRIIE(0, (0(/10X,0E13.3))))((10KK)(1,3),1=1,6),3=1,6) |
| 0045 | WRITE(6, (//, IUX, ISHDISPLACEMENTS)') |
| 0045 640 | MKIIE(0, (0(/10X,0E10.0)))((DEP(1,0),1=1,0),0=1,NLUAD) |
| 0047 | JREL=1 |
| 0047 | NRELEI |
| 0048 | DU 20 IPIL=1,NPILE |
| 0049 | READ(3,REC=191L)((AIRANS(1,J),J=1,b),1=1,b) |
| 0050 | KEAU(7, KEU=IPIL) ((NIKK(1,J),J=1,6),I=1,6) |
| 0051 | CALL MATCAR(6, NLUAD, ATRANS, DEP, DEPUR) |
| 0052 | CALL MAICAR(6,NLOAD,NIKR,DEPOR,PDC) |
| 0053 | DU 21 JLUAD=1,NLUAD |
| 0054 | WRITE(9, REC=JREC) (DEPOR(1, JLOAD), 1=1,6) |
| 0055 | WRITE(10, REC=JREC) (POC(1, JLOAD), I=1,6) |
| 0056 21 | JREC=JREC+1 |
| 0057 | DO 20 IK=1,2 |
| 0058 | IREC=2*IPIL*(ND-1)+IK-2 |
| 0059 | 00 211 1=1,3 |
| 0060 | DO 211 J=1,NLOAD |
| 0061 211 | DIS(I,J)=DEPOR(ROW(I+3*(IK-1)),J) |
| 0062 | CALL READER(3,ND) |
| 0063 | CALL MATCAR(3,NLOAD,COF,DIS,POF) |
| 0064 | WRITE(11, REC=NREC)((DIS(I, J), I=1, 3), J=1, NLOAD) |
| 0065 | WRITE(12,REC=NREC)((POF(I,J),I=1,3),J=1,NLOAD) |
| 0066 | NREC=NREC+1 |
| 0067 | DO 212 ID=1,ND-1 |
| 8300 | CALL READER(2,ND) |
| 0069 | CALL MATCAR(3,NLOAD, COF, DIS, POF) |
| 0070 | CALL READER(1,ND) |
| 0071 | CALL SOLVE(3,NLOAD,COF,POF,DIS) |
| 0072 | WRITE(11, REC=NREC)((DIS(I, J), I=1, 3), J=1, NLOAD) |
| 0073 | WRITE(12, REC=NREC)((POF(I, J), I=1, 3), J=1, NLOAD) |
| 0074 | NREC=NREC+1 |
| 0075 212 | IREC=IREC-2 |
| 0076 20 | CONTINUE |
| 0077 | CALL OUTPUT(P,ND,ITR) |
| 0078 | NTL=NTL+1 |
| 0079 | GO TO 750 |
| 0080 650 | CLOSE(UNIT=8,DISP='DELETE') |
| 0081 | STOP |
| 0082 | END |

PROGRAM SECTIONS

| Size | | Attributes |
|--------|---|---|
| 003562 | 953 | RW, I, CON, LCL |
| 000760 | 248 | RW.D.CON.LCL |
| 000010 | 4 | RH.D.CON.LCL |
| 004110 | 1060 | RH, D, CON, LCL |
| | Siz 003562 000760 000010 004110 | Size 003562 953 000760 248 000010 4 004110 1060 |

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| STEMPS | 000010 | 4 | RH, D, CON, LCL |
|--------|--------|-----|-----------------|
| BLOCK1 | 001666 | 475 | RW, D, OVR, GBL |
| BLOCK2 | 000126 | 43 | RW, D, OVR, GBL |
| BLOCK3 | 000004 | 2 | RW, D, OVR, GBL |
| BLOCK4 | 000224 | 74 | RW, D, OVR, GBL |
| | | | |

Total Space Allocated = 013136 2863

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|-----------|-------------------|----------------------------------|-------------------|----------------------|
| PILFON.FT | IN;1 /F77/ | OP/TR:BLOCKS/ | WR | |
| • | | | | |
| 0001 | SUBROUTINE PILR | I(IPIL) | | |
| 0002 | DIMENSION X(300 |),C(100),EL(1 | UU),GL(1UU),CU(1 | 2) () ATRANO(5 (|
| | | C C) TONCLT/C |),10KKM(6,6),A(6 | , b) , AI KANS(b, b |
| 0000 | | 0,0), INVSLI(0 | ID) | |
| 0003 | COMMON/PLOCK2/E | P(200),100,13 | 5,190,1KK(0,0) | |
| 0004 | INTEGER RN. ROW | 6) | | |
| 0005 | REAL MU | ., | | |
| 0007 | REAL+4 IKR.NIKR | .IDKR.IDKRM | | |
| 0008 | CHARACTER*5 KP, | KPILE | | |
| 0009 | DOUBLE PRECISIC | N PI, ALFA, ALF | AY | |
| 0010 | DATA KPILE, PI/ | PILE:',3.1415 | 92654/ | |
| 0011 | DATA ROW/6,1,2, | 5,4,3/ | | |
| 0012 | KS(I,J)=(J−I)* | D*3-(J-I-1)*(| J-1)*0.5+1 | |
| 0013 | READ(4, '(12, 3X, | A5)') IROW, KP | | |
| 0014 | IF(IROW.NE.IPIL | .OR.KP.NE.KPI | LE) THEN | |
| 0015 | WRITE(6, '(5X, 12 | ,3X,23HPILE H | ead card is wron | G)') IPIL |
| 0016 | GO TO 75 | | | |
| 0017 | ENDIF | IL GALL VOT UT | | |
| 8100 | KEAU(4,61)U,E,F | U,C(1),KSI,KI | Y,(CU(1),1=4,6) | |
| 0013 | PEAD(4, (0F10.0 | $))(\lambda(1), 1=1, \dots, 1)$ | NUX3,3) | |
| 0020 | READ(4 / (RE10.0 | (X(1), 1-2, 1) | ND+2 21 | |
| 0022 | IF(KTY F0.0) TH | (A(1),1-3, | 140×3,3) | |
| 0023 | DO 12 I=2.ND-1 | | | |
| 0024 | 12 C(1)=C(1) | | | |
| 0025 | ELSEIF(KTY.EQ.1 |) THEN | | |
| 0026 | READ(4, '(8E10.0 |)')(C(I),I=1, | ND-1) | |
| 0027 | ENDIF | | | |
| 0028 | G=E/(2*(1+2*MU) |) | | 1.1.1 |
| 0029 | IF(KST.EQ.0) Th | EN | | |
| 0030 | EF=E*PI*D**2/4 | in with a | | |
| 0031 | EIX=E*PI*D**4/6 | ;4 | | 4 |
| 0032 | EIY=EIX | | | |
| 0033 | GJ=G*PI*D**4/32 | | | |
| 0039 | ELSEIF(KSI.EU.) | .) THEN | | |
| 0033 | | | | |
| 0030 | EIX-EXVAX4/12 | | | 1 |
| 0038 | GJ=GtD+t4/6 | | | 1: |
| 0039 | ENDLE | | | |
| 0040 | J=1 | | | |
| 0041 | DO 20 I=1.3*(NO | -1).3 | | |
| 0042 | EL(J)=SQRT((X() | +3)-X(I))**2 | | |
| | 1 +(X(1 | +4)-X(I+1))** | 2 | |
| | 2 +(X() | +5)-X(1+2))** | 2) | |
| 0043 | GL(J)=EL(J)*SQF | T(SQRT(C(J)*D | *1000/(4*EIX))) | |
| 0044 | 20 J=J+1 | | | |
| 0045 | IL=3*ND-5 | | | |
| 0046 | SS=KS(IL, 3KND) | | | |
| 0047 | 188=1 | | | |
| 0048 | 155=3 | | | |
| 0050 | 00 20 1-1 200 | | Street Bringhouse | |
| | 00 30 1-1,200 | | | |

| PILFON. | FUN | ;1 /F77/0P/TR:BLOCKS/WR |
|---------|-----|---|
| 0051 | | 30 SR(I)=0 |
| 0052 | | 00 9 NI=1,ND-1 |
| 0053 | | IF(K.EQ.1) THEN |
| 0054 | | CALL ELRI(EF,EL(NI),EIX,GL(NI)) |
| 0055 | | ELSE |
| 0056 | | CALL ELRI(GJ,EL(NI),EIY,GL(NI)) |
| 0057 | | ENDIF |
| 0058 | | IS=(NI-1)*3+1 |
| 0059 | | JS=IS |
| 0060 | | LS=6 |
| 0061 | | LM=1 |
| 0062 | | DO 10 L=1,6 |
| 0063 | | KL=KS(IS,JS) |
| 0064 | | DO 11 M=1,LS |
| 0065 | | SR(KL+M-1)=SR(KL+M-1)+ER(LM) |
| 0066 | | 11 LM=LM+1 |
| 0067 | | LS=LS-1 |
| 0068 | | 10 JS=JS+1 |
| 0069 | | 9 CONTINUE |
| 0070 | | CALL ELE |
| 0071 | | CALL KURIKR |
| 0072 | | I88=4 |
| 0073 | | ISS=6 |
| 0074 | | 8 CONTINUE |
| | C | |
| | C | NEW ORDER OF PILE STIFFNESS MATRICE |
| | C | |
| 0075 | | DO 21 I=1,6 |
| 0076 | | DO 21 J=1,6 |
| 0077 | | 21 NIKR(I,J)=0 |
| 0078 | | DO 22 I=1,6 |
| 0079 | | 00 22 J=1,6 |
| 0080 | | 22 NIKR(ROW(I), ROW(J)) = IKR(I, J) |
| 0081 | | WRITE(7,REC=IPIL)((NIKR(I,J),J=1,6),I=1,6) |
| | C | |
| | C | CALCULATION OF DIRECTION COSINES |
| | C | |
| 0082 | | CO(1)=X(1) |
| 0083 | | CO(2)=X(2) |
| 0084 | | CO(3)=X(3) |
| 0085 | | MS=ND*3-2 |
| 0086 | | CO(10)=X(MS) |
| 0087 | | CU(11)=X(MS+1) |
| 8800 | | CO(12)=X(MS+2) |
| 2800 | | DO 31 I=1,3 |
| 0090 | | 31 CO(1)=CO(9+1)-CO(1) |
| 0091 | | DELTA=1/(SQRT(CO(1)*CO(1)+CO(2)*CO(2)+CO(3)*CO(3))) |
| 0092 | | 00 32 1=1,3 |
| 0093 | | 32 CU(1)=CU(1)*DELTA |
| 0094 | | IF(CU(3).EQ1) THEN |
| 0095 | | CU(4) =0. |
| 00056 | | CU(5)=-1. |
| 0097 | | CU(6) =0. |
| 8600 | | ENDIF |
| 0099 | | (117)=(17)=(17)=(17)=(17)=(17)=(17)=(17) |

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| PDP-11 | FOR | r ah | 1-77 V5.0-0 | 11:02:05 | 30-Nov-85 | Page 6 |
|---------|-----|-------------|---|------------------|---------------|-------------------------------|
| PILFON. | FTN | 1 | /F77/0 | P/TR:BLOCKS/W | 1 | |
| | | | | | | |
| 0100 | | | CO(8)=CO(3)*CO(4 | 1)-CO(1)*CO(6) | | |
| 0101 | | | CO(9)=CO(1)*CO(5 | 5)-CO(2)*CO(4) | | |
| 0102 | | | REWIND 08 | | | |
| 0103 | | - | WRITE(8. (12E10. | 4)')(CO(I),I= | .12) | |
| 0104 | | | REWIND 08 | , /(00(1/)1. | | |
| 0105 | | | PEAD (9 /(12510 | 4)/)(CO(1) 1- | 12) | |
| 0105 | c | | UDITE(6 //2515 | 1)/)((0(1) 1-1 | 12) | |
| | c | | MULLO (0113. | *))(((1),1-1 | ,12) | |
| | C. | | FORMATION OF TH | DOTATION MAT | | |
| | 5 | | FURNALIUN UP IN | KUTATION MAI | RILE | |
| | L | | | | | |
| 0106 | | | 00 41 1=1,6 | | | |
| 0107 | | | 00 41 J=1,6 | | | |
| 0108 | | 41 | ROTA(I,J)=0 | | | |
| 0109 | | | DO 42 K=1,4,3 | | | 和"如果"的"不是是不是是是 |
| 0110 | | | DO 42 I=K,K+2 | | | |
| 0111 | | | DO 42 J=K,K+2 | | | |
| 0112 | | 42 | ROTA(1,J)=CO(3*) | (I-K)+(J-K+1)) | | |
| · | C | | | | | |
| | C | | FORMATION OF THE | TRANSPOSE OF | THE TRANSLA | TION MATRICE |
| | C | | | | | |
| 0113 | | | 00 51 I=1.6 | | | |
| 0114 | | | DO 51 J=1.6 | | | |
| 0115 | | | IF(I NE J) THEN | | | |
| 0116 | | | TRNSIT(I J)=0 | | | |
| 0117 | | | FICE | | | |
| 0117 | | | TONCLT/I IN-4 | | | |
| 0110 | | | TRNSLI(1,J)=1. | | | |
| 0119 | | - | CNUIF | | | |
| 0120 | | 21 | CUNTINUE | | | |
| 0121 | | | $1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times$ | (11) | | |
| 0122 | | | TRNSLT(5,3) = -CO(| (10) | | |
| 0123 | | | TRNSLT(6,1) = -CO(| (11) | | |
| 0124 | | | TRNSLT(6,2) = CO(| (10) | | |
| | С | | | | | |
| | C | | FORMATION OF THE | TRANSFORMATI | ON MATRICE | |
| | С | | | | | |
| 0125 | | | CALL MATCAR(6,6 | TRNSLT, ROTA, A |) | |
| 0126 | | | DO 52 I=1.6 | | | |
| 0127 | | | 00 52 J=1.6 | | | |
| 0128 | | 52 | ATRANS(I.J)=A(J | .1) | | |
| 0129 | | | WRITE(3 REC=IPI |) (ATRANS(1 .I |) .I=1 6) I=1 | 6) |
| | C | | | -)((()))))(1)0 | ,,0-1,0,,1-1 | 101 |
| | c | | DOTATION AND TO | NICIATION OF C | | INATED DILE CTIEDIECO MATDICE |
| | 5 | | NUTHITON HOU IN | | HUSSIAN ELIM | INHIED FILE STIFFNESS MAIKILE |
| 01.00 | L | | CALL MATCARUE C | WIND ATOWN | | |
| 0130 | | | CALL MATCAR(6,6 | MIRK, AIRANS, I | UKR) | |
| 0131 | | | UALL MATCAR(6,6 | A, IDKR, IDKRM) | | |
| 0132 | | | WKITE(2, REC=IPI | (IOKRM(I,J)) | ,J=1,6),I=1, | 6) |
| 0133 | | 61 | FORMAT(4E10.0,2) | (5,3E10.0) | | |
| 0134 | | 75 | RETURN | | | |
| 0135 | | | END | | | |

PROGRAM SECTIONS

Size

Nane

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POP-11 FORTRAN-77 V5.0-0 11:02:05 . 30-Nov-85 PILFON.FTN;1 /F77/OP/TR:BLOCKS/WR

| \$CODE1 | 005166 | 1339 | RW, I, CON, LCL |
|---------|--------|------|-----------------|
| \$PDATA | 000210 | 68 | RW, D, CON, LCL |
| \$IDATA | 000032 | 13 | RW, D, CON, LCL |
| SUARS | 006766 | 1787 | RW, D, CON, LCL |
| STEMPS | 000014 | 6 | RW, D, CON, LCL |
| BLOCK1 | 001666 | 475 | RW, D, OVR, GBL |
| BLOCK2 | 000126 | 43 | RW, D, OVR, GBL |

Total Space Allocated = 016446 3731

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|--------------|--------------------|--------------------------|---------------|---------------------------------------|
| PILFON.FTN:1 | /F77/0 | P/TR:BLOCKS/W | R | |
| | | | | |
| | | | | |
| 0001 | SUBROUTINE ELRI(| EF,EL,EI,GL) | | |
| 0002 | COMMON/BLOCK2/ER | (21),RN | | |
| 0003 | INTEGER RN | | | |
| C | | | | |
| С | FORMATION OF THE | ELEMENT STIF | FNESS MATRICE | ON ELASTIC FOUNDATION |
| С | | | | |
| 0004 | CH=COSH(GL) | | | |
| 0005 | CO=COS(GL) | | | |
| 0006 | SH=SINH(GL) | | | |
| 0007 | SI=SIN(GL) | | | |
| 0008 | SHCH=SH*CH | المحر سل أقبر المصمو سال | | |
| 0009 | CHSI=CH#SI | | | |
| 0010 | SHCO=SH*CO | | | |
| 0011 | SICO=SI*CO | | | |
| 0012 | PYDT=1./(SHASH-S | (tst) | | |
| C. | | | | |
| c | MEMBERS OF THE S | TIFFNESS MATE | ICE | |
| c | HEIDEND OF THE C | 111111200 11111 | | |
| 0013 | CK1=2+FI+GI /FI | | | |
| 0014 | CK2=2+CK1+GI /FI | | | |
| 0015 | CK3=CK2+GI /FI | | | |
| C | | | | |
| č | FORMATION OF FLE | MENT STIFFNES | S MATRICE IN | ONE DIMENSIONAL LEDI SEOUSNEE |
| č | TOWPHICK OF LEE | | S INITICE IN | are principation [EN] seconde |
| 0016 | FR(1) =CK1+(SHCH | -SICO)+PYDT | | |
| 0017 | FR(2) =FF/FI | 0100/-1101 | | |
| 0018 | ER(3) = CK3t(SHCH) | +SICO) +PYDT | | |
| 0019 | FR(4) = FR(1) | 10100/11/01 | | |
| 0020 | ER(5) = ER(2) | | | |
| 0021 | FR(6) = FR(3) | | | · |
| 0022 | ER(9) =CK2t(SHtS | I+PYDT) | | |
| 0023 | FR(12)=CK2t0.5t(| SHXSH+SIXSI)X | PYDT | |
| 0024 | FR(15)=FR(12) | | | |
| 0025 | FR(16)=CK1*(CHSI | -SHCO) *PYDT | | |
| 0026 | ER(17)=FR(2) | 011007-1101 | | |
| 0027 | ER(18)=CK3t(CHSI | +SHCO) *PYDT | | |
| 0028 | ER(21)=ER(9) | | | |
| 0029 | WRITE(1.REC=RN)F | R | | |
| 0030 | RN=RN+1 | | | 1. |
| 0031 | RETURN | | | · · · · · · · · · · · · · · · · · · · |
| 0032 | END | | - | |
| | | | | |

PROGRAM SECTIONS

| Name | Size | | | Attributes | |
|---------|--------|-----|---|-----------------|--|
| \$CODE1 | 000650 | 212 | , | RW, I, CON, LCL | |
| \$IDATA | 000014 | 6 | | RW, D, CON, LCL | |
| \$VARS | 000060 | 24 | | RW, D, CON, LCL | |
| BLOCK2 | 000126 | 43 | | RH, D, OVR, GBL | |

POP-11 FORTRAN-77 V5.0-0 11:02:56 30-Nov-85 PILFON.FTN;1 /F77/OP/TR:BLOCKS/WR

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| 0001 | | SUBROUTINE KURIKR |
|------|----|---|
| 0002 | | COMMON/BLOCK1/SR(200), IBB, ISS, ND, IKR(6,6) |
| 0003 | | REAL*4 IKR |
| 0004 | | M=3+ND-2 |
| 0005 | | ME=M |
| 0006 | | K=1 |
| 0007 | | DO 10 I=IBB,ISS |
| 0008 | | ART=ND*3 |
| 0009 | | 00 20 J=I,ISS |
| 0010 | | IKR(I,J)=SR(ME) |
| 0011 | | IF(I.NE.J) IKR(J,I)=IKR(I,J) |
| 0012 | | ME=ME+ART |
| 0013 | 20 | ART=ART-1 |
| 0014 | | ME=MHK |
| 0015 | 10 | K=K+1 |
| 0016 | | RETURN |
| 0017 | | END |

PROGRAM SECTIONS

| Name | Size | | Attributes |
|---------|--------|-----|-----------------|
| \$CODE1 | 000314 | 102 | RH, I, CON, LCL |
| \$VARS | 000016 | 7 | RW, D, CON, LCL |
| BLOCK1 | 001666 | 475 | RW, D, OVR, GBL |

Total Space Allocated = 002220 584

| 0P-11 | FORTRAN-77 | V5.0-0 | 11:03:00 | 30-Nov-85 |
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| ILFON. | FTN;1 | 1 | F77/OP/TR:BLOCKS/W | R |

| 0001 | | | SUBROUTINE ELE |
|-------------------------|---|----|---|
| 0002 | | | INTEGER YBG, BG |
| 0003 | | | COMMON/BLOCK1/A(200), IB8, ISS, ND, IKR(6,6) |
| 0004 | | | K(I,J)=(J-I)*N-(J-I-1)*(J-I)*0.5+I |
| 0005 | | | N=3*ND |
| 0006 | | | NS=N-3 |
| 0007 | | | YBG=6 |
| 8000 | | | IL=N-YBG+1 |
| 0009 | | | KS=K(IL.N) |
| 1999 | C | | attailed and the second and the |
| | C | | ELEMINATION |
| | C | | nergeneret forther transferinging for an |
| 0010 | | | DO 10 I=2.NS |
| 0011 | | | IF(I.GT.IL) GO TO 19 |
| 0012 | | | JS=I+YBG-2 |
| 0013 | | | GO TO 20 |
| 0014 | | 19 | JS=N |
| 0015 | | 20 | ORAN=A(K(I-1.I))/A(K(I-1.I-1)) |
| 0016 | | | DO 11 J=I.JS |
| 0017 | | 11 | A(K(I,J)) = A(K(I,J)) - ORAN + A(K(I-1,J)) |
| 0018 | | 10 | CONTINUE |
| 0019 | | | RETURN |
| 0020 | | | END |
| A STATISTICS IN COMPANY | | | The second second second second second second second second second second second second second second second se |

PROGRAM SECTIONS

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| Name | Siz | 1000 | Attributes |
|---------|--------|------|-----------------|
| \$CODE1 | 000622 | 201 | RW, I, CON, LCL |
| \$PDATA | 000014 | 6 | RH, D, CON, LCL |
| \$IDATA | 000022 | 9 | RH.D.CON.LCL |
| SWARS | 000026 | 11 | RH.D.CON.LCL |
| STEMPS | 000004 | 2 | RW.D.CON.LCL |
| BLOCK1 | 001556 | 439 | RW, D, OVR, GBL |

10111 (6,1913 (SH) OH ADEP

ALLAND AND ALL CONTRACTORS (S. P. P. S. D. M. M. D. D.

NUTE (C. 101) (J. D. CONST. C. D. P. N. J. C. M. W. W. S.

Total Space Allocated = 002470 668

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| 0011 SUBROUTINE OUTPUT(P,ND, ITR) 0022 DIMENSION P(6,10), DISP(6,10), PREC(6,10) 0033 COMMON REDOKSAV PPILE, NLGAD 0044 INTEGER RGN(6) 0055 CHARACTERK2_SEQ(30), HDEP(6), HFDR(6), HLDAD(6) 0066 CHARACTERK2_SEQ(30), HDEP(6), HFDR(6), HLDAD(6) 0076 DATA RGM/6, 1, 2, 5, 4, 3' 0077 DATA RGM/6, 1, 2, 5, 4, 3' 0088 DATA TAM, LSM2, ISM3', LDAD ND: ',' PILE ND:',' NODE ND:'/ 0019 DATA RGM/6, 1, 2, 5, 4, 3' 0010 DATA RGM/6, 1, 2, 5, 4, 3' 0011 DATA SEQ(21), 252(2), 522(3), 552(3), 552(4)'.'ST', 'ND',' RD',' 0012 DATA SEQ(21), SEQ(2), SEQ(3), SEQ(4)'.'ST', 'ND', 'RD',' 0013 DATA SEQ(21), SEQ(2), SEQ(3), SEQ(4)'.'ST', 'ND', 'RD',' 0014 D 10 10 1-4, 30 D 0015 IF(1, LE, 20, OR.I. GE. 24) SEQ(1)=SEQ(4) 0016 ID CONTINUE D 0017 WRITE(6, 101) SM1, HLADAD 0021 D 0 10 J LADA-1, NLADA 0022 WRITE(6, 103) SM1, ISM2, HDEP 0033 MO 2 J LGAD-1, NLADA 0034 RED(6, S, LDAD, F | PDP-11 PILFON. | FORTRA | N-77 V5.0-0 11:03:05 30-Nov-85 /F77/OP/TR:BLOCKS/WR | Page 11 |
|--|----------------|--------|---|------------|
| 001 SUBROUTINE OUTPUT(P,NO,TR) 002 DIMENSION P(6,10),DISP(6,10),PREC(6,10) 003 COMMOX BLOCK3/ NPILE,MLOAD 004 INTEGER RGH(6) 005 CHARACTER*2_SEQ(30),HDEP(6),HFDR(6),HLOAD(6) 006 CHARACTER*2_SEQ(30),HDEP(6),HFDR(6),HLOAD(6) 006 CHARACTER*2_SEQ(30),FDEP(6),HFDR(6),HLOAD(6) 007 DATA RGM/61,2,5,4,3' 008 DATA TSM,LSM2,STAT,'TY','TZ','NX','PY','PS','PS',' 009 DATA HOP /'D',','Q2','P3','P4','PS','P6',' 0010 DATA HOP /'D',','Q2','P3','P4','PS','P6',' 0011 DATA SEQ(1),SEQ(22),SEQ(3),SEQ(4),'ST','ND','RD',' 0012 DATA SEQ(1),SEQ(22),SEQ(23),'ST','ND','RD',' 0013 DATA SEQ(1),SEQ(22),SEQ(23),'ST','ND','RD',' 0014 DO 10 JLADO-I,MLOAD 0015 IF(1,LE.20.OR.I.GE.24) SEQ(1)=SEQ(4) 016 MRITE(6,102),JLOAD,(P(1,JLOAD),I=1,6) 019 DO 10 JLADO-I,MLOAD 0101 DATA,SEQ(1),SEQ(22),SEQ(23),SEQ(1),SEQ(23),SEQ(1),SEQ(23),SEQ(1),SEQ(23),SEQ(1),SEQ(23),SEQ(1) | | | | |
| 0002 DIMENSION P(6,10), pISP(6,10), pREC(6,10) 0003 COMMON/BLOCK3/ NPILE, NLOAD 0004 INTEGER ROM(6) 0005 CHARACTERK2 0006 CHARACTERK2 0007 DATA ROM/6, 1, 2, 5, 4, 3/ 0008 DATA HOE//1, 192, 1SH3/ 0010 DATA HOE//1, 192, 1SH3/ 0011 DATA HOE//11, 192, 1SH3/ 0012 DATA HOE//11, 192, 1SH3/ 0013 DATA HOE//11, 192, 1SH3/ 0014 DOTA HOE//11, 192, 1SH3/ 0015 DATA HOE//11, 722, 'P3', 'P4', 'P5', 'P6'/ 0011 DATA SEQ(1), SEQ(2), SEQ(2), SEQ(3)/'ST', 'N0', 'R0', 'TH'/ 0013 DATA SEQ(1), SEQ(2), SEQ(2), SEQ(2)/'SEQ(4) 0014 D0 110 1=4, 30 0015 IF(1.LE.20.0R.1, GE.24) SEQ(1)=SEQ(4) 0016 IO CONTINUE 0017 WRITE(6, 101) SH1, HCADA 0018 WRITE(6, 102) JLOAD, (P(1, JLOAD), I=1, 6) 0021 DO 20 JLOAD=1, NLOAD 0022 WRITE(6, 102) JLOAD, PILL, (DISP(1, JLOAD), I=1, 6) 0023 D0 20 JLOAD=1, NLOAD 0024 D0 20 JLO | 0001 | | SUBROUTINE OUTPUT(P,ND,ITR) | |
| 0003 COMMON/BLOCK3/ NPILE,NLGAD 0004 INTEGER ROW(6) 0005 CHARACTERX10 15M1,15M2,15M3 0007 DATA 15M1,15M2,15M3/ LOAD ND: ',' PILE ND:',' NODE ND: ',' 0018 DATA 15M1,15M2,15M3/ LOAD ND: ',' PILE ND:',' NODE ND: ',' 0019 DATA HOLP /'D1','D2','D3','D4','D5','D6'/ OD1 DATA SEQ(1),SEQ(2),SEQ(3),SEQ(4)/'ST','M0','R0'/ 0011 DATA HOLP /'D1','D2','D3','D4','D5','P6'/ OD1',' PILE ND:',' ND','R0'/ 0011 DATA HOLP /'D1','D2','D3','D4','D5','P6'/ OD1',' PILE ND:',' ND','R0'/ 0012 DATA SEQ(21),SEQ(23),SEQ(3),SEQ(4)/'ST','ND','R0'/ PIL',' PIL','R0','R0'/ 0013 DATA SEQ(21),SEQ(22),SEQ(23)/'ST','ND','R0'/ PIL',' PIL','R0'/ 0014 D0 10 10 1-4,30 C1-1,50 C1-1,50 0015 IF(1.LE,010,R1,1,40AD LOADS)') OD18 MRITE(6,101)15M1,HADAD 0014 D0 10 JLGAD-1,NLGAD PILE PILE PILE 0014 D0 10 JLGAD-1,NLGAD PILE PILE 0021 DO 21 JLADA-1,NLGAD PILE PIL | 0002 | | DIMENSION P(6,10), DISP(6,10), PREC(6,10) | |
| 0004 INTEGER RCM(6) 0005 CHARACTERA2 SEQ(30), HDEP(6), HFCR(6), HLOAD(6) 0006 CHARACTERA10 ISM1, ISM2, ISM3 0007 DATA RCM/6, 1, 2, 5, 4, 3/ 0008 DATA HOP /017, '027, '037, '04', '057, '06'/ 0010 DATA HCM /17, '727, '747, '757, '74', '757, '76'/ 0011 DATA SEQ(2), SEQ(2), SEQ(2), SEQ(3), 'SEQ(4), 'ST', 'N0', 'R0', 'TH'/ 0012 DATA SEQ(1), SEQ(2), SEQ(2), SEQ(2), 'SEQ(4), 'ST', 'N0', 'R0', 'TH'/ 0013 DATA SEQ(1), SEQ(2), SEQ(2), SEQ(2), 'SEQ(4), 'ST', 'N0', 'R0', 'TH'/ 0014 D0 110 1-4, 30 IF(1.LE.20.OR.1.GE.24) SEQ(1)=SEQ(4) 0015 IF(1.LE.20.OR.1.GE.24) SEQ(1)=SEQ(4) IST 0016 IO TOMTHVE WRITE(6, 101) ISM1, HCADA 0017 WRITE(6, 102), JLOAD, (P(1, JLOAD), I=1, 6) IST 0021 IO CONTINUE IRTE(6, 102), JLOAD, (P(1, JLOAD), I=1, 6) IRTE(6, IOS), JLOAD = 1, NLOAD 0022 WRITE(6, 103), ISM1, ISM2, HDEP IST FACAUG, RECEREC) (DISP(1, JLOAD), I=1, 6) 0023 LARCE(IPIL-1) +MLOAD+JLOAD IRTE(6, 103), ISM1, ISM2, HDEP IST 0034 LADAD-1, NLOAD IRTE(6, 100, JLOAD - 1, NLOAD <td>0003</td> <td></td> <td>COMMON/BLOCK3/ NPILE, NLOAD</td> <td></td> | 0003 | | COMMON/BLOCK3/ NPILE, NLOAD | |
| 0005 CHARACTER#2 SEQ(30), HDCP(6), HFCR(6), HLCAD(6) 0006 CHARACTER#10 ISHI, ISH2, ISH3 0007 DATA RGM/6, 1, 2, 5, 4, 3/ 0008 DATA ISHI, ISH2, ISH3// LOAD ND: ',' PILE ND:',' NODE ND:'/ 0019 DATA HDEP /'DI','D2','D3','D4','D5','D6'/ 0010 DATA HDEP /'DI','D2','P3','P4','P5','P6'/ 0011 DATA HLCAD/'P1','P2','P3','P4','P5','P6'/ 0012 DATA SEQ(21),SEQ(22),SEQ(33),SEQ(4)/'ST','N0','R0','TH'/ 0013 DATA SEQ(21),SEQ(22),SEQ(33),SEQ(4)/'ST','N0','R0','TH'/ 0014 DO 110 I=4,30 0015 IF(I.LE.20.OR.I.GE.24) SEQ(1)=SEQ(4) 0016 110 CONTINUE 0017 MRITE(6,101)ISH1,HLCAD 0018 WRITE(6,102)JLOAD,(P(I,JLCAD),I=1,6) 019 D0 10 JLCAD=1,MLCAD 0021 10 CONTINUE 0022 HRITE(6,103)ISH1,ISH2,HDEP 0024 DO 20 LOAD=1,MLCAD 0025 DO 21 IPL=1,NPILE 0026 IREEC=(IPLL-1)#MLCAD+JLCAD 0027 READ(9,REC=IREC) (DISP(I,JLCAD),I=1,6) 0028 21 MRITE(6,106)JLCAD,IPIL,(OREC(I,JLCAD),I=1,6) | 0004 | | INTEGER ROW(6) | |
| 0006 CHARACTERTIC 1991, 1992, 1993 0007 DATA ROW(6,1,2,5,4,3) 0008 DATA ISMI, 1992, 1983/' LOAD NO: ',' PILE NO:',' NODE NO:'/ 0019 DATA HEDR /'TX','TY','TZ','NX','MY','YC/ 0010 DATA HEDR /'TX','TY','TZ','NX','MY','YC/ 0011 DATA HEDR /'TX','TY','TZ','NX','MY','YC/ 0012 DATA SEQ(1),SEQ(2),SEQ(3),SEQ(4)/'ST','ND','RD',' 0013 DATA SEQ(21),SEQ(22),SEQ(3)/ST','ND','RD',' 0014 DO 10 10 [4,30 015 IF(1.LE.20.OR.I.GE.24) SEQ(1)=SEQ(4) 016 110 CONTINUE 0015 IF(1.LE.20.OR.I.GE.24) SEQ(1)=SEQ(4) 016 100 CONTINUE 017 NRITE(6,101)ISHI,HLOAD 018 HRITE(6,102)JLOAD,(P(1,JLOAD),1=1,6) 019 DO 10 JLOAD=1,NLOAD 0102 NRITE(6,103)ISHI,ISH2,HDEP 024 DO 20 JLOAD=1,NLOAD 025 DO 21 IPIL=1,NPILE 026 IRECE(1PIL-1)#NLOAD+JLOAD 027 READ(9,REC=IREC) (DISP(1,JLOAD),1=1,6) 028 21 RRITE(6,103)JLOAD, IPIL,(IDSP(1,JLOAD),1=1,6) 029 20 CONTINUE <t< td=""><td>0005</td><td></td><td>CHARACTER*2 SEQ(30), HDEP(6), HFOR(6), HLOAD(6)</td><td></td></t<> | 0005 | | CHARACTER*2 SEQ(30), HDEP(6), HFOR(6), HLOAD(6) | |
| 0007 DATA RUM/5,1,2,5,4,37 0008 DATA HSM1,ISM2,ISM37' LOAD ND: ',' PILE ND:',' NODE ND:'/ 0019 DATA HEDR /'D1','P2','P3','P4','P5','P6'/ 0010 DATA HEDR /'TX','TY','TZ','MX','MY','M2'/ 0011 DATA HEDR /'TX','TY','TZ','MX','MY','M2'/ 0012 DATA SEQ(21),SEQ(2),SEQ(3),SEQ(4)/'ST','NO','RO','TH'/ 0013 DATA SEQ(21),SEQ(22),SEQ(23)/'ST','NO','RO','TH'/ 0014 D0 110 I=4,30 015 IF(I.LE.20.OR.I.GE.24) SEQ(I)=SEQ(4) 016 IO CONTINUE WRITE(6,101)ISM1,HLOAD 0013 DO 10 JLOADE1,MLOAD 0014 D0 10 JLOADE1,MLOAD 0015 IF(ILLE.20.OR.I.GE.24) SEQ(I)=SEQ(4) 016 IO CONTINUE WRITE(6,102)LOAD,(P(I,JLOAD),I=1,6) 0021 IO CONTINUE WRITE(6,102)LOADE1,MLOAD 0022 RRITE(6,103)ISIN1,ISM2,HDEP 0024 DO 20 JLOADE1,MLOAD 0025 D0 21 IPIL=1,NPILE 0026 IREC=(IPIL-1)MLOAD-JLOAD 0027 READ(9,REC=IREC) (DISP(I,JLOAD),I=1,6) 0028 21 WRITE(6,104)ISM1,ISM2,HOPR | 0006 | | CHARACTER*10 ISM1, ISM2, ISM3 | |
| 0000 0414 ISH [ISH2] ISH2/: LOAD NO: ', 'PILE NU:',' NUDE NU:',' 0000 DATA HOEP //D1','O2','D3','D4','D5','D6',' 0110 DATA HOEP //D1','O2','P3','P4','P5','P6',' 0111 DATA HEOR /'TX', 'TT','TZ','RX','MY','NZ',' 0111 DATA HEOR /'TX', 'TY','TZ','RX','MY','NZ',' 0111 DATA SEQ(1),SEQ(2),SEQ(3),SEQ(4)/'ST','NO','RO',' 0113 DATA SEQ(2),SEQ(2),SEQ(3),SEQ(4)/'ST','NO','RO',' 0114 DO 110 I=4,30 0115 IF(I.LE.20.OR.I.GE.24) SEQ(1)=SEQ(4) 0116 IONTINUE 0117 WRITE(6,101,SH1,HADAD 0118 WRITE(6,102,JLADAD,(P(I,JLADAD),I=1,6) 0121 IO CONTINUE 0121 IO CONTINUE 0122 WRITE(6,103,JISH1,ISM2,HOEP 0123 WRITE(6,103,JISH1,ISM2,HOEP 0124 DO 20 JUCADE1,NLGAD 0125 DO 21 IIPL=1,NPILE 0126 IREC=(IPL-1)+#NLGAD+JLOAD 0127 READ(3,REC=IREC) (DISP(I,JLOAD),I=1,6) 0128 I HITE(6,104)/ISM1,ISM2,HOEP 0129 DO 31 IPL=1,NPILE 0120 INTINE | 0007 | | DATA ROW/6,1,2,5,4,3/ | |
| 0009 DATA HORP / D1', D2', J3', J4', D3', J6', 0010 DATA HFUR //TX', TY', TZ', Y8', Y8', Y8', Y8', 0011 DATA HFUR //TX', TY', Y2', Y3', Y4', Y5', Y8', 0012 DATA SEQ(21), SEQ(22), SEQ(3), SEQ(4)/'ST', 'N0', 'R0', 'TH'/ 0013 DATA SEQ(21), SEQ(22), SEQ(3), SEQ(4)/'ST', 'N0', 'R0', 'TH'/ 0014 D0 110 I=4,30 015 IF(1.LE.20.OR.I.GE.24) SEQ(1)=SEQ(4) 016 110 CONTINUE 0017 WRITE(6,101)ISH1, HLOAD 0018 WRITE(6,102)JLOAD, (P(1,JLOAD), I=1,6) 019 D0 10 JLOAD=1, NLOAD 0020 WRITE(6,103)ISH1, ISH2, HOEP 0021 D0 10 JLOAD=1, NLOAD 0022 WRITE(6,103)ISH, ISH2, HOEP 0023 MRITE(6,103)ISH, ISH2, HOEP 0024 D0 20 JLOAD=1, NLOAD 0025 D0 21 IPIL=1, NFILE 0026 IREC=(IPIL=1) #NLOAD 0027 READ(3, REC=TREC) (DISF(1,JLOAD), I=1,6) 018 WRITE(6,104)ISH1, ISH2, HFOR 019 D0 30 JLOAD=1, NLOAD 019 D0 30 JLOAD=1, NLOAD 0103 WRITE(6,104)ISH, ISH2, HFOR 011 WRITE(6,104)ISH, ISH2, HFOR | 8000 | | DATA 15M1,15M2,15M3/ LOAD NO: ',' PILE NO:',' 1 | NODE NO: " |
| U010 U011 <th< td=""><td>0009</td><td></td><td>UATA HUEP / 'DI', 'D2', 'D3', 'D4', 'D3', 'D6'/</td><td></td></th<> | 0009 | | UATA HUEP / 'DI', 'D2', 'D3', 'D4', 'D3', 'D6'/ | |
| ODI DATA SEQ(1), SEQ(2), SEQ(3), SEQ(4)/'ST', 'ND', 'RD', 'TH'/ 0012 DATA SEQ(21), SEQ(22), SEQ(23), ST', 'ND', 'RD', | 0010 | | DATA HFUR / IX', IY', IZ', MX', MY', MZ'/ | |
| 0012 DATA SEQ(1), SEQ(2), SEQ(3), SEQ(4), 'SI', 'ND', 'N | 0011 | | DATA HLUAU/ P1', P2', P3', P4', P5', P6'/ | |
| 0014 D0110 I=4,30 0015 IF(I.LE.20.OR.I.GE.24) SEQ(I)=SEQ(4) 0016 110 CONTINUE 0017 WRITE(6,101)ISM1,HLOAD 0018 WRITE(6,101)ISM1,HLOAD 0019 D0 10 JLOAD=1,NLOAD 0020 WRITE(6,102)JLOAD,(P(I,JLOAD),I=1,6) 0021 10 CONTINUE 0022 WRITE(6,103)ISM1,ISM2,HDEP 0023 WRITE(6,103)ISM1,ISM2,HDEP 0024 D0 20 JLOAD=1,NLOAD 0025 D0 21 IPIL=1,NPILE 0026 IREC=(IPIL=1)+NLOAD 0027 READ(9,REC=IREC) (DISP(I,JLOAD),I=1,6) 0028 21 WRITE(6,(5,105)JLOAD,IPIL,(OISP(I,JLOAD),I=1,6) 0029 20 CONTINUE 0030 WRITE(6,104)ISM1,ISM2,HFOR 0032 D0 30 JLOAD=1,NLOAD 0033 D0 31 IPIL=1,NPILE 0034 IREC=(IPIL=1)+NLOAD/JLOAD 0035 READ(10,REC=IREC) (REC(I,JLOAD),I=1,6) 0036 31 WRITE(6,(104,REC=REC)(REC(I,JLOAD),I=1,6) 0037 30 CONTINUE 0038 IF(ITR.EQ.0) RETURN 0039 WRITE(6,(104,REC=REC)(REC(I,JLOAD),I=1,6) 039 WRI | 0012 | | UATA SEU(1), SEU(2), SEU(3), SEU(4)/'ST', 'ND', 'KD', ' | 18.1 |
| 00110 1-4-30 0015 IF(I.LE.20.0R.I.GE.24) SEQ(I)=SEQ(4) 0016 110 CONTINUE 0017 HRITE(6,101)ISML,HLGAO 0018 HRITE(6,102)JLGAD,(P(I,JLGAD),I=1,6) 0020 HRITE(6,102)JLGAD,(P(I,JLGAD),I=1,6) 0021 10 CONTINUE 0022 HRITE(6,102)JLGAD,(P(I,JLGAD),I=1,6) 0023 HRITE(6,103)ISML,ISM2,HDEP 0024 D0 20 JLGAD=1,NLGAD 0025 D0 21 IPIL=1,NPILE 0026 IREC=(IPIL-1)+NLGAD 0027 READ(9,REC=IREC) (DISP(I,JLGAD),I=1,6) 0028 21 MRITE(6,103)ISML,ISM2,HFOR 0029 20 CONTINUE 0030 MRITE(6,104)ISML,ISM2,HFOR 0032 D0 30 JLGAD=1,NLGAD 0033 D0 31 IPIL=1,NPILE 0034 IREC=(IPIL-1)+NLGAD 0035 READ(10,REC=IREC)(PREC(I,JLGAD),I=1,6) 0036 31 HRITE(6,106)JLGAD,IPIL,(PREC(I,JLGAD),I=1,6) 0037 30 CONTINUE 0038 IF(ITR.E0,0) RETURN 0039 HRITE(6,'(//1,1/1,2,24,22,25,5HPILE:)') IPIL,SEQ(IPIL) 0040 IPIL=1,NPILE 0037 3 | 0013 | | DATH SEQ(21), SEQ(22), SEQ(23)/ ST , NO. , KU/ | |
| 0016 110 CONTINUE 0016 110 CONTINUE WRITE(6,'(//,11X,11HNODAL LOADS)') 0018 WRITE(6,101)ISM1,HLOAD 0019 00 10 JLOAD=1,NLOAD 0020 WRITE(6,102)JLOAD,(P(I,JLOAD),I=1,6) 0021 10 CONTINUE 0022 WRITE(6,103)ISM1,ISM2,HDEP 0023 WRITE(6,103)ISM1,ISM2,HDEP 0024 D0 20 JLOAD=1,NLOAD 0025 D0 21 IPIL=1,NPILE 0026 IREC=(IPIL-1)+NLOAD+JLOAD 0027 READ(9,REC=IREC) (DISP(I,JLOAD),I=1,6) 0028 21 WRITE(6,105)JLOAD,IPIL,(DISP(I,JLOAD),I=1,6) 0029 20 CONTINUE 0030 HRITE(6,104)ISM1,ISM2,HFOR 0032 D0 30 JLOAD=1,NLOAD 0033 D0 31 IPIL=1,NPILE 0034 IREC=(IPIL-1)+NLOAD+JLOAD 0035 READ(10,REC=IREC) (PREC(I,JLOAD),I=1,6) 0036 31 WRITE(6,'(LM1,//,11X,26HPILE ELEMENT DISPLACEMENTS)') 0031 IPIL=1,NPILE 0033 D0 31 IPIL=1,NPILE 0034 IRCE(F(IREC) (IDISP(RC(I,JLOAD),I=1,6) 0035 READ(10,REC=IREC) (PREC(I,JLOAD),I=1,6) 0036 | 0015 | | | |
| 0017 HR ITE(6, '(//, 11X, 11H, 0AAL LOADS)') 0017 HR ITE(6, 101) ISM1, HLOAD 0019 D0 10 JLOAD=1, NLOAD 0020 HR ITE(6, 102) JLOAD, (P(1, JLOAD), I=1, 6) 0021 10 CONTINUE 0022 HR ITE(6, 102) JLOAD, (P(1, JLOAD), I=1, 6) 0023 HR ITE(6, 103) ISM1, ISM2, HDEP 0024 D0 20 JLOAD=1, NLOAD 0025 D0 21 IPIL=1, NPILE 0026 IREC=(IPIL-1) *NLOAD-JLOAD 0027 READ(9, REC=IREC) (DISP(I, JLOAD), I=1, 6) 0028 21 HRITE(6, 105) JLOAD, IPIL, (DISP(I, JLOAD), I=1, 6) 0029 20 CONTINUE 0030 HRITE(6, 104) ISM1, ISM2, HFOR 0031 HRITE(6, 104) ISM1, ISM2, HFOR 0032 D0 30 JLOAD=1, NLOAD 0033 D0 31 IPIL=1, NPILE 0034 IREC=(IPIL-1) *NLOAD+JLOAD 0035 REAO(10, REC=IREC) (PREC(I, JLOAD), I=1, 6) 0036 31 HRITE(6, 106) JLOAD, IPIL, (PREC(I, JLOAD), I=1, 6) 0037 30 CONTINUE 0038 IF(ITR.EQ.0) RETURN 0039 HRITE(6, '(//, 10X, I2, A2, 2X, 5HPILE:)') IPIL, SEQ(IPIL) 0040 IPIL=1, NPILE <t< td=""><td>0015</td><td>110</td><td>17(1.LE.20.0K.1.0E.24) SEU(1)=SEU(4)</td><td></td></t<> | 0015 | 110 | 17(1.LE.20.0K.1.0E.24) SEU(1)=SEU(4) | |
| 0019 WRITE(6, (//) IIX, IIMMORE LOUS) / 0019 WRITE(6, 101) ISM1, HLOAD 0020 WRITE(6, 102) JLOAD, (P(I, JLOAD), I=1, 6) 0021 10 CONTINUE 0022 WRITE(6, 103) ISM1, ISM2, HDEP 0023 WRITE(6, 103) ISM1, ISM2, HDEP 0024 D0 20 JLOAD=1, NLOAD 0025 D0 21 IPIL=1, NPILE 0026 IREC=(IPIL-1)*NLOAD+JLOAD 0027 READ(9, REC=IREC) (DISP(I, JLOAD), I=1, 6) 0028 21 WRITE(6, 105) JLOAD, IPIL, (DISP(I, JLOAD), I=1, 6) 0029 20 CONTINUE 0030 WRITE(6, 104) ISM1, ISM2, HFOR 0031 WRITE(6, 104) ISM1, ISM2, HFOR 0032 D0 30 JLOAD=1, NLOAD 0033 D0 31 IPIL=1, NPILE 0034 IREC=(IPIL-1)*NLOAD+JLOAD 0035 READ(10, REC=IREC) (PREC(I, JLOAD), I=1, 6) 0036 31 WRITE(6, 106) JLOAD, IPIL, (PREC(I, JLOAD), I=1, 5) 0037 30 CONTINUE 0038 IF(ITR.EQ.0) RETURN 0039 WRITE(6, 103) ISM1, ISM3, HOEP 0040 D0 40 IPIL=1, NPILE 0041 WRITE(6, 101, NG 0144 WRITE(6, 101, NG | 0010 | 110 | | |
| 0019 D0 10 JLOADD=1,NLOAD 0019 D0 10 JLOADD=1,NLOAD 0020 WRITE(6,102)JLOAD,(P(I,JLOAD),I=1,6) 0021 10 CONTINUE 0022 WRITE(6,103)ISH1,ISM2,HDEP 0024 D0 20 JLOADD=1,NLOAD 0025 D0 21 JFIL=1,NFILE 0026 IREC=(IFIL=1)+NLOAD 0027 READ(9,REC=IREC) (DISP(I,JLOAD),I=1,6) 0028 21 WRITE(6,105)JLOAD,IPIL,(DISP(I,JLOAD),I=1,6) 0029 20 CONTINUE 0030 WRITE(6,104)ISM1,ISM2,HFOR 0032 D0 30 JLOADD=1,NLOAD 0033 D0 31 IPIL=1,NPILE 0034 IREC=(IPIL=1)+NLOAD+JLOAD 0035 READ(10,REC=IREC) (PREC(I,JLOAD),I=1,6) 0036 31 WRITE(6,106)JLOAD,IPIL,(PREC(I,JLOAD),I=1,6) 0037 30 CONTINUE 0038 IF(ITR.EQ.0) RETURN 0039 WRITE(6,'(//11X,12,A2,2X,SHPILE ELEMENT DISPLACEMENTS)') 0040 D0 40 IPIL=1,NPILE 0041 WRITE(6,103)ISM1,ISM3,HOEP 0043 D0 40 ID=1,ND 0044 NREC=2MDA(11,REC=NREC)((DISP(ROH(I),J),I=1,3),J=1,NLOAD) 0045 READ(11,REC=NREC)((IDISP(ROH(I),J), | 0017 | | URITE(6, (//,IIA,IIANOUHL LUHUS)) | |
| 0010 0010 0020 WRITE(6,102)JLOAD, (P(1,JLOAD), I=1,6) 0021 10 CONTINUE 0022 WRITE(6,103)ISM1, ISM2, HDEP 0023 WRITE(6,103)ISM1, ISM2, HDEP 0024 D0 20 JLOAD=1, NLOAD 0025 D0 21 IPIL=1, NPILE 0026 IREC=(IPIL-1)*NLOAD+JLOAD 0027 READ(9, REC=IREC) (DISP(I,JLOAD), I=1,6) 0028 21 WRITE(6, 105)JLOAD, IPIL, (DISP(I,JLOAD), I=1,6) 0029 20 CONTINUE 0030 WRITE(6, 104) ISM1, ISM2, HFOR 0032 0031 WRITE(6, 104) ISM1, ISM2, HFOR 0032 0032 D0 30 JLOAD=1, NLOAD 0033 D0 31 IPIL=1, NPILE 0034 IREC=(IPIL-1)*NLOAD+JLOAD IREC 0035 READ(10, REC=IREC) (PREC(I,JLOAD), I=1,6) 0036 31 WRITE(6, 106)JLOAD, IPIL, (PREC(I,JLOAD), I=1,6) 0037 30 CONTINUE IPIL=1, NPILE 0038 IF(ITR.EQ, 0) RETURN ISPILACEMENTS)') 0039 WRITE(6, 103)ISM1, ISM3, HOEP I | 010 | | | |
| 0021 10 CONTINUE 0022 WRITE(6, 102)GEURD, ((', 1, 0EURD), 1-1, 0) 0023 WRITE(6, 102)GEURD, ((', 1, 0EURD), 1-1, 0) 0024 D0 20 JLQAD=1, NLQAD 0025 D0 21 IPIL=1, NPILE 0026 IREC=(IPIL-1) #NLQAD+JLQAD 0027 READ(9, REC=IREC) (DISP(I, JLQAD), I=1, 6) 0028 21 WRITE(6, 105)JLQAD, IPIL, (DISP(I, JLQAD), I=1, 6) 0029 20 CONTINUE 0030 WRITE(6, 104)ISM1, ISM2, HFOR 0031 WRITE(6, 104)ISM1, ISM2, HFOR 0032 D0 30 JLQAD=1, NLQAD 0033 D0 31 IPIL=1, NPILE 0034 IREC=(IPIL-1) #NLQAD+JLQAD 0035 READ(10, REC=IREC) (PREC(I, JLQAD), I=1, 6) 0036 31 WRITE(6, 106 JLQAD, IPIL, (PREC(I, JLQAD), I=1, 6) 0037 30 CONTINUE 0038 IF(ITR.EQ.0) RETURN 0039 WRITE(6, '(//, 10X, 12, A2, 2X, SHPILE 1)') IPIL, SEQ(IPIL) 0040 ID=1, ND 0041 WRITE(6, 103) ISM1, ISM3, HOEP 0043 D 040 ID=1, ND 0044 NREC=2MDA(IPIL-1) #ND-ID+1 0045 READ(11, REC=NREC)((IDSP(RCM(I), J), I=1, 3), J=1, NLQAD) | 0010 | | $ \begin{array}{c} \text{UPITE(S 102) II (AA) (P(I II (AA)) I-1 S)} \end{array} $ | |
| 0022 HRITE(6, ///, 11X, 23HPILE HEAD DISPLACEMENTS) ') 0023 WRITE(6, 1//, 11X, 23HPILE HEAD DISPLACEMENTS) ') 0024 D0 20 JLOAD=1, NLOAD 0025 D0 21 IPIL=1, NPILE 0026 IREC=(IPIL-1) +NLOAD+JLOAD 0027 READ(9, REC=IREC) (DISP(I, JLOAD), I=1, 6) 0028 21 HRITE(6, 105) JLOAD, IPIL, (DISP(I, JLOAD), I=1, 6) 0029 20 CONTINUE 0030 WRITE(6, 105) JLOAD, IPIL, (DISP(I, JLOAD), I=1, 6) 0031 WRITE(6, 104) ISM1, ISM2, HFOR 0032 D0 30 JLOAD=1, NLOAD 0033 D0 31 IPIL=1, NPILE 0034 IREC=(IPIL-1) +NLOAD+JLOAD 0035 READ(10, REC=IREC) (PREC(I, JLOAD), I=1, 6) 0036 31 HRITE(6, 106) JLOAD, IPIL, (PREC(I, JLOAD), I=1, 6) 0037 30 CONTINUE 0038 IF(ITR.EQ.0) RETURN 0039 WRITE(6, '(HI, //, 11X, 26HPILE ELEMENT DISPLACEMENTS)') 0040 D0 40 IPIL=1, NPILE 0041 WRITE(6, 103) ISM1, ISM3, HOEP 0043 D0 40 ID=1, ND 0044 NREC=2MD& (IPIL-1) +HO-ID+1 0045 READ(11, REC=NREC) ((IDISP(ROH(1), J), I=1, 3), J=1, NLOAD) 00 | 0020 | 10 | CONTINUE | |
| 0023 WRITE(6, (/), IXX, SUM TELE HEAD DISPLACEMENTS) / 0024 D0 20 JLQAD=1, NLQAD 0025 D0 21 IPIL=1, NPILE 0026 IREC=(IPIL-1) #NLQAD+JLQAD 0027 READ(9, REC=IREC) (DISP(I, JLQAD), I=1, 6) 0028 21 WRITE(6, 105) JLQAD, IPIL, (DISP(I, JLQAD), I=1, 6) 0029 20 CONTINUE 0030 WRITE(6, 104) ISM1, ISM2, HFOR 0031 WRITE(6, 104) ISM1, ISM2, HFOR 0032 D0 30 JLQAD=1, NLQAD 0033 D0 31 IPIL=1, NPILE 0034 IREC=(IPIL-1) #NLQAD+JLQAD 0035 READ(10, REC=IREC) (PREC(1, JLQAD), I=1, 6) 0036 31 WRITE(6, 106) JLQAD, IPIL, (PREC(1, JLQAD), I=1, 6) 0037 30 CONTINUE 0038 IF(ITR.EQ.0) RETURN 0039 WRITE(6, '(//, 10X, 12, A2, 2X, 5HPILE ELEMENT DISPLACEMENTS)') 0040 D0 40 IPIL=1, NPILE 0041 WRITE(6, 103) ISM1, ISM3, HOEP 0043 D0 40 ID=1, ND 0044 NREC=2MND4(IPIL-1) HND-ID+1 0045 READ(11, REC=MREC)((DISP(ROH(I), J), I=1, 3), J=1, NLQAD) 0046 NREC=MRECHND 0047 READ(11, REC=MREC)((DISP(ROH(I), J) | 0021 | 10 | URITE(6 (/// 11Y 22UPILE UEAD DISPLACEMENTS)() | |
| 0024 D0 20 JL0AD=1,NL0AD 0025 D0 21 IPIL=1,NPILE 0026 IREC=(IPIL=1,NL0AD+JL0AD 0027 READ(9,REC=IREC) (DISP(I,JL0AD),I=1,6) 0028 21 WRITE(6,105)JL0AD,IPIL,(DISP(I,JL0AD),I=1,6) 0029 20 CONTINUE 0030 WRITE(6,104)ISM1,ISM2,HF0R 0031 WRITE(6,104)ISM1,ISM2,HF0R 0032 D0 30 JL0AD=1,NL0AD 0033 D0 31 IPIL=1,NPILE 0034 IREC=(IPIL-1)*ML0AD+JL0AD 0035 READ(10,REC=IREC)(PREC(1,JL0AD),I=1,6) 0036 31 WRITE(6,106)JL0AO,IPIL,(PREC(I,JL0AD),I=1,6) 0037 30 CONTINUE 0038 IF(ITR.EQ.0) RETURN 0039 WRITE(6,'(//,10X,12,A2,2X,5HPILE ELEMENT DISPLACEMENTS)') 0040 D0 40 IPIL=1,NPILE 0041 WRITE(6,103)ISM1,ISM3,H0EP 0042 WRITE(6,103)ISM1,ISM3,H0EP 0043 D0 40 ID 1,ND 0044 NREC=2MREC)((DISP(RCH(I),J),I=1,3),J=1,ML0AD) 0045 READ(11,REC=NREC)((DISP(RCH(I),J),I=4,6),J=1,ML0AD) 0046 NREC=NRECHND 0047 READ(11,REC=NREC)((DISP(RCH(I),J),I=4,6),J=1,ML0AD) 0048 | 0022 | | URITE(6 102) IGM1 IGM2 UNED | |
| 0025 D0 21 IPIL=1,NPILE 0026 IREC=(IPIL-1)*NLCADO+JLOAD 0027 READ(9,REC=IREC) (DISP(I,JLOAD),I=1,6) 0028 21 WRITE(6,105)JLOAD,IPIL,(DISP(I,JLOAD),I=1,6) 0029 20 CONTINUE 0030 WRITE(6,104)ISM1,ISM2,HFOR 0031 WRITE(6,104)ISM1,ISM2,HFOR 0032 D0 30 JLOAD=1,NLOAD 0033 D0 31 IPIL=1,NPILE 0034 IREC=(IPIL-1)*NLOAD+JLOAD 0035 READ(10,REC=IREC)(PREC(I,JLOAD),I=1,6) 0036 31 WRITE(6,106)JLOAD,IPIL,(PREC(I,JLOAD),I=1,6) 0037 30 CONTINUE 0038 IF(ITR.EQ.0) RETURN 0039 WRITE(6,'(141,//,11X,26HPILE ELEMENT DISPLACEMENTS)') 0040 D0 40 IPIL=1,NPILE 0041 WRITE(6,103)ISM1,ISM3,HOEP 0042 WRITE(6,103)ISM1,FSM3,HOEP 0043 D0 40 ID=1,ND 0044 NREC==NREC)((DISP(ROH(I),J),I=1,3),J=1,NLOAD) 0045 READ(11,REC=NREC)((DISP(ROH(I),J),I=4,6),J=1,NLOAD) 0046 NREC=NRECHND 0047 READ(11,REC=NREC)((DISP(ROH(I),J),I=1,6),J=1,NLOAD) 0048 WRITE(6,'(141,//,11X,22HPILE ELEMENT REACTIONS)') | 0020 | | | |
| 0026 IREC=(IPIL-1)*NLCAD+JLOAD 0027 READ(9,REC=IREC) (DISP(I,JLOAD),I=1,6) 0028 21 WRITE(6,105)JLOAD,IPIL,(DISP(I,JLOAD),I=1,6) 0029 20 CONTINUE 0030 WRITE(6,104)ISM1,ISM2,HFOR 0032 D0 30 JLOAD=1,NLOAD 0033 D0 31 IPIL=1,NPILE 0034 IREC=(IPIL-1)*NLOAD+JLOAD 0035 READ(10,REC=IREC) (PREC(I,JLOAD),I=1,6) 0036 31 WRITE(6,106)JLOAD,IPIL,(PREC(I,JLOAD),I=1,6) 0037 30 CONTINUE 0038 IF(ITR.EQ.0) RETURN 0039 WRITE(6,'(141,//,11X,26HPILE ELEMENT DISPLACEMENTS)') 0040 D0 40 IPIL=1,NPILE 0041 WRITE(6,103)ISM1,ISM3,HOEP 0042 WRITE(6,103)ISM1,FSM3,HOEP 0043 D0 40 ID=1,ND 0044 NREC==NREC)((DISP(ROH(I),J),I=1,3),J=1,NLOAD) 0045 READ(11,REC=NREC)((DISP(ROH(I),J),I=4,6),J=1,NLOAD) 0046 NREC=NRECHND 0047 READ(11,REC=NREC)((DISP(ROH(I),J),I=1,6),J=1,NLOAD) 0048 WRITE(6,105)(J,ID,(DISP(I,J),I=1,6),J=1,NLOAD) 0049 40 CONTINUE 0050 WRITE(6,'('/111,//,11X,22HPILE ELEMENT | 0025 | | 00 21 IPII =1 NPII F | |
| 1112 | 0026 | | IREC=(IPIL-1) #NI (ADH-II (AD) | |
| 111 1111 111 111 | 0027 | | READ(9, REC=IREC) (DISP(1, JLOAD), I=1, 6) | the a sta |
| 0029 20 CONTINUE 0030 HRITE(6,'(/',11X,19HPILE HEAD REACTIONS)') 0031 HRITE(6,104)ISM1,ISM2,HFOR 0032 00 30 JLOAD=1,NLOAD 0033 D0 31 IPIL=1,NPILE 0034 IREC=(IPIL-1)*NLOAD+JLOAD 0035 READ(10,REC=IREC)(PREC(I,JLOAD),I=1,6) 0036 31 HRITE(6,106)JLOAD,IPIL,(PREC(I,JLOAD),I=1,6) 0037 30 CONTINUE 0038 IF(ITR.EQ.0) RETURN 0039 HRITE(6,'(//,10X,12,A2,2X,SHPILE:)') IPIL,SEQ(IPIL) 0040 D0 40 IPIL=1,NPILE 0041 HRITE(6,103)ISM1,ISM3,HOEP 0042 HRITE(6,103)ISM1,ISM3,HOEP 0043 D0 40 ID=1,ND 0044 NREC=2*ND*(IPIL-1)+ND-ID+1 0045 READ(11,REC=NREC)((DISP(RCH(I),J),I=1,3),J=1,NLOAD) 0046 NREC=NRECHND 0047 READ(11,REC=NREC)((DISP(RCH(I),J),I=4,6),J=1,NLOAD) 0048 HRITE(6,'(1H1,/',11X,22HPILE ELEMENT REACTIONS)') 0050 HRITE(6,'(1H1,/',11X,22HPILE ELEMENT REACTIONS)') 0051 D0 50 IPIL=1,NPILE 0052 HRITE(6,104)ISM1,ISM3,HFOR | 0028 | 21 | WRITE(6,105), IL OAD, IPIL (DISP(1, 1000), I=1,6) | |
| 0030 HRITE(6,'(//,11X,19HPILE HEAD REACTIONS)') 0031 HRITE(6,104)ISM1,ISM2,HFOR 0032 D0 30 JLOAD=1,NLOAD 0033 D0 31 IPIL=1,NPILE 0034 IREC=(IPIL-1)*NLOAD+JLOAD 0035 READ(10,REC=IREC)(PREC(I,JLOAD),I=1,6) 0036 31 HRITE(6,106)JLOAD,IPIL,(PREC(I,JLOAD),I=1,6) 0037 30 CONTINUE 0038 IF(ITR.EQ.0) RETURN 0039 HRITE(6,'(1H1,//,11X,26HPILE ELEMENT DISPLACEMENTS)') 0040 D0 40 IPIL=1,NPILE 0041 HRITE(6,'(1H1,//,11X,26HPILE ELEMENT DISPLACEMENTS)') 0040 D0 40 IPIL=1,NPILE 0041 HRITE(6,(103)ISM1,ISM3,HOEP 0042 HRITE(6,103)ISM1,ISM3,HOEP 0043 D0 40 ID=1,ND 0044 NREC=2*ND*(IPIL-1)+ND-ID+1 0045 READ(11,REC=NREC)((DISP(RCH(I),J),I=1,3),J=1,NLOAD) 0046 NREC=NRECHND 0047 READ(11,REC=NREC)((DISP(RCH(I),J),I=4,6),J=1,NLOAD) 0048 HRITE(6,105)(J,ID,(DISP(I,J),I=1,6),J=1,NLOAD) 0049 40 CONTINUE 0050 HRITE(6,'(1H1,//,11X,22HPILE ELEMENT REACTIONS)') 0051 D0 50 IPIL=1,NPILE <td>0029</td> <td>20</td> <td>CONTINUE</td> <td></td> | 0029 | 20 | CONTINUE | |
| 0031 WRITE(6,104)ISM1,ISM2,HFOR 0032 D0 30 JLOAD=1,NLOAD 0033 D0 31 IPIL=1,NPILE 0034 IREC=(IPIL-1)*NLOAD+JLOAD 0035 READ(10,REC=IREC)(PREC(I,JLOAD),I=1,6) 0036 31 WRITE(6,106)JLOAD,IPIL,(PREC(I,JLOAD),I=1,6) 0037 30 CONTINUE 0038 IF(ITR.EQ.0) RETURN 0039 WRITE(6,'(1H1,//,11X,26HPILE ELEMENT DISPLACEMENTS)') 0040 D0 40 IPIL=1,NPILE 0041 WRITE(6,'(1H1,//,11X,26HPILE ELEMENT DISPLACEMENTS)') 0042 WRITE(6,103)ISM1,ISM3,HDEP 0043 D0 40 ID=1,ND 0044 NREC=2MND*(IPIL-1)+ND-ID+1 0045 READ(11,REC=NREC)((DISP(ROW(I),J),I=1,3),J=1,NLOAD) 0046 NREC=NREC(HND 0047 READ(11,REC=NREC)((DISP(ROW(I),J),I=4,6),J=1,NLOAD) 0048 WRITE(6,105)(J,ID,(DISP(I,J),I=1,6),J=1,NLOAD) 0049 40 CONTINUE 0050 WRITE(6,'(1H1,//,11X,22HPILE ELEMENT REACTIONS)') 0051 D0 50 IPIL=1,NPILE 0052 WRITE(6,'(1H1,//,11X,2A2,2X,5HPILE;)') IPIL,SEQ(IPIL) 0053 WRITE(6,104)ISM1,ISM3,HFOR | 0030 | Radin | WRITE(6.'(//.11X.19HPILE HEAD REACTIONS)') | |
| 0032 D0 30 JLQAD=1,NLQAD 0033 D0 31 IPIL=1,NPILE 0034 IREC=(IPIL-1)*NLQAD+JLQAD 0035 READ(10,REC=IREC)(PREC(I,JLQAD),I=1,6) 0036 31 WRITE(6,106)JLQAD,IPIL,(PREC(I,JLQAD),I=1,6) 0037 30 CONTINUE 0038 IF(ITR.EQ.0) RETURN 0039 WRITE(6,'(1H1,//,11X,26HPILE ELEMENT DISPLACEMENTS)') 0040 D0 40 IPIL=1,NPILE 0041 WRITE(6,'(//,10X,I2,A2,2X,5HPILE:)') IPIL,SEQ(IPIL) 0042 WRITE(6,103)ISM1,ISM3,HDEP 0043 D0 40 ID=1,ND 0044 NREC=2*ND*(IPIL-1)+ND-ID+1 0045 READ(11,REC=NREC)((DISP(RGW(I),J),I=1,3),J=1,NLQAD) 0046 NREC=NRECHND 0047 READ(11,REC=NREC)((DISP(RGW(I),J),I=4,6),J=1,NLQAD) 0048 WRITE(6,105)(J,ID,(DISP(I,J),I=1,6),J=1,NLQAD) 0049 40 CONTINUE 0050 WRITE(6,'(1H1,//,11X,22HPILE ELEMENT REACTIONS)') 0051 D0 50 IPIL=1,NPILE 0052 WRITE(6,'(//,10X,I2,A2,2X,5HPILE:)') IPIL,SEQ(IPIL) 0053 WRITE(6,104)ISM1,ISM3,HFOR | 0031 | | WRITE(6,104) ISM1. ISM2. HFOR | |
| 0033 D0 31 IPIL=1,NPILE 0034 IREC=(IPIL-1)*NLOAD+JLOAD 0035 READ(10,REC=IREC)(PREC(I,JLOAD),I=1,6) 0036 31 WRITE(6,106)JLOAD,IPIL,(PREC(I,JLOAD),I=1,6) 0037 30 CONTINUE 0038 IF(ITR.EQ.0) RETURN 0039 WRITE(6,'(1H1,//,11X,26HPILE ELEMENT DISPLACEMENTS)') 0040 D0 40 IPIL=1,NPILE 0041 WRITE(6,'(//,10X,12,A2,2X,5HPILE:)') IPIL,SEQ(IPIL) 0042 WRITE(6,103)ISM1,ISM3,HOEP 0043 D0 40 ID=1,ND 0044 NREC=2*ND*(IPIL-1)+ND-ID+1 0045 READ(11,REC=NREC)((DISP(ROW(I),J),I=1,3),J=1,NLOAD) 0046 NREC=NRECHND 0047 READ(11,REC=NREC)((DISP(ROW(I),J),I=4,6),J=1,NLOAD) 0048 WRITE(6,'05)(J,ID,(DISP(I,J),I=1,6),J=1,NLOAD) 0049 40 CONTINUE 0050 WRITE(6,'(1H1,//,11X,22HPILE ELEMENT REACTIONS)') 0051 D0 50 IPIL=1,NPILE 0052 WRITE(6,'(//,10X,I2,A2,2X,5HPILE:)') IPIL,SEQ(IPIL) 0053 WRITE(6,104)ISM1,ISM3,HFOR | 0032 | | DO 30 JLOAD=1.NLOAD | |
| 0034 IREC=(IPIL-1)*NLOAO+JLOAD 0035 READ(10,REC=IREC)(PREC(I,JLOAD),I=1,6) 0036 31 WRITE(6,106)JLOAD,IPIL,(PREC(I,JLOAD),I=1,6) 0037 30 CONTINUE 0038 IF(ITR.EQ.0) RETURN 0039 WRITE(6,'(1H1,//,11X,26HPILE ELEMENT DISPLACEMENTS)') 0040 D0 40 IPIL=1,NPILE 0041 WRITE(6,103)ISM1,ISM3,HOEP 0042 WRITE(6,103)ISM1,ISM3,HOEP 0043 D0 40 ID=1,ND 0044 NREC=2*ND*(IPIL-1)+ND-ID+1 0045 READ(11,REC=NREC)((DISP(ROW(I),J),I=1,3),J=1,NLOAD) 0046 NREC=NREC+ND 0047 READ(11,REC=NREC)((DISP(ROW(I),J),I=4,6),J=1,NLOAD) 0048 WRITE(6,105)(J,ID,(DISP(I,J),I=1,6),J=1,NLOAD) 0049 40 CONTINUE 0050 WRITE(6,'(1H1,//,11X,22HPILE ELEMENT REACTIONS)') 0051 D0 50 IPIL=1,NPILE 0052 WRITE(6,'(//,10X,I2,A2,2X,5HPILE:)') IPIL,SEQ(IPIL) 0053 WRITE(6,104)ISM1,ISM3,HFOR | 0033 | | DO 31 IPIL=1.NPILE | |
| 0035 READ(10, REC=IREC) (PREC(I, JLOAD), I=1,6) 0036 31 WRITE(6,106) JLOAD, IPIL, (PREC(I, JLOAD), I=1,6) 0037 30 CONTINUE 0038 IF(ITR.EQ.0) RETURN 0039 WRITE(6,'(1H1,//,11X,26HPILE ELEMENT DISPLACEMENTS)') 0040 D0 40 IPIL=1,NPILE 0041 WRITE(6,'(1/,10X,12,A2,2X,5HPILE:)') IPIL,SEQ(IPIL) 0042 WRITE(6,103) ISM1, ISM3, HOEP 0043 D0 40 ID=1,ND 0044 NREC=2*NO*(IPIL-1)+ND-ID+1 0045 READ(11,REC=NREC)((DISP(ROH(I),J),I=1,3),J=1,NLOAD) 0046 NREC=NREC)((DISP(ROH(I),J),I=4,6),J=1,NLOAD) 0047 READ(11,REC=NREC)((DISP(ROH(I),J),I=4,6),J=1,NLOAD) 0048 WRITE(6,105)(J,ID,(DISP(I,J),I=1,6),J=1,NLOAD) 0049 40 CONTINUE 0050 WRITE(6,'(1H1,//,11X,22HPILE ELEMENT REACTIONS)') 0051 D0 50 IPIL=1,NPILE 0052 WRITE(6,'(1H1,//,10X,12,A2,2X,5HPILE:)') IPIL,SEQ(IPIL) 0053 WRITE(6,104)ISM1,ISM3,HFOR | 0034 | | IREC=(IPIL-1)*NLOAD+JLOAD | |
| 0036 31 WRITE(6,106) JLOAD, IPIL, (PREC(I, JLOAD), I=1,6) 0037 30 CONTINUE 0038 IF(ITR.EQ.0) RETURN 0039 WRITE(6, '(1H1, //, 11X, 26HPILE ELEMENT DISPLACEMENTS)') 0040 D0 40 IPIL=1,NPILE 0041 WRITE(6, '(//, 10X, I2, A2, 2X, 5HPILE:)') IPIL, SEQ(IPIL) 0042 WRITE(6, 103) ISM1, ISM3, HOEP 0043 D0 40 ID=1, ND 0044 NREC=2MND*(IPIL-1) HND-ID+1 0045 READ(11, REC=NREC)((DISP(ROH(I), J), I=1, 3), J=1, NLOAD) 0046 NREC=NRECHND 0047 READ(11, REC=NREC)((DISP(ROH(I), J), I=4, 6), J=1, NLOAD) 0048 WRITE(6, 105)(J, ID, (DISP(I, J), I=1, 6), J=1, NLOAD) 0049 40 CONTINUE 0050 WRITE(6, '(1H1, //, 11X, 22HPILE ELEMENT REACTIONS)') 0051 D0 50 IPIL=1, NPILE 0052 WRITE(6, '(1H1, //, 11X, 22HPILE ELEMENT REACTIONS)') 0051 D0 50 IPIL=1, NPILE 0052 WRITE(6, '(1H1, //, 10X, I2, A2, 2X, 5HPILE:)') IPIL, SEQ(IPIL) 0053 WRITE(6, 104) ISM1, ISM3, HFOR | 0035 | | READ(10, REC=IREC)(PREC(1, JLOAD), I=1,6) | |
| 0037 30 CONTINUE 0038 IF(ITR.EQ.0) RETURN 0039 WRITE(6,'(1H1,//,11X,26HPILE ELEMENT DISPLACEMENTS)') 0040 D0 40 IPIL=1,NPILE 0041 WRITE(6,'(1/,10X,12,A2,2X,5HPILE:)') IPIL,SEQ(IPIL) 0042 WRITE(6,103)ISM1,ISM3,HDEP 0043 D0 40 ID=1,ND 0044 NREC=24ND*(IPIL-1)+ND-ID+1 0045 READ(11,REC=NREC)((DISP(ROH(I),J),I=1,3),J=1,NLOAD) 0046 NREC=NRECND 0047 READ(11,REC=NREC)((DISP(ROH(I),J),I=4,6),J=1,NLOAD) 0048 WRITE(6,105)(J,ID,(DISP(I,J),I=1,6),J=1,NLOAD) 0049 40 CONTINUE 0050 WRITE(6,'(1H1,//,11X,22HPILE ELEMENT REACTIONS)') 0051 D0 50 IPIL=1,NPILE 0052 WRITE(6,'(//,10X,I2,A2,2X,5HPILE:)') IPIL,SEQ(IPIL) 0053 WRITE(6,104)ISM1,ISM3,HFOR | 0036 | 31 | WRITE(6,106) JLOAD, IPIL, (PREC(1, JLOAD), I=1,6) | |
| 0038 IF(ITR.EQ.0) RETURN 0039 WRITE(6,'(1H1,//,11X,26HPILE ELEMENT DISPLACEMENTS)') 0040 D0 40 IPIL=1,NPILE 0041 WRITE(6,'(//,10X,I2,A2,2X,5HPILE:)') IPIL,SEQ(IPIL) 0042 WRITE(6,103)ISM1,ISM3,H0EP 0043 D0 40 ID=1,ND 0044 NREC=24ND*(IPIL-1)HND-IDH1 0045 READ(11,REC=NREC)((DISP(ROH(I),J),I=1,3),J=1,NLOAD) 0046 NREC=NRECHND 0047 READ(11,REC=NREC)((DISP(ROH(I),J),I=4,6),J=1,NLOAD) 0048 WRITE(6,105)(J,ID,(DISP(I,J),I=1,6),J=1,NLOAD) 0049 40 CONTINUE 0050 WRITE(6,'(1H1,//,11X,22HPILE ELEMENT REACTIONS)') 0051 D0 50 IPIL=1,NPILE 0052 WRITE(6,'(1H1,//,10X,I2,A2,2X,5HPILE:)') IPIL,SEQ(IPIL) 0053 WRITE(6,104)ISM1,ISM3,HFOR | 0037 | 30 | CONTINUE | |
| 0039 WRITE(6, '(1H1,//,11X,26HPILE ELEMENT DISPLACEMENTS)') 0040 D0 40 IPIL=1,NPILE 0041 WRITE(6, '(//,10X,I2,A2,2X,5HPILE:)') IPIL,SEQ(IPIL) 0042 WRITE(6,103)ISM1,ISM3,HDEP 0043 D0 40 ID=1,ND 0044 NREC=2*ND*(IPIL-1)+ND-ID+1 0045 READ(11,REC=NREC)((DISP(ROW(I),J),I=1,3),J=1,NLOAD) 0046 NREC=NREC)((DISP(ROW(I),J),I=4,6),J=1,NLOAD) 0047 READ(11,REC=NREC)((DISP(ROW(I),J),I=4,6),J=1,NLOAD) 0048 WRITE(6,105)(J,ID,(DISP(I,J),I=1,6),J=1,NLOAD) 0049 40 CONTINUE 0050 WRITE(6,'(1H1,//,11X,22HPILE ELEMENT REACTIONS)') 0051 D0 50 IPIL=1,NPILE 0052 WRITE(6,'(//,10X,I2,A2,2X,5HPILE:)') IPIL,SEQ(IPIL) 0053 WRITE(6,104)ISM1,ISM3,HFOR | 0038 | | IF(ITR.EQ.0) RETURN | 1 : |
| 0040 D0 40 IPIL=1,NPILE 0041 WRITE(6,'(//,10X,I2,A2,2X,5HPILE:)') IPIL,SEQ(IPIL) 0042 WRITE(6,103)ISM1,ISM3,HDEP 0043 D0 40 ID=1,ND 0044 NREC=2*NO*(IPIL-1)+ND-ID+1 0045 READ(11,REC=NREC)((DISP(ROH(I),J),I=1,3),J=1,NLOAD) 0046 NREC=NREC+ND 0047 READ(11,REC=NREC)((DISP(ROH(I),J),I=4,6),J=1,NLOAD) 0048 WRITE(6,105)(J,ID,(DISP(I,J),I=1,6),J=1,NLOAD) 0049 40 CONTINUE 0050 WRITE(6,'(1H1,//,11X,22HPILE ELEMENT REACTIONS)') 0051 D0 50 IPIL=1,NPILE 0052 WRITE(6,'(//,10X,I2,A2,2X,5HPILE:)') IPIL,SEQ(IPIL) 0053 WRITE(6,104)ISM1,ISM3,HFOR | 0039 | | WRITE(6, '(1H1, //, 11X, 26HPILE ELEMENT DISPLACEMENTS | 5)') |
| 0041 WRITE(6,'(//,10X,I2,A2,2X,5HPILE:)') IPIL,SEQ(IPIL) 0042 WRITE(6,103)ISM1,ISM3,H0EP 0043 D0 40 ID=1,ND 0044 NREC=2MND*(IPIL-1)+ND-ID+1 0045 READ(11,REC=NREC)((DISP(ROH(I),J),I=1,3),J=1,NLOAD) 0046 NREC=NRECND 0047 READ(11,REC=NREC)((DISP(ROH(I),J),I=4,6),J=1,NLOAD) 0048 WRITE(6,105)(J,ID,(DISP(I,J),I=1,6),J=1,NLOAD) 0049 40 0050 WRITE(6,'(1H1,//,11X,22HPILE ELEMENT REACTIONS)') 0051 D0 50 IPIL=1,NPILE 0052 WRITE(6,'(//,10X,I2,A2,2X,5HPILE:)') IPIL,SEQ(IPIL) 0053 WRITE(6,104)ISM1,ISM3,HFOR | 0040 | | DO 40 IPIL=1,NPILE | |
| 0042 WRITE(6,103)ISM1,ISM3,H0EP 0043 D0 40 ID=1,ND 0044 NREC=2*ND*(IPIL-1)+ND-ID+1 0045 READ(11,REC=NREC)((DISP(ROH(I),J),I=1,3),J=1,NLOAD) 0046 NREC=NREC+ND 0047 READ(11,REC=NREC)((DISP(ROH(I),J),I=4,6),J=1,NLOAD) 0048 WRITE(6,105)(J,ID,(DISP(I,J),I=1,6),J=1,NLOAD) 0049 40 0050 WRITE(6,'(1H1,//,11X,22HPILE ELEMENT REACTIONS)') 0051 D0 50 IPIL=1,NPILE 0052 WRITE(6,'(//,10X,I2,A2,2X,5HPILE:)') IPIL,SEQ(IPIL) 0053 WRITE(6,104)ISM1,ISM3,HFOR | 8041 | | WRITE(6, '(//, 10X, 12, A2, 2X, 5HPILE:)') IPIL, SEQ(IPI | .) |
| 0043 D0 40 ID=1,ND 0044 NREC=2#ND*(IPIL-1)+ND-ID+1 0045 READ(11,REC=NREC)((DISP(ROH(I),J),I=1,3),J=1,NLOAD) 0046 NREC=NREC+ND 0047 READ(11,REC=NREC)((DISP(ROH(I),J),I=4,6),J=1,NLOAD) 0048 WRITE(6,105)(J,ID,(DISP(I,J),I=1,6),J=1,NLOAD) 0049 40 0050 WRITE(6,'(1H1,//,11X,22HPILE ELEMENT REACTIONS)') 0051 D0 50 IPIL=1,NPILE 0052 WRITE(6,'(//,10X,I2,A2,2X,5HPILE:)') IPIL,SEQ(IPIL) 0053 WRITE(6,104)ISM1,ISM3,HFOR | 0042 | | WRITE(6,103)ISM1, ISM3, HDEP | |
| 0044 NREC=2*ND*(IPIL-1)+ND-ID+1 0045 READ(11,REC=NREC)((DISP(ROH(I),J),I=1,3),J=1,NLOAD) 0046 NREC=NREC+ND 0047 READ(11,REC=NREC)((DISP(ROH(I),J),I=4,6),J=1,NLOAD) 0048 WRITE(6,105)(J,ID,(DISP(I,J),I=1,6),J=1,NLOAD) 0049 40 0050 WRITE(6,'(1H1,//,11X,22HPILE ELEMENT REACTIONS)') 0051 D0 50 IPIL=1,NPILE 0052 WRITE(6,'(//,10X,I2,A2,2X,5HPILE:)') IPIL,SEQ(IPIL) 0053 WRITE(6,104)ISM1,ISM3,HFOR | 0043 | | DO 40 ID=1,ND | |
| 0045 READ(11,REC=NREC)((DISP(ROW(I),J),I=1,3),J=1,NLOAD) 0046 NREC=NRECHND 0047 READ(11,REC=NREC)((DISP(ROW(I),J),I=4,6),J=1,NLOAD) 0048 WRITE(6,105)(J,ID,(DISP(I,J),I=1,6),J=1,NLOAD) 0049 40 0050 WRITE(6,'(1H1,//,11X,22HPILE ELEMENT REACTIONS)') 0051 D0 50 IPIL=1,NPILE 0052 WRITE(6,'(//,10X,I2,A2,2X,5HPILE:)') IPIL,SEQ(IPIL) 0053 WRITE(6,104)ISM1,ISM3,HFOR | 0044 | | NREC=2*ND*(IPIL-1)+ND-ID+1 | |
| 0046 NREC=NRECHND 0047 READ(11,REC=NREC)((DISP(ROH(I),J),I=4,6),J=1,NLOAD) 0048 WRITE(6,105)(J,ID,(DISP(I,J),I=1,6),J=1,NLOAD) 0049 40 0050 WRITE(6,'(1H1,//,11X,22HPILE ELEMENT REACTIONS)') 0051 D0 50 IPIL=1,NPILE 0052 WRITE(6,'(//,10X,I2,A2,2X,5HPILE:)') IPIL,SEQ(IPIL) 0053 WRITE(6,104)ISM1,ISM3,HFOR | 0045 | | READ(11, REC=NREC)((DISP(ROW(I), J), I=1, 3), J=1, NLOA |)) |
| 0047 READ(11,REC=NREC)((DISP(ROH(I),J),I=4,6),J=1,NLOAD) 0048 WRITE(6,105)(J,ID,(DISP(I,J),I=1,6),J=1,NLOAD) 0049 40 CONTINUE 0050 WRITE(6,'(1H1,//,11X,22HPILE ELEMENT REACTIONS)') 0051 D0 50 IPIL=1,NPILE 0052 WRITE(6,'(//,10X,I2,A2,2X,5HPILE:)') IPIL,SEQ(IPIL) 0053 WRITE(6,104)ISM1,ISM3,HFOR | 0046 | | NREC=NREC+HD | |
| 0048 WRITE(6,105)(J,ID,(DISP(I,J),I=1,6),J=1,NLOAD) 0049 40 CONTINUE 0050 WRITE(6,'(1H1,//,11X,22HPILE ELEMENT REACTIONS)') 0051 D0 50 IPIL=1,NPILE 0052 WRITE(6,'(//,10X,I2,A2,2X,5HPILE:)') IPIL,SEQ(IPIL) 0053 WRITE(6,104) ISM1,ISM3,HFOR | 0047 | P. A. | READ(11, REC=NREC)((DISP(ROW(I), J), I=4,6), J=1, NLOA |)) |
| 0049 40 CONTINUE 0050 WRITE(6,'(1H1,//,11X,22HPILE ELEMENT REACTIONS)') 0051 D0 50 IPIL=1,NPILE 0052 WRITE(6,'(//,10X,I2,A2,2X,5HPILE:)') IPIL,SEQ(IPIL) 0053 WRITE(6,104)ISM1,ISM3,HFOR | 0048 | | WRITE(6,105)(J,ID,(DISP(I,J),I=1,6),J=1,NLOAD) | |
| 0050 WRITE(6,'(1H1,//,11X,22HPILE ELEMENT REACTIONS)') 0051 D0 50 IPIL=1,NPILE 0052 WRITE(6,'(//,10X,I2,A2,2X,5HPILE:)') IPIL,SEQ(IPIL) 0053 WRITE(6,104)ISM1,ISM3,HFOR | 0049 | 40 | CONTINUE | |
| 0051 D0 50 IPIL=1,NPILE 0052 WRITE(6,'(//,10X,I2,A2,2X,5HPILE:)') IPIL,SEQ(IPIL) 0053 WRITE(6,104)ISM1,ISM3,HFOR | 0050 | | WRITE(6, '(1H1, //, 11X, 22HPILE ELEMENT REACTIONS)') | |
| 0052 WRITE(6,'(//,10X,I2,A2,2X,5HPILE:)') IPIL,SEQ(IPIL) 0053 WRITE(6,104) ISM1,ISM3,HFOR WRITE(6,104) ISM1,ISM3,HFOR | 0051 | | DO 50 IPIL=1,NPILE | |
| 0053 WRITE(6,104)ISM1,ISM3,HFOR | 0052 | | WRITE(6, '(//,10X,12,A2,2X,5HPILE:)') IPIL, SEQ(IPI | L) |
| | 0053 | | WRITE(6,104)ISM1,ISM3,HFOR | |

00 50 ID=1,ND

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| PDP-11 | FORTRAM | 1-77 V5.0-0 | 11:03:05 | 30-Nov-85 | P |
|--------|---------|-----------------|----------------------|---------------------|----------|
| PILFON | FTN;1 | /F77 | OP/TR:BLOCKS/ | WR | |
| 0055 | | NREC=2*ND*(IPI | L-1)+ND-10+1 | | |
| 0056 | | READ(12, REC=NR | EC) ((PREC(ROH(| I), J), I=1, 3), J= | 1,NLOAD) |
| 0057 | | NREC=NREC+ND | | | |
| 0058 | | READ(12, REC=NR | EC) ((PREC (ROH (| 1), J), I=4,6), J= | 1,NLOAD) |
| 0059 | 1. La | WRITE(6,106)(J | .10.(PREC(1,J) | ,I=1,6),J=1,NL0 | AD) |
| 0060 | 50 | CONTINUE | AND AND AND A | | |
| 0061 | 101 | FORMAT(//10X.A | 10.21X.6(A2.13 | X)) | |
| 0062 | 102 | FORMAT(/15X,12 | .12X.6F15.2) | | |
| 0063 | 103 | FORMAT(//10X.2 | A10,12X,6(A2,1 | 3X)) | |
| 0064 | 104 | FORMAT(//10X.2 | A10,13X,6(A2,1 | 3X)) | |
| 0065 | 105 | FORMAT(/15X.12 | .8X.12.5X.6E15 | .3) | |
| 0066 | 106 | FORMAT(/15X.12 | .8X.12.5X.6F15 | .3) | |
| 0067 | | RETURN | | | |
| 0068 | | END | | | |

1. ALL SPERSON

PROGRAM SECTIONS

| Nane | Siz | e | Attributes |
|---------|--------|------|-----------------|
| SCODE1 | 004050 | 1044 | RH, I, CON, LCL |
| \$PDATA | 000424 | 138 | RW, D, CON, LCL |
| \$IDATA | 000042 | 17 | RW, D, CON, LCL |
| \$VARS | 001170 | 316 | RH, D, CON, LCL |
| \$TEMPS | 000006 | 3 | RW, D, CON, LCL |
| BLOCK3 | 000004 | 2 | RH, D, OVR, GBL |

Total Space Allocated = 005740 1520

No FPP Instructions Generated

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1 385 - TALKA .. 201 .

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1: :

| POP-11 PILFON. | FORTRA | N-77 V5.0-0 /1 | 11:03:34 F77/OP/TR:BLOCKS/ | 30-Nov-85 WR | Page 13 |
|-------------------|---------|-------------------|-------------------------------|--|----------------------|
| 0001 | | | | 1000 21 | |
| 0001 | c | SUDROUTINE : | DULVE (N, I'D, CUEFI'H | ,LUHU,A) | |
| | C | SOLUTION FOR | R LINEAR EQUATION | s by means of | GAUSSIAN ELIMINATION |
| 0002 | | DIMENSION D | (6.16).X(6.10) | | |
| 0003 | | REAL*4 COEFT | 4(6.6).LOAD(6.10 |) | |
| 0004 | | 00 100 I=1. | Ν | | |
| 0005 | | DO 100 J=1.1 | HMD | | |
| 0006 | | IF(J.LE.N) | THEN | | |
| 0007 | | D(I,J)=COEF | 'A(I,J) | | |
| 8000 | | ELSE | | | |
| 0009 | | D(I.J)=LOAD | (I.J-N) | | |
| 0010 | | ENDIF | | | |
| 0011 | 100 | CONTINUE | | | |
| | С | | | | |
| | С | ELEMINATION | | | |
| | С | | | | |
| 0012 | | DO 10 K=1.N- | -1 1.0.00.0 | | |
| 0013 | | DO 10 I=K+1 | N.N | | |
| 0014 | | OR=D(1.K)/D | (K.K) | | |
| 0015 | | DO 10 J=1.N | HMD | | Provide States |
| 0016 | 10 | D(I,J)=D(I, | $J) - OR \pm D(K, J)$ | | |
| | С | Anderse a de | 0448 | | |
| | C C | SUBSTITUTION | 4 | | |
| 0017 | | DO 80 I=1.N | | | |
| 0018 | | DO 40 L=1,M | D | | |
| 0019 | | X(N,L)=D(N,N | HL)/D(N,N) | | |
| 0020 | | DO 40 M=N-1 | ,1,-1 | | |
| 0021 | | TOP=0 | | | |
| 0022 | | DO 50 J=++1 | ,N | | |
| 0023 | 50 | TOP=TOP+D(M | ,J)*X(J,L) | | |
| 0024 | | D(M,N+L)=D(N | M,NHL)-TOP | | |
| 0025 | 40 | X(M,L)=D(M,N) | HL)/D(M,M) | | |
| 0026 | 80 | CONTINUE | | | |
| 0027 | | RETURN | | | |
| 0028 | | END | | | |
| | | | | | |
| PROGRAM | I SECTI | ONS | | | /: |
| | | | | | |
| Name | S | ize | Attributes | | |
| SCODE1 | 00145 | 4 410 | RU T CON I | CI | |
| SIDATA | 00003 | 6 15 | RUD CON L | CL | |
| SUARS | 00062 | 2 201 | RU D CON L | | |
| | | | init of out the | Who is a second se | |

Total Space Allocated = 002360 632

| POP-11 | FORTRAN-77 | V5.0-0 | 11:03:44 | 30-Nov-85 |
|---------|------------|--------|----------------------|-----------|
| PILFON. | FTN;1 | | /F77/OP/TR:BLOCKS/WR | |

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| 0001 | S | UBROUTINE MATCAR(IM, IL, Q, R, S) |
|------|------|--------------------------------------|
| 0002 | R | EAL*4 Q(6,6),R(6,10),S(6,10) |
| 0003 | D | 0 10 I=1,IM |
| 0004 | D | 0 10 J=1,IL |
| 0005 | S | (I,J)=0 |
| 0006 | D | 0 10 K=1,IM |
| 0007 | 10 5 | (1, J) = S(1, J) + Q(1, K) + R(K, J) |
| 8000 | R | ETURN |
| 0009 | E | ND |
| | | |

PROGRAM SECTIONS

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| Name | Siz | | Attributes |
|---------|--------|-----|-----------------|
| \$CODE1 | 000366 | 123 | RH, I, CON, LCL |
| SIDATA | 000036 | 15 | RW, D, CON, LCL |
| SUARS | 000006 | 3 | RW, D, CON, LCL |
| STEMPS | 000006 | 3 | RW, D, CON, LCL |

Total Space Allocated = 000440 144

| PDP-11 | FURIKAN | -// V5.0-0 11:03:48 30-Nov-85 Page |
|--------|---------|---|
| PILFON | .FTN;1 | /F77/OP/TR:BLOCKS/WR |
| | | |
| 0001 | | SUBRUUTINE REAVER (NR, NU) |
| 0002 | | LUMPLON BLOCK4/ ID, IREC, CUP |
| 0003 | | DIMENSION CUEFFI(6,6), CUF(6,6), ER(21), INTI(3), INTJ(3) |
| 0004 | | DATA INTI/0,0,1/ |
| 0005 | | DATA INTJ/0,1,1/ |
| 0006 | | (S(I,J)=(J-I)*6-(J-I-1)*(J-I)*0.5+I |
| 0007 | | READ(1, REC=IREC)(ER(I), I=1,21) |
| 0008 | | DO 10 I=1,6 |
| 0009 | | DO 10 J=I,6 |
| 0010 | | COEFFI(I,J)=ER(KS(I,J)) |
| 0011 | 10 | COEFFI(J,I)=COEFFI(I,J) |
| 0012 | | 00 11 I=1,3 |
| 0013 | | 00 11 J=1,3 |
| 0014 | 11 | COF(1,J)=COEFFI((3*INTI(NR)+I),(3*INTJ(NR)+J)) |
| 0015 | | IF(NR.EQ.1.AND.ND.GT.2.AND.ID.LT.(NO-1)) THEN |
| 0016 | | READ(1,REC=IREC-2)(ER(I),I=1,21) |
| 0017 | | NR=3 |
| 0018 | | 00 20 I=1,6 |
| 0019 | | DO 20 J=I,6 |
| 0020 | 20 | COEFFI(I,J)=ER(KS(I,J)) |
| 0021 | | DO 21 I=1,3 |
| 0022 | | 00 21 J=I,3 |
| 0023 | 21 | COF(I,J)=COF(I,J)+COEFFI((3*INTI(NR)+I),(3*INTJ(NR)+J)) |
| 0024 | | ENDIF |
| 0025 | | RETURN |
| 0026 | | END |

PROGRAM SECTIONS

.

....

| Siz | 8 | Attributes | |
|--------|---|---|--|
| 001360 | 376 | RW, I, CON, LCL | |
| 000006 | 3 | RW, D, CON, LCL | |
| 000364 | 122 | RW.D.CON.LCL | |
| 000002 | 1 | RW.D.CON.LCL | |
| 000224 | 74 | RW, D, OVR, GBL | |
| | Siz 001360 000006 000364 000002 000224 | Size 001360 376 000006 3 000364 122 000002 1 000224 74 | |

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Total Space Allocated = 002200 576

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APPENDIX 2 - INPUT DATA FORMAT

EBADAG

INPUT DATA FORMAT

TITLE SMADL COUNSING ANALE OF THE MANT BATA

| ROW NO | SYMBOL | COLUMN NO | NAME OF THE INPUT DATA | FORMAT |
|--------|--------|-----------|------------------------|--------|
| 1 | TOP | 1 | ·*, | A1 |
| 2 | BAS | 2_77 | Heading | 19A4 |

1 1

SYSTEM PROPERTIES

| ROW NO | SYMBOL | COLUMN NO | NAME OF THE INPUT DATA | FORMAT |
|--------|--------|-----------|--|--------|
| 1 | NPILE | 1_5 | Number of Piles | 15 |
| 2 | NLOAD | 6_10 | Number of Loadings | 15 |
| 3 | ND | 11_15 | Number of Node Numbers | 15 |
| 4 | ITR | 16_20 | Key for Printing Element Displacements and Reactions | 15 |
| 5 | NTR | 21_24. | Key for Printing Equivalent Pile Stiffness Matrix and Displacements | 15 |



LOADINGS

| ROW NO | SYMBOL | COLUMIN NO | NAME OF THE INPUT DATA | FORMAT |
|--------|--------|------------|------------------------|--------|
| 1 | P (1) | 1_10 . | Force in X direction | F 10.0 |
| 2 | P (2) | 11_20 | Force in Y direction | F 10.0 |
| 3 | P (3) | 21_30 | Force in Z direction | F10.0 |
| 4 | P (4) | 31_40 | Moment in X direction | F 10.0 |
| 5 | P (5) | 41 _ 50 | Moment in Y direction | F 10.0 |
| 6 | P (6) | 51_60 | Moment in Z direction | F 10.0 |

PILE PROPERTIES

| ROWNO | SYMBOL | сошми но | NAME OF THE INPUT DATA | FORMAT |
|-------|--------|----------|---|--------|
| 1 | D | Ť_10 | Pile Diameter | E10.0 |
| 2 | E | 11_20 | Elasticity Modulus | E10.0 |
| 3 | MU | 21_30 | Poisson's Ratio | E10.0 |
| 4 | С | 31_40 | Soil Modulus (If Constant) | E100 |
| 5 | KST | 41_45 | 0_ for Circle 1_ for Square | 15 |
| 6 | кту | 46_50 | 0_If Soil Modulus is Constant 1_ If Soil Modulus is Variable | 15 |

NODAL X COORDINATES

| ROW NO | SYMBOL | COLUMN NO | NAME OF THE INPUT DATA | FORMAT |
|--------------------|---------------------|-----------|---------------------------------|--------|
| 1_2_3_4 5_6_7_8 | X(I), I=1,4,7,10 | 1_80 | Sequence of Nodal X Coordinates | 8F10.0 |

NODAL Y COORDINATES

| ROW NO | SYMBOL | COLUMN NO | NAME OF THE INPUT DATA | FORMAT |
|--------------------|--------------------|-----------|---------------------------------|--------|
| 1_2_3_4 5_6_7_8 | X(I) I=2,5,8,11 | 1_80 | Sequence of Nodal Y Coordinates | 8F10.0 |

NODAL Z COORDINATES

| ROW NO | SYMBOL | COLUMN NO | NAME OF THE INPUT DATA | FORMAT |
|--------------------|--------------------|-----------|---------------------------------|--------|
| 1_2_3_4 5_6_7_8 | X(I) I=3,6,9,12 | 1_80 | Sequence of Nodal Z Coordinates | 8F10.0 |

SEQUENCE OF SOIL MODULUS

| ROW NO | SYMBOL | COLUMN NO | NAME OF THE INPUT DATA | FORMAT |
|--------------------|------------------|-----------|-------------------------------------|--------|
| 1_2_3_4 5_6_7_8 | C(I), I=1,2,3 | 1_80 | Sequence of Soil Modulus if KTY = 1 | 8F10.0 |

APPENDIX 3 - NUMERICAL EXAMPLES



FIGURE A-1 Example number one

| XAMPLE N | UMBER ONE(C=100 | 10 t/m3) | | | | | 81 |
|------------|-----------------|------------|------------|------------|-----------|------------|------------|
| 10001 1 00 | Ω¢ | | | | | -0.322.01 | |
| | | | | | | | |
| OAD NO: | | P1 | P2 | P3 | P4 | P5 | P6 |
| 1 | | 100.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | | 0.00 | 100.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | | 0.00 | 0.00 | 100.00 | 0.00 | 0.00 | 0.00 |
| 4 | | 0.00 | 0.00 | 0.00 | 100.00 | 0.00 | 0.00 |
| 5 | FILE ME | 0.00 | : 0.00 | 0.00 | 0.00 | 100.00 | 0.00 |
| . 6 | | 0.00 . | 0.00 | 0.00 | 0.00 | 0.00 | 100.00 |
| ile head | DISPLACEMENTS | | | | | -19,430 | |
| | | | 1 | | | | |
| DAD NO: | PILE NO: | 01 | . D2 | D3 | 04 | 05 | 06 |
| 1 | 1 | 0.241E-03 | 0.000E+00 | -0.850E-02 | 0.000E+00 | 0.241E-03 | 0.000E+00 |
| 1 | 2 | -0.241E-03 | 0.000E+00 | -0.850E-02 | 0.000E+00 | 0.241E-03 | 0.000E+00 |
| 1 | 3 | -0.241E-03 | 0.000E+00 | -0.850E-02 | 0.000E+00 | 0.241E-03 | 0.000E+00 |
| 1 | 4 | 0.241E-03 | 0.000E+00 | -0.850E-02 | 0.000E+00 | 0.241E-03 | 0.000E+00 |
| 2 | 1 | -0.241E-03 | -0.850E-02 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.241E-03 |
| 2 | 2 | -0.241E-03 | -0.850E-02 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.241E-03 |
| 2 | 3 | 0.241E-03 | -0.850E-02 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.241E-03 |
| 2 | 4 | 0.241E-03 | -0.850E-02 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.241E-03 |
| 3 | 1 . | -0.106E-03 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| 3 | 2 | -0.106E-03 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| 3 | 3 | -0.106E-03 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| 3 | 4 | -0.106E-03 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| 4 | 1 | 0.933E-04 | 0.145E-02 | 0.000E+00 | 0.000E+00 | 0.000E+00 | -0.933E-04 |
| 4 | 2 | 0.933E-04 | 0.145E-02 | 0.000E+00 | 0.000E+00 | 0.000E+00 | -0.933E-04 |
| 4 | 3 | -0.933E-04 | 0.145E-02 | 0.000E+00 | 0.000E+00 | 0.000E+00 | -0.933E-04 |
| 4 | 4 | -0.933E-04 | 0.145E-02 | 0.000E+00 | 0.000E+00 | 0.000E+00 | -0.933E-04 |
| 5 | 1 | -0.933E-04 | 0.000E+00 | 0.145E-02 | 0.000E+00 | -0.933E-04 | 0.000E+00 |
| 5 | 2 | 0.933E-04 | 0.000E+00 | 0.145E-02 | 0.000E+00 | -0.9338-04 | 0.000E+00 |
| 5 | 3 | 0.933E-04 | 0.000E+00 | 0.145E-02 | 0.000E+00 | -0.933E-04 | 0.000E+00 |

| 5 | 4 | -0.933E-04 | 0.000E+00 | 0.145E-02 | 0.000E+00. | -0.933E-04 | 0.000E+00 |
|----------|-----------|------------|------------|------------|------------|------------|-----------|
| 6 | 1 | 0.000E+00 | 0.119E-02 | -0.119E-02 | -0.119E-02 | 0.000E+00 | 0.000E+00 |
| 6 | 2 | 0.000E+00 | -0.119E-02 | -0.119E-02 | -0.119E-02 | 0.000E+00 | 0.000E+00 |
| 6 | 3 | 0.000E+00 | -0.119E-02 | 0.119E-02 | -0.119E-02 | 0.000E+00 | 0.000E+00 |
| 6 | 4 | 0.000E+00 | 0.119E-02 | 0.119E-02 | -0.119E-02 | 0.000E+00 | 0.000E+00 |
| ile head | REACTIONS | | 1.1.1 | | | | |
| DAD NO: | PILE NO: | ТХ | TY | TZ | MX | MY | MZ |
| 1 | 1 | 56.899 | 0.000 | -41.438 | 0.000 | -99.430 | 0.000 |
| 1 | 2 | -56.899 | 0.000 | -41.438 | 0.000 | -99.430 | 0.000 |
| 1 | 3 | -56.899 | 0.000 | -41.438 | 0.000 | -99.430 | 0.000 |
| 1 | 4 | 56.899 | 0.000 | -41.438 | 0.000 | -99.430 | 0.000 |
| 2 | 1 | -56.899 | -41.438 | 0.000 | 0.000 | 0.000 | -99.430 |
| 2 | 2 | -56.899 | -41.438 | 0.000 | 0.000 | 0.000 | -99.430 |
| 2 | 3 | 56.899 | -41.438 | 0.000 | 0.000 | 0.000 | -99.430 |
| 2 | 4 | 56.899 | -41.438 | 0.000 | 0.000 | 0.000 | -99.430 |
| 3 | 1 | -25.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 3 | 2 | -25.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 3 | 3 | -25.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 3 | 4 | -25.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 4 | 1 | 21.992 | 6.353 | 0.000 | 0.000 | 0.000 | 13.430 |
| 4 | 2 | 21.992 | 6.353 | 0.000 | 0.000 | 0.000 | 13.430 |
| 4 | 3 | -21.992 | 6.353 | 0.000 | 0.000 | 0.000 | 13.430 |
| 4 | 4 | -21.992 | 6.353 | 0.000 | 0.000 | 0.000 | 13.430 |
| 5 | 1 | -21.992 | 0.000 | 6.353 | 0.000 | 13.430 | 0.000 |
| 5 | 2 | 21.992 | 0.000 | 6.353 | 0.000 | 13.430 | 0.000 |
| 5 | 3 | 21.992 | 0.000 | 6.353 | 0.000 | 13.430 | 0.000 |
| 5 | 4 | -21.992 | 0.000 | 6.353 | 0.000 | 13.430 | 0.000 |
| 6 | 1 · · | 0.000 | 6.251 | -6.251 | -12.497 | -16.174 | 16.174 |
| 6 | 2 | 0.000 | -6.251 | -6.251 | -12.497 | -16.174 | -16.174 |
| 6 | 3 | 0.000 | -6.251 | 6.251 | -12.497 | 16.174 | -16.174 |
| 6 | 4 | 0.000 | 6.251 | 6.251 | -12.497 | 16.174 | 16.174 |



FIGURE A-2 Example number two

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XAMPLE NUMBER TWO(C=1000t/m3)

NDAL LOADS

| DAD NO: | P1 | P2 | P3 | P4 | P5 | P6 |
|---------|----------|--------|--------|--------|--------------|--------|
| 1 | 100.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0.00 | 100.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | 0.00 | 0.00 | 100.00 | 0.00 | 0.00 | 0.00 |
| 4 | 0.00 | 0.00 | 0.00 | 100.00 | 0.00 | 0.00 |
| 5 | 0.00 | : 0.00 | 0.00 | 0.00 | 100.00 | 0.00 |
| 6 | . 0.00 . | 0.00 | 0.00 | 0.00 | 0.00 | 100.00 |
| | | | | | · A Edderine | |

06

0.000E+00

0.000E+00

0.000E+00

0.000E+00

0.000E+00

0.234E-03

0.234E-03

PILE HEAD DISPLACEMENTS

PILE NO: LOAD NO: D1 02 D3 04 05 1 1 0.234E-03 0.000E+00 -0.744E-02 0.000E+00 0.234E-03 1 2 -0.234E-03 0.000E+00 -0.744E-02 0.000E+00 0.234E-03 1 3 -0.234E-03 0.000E+00 -0.744E-02 0.000E+00 0.234E-03 1 4 0.234E-03 0.000E+00 -0.744E-02 0.000E+00 0.234E-03 0.000E+00 1 5 0.000E+00 -0.744E-02 0.000E+00 0.234E-03 2 1 -0.234E-03 -0.744E-02 0.000E+00 0.000E+00 0.000E+00 2 2 -0.744E-02 -0.234E-03 0.000E+00 0.000E+00 0.000E+00

| 2 | 3 | 0.234E-03 | -0.744E-02 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.234E-03 |
|---|-----|------------|------------|-----------|-----------|-----------|------------|
| 2 | 4 - | 0.234E-03 | -0.744E-02 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.234E-03 |
| 2 | 5 | 0.000E+00 | -0.744E-02 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.234E-03 |
| 3 | 1 | -0.849E-04 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| 3 | 2 | -0.849E-04 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| 3 | 3 | -0.849E-04 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| 3 | 4 | -0.849E-04 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| 3 | 5 | -0.849E-04 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 | 0.000E+00 |
| 4 | 1 | 0.906E-04 | 0.141E-02 | 0.000E+00 | 0.000E+00 | 0.000E+00 | -0.906E-04 |
| 4 | 2 | 0.906E-04 | 0.141E-02 | 0.000E+00 | 0.000E+00 | 0.000E+00 | -0.906E-04 |
| 4 | 3 | -0.906E-04 | 0.141E-02 | 0.000E+00 | 0.000E+00 | 0.000E+00 | -0.906E-04 |
| 4 | 4 | -0.906E-04 | 0.141E-02 | 0.0005+00 | 0.0005+00 | 0.0005+00 | -0.9065-04 |

| 4 | 5 | 0.000E+00 | 0.141E-02 | 0.000E+00 | 0.000E+00 | 0.0002+00 | -0.906E-04 |
|---------|-------------|------------|------------|------------|------------|------------|------------|
| 5 | 1 | -0.906E-04 | 0.000E+00 | 0.141E-02 | 0.000E+00 | -0.906E-04 | 0.000E+00 |
| 5 | 2 | 0.906E-04 | 0.000E+00 | 0.141E-02 | 0.000E+00 | -0.906E-04 | 0.000E+00 |
| 5 | 3 | 0.906E-04 | 0.000E+00 | 0.141E-02 | 0.000E+00 | -0.906E-04 | 0.000E+00 |
| 5 | 4 | -0.906E-04 | 0.000E+00 | 0.141E-02 | 0.000E+00 | -0.906E-04 | 0.000E+00 |
| 5 | 5 | 0.000E+00 | 0.000E+00 | 0.141E-02 | 0.000E+00 | -0.906E-04 | 0.000E+00 |
| 6 | 1 | 0.000E+00 | 0.106E-02 | -0.106E-02 | -0.106E-02 | 0,000E+00 | 0.000E+00 |
| 6 | 2 | 0.000E+00 | -0.106E-02 | -0.106E-02 | -0.106E-02 | 0.000E+00 | 0.000E+00 |
| 6 | 3 | 0.000E+00 | -0.106E-02 | 0.106E-02 | -0.106E-02 | 0.000E+00 | 0.000E+00 |
| 6 | . 4 | 0.000E+00 | 0.106E-02 | 0.106E-02 | -0.106E-02 | 0.000E+00 | 0.000E+00 |
| 6 | 5 | 0.000E+00 | 0.000E+00 | 0.000E+00 | -0.106E-02 | 0.000E+00 | 0.000E+00 |
| ile hea | D REACTIONS | | | | | | |
| CAD NO: | PILE NO: | ТХ | TY | TZ | MX | MY | MZ |
| 1 | 1 | 55.238 | 0.000 | -35.958 | 0.000 | -85.479 | 0.000 |
| 1 | 2 | -55.238 | 0.000 | -35,958 | 0.000 | -85.479 | 0.000 |
| 1 | 3 | -55.238 | 0.000 | -35.958 | 0.000 | -85.479 | 0.000 |
| 1 | 4 | 55.238 | 0.000 | -35.958 | 0.000 | -85.479 | 0.000 |
| 1 | 5 | 0.000 | 0.000 | -35.958 | . 0.000 | -85.479 | 0.000 |
| 2 | 1 | -55.238 | -35.958 | 0.000 | 0.000 | 0.000 | -85.479 |
| 2 | 2 | -55.238 | -35.958 | 0.000 | 0.000 | 0.000 | -85.479 |
| 2 | 3 | 55.238 | -35.958 | 0.000 | 0.000 | 0.000 | -85.479 |
| 2 | 4 | 55.238 | -35.958 | 0.000 | . 0.000 | 0.000 | -85.479 |
| 2 | 5 | 0.000 | -35.958 | 0.000 | 0.000 | 0.000 | -85.479 |
| 3 | 1 | -20.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 3 | 2 | -20.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 3 | 3 | -20.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 3 | 4 | -20.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 3 | 5 | -20.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| 4 | 1 | 21.349 | 6.168 | 0.000 | 0.000 | 0.000 | 13.038 |
| 4 | 2 | 21.349 | 6.168 | 0.000 | 0.000 | 0.000 | 13.038 |
| 4 | 3 | -21.349 | 6.168 | 0.000 | 0.000 | 0.000 | 13.038 |

| 4 | 5 | 0.000 | 6.168 | 0.000 | 0.000 | 0.000 | 13.038 |
|---|---|---------|--------|--------|---------|---------|---------|
| 5 | 1 | -21.349 | 0.000 | 6.168 | 0.000 | 13.038 | 0.000 |
| 5 | 2 | 21.349 | 0.000 | 6.168 | 0.000 | 13.038 | 0.000 |
| 5 | 3 | 21.349 | 0.000 | 6.168 | 0.000 | 13.038 | 0.000 |
| 5 | 4 | -21.349 | 0.000 | 6.168 | 0.000 | 13.038 | 0.000 |
| 5 | 5 | 0.000 | 0.000 | 6.168 | 0.000 | 13.038 | 0.000 |
| 6 | 1 | 0.000 | 5.557 | -5.557 | -11.109 | -14.378 | 14.378 |
| 6 | 2 | 0.000 | -5.557 | -5.557 | -11.109 | -14.378 | -14.378 |
| 6 | 3 | 0.000 | -5.557 | Š.557 | -11.109 | 14.378 | -14.378 |
| 6 | 4 | 0.000 | 5.557 | 5.557 | -11.109 | 14.378 | 14.378 |
| 6 | 5 | 0.000 | 0.000 | 0.000 | -11.109 | 0.000 | 0.000 |
| | | | | | | | |

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0.1.258-62



FIGURE A-3 Example number three

ODAL LOADS

| OAD | NO: | | P1 | P2 | P3 | P4 | P5 | P6 |
|------|------|---------------|--------------|-----------|------------|------------|-----------|------------|
| | 1 | | 0.00 | 0.00 | 2927.26 | 4258.74 | 0.00 | 0.00 |
| ILE | HEAD | DISPLACEMENTS | | | | | 2.64 | |
| .0AD | NO: | PILE NO: | D1 · | D2 | D3 | 04 | 05 | . D6 |
| | 1 | 1 | -0.331E-03 | 0.125E-02 | -0.114E-09 | -0.442E-19 | 0.903E-11 | -0.990E-04 |
| | 1 | 2 | -0.331E-03 | 0.125E-02 | -0.114E-09 | -0.442E-19 | 0.903E-11 | -0.990E-04 |
| | 1 | 3 | -0.331E-03 | 0.125E-02 | -0.114E-09 | -0.442E-19 | 0.903E-11 | -0.990E-04 |
| | 1 | 4 | -0.331E-03 ' | 0.125E-02 | -0.114E-09 | -0.442E-19 | 0.903E-11 | -0.990E-04 |
| | 1 | 5 | -0.628E-03 | 0.125E-02 | -0.114E-09 | -0.442E-19 | 0.903E-11 | -0.990E-04 |
| | 1 | 6 | -0.628E-03 | 0.125E-02 | -0.114E-09 | -0.442E-19 | 0.903E-11 | -0.990E-04 |
| | 1 | 7 | -0.628E-03 | 0.125E-02 | -0.114E-09 | -0.442E-19 | 0.903E-11 | -0.990E-04 |
| | 1 | 8 | -0.628E-03 | 0.125E-02 | -0.114E-09 | -0.442E-19 | 0.903E-11 | -0.990E-04 |
| | 1 | 9 | -0.925E-03 | 0.125E-02 | -0.114E-09 | -0.442E-19 | 0.903E-11 | -0.990E-04 |
| | 1 | 10 | -0.925E-03 | 0.125E-02 | -0.114E-09 | -0.442E-19 | 0.903E-11 | -0.990E-04 |
| | 1 | 11 | -0.925E-03 | 0.125E-02 | -0.114E-09 | -0.442E-19 | 0.903E-11 | -0.990E-04 |
| | 1 | 12 | -0.925E-03 | 0.125E-02 | -0.114E-09 | -0.442E-19 | 0.903E-11 | -0.990E-04 |
| | 1 | 13 | -0.122E-02 | 0.125E-02 | -0.114E-09 | -0.442E-19 | 0.903E-11 | -0.990E-04 |
| | 1 | 14 | -0.122E-02 | 0.125E-02 | -0.114E-09 | -0.442E-19 | 0.903E-11 | -0.990E-04 |
| | 1 | 15 | -0.122E-02 | 0.125E-02 | -0.114E-09 | -0.442E-19 | 0.903E-11 | -0.990E-04 |
| | 1 | 16 | -0.122E-02 | 0.125E-02 | -0.114E-09 | -0.442E-19 | 0.903E-11 | -0.990E-04 |
| ILE | HEAD | REACTIONS | | | | | | |
| | | | 1.1 | | | | | |
| DAD. | NO: | PILE NO: | TX | TY | TZ | MX | MY | MZ |
| | 1 | 1 | -77.965 | 8.745 | 0.000 | 0.000 | 0.000 | 14.676 |
| | 1 | 2 | -77.965 | 8.745 | 0.000 | 0.000 | 0.000 | 14.676 |
| | 1 | 3 | -77.965 | 8.745 | 0.000 | 0.000 | 0.000 | 14.676 |
| | 1 | 4 | -77.965 | 8.745 | 0.000 | 0.000 | 0.000 | 14.676 |
| | 1 | 5 | -147.957 | 8.745 | 0.000 | 0.000 | 0.000 | 14.676 |

| 1 | 6 | -147.957 | 8.745 | 0.000 | 0.000 | 0.000 | 14.676 |
|---|----|----------|-------|---------|-------|-------|--------|
| 1 | 7 | -147.957 | 8.745 | 0.000 | 0.000 | 0.000 | 14.676 |
| 1 | 8 | -147.957 | 8.745 | 0.000 | 0.000 | 0.000 | 14.676 |
| 1 | 9 | -217.950 | 8.745 | 0.000 | 0.000 | 0.000 | 14.676 |
| 1 | 10 | -217.950 | 8.745 | 0.000 | 0.000 | 0.000 | 14.676 |
| 1 | 11 | -217.950 | 8.745 | 0.000 | 0.000 | 0.000 | 14.676 |
| 1 | 12 | -217.950 | 8.745 | 0.000 | 0.000 | 0.000 | 14.676 |
| 1 | 13 | -287.943 | 8.745 | 0.000 | 0.000 | 0.000 | 14.676 |
| 1 | 14 | -287.943 | 8.745 | 0.000 | 0.000 | 0.000 | 14.676 |
| 1 | 15 | -287.943 | 8.745 | - 0.000 | 0.000 | 0.000 | 14.676 |
| 1 | 16 | -287.943 | 8.745 | 0.000 | 0.000 | 0.000 | 14.676 |
| | | | | | | | |









FIGURE A-4 Example number four

)T

| IDOAL | IDADS |
|-------------|-------|
| ULTE | LUNUJ |

Ì

| CAD NO: | P1 | P2 | P3 | P4 | P5 | P6 |
|---------|------|------|---------|---------|------|------|
| 1 | 0.00 | 0.00 | 2927.26 | 4258.74 | 0.00 | 0.00 |

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PILE HEAD DISPLACEMENTS

| LOAD NO: | PILE NO: | D1 | D2 | D3 | D4 | 05 | 1D6 |
|-----------|-----------|------------|-----------|-----------|-----------|-----------|------------|
| 1 | 1 | -0.295E-03 | 0.118E-02 | 0.000E+00 | 0.000E+00 | 0.000E+00 | -0.942E-04 |
| 1 | 2 | -0.295E-03 | 0.118E-02 | 0.000E+00 | 0.000E+00 | 0.000E+00 | -0.942E-04 |
| 1 | 3 | -0.295E-03 | 0.118E-02 | 0.000E+00 | 0.000E+00 | 0.000E+00 | -0.942E-04 |
| 1 | 4 | -0.578E-03 | 0.118E-02 | 0.000E+00 | 0.000E+00 | 0.000E+00 | -0.942E-04 |
| 1 | 5 | -0.578E-03 | 0.118E-02 | 0.000E+00 | 0.000E+00 | 0.000E+00 | -0.942E-04 |
| 1 | 6 | -0.719E-03 | 0.118E-02 | 0.000E+00 | 0.000E+00 | 0.000E+00 | -0.942E-04 |
| 1 | 7 | -0.719E-03 | 0.118E-02 | 0.000E+00 | 0.000E+00 | 0.000E+00 | -0.942E-04 |
| 1 | 8 | -0.860E-03 | 0.118E-02 | 0.000E+00 | 0.000E+00 | 0.000E+00 | -0.942E-04 |
| 1 | 9 | -0.860E-03 | 0.118E-02 | 0.000E+00 | 0.000E+00 | 0.000E+00 | -0.942E-04 |
| 1 | 10 | -0.114E-02 | 0.118E-02 | 0.000E+00 | 0.000E+00 | 0.000E+00 | -0.942E-04 |
| 1 | 11 | -0.114E-02 | 0.118E-02 | 0.000E+00 | 0.000E+00 | 0.000E+00 | -0.942E-04 |
| 1 | 12 | -0.114E-02 | 0.118E-02 | 0.000E+00 | 0.000E+00 | 0.000E+00 | -0.942E-04 |
| PILE HEAD | REACTIONS | | • | | | | |
| LOAD NO: | PILE NO: | ТХ | TY | TZ | MX | MY | MZ |
| 1 | 1 | -100.112 | 17.344 | 0.000 | 0.000 | 0.000 | 28.996 |
| 1 | 2 | -100.112 | 17.344 | 0.000 | 0.000 | 0.000 | 28.996 |
| 1 | 3 | -100.112 | 17.344 | 0.000 | 0.000 | 0.000 | 28.996 |
| 1 | 4 | -195.996 | 17.344 | 0.000 | 0.000 | 0.000 | 28.996 |
| 1 | 5 | -195.996 | 17.344 | 0.000 | 0.000 | 0.000 | 28.996 |
| 1 | 6 | -243.938 | 17.344 | 0.000 | 0.000 | 0.000 | 28.996 |
| 1 | 7 | -243.938 | 17.344 | 0.000 | 0.000 | 0.000 | 28.996 |
| 1 | 8 | -291.880 | 17.344 | 0.000 | 0.000 | 0.000 | 28.996 |
| 1 | 9 | -291.880 | 17.344 | 0.000 | 0.000 | 0.000 | 28.996 |
| | | | | | | | |

| 28.996 |
|--------|
| 28.996 |
| 28.996 |
| |

10.52 50





FIGURE A-5 Example number five

EXAMPLE NUMBER FIVE(C=1000t/m3)

NODAL LOADS

| LOAD | NO: | | P1 | P2 | P3 | P4 | P5 | P6 |
|------|------|---------------|------------|------------------------|-----------|------------|------------|------------|
| | 1 | | 0.00 | 0.00 | 2927.26 | 4258.74 | 0.00 | 0.00 |
| PILE | HEAD | DISPLACEMENTS | | | | | | |
| LOAD | NO: | PILE NO: | 01 | D2 | D3 | 04 | 05 | . D6 |
| | 1 | 1 | -0.231E-03 | [:] 0.889E-03 | 0.194E-11 | -0.564E-12 | -0.307E-12 | -0.572E-04 |
| | 1 | 2 | -0.231E-03 | 0.889E-03 | 0.194E-11 | -0.564E-12 | -0.307E-12 | -0.572E-04 |
| | 1 | 3 | -0.231E-03 | 0.889E-03 | 0.194E-11 | -0.564E-12 | -0.307E-12 | -0.572E-04 |
| | 1 | 4 | -0.231E-03 | 0.889E-03 | 0.194E-11 | -0.564E-12 | -0.307E-12 | -0.572E-04 |
| | 1 | 5 | -0.231E-03 | 0.889E-03 | 0.194E-11 | -0.564E-12 | -0.307E-12 | -0.572E-04 |
| | 1 | 6 | -0.375E-03 | 0.889E-03 | 0.335E-11 | -0.564E-12 | -0.307E-12 | -0.572E-04 |
| | 1 | 7 | -0.375E-03 | 0.889E-03 | 0.335E-11 | -0.564E-12 | -0.307E-12 | -0.572E-04 |
| | 1 | 8 | -0.375E-03 | 0.889E-03 | 0.335E-11 | -0.564E-12 | -0.307E-12 | -0.572E-04 |
| | 1 | 9 | -0.375E-03 | 0.889E-03 | 0.335E-11 | -0.564E-12 | -0.307E-12 | -0.572E-04 |
| | 1 | 10 | -0.375E-03 | 0.889E-03 | 0.335E-11 | -0.564E-12 | -0.307E-12 | -0.572E-04 |
| | 1 | 11 | -0.518E-03 | 0.889E-03 | 0.476E-11 | -0.564E-12 | -0.307E-12 | -0.572E-04 |
| | 1 | 12 | -0.518E-03 | 0.889E-03 | 0.476E-11 | -0.564E-12 | -0.307E-12 | -0.572E-04 |
| | 1 | 13 | -0.518E-03 | 0.889E-03 | 0.476E-11 | -0.564E-12 | -0.307E-12 | -0.572E-04 |
| | 1 | 14 | -0.518E-03 | 0.889E-03 | 0.476E-11 | -0.564E-12 | -0.307E-12 | -0.572E-04 |
| | 1 | 15 | -0.661E-03 | 0.889E-03 | 0.617E-11 | -0.564E-12 | -0.307E-12 | -0.572E-04 |
| | 1 | 16 | -0.661E-03 | 0.889E-03 | 0.617E-11 | -0.564E-12 | -0.307E-12 | -0.572E-04 |
| | 1 | 17 | -0.661E-03 | 0.889E-03 | 0.617E-11 | -0.564E-12 | -0.307E-12 | -0.572E-04 |
| | 1 | 18 | -0.661E-03 | 0.889E-03 | 0.617E-11 | -0.564E-12 | -0.307E-12 | -0.572E-04 |
| | 1 | 19 | -0.661E-03 | 0.889E-03 | 0.617E-11 | -0.564E-12 | -0.307E-12 | -0.572E-04 |
| | 1 | 20 | -0.804E-03 | 0.889E-03 | 0.759E-11 | -0.564E-12 | -0.307E-12 | -0.572E-04 |
| | 1 | 21 | -0.804E-03 | 0.889E-03 | 0.759E-11 | -0.564E-12 | -0.307E-12 | -0.572E-04 |
| | 1 | 22 | -0.804E-03 | 0.889E-03 | 0.759E-11 | -0.564E-12 | -0.307E-12 | -0.572E-04 |
| | 1 | 23 | -0.804E-03 | 0.889E-03 | 0.759E-11 | -0.564E-12 | -0.307E-12 | -0.572E-04 |
| | 1 | 24 | -0.804E-03 | 0.889E-03 | 0.759E-11 | -0.564E-12 | -0.307E-12 | -0.572E-04 |
E HEAD REACTIONS

| AD NO: | PILE NO: | ТХ | TY | TZ | MX | MY | MZ |
|------------|----------|----------|-------|-------|-------|-------|-------|
| 1 | 1 | -54.538 | 3.896 | 0.000 | 0.000 | 0.000 | 8.236 |
| 1 | 2 | -54.538 | 3.896 | 0.000 | 0.000 | 0.000 | 8.236 |
| 1 | 3 | -54.538 | 3.896 | 0.000 | 0.000 | 0.000 | 8.236 |
| 1 | 4 | -54.538 | 3.896 | 0.000 | 0.000 | 0.000 | 8.236 |
| 1 | 5 | -54.538 | 3.896 | 0.000 | 0.000 | 0.000 | 8.236 |
| 1 | 6 | -88.253 | 3.896 | 0.000 | 0.000 | 0.000 | 8.236 |
| 1 | 7 | -88.253 | 3.896 | 0.000 | 0.000 | 0.000 | 8.236 |
| 1 | 8 | -88.253 | 3.896 | 0.000 | 0.000 | 0.000 | 8.236 |
| i | 9 | -88.253 | 3.896 | 0.000 | 0.000 | 0.000 | 8.236 |
| 1 | 10 | -88.253 | 3.896 | 0.000 | 0.000 | 0.000 | 8.236 |
| 1 | 11 | -121.969 | 3.896 | 0.000 | 0.000 | 0.000 | 8.236 |
| 1 | 12 | -121.969 | 3.896 | 0.000 | 0.000 | 0.000 | 8.236 |
| 1 | 13 | -121.969 | 3.896 | 0.000 | 0.000 | 0.000 | 8.236 |
| 1 | 14 | -121.969 | 3.896 | 0.000 | 0.000 | 0.000 | 8.236 |
| 1 | 15 | -155.685 | 3.896 | 0.000 | 0.000 | 0.000 | 8.236 |
| 1 | 16 | -155.685 | 3.896 | 0.000 | 0.000 | 0.000 | 8.236 |
| 1 | 17 | -155.685 | 3.896 | 0.000 | 0.000 | 0.000 | 8.236 |
| 1 | 18 | -155.685 | 3.8% | 0.000 | 0.000 | 0.000 | 8.236 |
| 1 | 19 | -155.685 | 3.896 | 0.000 | 0.000 | 0.000 | 8.236 |
| 1 | 20 | -189.401 | 3.896 | 0.000 | 0.000 | 0.000 | 8.236 |
| 1 | 21 | -189.401 | 3.896 | 0.000 | | 0.000 | 8.236 |
| 1 | 22 | -189.401 | 3.896 | 0.000 | 0.000 | 0.000 | 8.236 |
| 1 | 23 | -189.401 | 3.896 | 0.000 | 0.000 | 0.000 | 8.236 |
| 1 | 24 | -189.401 | 3.896 | 0.000 | 0.000 | 0.000 | 8.236 |
| No. Martin | | | | | | | |









96

| example NL | MBER SIX(C=1000 |)t/m3) | | | | | 97 |
|---------------------|-----------------|------------|------------|-----------|------------|------------|------------|
| Nodal Load |)S | | | | | | |
| LOAD NO: | | P1 | P2 | P3 | P4 | P5 | P6 |
| 1 | | 0.00 | 0.00 | 2927.26 | 4258.74 | 0.00 | 0.00 |
| | | | | | | 1.279 | |
| PILE HEAD | DISPLACEMENTS | | | 1.000 | | | |
| LOAD NO: | PILE NO: | D1 · | D2 | 03 | D4 | 05 | . 06 |
| 1 | 1 1 | -0.209E-03 | :0.103E-02 | 0.643E-11 | -0.114E-12 | -0.382E-12 | -0.564E-04 |
| 1 | 2 | -0.209E-03 | 0.103E-02 | 0.643E-11 | -0.114E-12 | -0.382E-12 | -0.564E-04 |
| 1 | 3 | -0.209E-03 | 0.103E-02 | 0.643E-11 | -0.114E-12 | -0.382E-12 | -0.564E-04 |
| 1 | 4 | -0.209E-03 | 0.103E-02 | 0.643E-11 | -0.114E-12 | -0.382E-12 | -0.564E-04 |
| . 1 | 5 | -0.3388-03 | 0.103E-02 | 0.670E-11 | -0.114E-12 | -0.382E-12 | -0.564E-04 |
| 1 | 6 | -0.338E-03 | 0.103E-02 | 0.670E-11 | -0.114E-12 | -0.382E-12 | -0.564E-04 |
| 1 | 7 | -0.389E-03 | 0.103E-02 | 0.680E-11 | -0.114E-12 | -0.382E-12 | -0.564E-04 |
| 1 | 8 | -0.389E-03 | 0.103E-02 | 0.680E-11 | -0.114E-12 | -0.382E-12 | -0.564E-04 |
| 1 | 9 | -0.479E-03 | 0.103E-02 | 0.698E-11 | -0.114E-12 | -0.382E-12 | -0.564E-04 |
| 1 | 10 | -0.479E-03 | 0.103E-02 | 0.698E-11 | -0.114E-12 | -0.382E-12 | -0.564E-04 |
| 1 | 11 | -0.569E-03 | 0.103E-02 | 0.717E-11 | -0.114E-12 | -0.382E-12 | -0.564E-04 |
| 1 | 12 | -0.569E-03 | 0.103E-02 | 0.717E-11 | -0.114E-12 | -0.382E-12 | -0.564E-04 |
| 1 | 13 | -0.620E-03 | 0.103E-02 | 0.727E-11 | -0.114E-12 | -0.382E-12 | -0.564E-04 |
| 1 | 14 | -0.620E-03 | 0.103E-02 | 0.727E-11 | -0.114E-12 | -0.382E-12 | -0.564E-04 |
| 1 | 15 | -0.750E-03 | 0.103E-02 | 0.753E-11 | -0.114E-12 | -0.382E-12 | -0.564E-04 |
| 1 | 16 | -0.750E-03 | 0.103E-02 | 0.753E-11 | -0.114E-12 | -0.382E-12 | -0.564E-04 |
| 1 | 17 | -0.750E-03 | 0.103E-02 | 0.7538-11 | -0.114E-12 | -0.382E-12 | -0.564E-04 |
| 1 | 18 | -0.750E-03 | 0.103E-02 | 0.753E-11 | -0.114E-12 | -0.382E-12 | -0.564E-04 |
| PILE HEAD REACTIONS | | | | | | | |
| LOAD NO: | PILE NO: | ТХ | TY | TZ | МХ | MY | HZ |
| 1 | 1 | -70.827 | 6.841 | 0.000 | 0.000 | 0.000 | 17.537 |
| 1 | 2 | -70.827 | 6.841 | 0.000 | 0.000 | 0.000 | 17.537 |
| 1 | 3 | -70.827 | 6.841 | 0.000 | 0.000 | 0.000 | 17.537 |

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| | | | | | 1 | | · · · · · |
|---|----|----------|-------|---------|--------|-------|-----------|
| 1 | 4 | -70.827 | 6.841 | 0.000 | 0.000. | 0.000 | 17.537 |
| 1 | 5 | -114.814 | 6.841 | 0.000 | 0.000 | 0.000 | 17.537 |
| 1 | 6 | -114.814 | 6.841 | 0.000 | 0.000 | 0.000 | 17.537 |
| 1 | 7 | -132.026 | 6.841 | 0.000 | 0.000 | 0.000 | 17.537 |
| 1 | 8 | -132.026 | 6.841 | 0.000 | 0.000 | 0.000 | 17.537 |
| 1 | 9 | -162.626 | 6.841 | 0.000 | 0.000 | 0.000 | 17.537 |
| 1 | 10 | -162.626 | 6.841 | 0.000 | 0.000 | 0.000 | 17.537 |
| 1 | 11 | -193.225 | 6.841 | 0.000 | 0.000 | 0.000 | 17.537 |
| 1 | 12 | -193.225 | 6.841 | 0.000 | 0.000 | 0.000 | 17.537 |
| 1 | 13 | -210.437 | 6.841 | 0.000 | 0.000 | 0.000 | 17.537 |
| 1 | 14 | -210.437 | 6.841 | 0.000 | 0.000 | 0.000 | 17.537 |
| 1 | 15 | -254.424 | 6.841 | 0.000 | 0.000 | 0.000 | 17.537 |
| 1 | 16 | -254.424 | 6.841 | 0.000 | 0.000 | 0.000 | 17.537 |
| 1 | 17 | -254.424 | 6.841 | . 0.000 | 0.000 | 0.000 | 17.537 |
| 1 | 18 | -254.424 | 6.841 | 0.000 | 0.000 | 0.000 | 17.537 |



FIGURE A-7 Example number seven

| 040 NO: | P1 | P2 | P3 | P4 | P5 | P6 |
|---------|--------|--------|--------|--------|--------|--------|
| 1 | 100.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0.00 | 100.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | 0.00 | 0.00 | 100.00 | 0.00 | 0.00 | . 0.00 |
| 4 | 0.00 | 0.00 | 0.00 | 100.00 | 0.00 | 0.00 |
| 5 | 0.00 | 0.00 | 0.00 | 0.00 | 100.00 | 0.00 |
| 6 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 100.00 |

ILE HEAD DISPLACEMENTS

| DAD NO: | PILE NO: | D1 . | 02 | 03 | D4 | 05 | 06 |
|---------|----------|------------|------------|------------|------------|------------|------------|
| 1 | 1 | 0.326E-03 | 0.431E-03 | -0.452E-02 | -0.114E-06 | 0.329E-04 | -0.152E-04 |
| 1 | 2 | -0.341E-03 | 0.429E-03 | -0.451E-02 | -0.243E-05 | 0.332E-04 | -0.152E-04 |
| 1 | 3 | -0.338E-03 | -0.135E-03 | -0.447E-02 | -0.271E-05 | 0.309€-04 | -0.194E-04 |
| 1 | 4 | 0.321E-03 | -0.134E-03 | -0.447E-02 | -0.396E-06 | 0.306E-04 | -0.194E-04 |
| 2 | 1 | -0.157E-03 | -0.404E-04 | -0.467E-04 | 0.314E-06 | -0.786E-06 | 0.340E-05 |
| 2 | 2 | -0.164E-03 | -0.397E-04 | -0.467E-04 | 0.777E-06 | -0.791E-06 | 0.340E-05 |
| 2 | 3 | -0.163E-03 | -0.540E-04 | -0.416E-04 | 0.782E-06 | -0.328E-06 | 0.347E-05 |
| 2 | 4 | -0.157E-03 | -0.546E-04 | -0.414E-04 | 0.319E-06 | -0.323E-06 | 0.347E-05 |
| 3 | 1 | 0.198E-03 | 0.281E-01 | 0.182E-02 | 0.139E-03 | 0.138E-03 | -0.171E-02 |
| 3 | 2 | 0.141E-03 | 0.284E-01 | 0.182E-02 | -0.881E-04 | 0.139E-03 | -0.171E-02 |
| 3 | 3 | -0.121E-03 | 0.318E-01 | -0.212E-02 | -0.884E-04 | -0.889E-04 | -0.171E-02 |
| 3 | 4 | -0.702E-04 | 0.315E-01 | -0.212E-02 | 0.139E-03 | -0.892E-04 | -0.171E-02 |
| 4 | 1 | 0.744E-04 | 0.982E-02 | 0.631E-03 | -0.730E-04 | 0.599E-04 | -0.738E-03 |
| 4 | 2 | 0.497E-04 | 0.966E-02 | 0.616E-03 | -0.173E-03 | 0.600E-04 | -0.738E-03 |
| 4 | 3 | -0.407E-04 | 0.112E-01 | -0.744E-03 | -0.173E-03 | -0.396E-04 | -0.739E-03 |
| 4 | 4 | -0.209E-04 | 0.113E-01 | -0.762E-03 | -0.731E-04 | -0.396E-04 | -0.739E-03 |
| 5 | 1 | 0.370E-04 | 0.563E-02 | 0.376E-03 | -0.205E-02 | 0.497E-04 | -0.593E-03 |
| 5. | 2 | 0,166E-04 | 0.148E-02 | 0.970E-04 | -0.215E-02 | 0.498E-04 | -0.593E-03 |
| 5 | 3 | -0.279E-05 | 0.295E-02 | -0.196E-03 | -0.215E-02 | -0.481E-04 | -0.593E-03 |

| | 5 | 4 | -0.198E-04 | 0.709E-02 | -0.474E-03 | -0.205E-02 | -0.481E-04 | -0.593E-03 |
|------|------|-----------|------------|-----------|-------------------------------------|------------|------------|------------|
| | 6 | 1 | 0.140E-03 | 0.484E-03 | -0.281E-03 | -0.454E-06 | 0.116E-03 | -0.541E-04 |
| | 6 | 2 | -0.128E-03 | 0.478E-03 | -0.267E-03 | -0.872E-05 | 0.117E-03 | -0.541E-04 |
| | 6 | 3 | -0.117E-03 | 0.577E-03 | -0.110E-03 | -0.972E-05 | 0.109E-03 | -0.692E-04 |
| | 6 | 4 | 0.120E-03 | 0.582E-03 | -0.125E-03 | -0.145E-05 | 0.108E-03 | -0.692E-04 |
| PILE | HEAD | REACTIONS | | | | | | |
| 0AD. | NO: | PILE NO: | TX | ΤΥ | TZ | MX | MY | MZ |
| | 1 | 1 | 51.000 | 1.947 | -21.936 | -0.001 | -52.840 | 4.318 |
| | 1 | 2 | -53.390 | 1.938 | -21.912 | -0.017 | -52.773 | 4.298 |
| | 1 | 3 | -52.923 | -0.904 | -21.719 | -0.019 | -52.370 | -2.807 |
| | 1 | 4 | 50.129 | -0.897 | -21.744 | -0.003 | -52.441 | -2.790 |
| | 2 | 1 | -24.620 | -0.159 | -0.240 | 0.002 | -0.614 | -0.286 |
| | 2 | 2 | -25.581 | -0.155 | -0.240 | 0.005 | -0.614 | -0.278 |
| | 2 | 3 | -25.528 | -0.225 | -0.210 | 0.005 | -0.525 | -0.447 |
| | 2 | 4 | -24.543 | -0.228 | -0.209 | 0.002 | -0.522 | -0.454 |
| | 3 | 1 | 30.970 | 118.199 | 10.664 | 0.973 | 30.365 | 238.413 |
| | 3 | 2 | 22.038 | 119.687 | 10.700 | -0.615 | 30.460 | 242.065 |
| | 3 | 3 | -18.954 | 136.528 | -11.563 | -0.617 | -31.076 | 283.300 |
| | 3 | 4 | -10.984 | 134.891 | -11.566 | 0.971 | -31.088 | 279.282 |
| | 4 | 1 | 11.639 | 39.592 | 3.848 | -0.510 | 11.261 | 74.818 |
| | 4 | 2 | 7.770 | 38.809 | 3.775 | -1.205 | 11.085 | 72.895 |
| | 4 | 3 | -6.368 | 46.183 | -4.159 | -1.206 | -11.408 | 90.951 |
| | .4 | 4 | -3.264 | 46.901 | -4.248 | -0.511 | -11.627 | 92.714 |
| | 5 | 1 | 5.780 | 20.657 | 2.461 | -14.323 | 7.548 | 32.720 |
| | 5 | 2 | 2.604 | 0.131 | 1.083 | -15.006 | 4.167 | -17.659 |
| | 5 | 3 | -0.437 | 7.398 | -1.550 | -15.006 | -5.261 | 0.173 |
| | 5 | 4 | -3.090 | 27.860 | -2.929 | -14.323 | -8.646 | 50.395 |
| | 6 | • 1 | 21.844 | 1.736 | 0.023 | -0.003 | 3.586 | 2.621 |
| | 6 | 2 | -19.948 | 1.706 | 0.107 | -0.061 | 3.821 | 2.548 |
| | 6 | 3 | -18.307 | 2.012 | 0.783 | -0.068 | 5.231 | 2.843 |
| | | | | | and the second second second second | | | |

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