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TECHNICAL REPORT GL-81-6

STRUCTURAL ANALYSIS COMPUTER PROGRAMS FOR RIGID MULTICOMPONENT PAVEMENT STRUCTURES WITH DISCONTINUITIES--WESLIQID AND WESLAYER

Report 2

MANUAL FOR THE WESLIQID FINITE ELEMENT PROGRAM

by

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Report 2 of a Series

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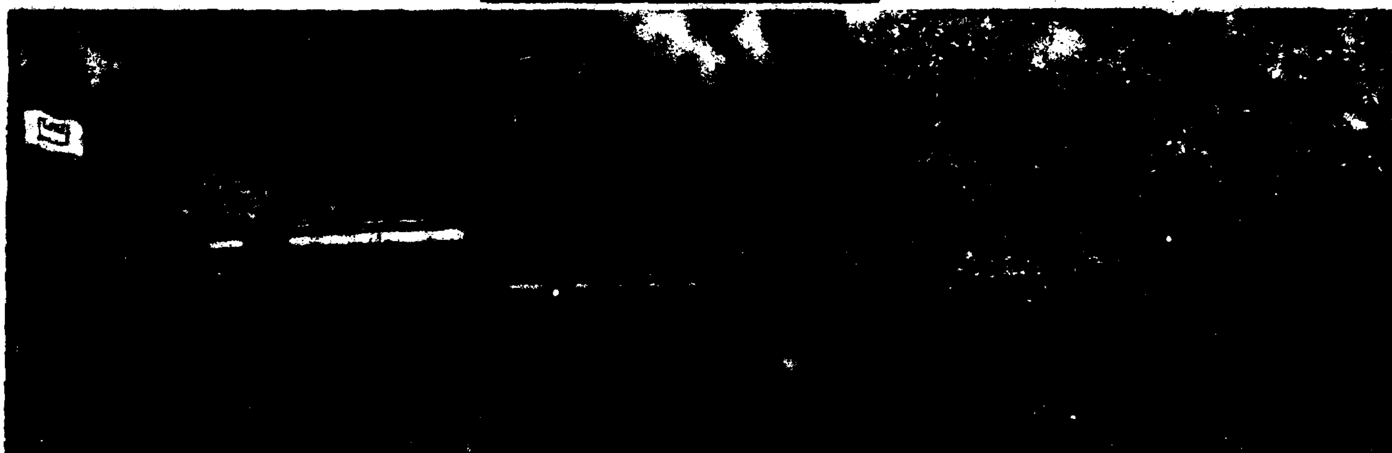

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This study was conducted to develop finite element computer programs to calculate stresses and deflections in rigid pavements with cracks and joints subjected to loads and temperature warping, as well as in the supporting subgrade soil. This report is presented as a user's manual for the WESLIQID program, which deals with pavements on a liquid foundation. The program allows for analysis of pavements with full or partial loss of subgrade support over
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designated regions of the pavements. Variable slab thickness and modulus of subgrade reaction k are incorporated and any number of slabs arranged in an arbitrary pattern can be handled. Also, multiple-wheel loads can be used, and the number of wheels is not limited.

The nature of the computer program and its programming logic are first delineated, followed by a general discussion on the efficient and correct usage of the program, e.g., the efficient way of arranging nodal numbers to minimize the bandwidth. The input guide to the computer program is presented with a detailed explanation for each input variable. Five example problems with input data are presented and the computer printouts of three problems are included with detailed explanations.

PREFACE

The study described herein was sponsored by the Office, Chief of Engineers, U. S. Army (OCE), as a part of the Mobility and Weapons Effects Technology RDT&E Project No. 4A762719AT40, Work Unit 001, "Airfield Pavement Design and Parametric Sensitivity Analysis," and Work Unit 003, "Rigid Airfield Pavement Load-Deformation Response Analysis."

This report is Report 2 of a three-report series concerning the computer programs WESLIQID and WESLAYER, which provide for analysis of rigid multicomponent pavements with discontinuities on liquid foundations (WESLIQID) and on linear layered elastic solids (WESLAYER). This report is a user's manual for WESLIQID. Report 1 provided a theoretical background and numerical results and discussed the capability and logic of the two programs. Report 3 will be a user's manual for WESLAYER.

The study was conducted by the U. S. Army Engineer Waterways Experiment Station (WES), Geotechnical Laboratory (GL), under the general supervision of Dr. Don C. Banks, Acting Chief, GL; Dr. Paul F. Hadala, Assistant Chief, GL; and Mr. Alfred H. Joseph, Chief, Pavement Systems Division (PSD), GL. Dr. Yu T. Chou, PSD, was in charge of the study and is the author of the report. Professor Y. H. Huang of the University of Kentucky, who originally developed the computer programs, assisted in the study.

COL John L. Cannon, CE, and COL Nelson P. Conover, CE, were Commanders and Directors of WES during this study and the preparation of this report. Mr. Fred R. Brown was Technical Director.

CONTENTS

CONVERSION FACTORS, U. S. CUSTOMARY TO METRIC (SI) UNITS OF MEASUREMENT

U. S. customary units of measurement used in this report can be converted to metric (SI) units as follows:

Multiply	By	To Obtain
Fahrenheit degrees	0.555	Celsius degrees or Kelvins*
feet	0.3048	metres
inches	2.54	centimetres
pounds (force)	4.448222	newtons
pounds (force) per inch	175.1268	newtons per metre
pounds (mass) per cubic inch	27,679.9	kilograms per cubic metre
pounds (force) per square inch	6,894.757	pascals
square inches	6.4516	square centimetres

* To obtain Celsius (C) temperature readings from Fahrenheit (F) readings, use the following formula: $C = 0.555(F - 32)$. To obtain Kelvin (K) readings, use: $K = 0.555(F - 32) + 273.15$.

STRUCTURAL ANALYSIS COMPUTER PROGRAMS FOR RIGID MULTICOMPONENT PAVEMENT STRUCTURES WITH DISCONTINUITIES-- WESLIQID AND WESLAYER

MANUAL FOR THE WESLIQID FINITE ELEMENT PROGRAM

PART I: INTRODUCTION

Background

1. The U. S. Army Corps of Engineers (CE) has realized for many years that much of the maintenance of rigid pavements is associated with cracks and joints. The current CE rigid pavement design procedures have certain limitations that were imposed by the state of the art at the particular stage of development. During the development of the procedure, it was necessary to make simplifying assumptions and, in many instances, to ignore the effects of cracks and joints. Since the advent of high-speed computers and the development of the finite element method, a more comprehensive investigation than previously possible of the state of stress at pavement joints, cracks, and other locations in multicomponent pavement structures can now be achieved. Consequently, a better and more reasonable design procedure may be developed for rigid pavements.

Purpose

2. The development of the finite element programs and the analysis of computed results are presented in Report 1 of this series. This report presents a user's manual for a computer program named WESLIQID. The program computes the state of stress in a linear elastic plate (approximating a rigid pavement) supported on a liquid foundation, as well as in the supporting subgrade soil.

Scope

3. The computer program is described in the report to give users a concise understanding of the program without reference to Report 1. The logic of the programming is explained by use of flowcharts. An input guide to the computer program is given, and five example problems are presented to illustrate the input procedures for using the computer program. The computer printouts for three example problems are also explained.

PART II: PROGRAM DESCRIPTION

4. This report describes a finite element computer program named WESLIQID for the analysis of concrete pavements subjected to multiple-wheel loads. The program is developed for subgrade soil represented as a Winkler foundation (or a liquid foundation); i.e., only forces and deformations in the vertical direction are considered and the force is proportional to the deformation. The program can handle any number of rectangular-shaped slabs arranged in an arbitrary pattern. The slabs are connected to each other at joints by steel bars or other load transfer devices and can have cracks in directions parallel to or perpendicular to the joints.

5. The program determines stresses and displacements in the pavement and in the supporting subgrade soil due to loads and temperature warping. Part of the pavement can be out of contact with the supporting subgrade before applying the load and the temperature gradient, and the program determines the condition of contact at each nodal point after the application of loads and temperature gradient. Input data of the programs include (a) the physical properties and geometry of the pavement and subgrade soil, (b) the magnitude and distribution of the loads, (c) the temperature gradient, (d) gaps under the pavement at certain nodal points, if any, and (e) joint and crack conditions.

6. At a joint or a crack, the program considers both shear and moment transfer. Three options can be used for shear transfer: (a) the assumption of an efficiency of shear transfer at the joint, which is defined as a ratio between the deflection of the unloaded or less loaded slab and the deflection of the loaded slab; (b) the assumption of a spring constant at the joint, which is defined as the force in pounds per linear inch and which can be used for key joints or joints with aggregate interlock for shear transfer; and (c) consideration of the diameter and spacing of steel bars. The efficiency of moment transfer is not defined as the rotation ratio between the unloaded and loaded slabs, but as a fraction of the full moment, which is determined

by assuming that the rotations on both sides of the crack are the same. The theoretical development of the finite element model is presented in Report 1 of this series.

7. WESLIQID can analyze pavements with variable thicknesses. This option is useful for pavements with thickened edge joints or pavements adjacent to a cement-stabilized shoulder. Multiple-wheel loads can be input, and the number of wheels is not limited. The number of slabs is also not limited, but is subjected to the dimension and computer storage requirements. Also, the solution becomes more difficult to converge as the number of slabs and nodal points are increased. The slabs can have two layers with different physical properties. The interface of the layers can be either bonded or unbonded. The program is capable of considering variable subgrade reactive forces. This option is useful in dealing with nonuniform subgrade support.

PART III: PROGRAM APPROACH

8. The storage space required for the program depends on the total number of elements used in the problem. An iteration scheme is used in the program so that the computation is made only for one slab at each time. This scheme results in a great savings in computer time because the number of equations to be solved each time is reduced to only one slab. Two series of iterations are involved in the program: one is with respect to subgrade contact and the other is with respect to load transfer across the joint.

9. In the iteration with respect to subgrade contact, the contact condition at each node, i.e., whether the slab and subgrade are in contact or not, is first assumed; and the iteration with respect to load transfer proceeds until either the convergence criteria (DEL in Item 6 of Table 2,* the input guide) are satisfied or the maximum allowable number of iterations (ICL in Item 6 of Table 2) is reached. At this stage, the resulting contact condition is determined. If some nodes originally assumed in contact are found out of contact, or vice versa, the newly found contact condition is assumed, and the process is repeated until the same contact condition is obtained. This can usually be achieved in only a few iterations. The only control by the user is to specify the maximum number of iteration cycles NCYCLE . If NCYCLE = 1 , the contact condition between the slab and subgrade is known *a priori*, and no iterations are needed.

10. In the iteration with respect to load transfer across the joint, the computation is made successively from the first slab to the last one. The reaction between two adjacent slabs can be either the superimposition of displacements or the transfer of shear forces along the joints. The rule to follow is that when the displacements for slab i are computed, the displacements along the joint will be superimposed to the adjacent slabs which have slab numbers greater than i , and the vertical shear forces will be transferred to the slabs that have

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* Table 2 appears in Part IV where it is discussed in detail.

smaller slab numbers. The shear forces are computed from the deflections of elements adjacent to the joint through the stiffness matrix of the slab.

11. In the iterations with respect to load transfer, the vertical shear forces are also used for checking convergence. If the shear forces at the joints are changed too much between two iterations, the solution may diverge and the shear forces will become unreasonably large. To ensure convergence, a self-adjusting relaxation factor is incorporated into the program.

12. In this method, the vertical shear force at each node along the joints obtained in a given iterations is not used directly in the next iteration. Instead, an underrelaxation factor R_f is applied such that

$$F_{i+1} = F_{i-1} + R_f(F_i - F_{i-1}) \tag{1}$$

in which F_{i+1} is the vertical force to be used at $(i+1)^{th}$ iteration; and F_i and F_{i-1} are vertical forces obtained during the i^{th} and $(i-1)^{th}$ iterati ns, respectively. When $R_f = 1$, $F_{i+1} = F_i$, or the force obtained in iteration i is used directly in the next iteration, i + 1 . It was found that for most problems, the solution could not converge when $R_f = 1$. An initial relaxation factor RFI must be specified by the user. An initial value of 0.5 can be arbitrarily assumed unless the user's experience indicates that a smaller value is more appropriate.

13. To adjust the relaxation factor automatically, a maximum shear force at a given node on a joint MAXFAJ must be specified by the user. If the shear force at the node exceeds MAXFAJ , the indication is that the solution is divergent and a smaller relaxation factor should be used. If it is desired, beginning from the sixth iteration, the program also checks the convergence of the specified vertical force after every five iterations. If the solution diverges or oscillates back and forth, the relaxation factor is reduced by one-half (or one-quarter if desired), and the computation is restarted.

14. The program first computes the dimensions of certain important variables and checks them with the declared dimensions. If the computed value exceeds the declared value, the program will be stopped and unnecessary computations are avoided. Once the checks are performed, the program carries out the computations in the following sequence (see the flowchart, Figure 1):

a. Generate stiffness matrix for each element and then superimpose them to form an overall stiffness matrix.

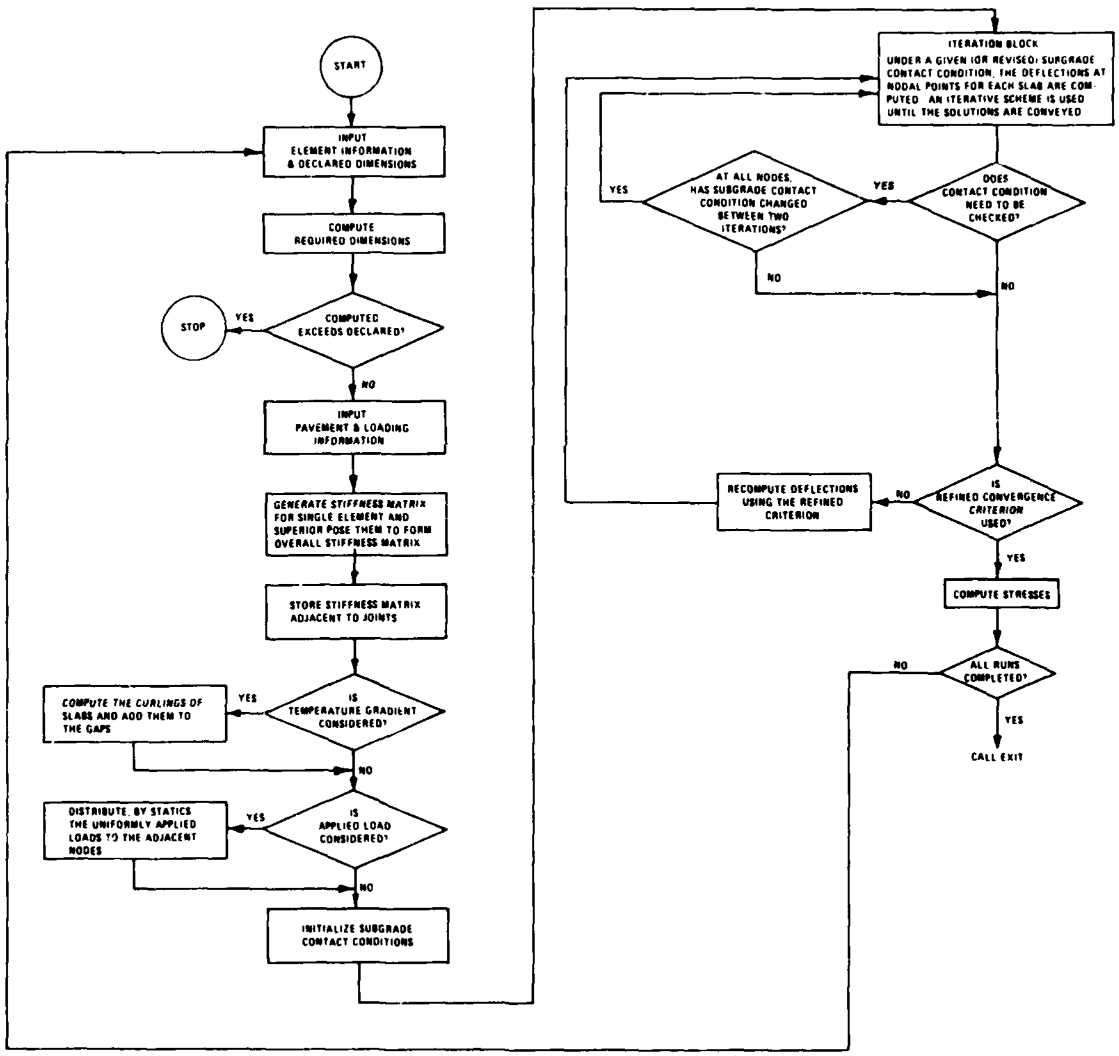


Figure 1. Flowchart for computer program WESLIQID

b. Store stiffness matrix adjacent to joints for later use.

c. If it is known that gaps exist under certain nodes in the subgrade soil, the gaps are read into the program to combine them with the computed curls of the slabs due to temperature warping to form the initial subgrade contact condition.

d. Determine the nodal reactive condition based on the subgrade contact condition.

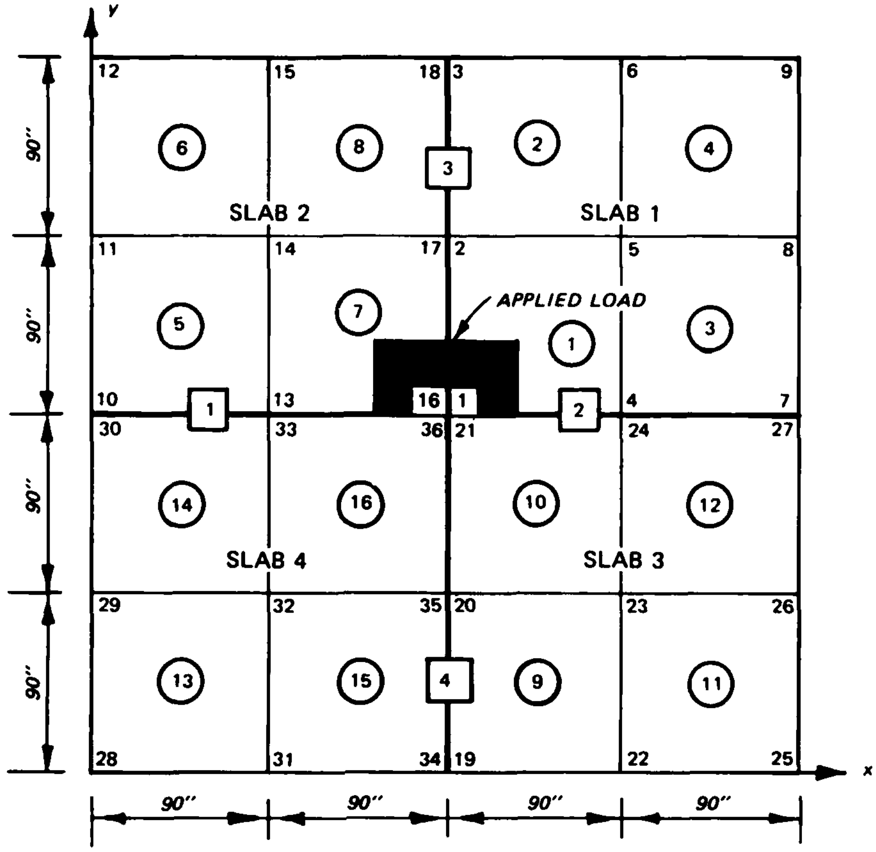
e. If externally applied loads are considered, the uniformly applied loads are distributed to the adjacent nodes using statics.

f. Compute the displacements of slab 1, assuming that there is no shear and moment transfer along the joints; i.e., slab 1 has four free edges.

g. Impose deflections along the joints to the adjacent slabs that have greater slab numbers. For illustrative purposes, a four-slab pavement system is chosen, as shown in Figure 2. Displacements of slab 1 at nodes 1, 2, and 3 of joint 3 and nodes 1, 4, and 7 of joint 2 are superimposed to slabs 2 and 3, respectively.

h. Compute the displacements of slab 2. This is done with a fixed boundary condition at joint 3 and reactive forces at nodes 10, 13, and 16 of joint 1 that are induced from the deflections of slab 4 computed in the previous iteration cycle. At the first cycle, the reactive forces at the nodes are zero because the deflections of slab 4 have not been computed and are thus assumed to be zeros. The nodal reactive forces are identical to the vertical shear forces mentioned earlier. It should be pointed out that reactive forces at nodes 16, 17, and 18 at joint 3 induced by the deflections of slab 1 exist but are of no importance in the computation of displacements of slab 2 because the boundary condition at joint 3 is arbitrarily fixed as the prescribed displacement imposed by slab 1. Once the displacements of slab 2 are computed, the displacements at the joints are superimposed to the adjacent slabs which have greater slab numbers, such as slab 4 in Figure 2.

i. Compute the nodal reactive forces at the joints between slab 2 and adjacent slabs that have smaller slab numbers, such as joint 3 in Figure 2. The reactive forces acting at nodes 1, 2, and 3 of slab 1 are induced by the deflections computed at slab 2. It may be worth mentioning here that the relaxation factor is used in transferring the shear forces from slab 2 to slab 1.



NOTE: NUMBER NEXT TO THE NODES DENOTES NODAL NUMBER.
NUMBER INSIDE THE CIRCLE DENOTES ELEMENT NUMBER.
NUMBER INSIDE THE SQUARE ALONG THE JOINT DENOTES JOINT NUMBER.

Figure 2. A four-slab pavement system

Once the shear forces are transferred, they become nodal reaction forces at slab 1. The adjusted nodal forces are computed from Equation 1.

j. Compute the difference in deflection between the two slabs, which is equal to $\Delta_s + 2\Delta_c$, where Δ_s is the shear deformation of the dowel bars and Δ_c is the deformation of concrete due to the shear force on the dowel bar. The values of Δ_s and Δ_c are computed from Equations 18 and 19a of Report 1 of this series.

k. Continue the process for slabs 3 and 4. The displacements in slab 3 are computed with fixed displacements at joint 2 superimposed from slab 1 and reactive nodal forces at joint 4 induced by the deflections of slab 4. As explained earlier, the reactive forces are zero at the first cycle of iteration. Once the displacements at slab 3 are computed, the displacements are superimposed to slab 4 at joint 4, and the reactive forces at nodes 1, 4, and 7 at slab 1 induced by the deflections of slab 3 are computed and the difference in deflection between slabs 3 and 1 is computed. With superimposed displacements at joints 1 and 4, the displacements at slab 4 are computed.

l. With displacements of slab 4, the vertical nodal, or shear, forces at joints 1 and 4 are computed and the differences in deflections between slabs 2 and 4 and slabs 3 and 4 are computed. Assuming joint 1 is the joint designated for checking convergence, this completes the first cycle of iteration with respect to load transfer.

m. With reactive nodal forces at joints 2 and 3, the displacements at slab 1 are computed again.

n. Repeat steps h through l until the vertical forces along joint 1 converge to a specified tolerance. In step h at this time the displacements of slab 2 are computed by setting the deflections along joint 3 equal to the deflections of slab 1 minus the difference in deflections between slabs 1 and 2 computed previously and the reactive forces at joint 1 induced from displacements of slab 4.

o. Once a convergent solution is obtained or the maximum allowable number of iterative cycles has been reached (ICL of Item 6 of Table 2), the signs of the deflections at each node are compared with those of the initial (or the previous) subgrade contact condition. A change of sign at any node indicates that the contact condition at these nodes has changed. Based on the renewed subgrade contact condition, the computational process from steps g to k is repeated. The iteration process stops when either the contact condition ceases changing or the maximum allowable number of iterations (NCYCLE , Item 6 of Table 2) has been reached.

p. Once the subgrade contact condition no longer changes, the computational process from steps g through k is repeated once more with a refined convergence criterion. The controlling variables in the program are ICLF and DELF in Item 6 of Table 2.

q. The stresses at selected nodal points are computed based on the curvature of the deflected slab, i.e., the nodal displacements.

r. Compute stresses and deflections in the subgrade soil if so desired.

s. Note for a single slab, i.e., NSLAB = 1 , the steps from g to n are neglected.

15. In superimposing the displacements along the joint, both vertical deflection and rotations are involved. The amounts of vertical deflections superimposed are determined based on the three shear transfer methods. The rotations superimposed depend on the efficiency of moment transfer. For 100 percent moment transfer, the rotations are equal at both the loaded and unloaded slabs. For zero percent moment transfer, the moments are zeros at both slabs. For a percent moment transfer other than zero or 100 percent, the process becomes more complicated. In dealing with such cases, users should consult Part II of Report 1. Example Problem 5 in Part V of this report presents such a case.

PART IV: OPERATION OF THE PROGRAM

General Discussion

16. The input guide for the program is presented in this Part of the report. Special features in the correct and efficient use of the program are presented and discussed in the following paragraphs.

Element size and shape

17. As with many other numerical procedures for solving structural problems, the accuracy of the finite element method depends greatly on the correct use of the technique. While the computational cost and computer storage space increase drastically with an increasing number of elements, the program does have a required number of elements. The element size should be smaller near the loads (such as 10 to 12 in. in one dimension) and joints where stresses are transferred to another slab. In some cases, the minimum number of elements for a particular problem has to be determined by a trial-and-error procedure. It was found that an insufficient number of elements can cause the solution to diverge. This is particularly true when temperature warping is considered and gaps exist under the pavement. Also, users should be aware that the aspect ratio of an element, defined as the ratio of the larger dimension to the smaller dimension of a rectangular element, should not exceed four or five to one. It is always a good practice for the beginning user of this program to familiarize himself with the program by using different numbers of elements for a particular problem and then comparing the results.

Dimension requirements

18. The method developed in this program can be applied to any number of slabs. Based on the present dimensions declared in this program, it can be applied to 9 slabs, 12 joints, 200 nodes, and 130 elements. Each slab can have as many as 15 X-coordinates and 15 Y-coordinates. A maximum of 75 nodal points may be out of contact from the subgrade support. If an axis of symmetry exists, each axis can have a maximum number of 50 nodes. If any of these dimensions is

exceeded, the corresponding dimensions should be increased accordingly. The variables whose dimensions are subject to increase are given in Table 1 for various conditions.

19. The dimensions of C , G , CL , and CU vary with the number of elements and the half bandwidth. The required dimensions are explained in the input guide. The storage, and consequently the cost, required for a particular problem depends primarily on the dimensions of C and G , and therefore the dimensions of C and G should be changed according to the requirement of the problem.

20. It should be noted that when the dimensions of certain variables are changed in the main program, they should also be changed accordingly in the subroutines when the dimensions of the same variables are declared.

Arrangement of slabs

21. Although the slabs can be arranged in any manner, there are rules to be followed. Along a joint between two slabs, the rules are: (a) the number of nodes along the joint should be equal, and (b) for a node on one side of the joint, there is one and only one corresponding node on the other side and the distance between the two nodes is the joint width.

22. The arrangements shown in a and b of Figure 3 are allowable. Arrangement c is not acceptable because at the intersection of the joints, the node in slab 3 corresponds not only to the node in slab 1 but also to the node in slab 2. This situation may be remedied by creating a fictitious joint in slab 3 as shown in Figure 3d. The efficiencies of moment and shear transfers are both 100 percent along the fictitious joint. In this way, when the stresses are transferred along the joint between slabs 3 and 4, the node in slab 4 near the intersection of the joints corresponds to the node in slab 3. The same node in slab 4 corresponds to another node in slab 2 when the stresses are transferred along the joint between slabs 2 and 4, which is permissible. Similarly, the arrangement in e of Figure 3 is not acceptable because the number of nodes along the joint in slab 2 is greater than

Table 1. List of Variable Names, the Dimensions of Which Are Subject to Increase

Conditions	Variable Location: Main Program	Variable Location: Slab Subroutine	Dimensions of Variables Need to be Increased
When number of slabs exceeds 9	X		INITNP(9), JONO(9,4), LASTNP(9), NB(9), NO(9), NOB(9), NX(9), NY(9)
		X	INITNP(9), JONO(9,4), LASTEN(9), LASTNP(9), NB(9), NO(9), NOB(9), NX(9), NY(9), X(9,15), XX(9), Y(9,15), YY(9), AREA (9,130)
When number of joints exceeds 12	X		EFF(12,3), ICK(12), IJOINT(12), ISLAB(12), ISNN(12,2), IST(12,2), LFNN(12,2), LLS(12), LUS(12), NJT(12,2), NKT(12,2), ISLAB1(12)
		X	BARNO(12,15), BD(12), BS(12), DC(12,15), DCGF(12), DID(12,15), DIDF(12), DS(12), EFF(12,3), FAJ(12,15,3), FGF(12), FOJ(12,15,3), ICK(12), IJOINT(12), ISLAB(12), ISNN(12,2), IST(12,2), LFNN(12,2), LLS(12), LTR(12), LUS(12), NJT(12,2), NKT(12,2), PFAJ(12,15,3), SCKV(12,2), SPCON(12), WJ(12), ISLAB1(12), CEF(12,15)
When total number of nodes exceeds 200		X	AB(200), CURL(200), GAP(200), NCC(200), NCCP(200), NG(200), NP(200), NS(200), NT(200), SUBMOD(200), STR(200,6,2), T(200,2), XN(200), YN(200), AREA E(200)
When total number of concentrated forces (moments included) exceeds 200		X	NFF(200), NFI(200), NF(200)
	X		NNPD
When total number of elements exceeds 130		X	DN(130,2), NL(130), PC(130), Q(130), RM(130,2), XDA(130,2), YDA(130,2)
	X		NELD
When number of nodes at either X- or Y-axis of one slab exceeds 15		X	BARNO(12,15), DC(12,15), DFAJ(15,3), DID(12,15), DSB(15), FAJ(12,15,3), FOJ(12,15,3), PDFAJ(15,3), PFAJ(12,15,3), X(9,15), Y(9,15), FAJPD(15,3), CEF(12,15)
When the number of nodes at an axis of symmetry exceeds 50		X	NODSX(50), NODSY(50)
When number of nodal points out of contact exceeds 75		X	NODNC(75)
When number of nodes exceeds 130 in any slab		X	AREA (9,130)

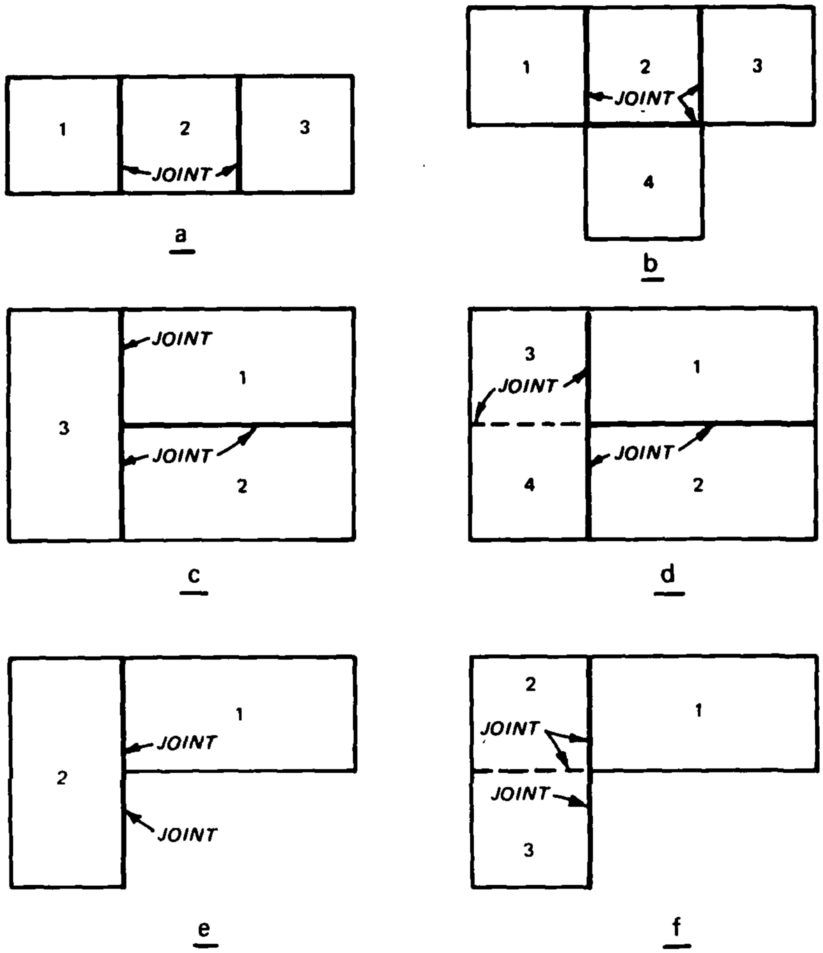


Figure 3. Arrangements of slabs

that in slab 1. Again this can be remedied by creating a fictitious joint, as shown in the arrangement of Figure 3.

<u>Symmetries</u>

23. The application of the finite element method for analyzing rigid pavements invovles solving a large set of simultaneous equations. However, because of symmetry, the number of simultaneous equations could be greatly reduced by considering only one quarter or one half of the slab. The symmetry is with respect to the load, the pavement geometry and property, the finite element grid space, and the load transfer device along the joint. The users are strongly urged to take advantage

of the symmetry option provided by the program to arrange the loadings in such a way that the problem becomes symmetrical. A coded data input for a symmetrical example problem is presented in Part V. It should be pointed out that symmetry should not be placed at a joint, unless the joint is 100 percent rigid, i.e., 100 percent shear and moment transfers.

24. When the effects due to temperature and loadings are considered separately, the computed results due to temperature alone are expected to be symmetrical with respect to the pavement geometry. For instance, the stresses and deflections are the same at the four corner nodes in a square slab subjected to a temperature warping. This may not be the case, however, if the finite element grid lines are not divided symmetrically. In practical cases, smaller elements can be used around the applied loads, which may result in a nonsymmetrical finite element grid pattern. If this is the case, the computed results due to temperature alone may not be symmetrical as they ought to be and consequently may affect to a certain extent the final results when the temperature effect is combined with the effect of the load. The error in most cases is insignificant because the load effect usually outshadows that of the temperature. Nevertheless, users should be aware of this possible discrepancy. The finite element grid pattern shown in Figure 4 can be used to illustrate this point.

25. In Figure 4, the loads are placed at the pavement's center next to the joint. Smaller elements are used around the loads and larger elements are used elsewhere. Although the finite element pattern is symmetrical with respect to the pavement center line and symmetrical with respect to the joint, the element sizes are not identical. Consequently, if there is no moment transfer along the joint, the computed results due to the temperature's effect at nodes 1 and 57 are not equal as they are theoretically supposed to be. Consequently, the final computed results are not strictly correct. However, the error is believed to be insignificant when the effect of applied loads is combined. It should be pointed out that the solutions obtained from the finite element application are by no means completely correct; they are only close, acceptable approximations. It is the correctness of the computed larger

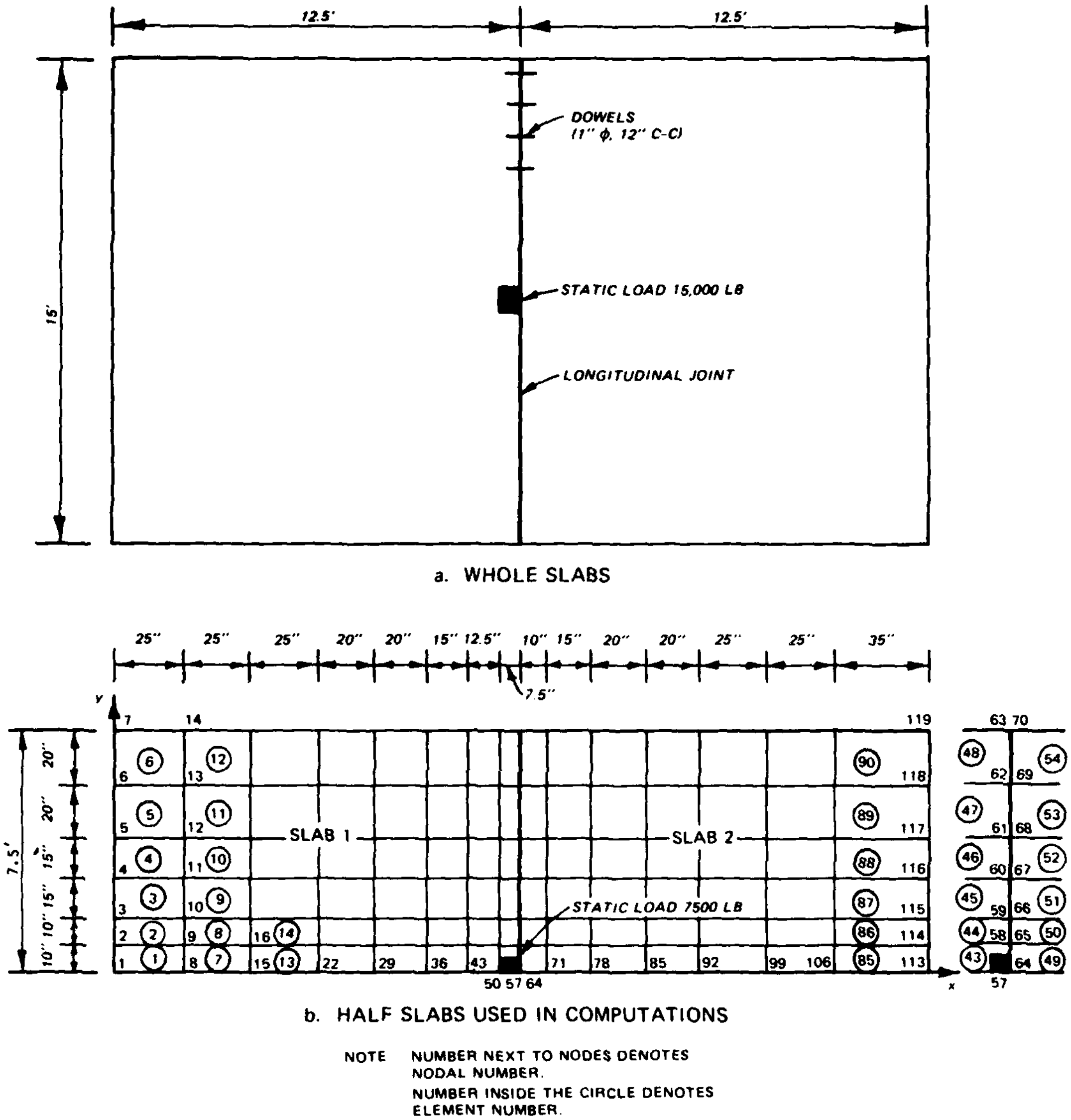


Figure 4. Finite element layout for Example Problem 3

values that is important. The smaller values computed at insignificant locations of the pavement, such as at places far away from the load, are of no significance in engineering problems.

Slab numbering system

26. The iterative scheme developed in this program provides the computation of displacements for one slab at a time; the computations

are then carried out for other slabs in a sequential order until the shear forces converge to a prescribed limit. The relationships among the slabs are (a) the superimposition of displacements to an adjacent slab through the joint and (b) the nodal reactive forces at the joints, which are induced by the deflections of adjacent slabs. When the displacements are superimposed from one slab to its adjacent slab, it makes sense only when the displacements of the imposing slab are greater than those of the slab being imposed upon; otherwise, the solution will either diverge or converge slowly. The rule of thumb in the numbering system is that the slabs are numbered such that the deflections in a slab are superimposed to the adjacent slab that has smaller deflections. Therefore, the slab with greater deflections should be numbered earlier than the neighboring slab that has lesser deflections. Accordingly, the slab subjected to the largest load is numbered first. Slabs that do not carry loads should be numbered based on the anticipated magnitude of deflections. For instance, in Figure 5a, slab 1 is subjected to the largest load and slab 2 to the smallest load. Since the deflections in slab 3 are anticipated to be greater than those in slab 4, slab 3 is numbered before slab 4. The numbering system shown in Figure 5a ensures proper convergence of the solution. If the loads on two slabs are nearly the same or it is difficult to judge which is greater, either order may be used. Figure 5b shows the proper slab numbering system for a five-slab pavement. For illustrative purposes, the slab numbers for the same five-slab pavement are changed as shown in Figure 5c. The load transfer mechanism along joint 1 will have a problem since the deflection in slab 5 is greater than that of slab 4, and thus the deflection should transfer from slab 5 to slab 4 along joint 1. According to the slab numbering system shown in Figure 5c, the deflections in slab 4 are transferred to slab 5, as the slab number of slab 4 is smaller than that of slab 5. However, it is not logical to transfer the deflections from slab 4, which has smaller deflections, to slab 5, which has greater deflections. In doing so, the solutions will either be divergent or erroneous.

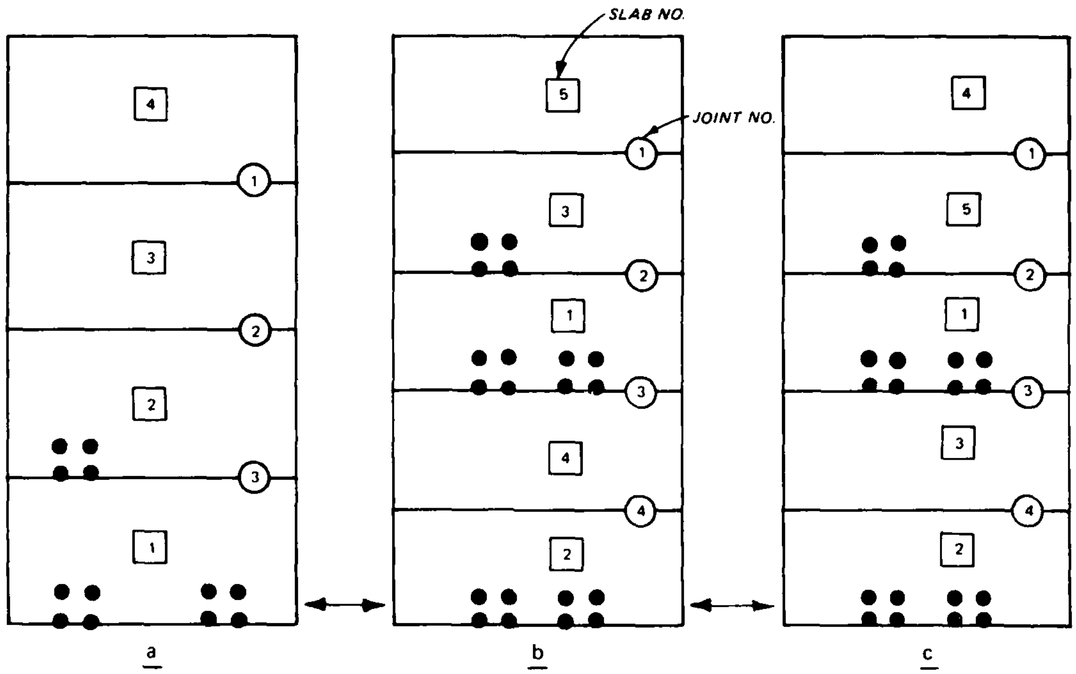


Figure 5. Illustration of slab numbering system

Relaxation factors

27. In the iterations with respect to load transfer, the vertical shear forces at a specified node on a specified joint are checked for convergence. If the shear forces at the joints are changed too much between two iterations, the solution may diverge and the shear forces become unreasonably large. To ensure convergence, a self-adjusting relaxation factor is incorporated in the program. More information in this respect can be found in paragraphs 13 and 40 of this report.

Efficiencies of shear and moment transfer

28. Detailed explanations of the definitions of efficiencies of shear and moment transfer are given in Report 1 of this series. It should be reiterated that the efficiency of shear transfer is defined as a ratio between the deflection of the unloaded, or less loaded, slab and the deflection of the loaded slab. Also, the efficiency of moment transfer is the ratio between the actual moment and the moment in the case of 100 percent moment transfer. One hundred percent efficiency of

moment transfer occurs when the rotations at both sides of the joints are the same, and consequently the moments at both sides of the joint are the same. Zero percent efficiency of moment transfer means that the crack opening is so large that moment does not exist along the joint. For an efficiency of 50 percent moment transfer, the moments are 50 percent of those computed from the 100 percent efficiency of moment transfer, and the moments on both sides of the joint are still equal. This is why when the efficiency of moment transfer for a certain joint is some value other than zero or 1, it is necessary to first run the problem with 100 percent efficiency.

29. When a joint has 100 percent efficiency for both shear and moment transfer, the cracks along the joint actually do not exist. A joint with 100 percent efficiency for shear transfer but zero percent efficiency for moment transfer physically means that the dowel bars placed along the joints are so strong that the deflections (and also the shear forces or stresses) on both sides of the joint are the same, but because the crack opening is so large, moments cannot be carried along the joint at all. The joint reacts as a hinge in which the shear force is 100 percent transferred through the joint, but the moment is zero.

Half bandwidth

30. The definition of a half bandwidth of a matrix can be found in any structures book. The size of the half bandwidth directly influences the size of the storage space. A proper nodal numbering system may reduce the size of the half bandwidth. This is illustrated in the two different numbering systems shown in Figure 6. Both slabs in Figures 6a and 6b have 20 nodes and 12 elements, but the half bandwidth for the arrangement shown in Figure 6a is $(4 + 2) \times 3 = 18$ and that of Figure 6b is $(5 + 2) \times 3 = 21$. The rule of thumb is to arrange the finite element grid with the side having fewer nodes in the vertical direction. Note the rule used in the programs in the nodal point-numbering system is to 80 from left to right and to increase from bottom to top.

Weight of concrete slab

31. In the classical Westergaard solution, the weight of the slab is not considered in the computation. Consideration of the weight

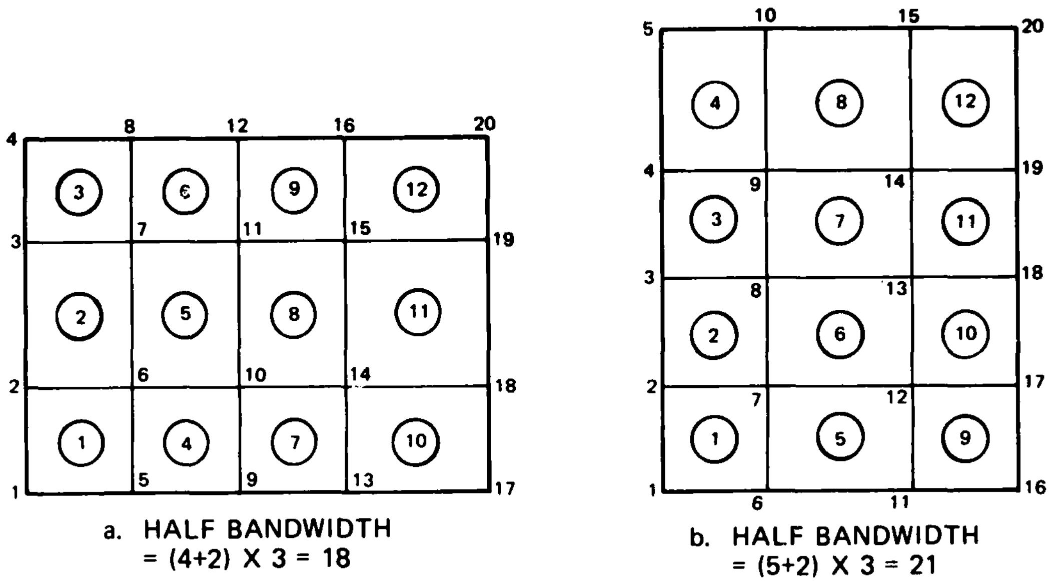


Figure 6. Influence of finite element arrangement on the size of half bandwidth

of the slab is an option in this computer program. When temperature and loads are not considered and the subgrade is uniform and in full contact with the slab, the weight of the slab only causes the slab to settle uniformly and induces no bending in the slab. Consequently, stresses are not induced in the slab. In some cases, the consideration of the weight of the slab is mandatory, as discussed below.

32. The major difference in procedure between full and partial contact between the slab and the subgrade is that it is not necessary to consider the weight of the slab in the case of full contact, but the weight of the slab must be considered in the case of partial contact; otherwise, the solution may diverge.

33. When problems involve temperature warping, the weight of the slab must be considered to avoid the possible divergence of the solution. This is particularly true when gaps exist under some nodes. For the case of partial contact, the weight of the slab must be considered even when temperature is not considered.

Selected points of stress computations

34. While the displacements are computed automatically for every

nodal point, the stresses are computed only on request. The stress matrix is used each time stresses at a nodal point are computed. Some computer time can be saved if the stresses at only a few selected nodes are computed.

Analysis of two-layer slabs

35. The program can be applied to two-layer slabs, either bonded or unbonded. The derivation of the two-layer system is presented in Appendix A.

Temperature considerations

36. When the temperature is considered, the dimensions of each slab have to be identical; otherwise, the execution of the program will be terminated. Also, the thickness of each slab has to be uniform. The deformed surfaces of the slabs are assumed in the program to be spherical. This assumption is not valid when the thicknesses of the slabs are not uniform.

37. The computed initial curlings are independent of the arrangement of the finite element grid pattern and concrete slab unit weight. The amount of initial curling at each node is computed by means of Equation 10b in Report 1 of this series. The only variable in Equation 10b is the distance R between the center of each slab and the node where the curling is computed.

Correctness and divergence of the obtained solution

38. Users of the computer program should always be scrupulous with the computed results. Stresses and deflections may be computed and tabulated, but the values still may not be meaningful. Certain features in the program deserve special attention and are explained below.

39. Number of iterations. When the number of iterations with respect to shear transfer IC has reached the maximum allowable number of iterations--ICL and ICLF (Item 6 of Table 2), the solution has not converged (or the specified criterion was too difficult to meet). The problem should be recomputed with larger values of ICLF (and also ICL in certain cases). However, it may be wise at this stage to see whether

the solution obtained is good enough for engineering purposes. In some cases, a solution may not be obtainable if the convergence criterion is too strict. The same reasoning can be used when checking the number of iterations with respect to subgrade contact NIC against the maximum allowable number of iterations (NCYCLE). The value of ICL is not as critical as the value of ICLF ; however, a large difference between the actual value of IC (printed in the output) and specified ICL is not recommended.

40. Reduction of relaxation factor RFI . If convergent results cannot be obtained, the program reduces the factor automatically. Too small a value of the relaxation factor results in too small of a shear transfer across the joint during each iteration; consequently, the computed results could be erroneous because the convergence of the solution is artificially enforced. It was found that when the number of slab NSLAB is large, such as 7, and when the solution is difficult to converge, the option stated at the bottom of paragraph 13 of this report should be waived. To reduce the relaxation factor too rapidly could cause the solution to diverge.

41. Large number of concrete slabs. When a large number of slabs are involved in the computation, it is reasonable to have a lesser number of elements in the slabs that are far away from the load. However, users should be cautioned that the size of the elements next to the joints in these slabs should not be too large. Otherwise, the subgrade reactive forces along the joint in those slabs tend to become too large and affect the overall computed results without causing any divergence. The reason is that the joint where convergence criteria are checked is not at slabs far away from the load; convergent solutions may be obtained but the results may not be correct.

42. Slab numbering systems. The rule used for the numbering of the slab system was explained earlier in this section. Incorrect use results in either solution divergence or erroneous results. In the former case, the user has the chance to locate the mistake since the solution has not been obtained yet. In the latter case, however, the stresses and deflections are computed and tabulated but the accuracies

of the results are doubtful, depending on how incorrectly the slabs are numbered. Unfortunately, a warning system cannot be established in the program when the slabs are numbered incorrectly; users are thus urged to be cautious in numbering the slabs.

43. Symmetries. When symmetry in a given direction is used and deflections and stresses across a certain joint are supposed to be equal, the efficiency of load transfer across the joint should be input only as 100 percent. Otherwise, erroneous results will be computed.

Input Guide

44. The input guide for the program is given in Table 2, with detailed explanations of each entry presented as follows:

a. Item 1: Number of Runs Card (I5).

Notes	Columns	Variables	Entry
(1)	1-5	NRUN	Number of runs to be computed

NOTES:

(1) The number of runs is first specified at the onset of computations. The nature of the problems in each individual run is generally different. However, results of one run can be used in the next run immediately followed by the input NREAD or NSTORE. They are explained in Item 6.

b. Item 2: Identification Card (A80).

Notes	Columns	Variables	Entry
(1)	1-80	TITLE(12)	Enter the heading information to be printed with the output

NOTES:

(1) Begin each new run with a new heading card.

c. Item 3: Dimension of Matrices Card (16I5).

Notes	Columns	Variables	Entry
(1)	1-5	NSLAB	Number of slabs in the model
(2)	6-10	NJOINT	Number of joints in the model

Table 2. Input Guide for WESLIQID--Pavements on Winkler Foundation

FORTRAN STATEMENT

Item 1. Number of Runs Card (I5)

NRUN

Item 2. Identification Card (12A6)

Problem description (title) can be described in columns 1-80.

Item 3. Dimension of Matrices Card (16I5)

```
NSLAB     NJOINT    LNOND     LCUD      LCLD      NNPD      NNLD
```

Note: The values of LNOND, LCUD, and LCLD should be identical with the dimensions of C and G, CU and CL in the main program.

Item 4. Element Coordinates Card (16I5)

```
NX(I)     NY(I)     JONO(I,1) JONO(I,2) JONO(I,3) JONO(I,4)
```

Note: One card for each joint (I_{max} = NJOINT)

(Continued)

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Table 2 (Continued)

FORTRAN STATEMENT

Item 5. Joint Efficiency Cards (3F10.5)

EFF(I,1)	EFF(I,2)	

If the number of joint is greater than 1 (I_{max} = NJOINT in Item 3), continue to next data card using same format.

Note: Use a blank card if NSLAB = 1 in Item 3.

Item 6. Miscellaneous Data Cards

Card 1. (8I5)

NLAYER	NBOND	NOTCON	NGAP	NCYCLE	NSTORE	NREAD	IHDP	NPRINT

Card 2. (8I5)

NTEMP	ICX	ICY	NLOAD	NMCP	NWT	NMT	NSX	NSY

Card 3. (8I5)

NCK	JNCK	[illegible]CK	[illegible]CK	ICL	ICLF	IGNOR	MERFR	MAXFAJ

Card 4. (8I5)

NAS	NAT(1)	NAT(2)	IFPR	ILPR	NPUNCH

Card 5. (3F10.5, 3E10.3, F1.05)

SUBMOD(1)	TEMP	RFI	DEL	DELF	YMSB	PRSB	NCOMP

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Table 2 (Continued)

FORTRAN STATEMENT

```
Item 7.  Subgrade Moduli Card (5(I5, F10.5))

NS(1)     SUBMOD(NS(1))   NS(2)    SUBMOD(NS(2))  ----------------------------  NS(5)   SUBMOD(NS(5))

     Repeat the input for each node at which the modulus is different from SUBMOD(1).  SUBMOD(1) is input in Item 6.

     Note:  Use a blank card if the subgrade has a uniform subgrade modulus.

Item 8.  Nodal Points Coordinate Cards (8F10.5)

     X(I,1)          X(I,2)          X(I,3)          ---
     Y(I,1)          Y(I,2)          Y(I,3)          ---

If the number of slabs is greater than 1, continue to next data card using same format until the number of slabs (NSLAB in Item 3) is satisfied.

Item 9.  Layer Properties Cards (2(2F10.5, E10.3))

       T(1,1)       PR(1)         YM(1)         T(1,2)       PR(2)        YM(2)
```

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(Continued)

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Table 2 (Continued)

C-COMMENT | STATEMENT NUMBER | CONTINUATION | FORTRAN STATEMENT

If the number of the layer is 1, stop the input at column 30. If thickness is not uniform, a thickness different from T(1,I) will be read in later.

Item 10. Slab Thickness Cards (5(I5, F10.5))

NT(1)	T(NT(1))	NT(2)	T(NT(2))	NT(3)	T(NT(3))	NT(4)	T(NT(4))	NT(5)	T(NT(5))
NT(6)	T(NT(6))								

Continue the input for thicknesses which are different from T(1,NLAYER). If the number of the layer is 2, continue to next data card using same format

Note: If the thickness is uniform in the layer, place a blank card for that layer. Two blank cards are required if thicknesses in both layers are uniform.

Item 11. Joint Information Cards (I5, F10.3, 3F10.5, 2E10.3, F10.5)

LTR(I)	SPCON(I)	BD(I)	BS(I)	WJ(I)	SCKV(I,1)	SCKV(I,2)	DCGP(I)

If the number of joint is greater than 1, continue to next data card using same format (I_{max} = NJOINT in Item 3). SPCON may be left 0 if LTR is not 1, and BD, BS, WJ, SCKV's may be left blank if LTR is not equal to 2. Use a blank card if NSLAB = 1.

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Table 2 (Continued)

FORTRAN STATEMENT

Item 12. Total Uniformly Applied Load Card (F12.2)

HLOAD

Skip this card if there is no load uniformly applied on the slabs. A blank card is not needed.

Item 13. Loading Cards (I5, 5F10.5)

NL(I) XDA(I,1) XDA(I,2) YDA(I,1) YDA(I,2) Q(I)

If the number of loaded elements is greater than 1 (I_{max} = NLOAD in Item 6), continue to next data card using same format.

Note: Use a blank card if there is no uniform load applied on the slabs.

Item 14. Subgrade Contact Card (16I5)

NODNC(1) NODNC(2) NODNC(3) ... NODNC(11) ... NODNC(NOTCON)

Continue the input until the number of NOTCON (input in Item 6) is satisfied.

Note: Use a blank card if the slabs are initially in full contact with the subgrade.

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Table 2 (Continued)

FORTRAN STATEMENT

```
Item 15.  Stresses Print Card (16I5)

NP(1)     NP(2)  NP(3)    NP(4)  ----------------------------------  NP(12)  ----------
---------------------------------  NP(NPRINT)

Continue the input until the number of  NPRINT  (Item 6) is satisfied.  Use a blank card if the stress at all nodal points needs to be printed.

Item 16.  Symmetry Cards

     Card 1.  Symmetry on X-axis card (16I5)

NODSX(1)  NODSX(2)  NODSX(3)  ---------------------------------  NODSX(13)  ----------
------------------------------------  NODSX(NSX)

     NSX  is the number of nodal points on X-axis which is an axis of symmetry and is input in Item 6.

Note:  Use a blank card if X-axis is not an axis of symmetry.

     Card 2.  Symmetry on Y-axis card (16I5)

NODSY(1)  NODSY(2)  NODSY(3)  ---------------------------------  NODSY(13)  ----------
------------------------------------  NODSY(NSY)

     NSY  is the number of nodal points on Y-axis which is an axis of symmetry and is input in Item 6.
```

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Table 2 (Continued)

FORTRAN STATEMENT

```
Item 17.  Thermal Stresses and Thermal Deflections Read In Card

   Card 1.  Stresses (6F10.5)

  STRSTO(1,1,L)   STRSTO(1,2,L)   STRSTO(1,3,L)   STRSTO(1,4,L)   STRSTO(1,5,L)   STRSTO(1,6,L)
                        :               :               :               :               :
                        :               :               :               :               :
 STRSTO(LMP,1,L)  STRSTO(LMP,2,L) STRSTO(LMP,3,L) STRSTO(LMP,4,L) STRSTO(LMP,5,L) STRSTO(LMP,6,L)

     Where  LMP  is the total number of nodes for all the slabs considered

     Note:  If the slab has a second layer, repeat the same format for  L = 2 ; otherwise  L = 1 .
     Use a blank card if  NSTORE  is not equal to 1.

     Card 2.  Vertical deflections (8F10.5)

    FSTORE(1)       FSTORE(2)       FSTORE(3)      ----------------------------    FSTORE(LMP)

     Note:  Use a blank card if Y-axis is not an axis of symmetry.
```

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Table 2 (Continued)

FORTRAN STATEMENT

```
Item 18.  Gaps Read In Card (5(I5, F10.5))

NG(1)   Curl(NG(1))   NG(2)   Curl(NG(2))   NG(3)      Curl(NG(3))      NG(4)   Curl(NG(4))   NG(5)   Curl(NG(5))
                                            NG(NGAP)   Curl(NG(NGAP))

Note:  Use a blank card if NGAP = 0.

Item 19.  Concentrated Forces or Moments Card (4(I5, I5, F10.2))

NF(1)   NFF(1)   FO(NF(1)-1)×3      NF(2)   NFF(2)   FO(NF(2)-1)×3
                   + (NFF(1))                          + (NFF(2))

        Continue the input for all the nodes at which moments or concentrated forces are specified (NMCF).

Note:  Use a blank card if there are no concentrated forces or moments.
```

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(Continued)

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Table 2 (Concluded)

```
C-COMMENT / STATEMENT NUMBER / CONTINUATION        FORTRAN STATEMENT                IDENTIFICATION

Item 20.  Moments at Joints Read in Cards (6F12.3)

    FAJ(I,1)    FAJ(I,2)    FAJ(I,3) ------------------------------ FAJ(I,6)  -----
------------------------  FAJ(I, NX or NY(NJOINT))

    Continue to next data card using same format for next joint at which the efficiency of moment transfer is not equal to 0 or 1.

Note: Use a blank card if NREAD1 is not equal to 1.

Item 21.  Efficiency of Moment Card (8(F10.5))

    CM(1)      CM(2)  --------------------------  CM(NMT)

    NMT is total number of cases to be solved for moment transfer.

ITEM 22.  SUBGRADE STRESS CARD
    E(1)      V(1)      E(2)      V(2)   - - - - - - - - - -   E(NCOMP)   V(NCOMP)
    N(Z)      N(R)
    ZZ(1)     ZZ(2)   - - - - - - - - -   ZZ(NZ)
    XR(1)     YR(1)     XR(2)     YR(2)  - - - - - - - - - -   XR(NR)     YR(NR)
NOTE: USE A BLANK CARD IF NCOMP=0

ITEM 23.  SUBGRADE STRESS DIRECTLY UNDER A NODE AND AT A JOINT CARD
    NAJ       NJP(1)    NJP(2)  - - - - - -  NJP(NAJ)
    JON(1,1)  JON(1,2)  JON(1,3)  JON(1,4)
       :         :         :         :
    JON(NAJ,1) JON(NAJ,2) JON(NAJ,3) JON(NAJ,4)

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Notes	Columns	Variables	Entry
(3)	11-15	LNOBD	Declared dimension of stiffness matrices C and G
(4)	16-20	LCUD	Declared dimension of matrix CU
(5)	21-25	LCLD	Declared dimension of matrix CL
(6)	26-30	NNPD	Declared number of nodal points, equaling 200
(6)	31-36	NELD	Declared element number, equaling 130

NOTES:

(1) The program is dimensioned for 9 slabs. If NSLAB is greater than nine, all subscripts with a dimension of 9 must be increased. When NSLAB is large, say greater than 5, element size at slabs away from the slab should be selected with care. Discussion in this report is given in Part IV in the section of the correctness of the obtained solution. For NSLAB = 1 , the iterations between each slab are not performed.

(2) The program is dimensioned for 12 joints. If NJOINT is greater than 12, all subscripts with a dimension of 12 must be increased.

(3) The value of LNOBD is the declared dimension of stiffness matrix of C and G and must be identical to the ones specified in the main program. The required dimension of C and G will be computed and printed in the main program. If the computed dimension exceeds the input declared dimension (LNOBD), an error message will be printed, and the execution of the problem will be terminated. When this happens, the dimensions of C and G in the main program must be increased to the computed value. If LNOBD is mistakenly input less than the dimension of C and G specified in the main program but is more than that computed, the program will be executed with no error. The dimension of LNOBD can be computed by means of the equation

$$\sum_{1}^{NSLAB} [NX(I) \times NY(I)] \times 3 \times HB$$

where $NX(I) \times NY(I)$ equals the total nodal points in slab I, 3 is the number of equations at each node, and HB is the half bandwidth of slab I and is equal to $[NY(I) + 2] \times 3$.

(4) LCUD is the declared dimension of matrix CU , which is the upper band matrix to be stored at the joints and must be input identically with the CU in the main program. The computed dimension will be printed in the main program. If the computed dimension is greater than the declared dimension, an error message will be printed, and the execution of the program will be terminate. The dimension of CU is difficult to determine since it depends on the joint conditions. A value of 1000 may be used and can be modified later.

(5) LCLD is the declared dimension of matrix CL , which is the lower band matrix to be stored at the joints and must be input identically with CL in the main program. Similarly to LCUD , the dimension of CL is difficult to determine. A value of 500 may be used.

(6) The present dimensions declared in the program for NNPD and NELD are for 200 nodes and 130 elements, respectively. If the computed numbers of nodes and elements exceed declared, the program will be stopped.

d. Item 4: Element Coordinates Cards (16I5).[1]

Notes	Columns	Variables	Entry
	1-5	NX(I)	Number of nodal point in X-direction in slab I
	6-10	NY(I)	Number of nodal point in Y-direction in slab I
(2)	11-15	JONO(I,1)	Joint number on left side of slab I
(2)	16-20	JONO(I,2)	Joint number on right side of slab I
(2)	21-25	JONO(I,3)	Joint number on lower side of slab I
(2)	26-30	JONO(I,4)	Joint number on upper side of slab I

NOTES:

(1) If the number of slab is greater than 1, continue to next data card using same format until the number of slab (NSLAB) is satisfied.

(2) The slabs are numbered according to the magnitude of load; i.e., the slab subjected to the largest load is numbered first. Detailed explanation of the numbering system is given earlier in this Part. The joints can be numbered in any arbitrary order. The joint number is zero for free edge. For the case of a single slab, the joint numbers should all be zeros. Figures shown in the example problems

given in Part V illustrate the coordinates of each element.

e. Item 5: Joint Efficiency Cards (2F10.5).(1)

Note: Use a blank card if number of slab is equal to 1.

Notes	Columns	Variables	Entry
(2)	1-10	EFF(I,1)	Efficiency of shear transfer at joint I
(2)	11-20	EFF(I,2)	Efficiency of moment transfer at joint I

NOTES:

(1) If the number of joint is greater than 1, continue to the next data card using same format until the number of joint (NJOINT) is satisfied.

(2) EFF(NJOINT,j) is the efficiency of load transfer for each joint, with subscript j equal to 1 for shear transfer and 2 for moment transfer. The program will change the subscript from 2 to 3 if the moment is with respect to the Y-axis, instead of with respect to the X-axis. The value of efficiency across a joint varies from 0 to 1. If the efficiency of moment transfer for a certain joint is other than 0 or 1, it is necessary to run the problem twice. The first run uses an efficiency of 1 and determines the moments at the joint for 100 percent moment transfer. Depending on the efficiency of moment transfer, the second run will assign the appropriate moment at each of the nodes along the joint. These two runs can be performed at the same time with the second run immediately following the first. They can also be run separately by reading in the 100 percent moments at those joints whose efficiency is not zero or 100 percent. In this case, NREAD (Item 6) should be set to one. If LTR (input in Item 11) is equal to 1 or 2, EFF(I,1) must be input as 1. However, it does not mean that 100 percent shear transfer is used in the program.

f. Item 6: Miscellaneous Data Cards.

Card 1 (9I5)

Notes	Columns	Variables	Entry
(1)	1-5	NLAYER	Number of layer in the concrete slab, either 1 or 2
(2)	6-10	NBOND	Bond between two layers in the concrete slab: EQ.1 only one layer exists or when two layers are bonded

Notes	Columns	Variables	Entry
			EQ.2 if two layers are not bonded
(3)	11-15	NOTCON	Total number of nodes at which reactive pressure is initially set at zero
(4)	16-20	NGAP	Total number of nodes at which a gap exists between slab and subgrade; assign zero if no gap exists
(5)	21-25	NCYCLE	Maximum number of cycles for checking subgrade contact; generally use 10 or more

Also, when LTR is equal to 1 or 2, the efficiency of moment transfer should always be zero. In most cases, solution convergence is much more difficult when the efficiency of moment transfer is not zero. The following tabulation shows the proper use of joint efficiency:

LTR	Efficiency of Shear Transfer	Efficiency of Moment Transfer
0	Open	Open
1	1	0
2	1	0

Notes	Columns	Variables	Entry
(6)	26-30	NSTORE	Options for thermal stress and thermal deflections:
			EQ.0 need not be read in from data cards punched
			EQ.1 needs to be read in from data cards punched
			EQ.2 the values determined from the previous problems are used
(7)	31-35	NREAD	A parameter indicating whether any moments at joint are to be read from data cards:
			EQ.0 no
			EQ.1 yes

Notes	Columns	Variables	Entry	
(8)	36-40	INDP	EQ.0	yes, i.e., dependent
			EQ.1	no, i.e., independent
(9)	41-45	NPRINT	Number of nodes at which stresses and deflections are to be printed	

NOTES:

(1) Description of the bond between the two layers of concrete slab can be found in Appendix A.

(2) Derivation of composite modulus and Poisson's ratio for bonded layers can be found in Appendix A.

(3) If the subgrade soil at certain nodal points is known to be not in contact with the pavement due to pumping or plastic deformation, the subgrade reactive pressure at these nodes can be initially set at zero to obtain speeding convergence. If NCYCLE = 1 (NCYCLE is listed in the following card), these nodes will never be in contact. If NCYCLE > 1 , these nodes may or may not be in contact, depending on calculated results.

(4) Description of gaps can be found in Part II of Report 1 of this series. <u>Note that gaps to not include those induced by the temperature warping</u> but those due to pumping or plastic deformation. However, it is difficult to separate the gaps caused by temperature warping and other sources in the fields. If it is believed that the measured gaps include the temperature warps, the computation should be carried out by setting NTEMP = 0 .

(5) If a Westergaard solution is desired, NCYCLE should be set to 1. In so doing, the subgrade is always in full contact with the slab, even though the slab should be curled up and <u>leaving gaps</u> between the slab and the subgrade soil due to either load or temperature differential.

(6) In the area of pavement design, engineers are interested in stresses induced by the applied load and the temperature warping. In the area of pavement research, however, engineers tend to measure only stresses due to the applied load because thermal stresses are difficult to measure. To compute stresses and deflections by the load alone, two separate but consecutive runs have to be conducted. The first run computes the thermal stresses alone. This is done by setting NSTORE = 0 , NWT = 1 , NTEMP = 1 , NGAP > 0 (if it is the case), NOTCON > 0 (if it is the case), INDP = 1 , and NLOAD = 0 in the first run. In the second run, the stresses induced by the applied load and the temperature warping are

computed by setting NSTORE = 2 , NWT = 1 , NTEMP = 1 , NGAP > 0 (if it is the case), NOTCON > 0 (if it is the case), INDP = 0 , and NLOAD equal to the actual number of loads. The differences between those computed in the first and second runs are the stresses and deflections due to the applied load alone and are computed and printed as output data by the computer. Note that when temperature is considered, the slab and the subgrade may be in partial contact; the principal of superposition may no longer be held true (see paragraph 47 of Report 1 of this series). It should also be pointed out in the case of the first and second runs discussed above, the input measured gaps should not include the gaps due to the temperature warping because they are to be computed. More discussions on this can be found in the explanation of NGAP in note 4 of this item.

(7) If the problem involves the efficiency of moment transfer for a certain joint that is other than 0 or 1 and the moments at this joint with 100 percent moment transfer are known, they can be read in at this point by setting NREAD = 1 . Users should refer to the notes in Item 5, the joint efficiency cards, and Item 21, the efficiency of moment card.

(8) When the stresses due to temperature (see NSTORE) or moments computed at 100 percent moment transfer (see NREAD) computed in the previous run are used in this run, this run is not considered to be independent and INDP should be 0, otherwise INDP is 1. Since the results from the previous runs are used in this run, the relaxation factor RFI used in the last iteration cycle in the previous run should be used in this run to obtain faster convergence.

(9) The deflections at each node are computed in the program, but the stresses at any node are computed only on request.

Card 2 (9I5)

Notes	Columns	Variables	Entry
(1)	1-5	NTEMP	Condition of temperature warping:
			EQ.0 temperature gradient is zero
			EQ.1 temperature gradient is not zero
(2)	6-10	ICX	A parameter indicating whether temperature curling exists in the X-direction:

Notes	Columns	Variables	Entry
			EQ.0 no
			EQ.1 yes
(2)	11-15	ICY	A similar parameter in the Y-direction
(3)	16-20	NLOAD	Number of elements on which load is applied; use 0 if there is no load
(4)	21-25	NMCF	Number of concentrated nodal forces and moments which are to be read in; assign 0 if no moments or forces are applied
(5)	26-30	NWT	Weight of slab consideration:
			EQ.0 weight is not considered
			EQ.1 weight is considered
(6)	31-35	NMT	Number of cases to be solved for moment transfer
(7)	36-40	NSX	Number of nodal points on X-axis, which is an axis of symmetry; assign 0 if X-axis is not an axis of symmetry
(7)	41-45	NSY	Number of nodal points on Y-axis, which is an axis of symmetry; assign 0 if Y-axis is not an axis of symmetry

NOTES:

(1) When temperature is considered in the problem, the program works only when the slabs have identical dimensions. Also, erroneous results will be obtained if NAT(I) in card 4 of Item 6 is not 0.

(2) Most pavement slabs have temperature warping in both X- and Y-directions. However, in the case of a continuously reinforced concrete pavement, temperature warping should not be considered in the longitudinal direction if cracks in the pavement do not exist. Otherwise, the amount of curling will be too large.

(3) Because the uniformly applied surface load at each element is lumped into concentrated loads at the four nodal

points, the accuracy of the solution can be improved if the size of the elements at which the loads are applied is reduced.

(4) The concentrated force is considered to be positive if it is acting downward and is negative if it is acting upward. Positive moment follows right-hand screw system (see Figure 1 of Report 1). The program is dimensioned for 200 concentrated forces and moments. If NMCF is greater than 200, dimensions of NFF , NFI , and NF must be increased.

(5) In the original Westergaard solution, the pavement slab was considered to be weightless, but temperature could be considered. Note that if the subgrade is assumed to be in full contact with the slab, the consideration of slab weight affects only deflections but not stresses. However, when the slab is in partial contact with the subgrade, slab weight has a significant effect on slab stresses.

(6) If the efficiency of moment transfer of a joint is 0.5, and it is desired to obtain solutions not only for an efficiency of 0.5 but also for efficiencies of 0.75 and 0.25, assign NMT to 3 and CM(NMT) in Item 21 to 1.0, 1.5, and 0.5, respectively. Set NMT = 1 if the efficiencies of moment transfer are zeros.

(7) The explanations on symmetry can be found earlier in this Part. When subgrade stresses and deflections are computed, symmetry should be used with caution. When either NSX or NSY is not zero, the total number of nodal reactive forces is reduced one half, and when both NSX and NSY are not zero, the total number of nodal reactive forces is reduced to one quarter. Symmetry should not be used at nodes along a joint.

Card 3 (8I5, I10)

Notes	Columns	Variables	Entry
(1)	1-5	JNCK	Joint number used to check convergence; one joint only
(2)	6-10	NBCK	Beginning node at the specified joint (JNCK) used for checking convergence. If NSLAB = 1 , use any integer number
(2)	11-15	NECK	Ending node at the joint used for checking convergence. If NSLAB = 1 , use any integer number

Notes	Columns	Variables	Entry
(2)	16-20	NNCK	A specified node between and including NBCK and NECK , which is used for determining whether the relaxation factor RFI should be reduced. If NSLAB = 1 , use any integer number
(3)	21-25	ICL	Maximum number of iterations allowed for coarse control; generally use 150
(3)	26-30	ICLF	Maximum number of iterations allowed for fine control; generally use 300
(4)	31-35	IGNOR	A parameter indicating whether the reduction of relaxation factor RFI should be ignored: EQ.0 if RFI is reduced EQ.1 if RFI is not reduced whenever the results diverge
(5)	36-40	MNRFR	Maximum number of times for which relaxation factor is allowed to reduce in half; generally use 10 or more
(6)	41-50	MAXFAJ	Maximum shear force at one node that may exist along the joint

NOTES:

(1) The most efficient joint for checking convergence is the joint closest to the heaviest loads. If NSLAB = 1 , JNCK can be any integer number.

(2) For a joint along the X-direction, the node is numbered from left to right; for a joint along the Y-direction, it is numbered from bottom to top. For instance, if the joint is along the Y-direction and there are seven nodes in the joint, and if the middle three nodes are used for checking convergence, thus NBCK = 3 and NECK = 5 . If NSLAB = 1 , NBCK , NECK , and NNCK can be any integer number.

(3) Coarse control is used before the subgrade contact condition is determined and fine control is used afterwards. For a given contact condition, coarse control is used to check the load transfer. Once the subgrade contact condition is finally determined, fine control is used to obtain accurate solutions. If NCYCLE = 1 , coarse control is still used prior to the use of fine control. In some problems, ICLF may be exhausted before the criterion DELF is satisfied. Before rejecting the solution, it may be wise to check to see how far the solution is from satisfying the criterion. For instance, if DELF = 0.001 and computed divergence is 0.002 or 0.0025 and the computed results seem to be reasonable, the solution may be considered acceptable. In some problems, it may be very hard to satisfy the specified convergence criterion. Note: ICLF should always be greater than ICL .

(4) IGNOR is used to increase the flexibility of the program. In some cases, it may be desirable to check the convergence condition when the relaxation factor is fixed at a certain value. The numerical technique used in this program involves an iterative procedure in which a solution may not always be feasible. If a solution is not obtained and if it is noticed from the printed output that the solution was convergent at a reasonable rate during a particular cycle (or relaxation factor), the problem should be run again using the particular relaxation factor and setting IGNOR to 1. In this case, the maximum number of iterations may need to be increased.

(5) If NSLAB = 1 , MNRFR can be any integer number.

(6) If the computed shear force at any node along the joint exceeds MAXFAJ , the relaxation factor will be reduced by one half and iterations restarted. Proper selection of MAXFAJ will expedite the convergence of the solution; however, the value of MAXFAJ varies with the problem. MAXFAJ can be estimated as the shear force acting on the particular node at which the convergence criterion is checked. If input MAXFAJ is less than the computed shear force, the solution will be difficult to converge. If this is the case, change the value according to the printed output or simply use a large number such as 5 or 10 times greater than the total load applied on that slab. The use of a larger value of MAXFAJ would ensure that the relaxation factor RFI is not reduced faster than necessary, and also it would not seriously affect the convergence, because when the solution is divergent and the relaxation factor RFI needs to be reduced, the computed shear forces at the joint tend to become extremely large and exceed the value of specified MAXFAJ , resulting in a reduction of RFI value. Consequently, too large a MAXFAJ tends to increase the computer

time but too small a MAXFAJ would reduce the RFI too rapidly and cause slow convergence or divergence. If temperature alone is considered, the shear force at a dowel bar at the joint should be equal to one quarter of the dead weight of the grid element at which the dowel is connected, which should be a very small force. For simplicity, a larger MAXFAJ can be used, such as from 500 to 10,000 lb. If NSLAB = 1 , MAXFAJ can be any integer number.

Card 4 (8I5)

Notes	Columns	Variables	Entry
	1-5	NAS	Number of additional moduli of subgrade reaction to be read in; assign 0 if the subgrade modulus is uniform throughout
	6-10	NAT(1)	Number of additional thicknesses to be read in for the top layer; assign 0 if thickness is uniform throughout
	11-15	NAT(2)	Number of additional thicknesses to be read in for the bottom layer; assign 0 if thickness is uniform throughout or NLAYER = 1
(1)	16-20	IFPR	First cycle at which displacements are to be printed; if IFPR = 0 , no displacements will be printed until the end
(2)	21-25	ILPR	Last cycle at which displacements are to be printed; ILPR should be equal to or greater than IFPR
(2)	26-30	NPUNCH	Option for punching values of thermal stresses and deflections on cards: EQ.0 no EQ.1 yes

NOTES:

(1) Computed displacements during iteration may be printed for inspection. If it is desired to print out the displacements computed at second and third cycles, set IFPR to 2 and ILPR to 3.

(2) Cards can be punched if NPUNCH is equal to 1. NPUNCH is used when either NSTORE = 1 or NREAD = 1 .

Card 5 (3F10.5, 3E10.3, F10.5)

Notes	Columns	Variables	Entry
(1)	1-10	SUBMOD(1)	Modulus of subgrade reaction, k , in pci
(2)	11-20	TEMP	Difference in temperature, in degrees Fahrenheit, between top and bottom of slab: EQ.positive slab curled upward EQ.negative slab curled downward
(3)	21-30	RFI	Initial relaxation factor at the joint; generally use 0.5
(4)	31-40	DEL	Tolerance of convergence for coarse control; usually use 0.01
(4)	41-50	DELF	Tolerance of convergence for fine control; usually use 0.001
(5)	51-60	YMSB	Young's modulus of dowel bars
(5)	61-70	PRSB	Poisson's ratio of dowel bars
(6)	71-75	NCOMP	Number of subgrade elastic moduli

NOTES:

(1) If subgrade modulus is not uniform, SUBMOD(1) is the modulus of the uniform part; while the modulus SUBMOD(I) at node I, which is different from SUBMOD(1) , will be read in later.

(2) If two layers are considered in the computation, the coefficient of thermal expansion is assumed to be equal for both layers.

(3) If convergent results cannot be obtained, the program will adjust the factor automatically. If LTR = 1 or 2 and a small spring constant or amount of dowels is used, a smaller RFI is recommended to reduce the number of iterations.

(4) DEL and DELF correspond to ICL and ICLD, respectively, in card 2 of this table. In the program when the ratio of the difference of shear force between two consecutive iterations to be shear force is greater than the specified DEL or DELF, the iteration cycle starts again.

(5) Any number can be used if LTR is not equal to 2.

(6) If stresses and deflections in the subgrade need not be computed, NCOMP must be input as zero. The value of the elastic modulus of the subgrade E (in psi) should correspond to the modulus of subgrade reaction k (in pci). Since direct relation between E and k does not exist, a trial-and-error method may have to be employed to determine an appropriate E value. Therefore, a number of subgrade E values may have to be used in computations.

g. Item 7: Subgrade Moduli Card (5(I5, F10.5)).

Note: Use a blank card if the subgrade has a uniform subgrade modulus.

Notes	Columns	Variables	Entry
(1)	1-5	NS(I)	Node number at which subgrade modulus is to be specified
(1)	6-15	SUBMOD(NS(I))	Subgrade modulus at node NS(I)

NOTES:

(1) Report NS(I) and SUBMOD(NS(I)) for each node at which the modulus is different from SUBMOD(1).

h. Item 8: Nodal Points Coordinate Cards (8(F10.5)).(1)

X-coordinate card

Notes	Columns	Variables	Entry
(2)	1-10	X(I,1)	X-coordinate of the first node in slab I
(2)	11-20	X(I,2)	X-coordinate of the second node in slab I
		:	:
		:	:
(2)		X(I,NX(I))	X-coordinate of the last node in slab I

Y-coordinate card

Notes	Columns	Variables	Entry
(2)	1-10	Y(I,1)	Y-coordinate of the first node in slab I
(2)	11-20	Y(I,2)	Y-coordinate of the second node in slab I
		:	:
		:	:
(2)		Y(I,NY(I))	Y-coordinate of the last node in slab I

NOTES:

(1) If the number of slab is greater than 1, continue to the next data card after the nodal points on Y-axis are input, using the same format until the number of slab (NSLAB) is satisfied.

(2) Both X- and Y-coordinates starting from 0 and increasing from left to right for the X-coordinate and increasing from bottom to top for the Y-coordinate. If the value NX or NY in a slab exceeds 8, continue the input to the second data card.

i. Item 9: Layer Properties Cards (2(2F10.5, E10.3)).[1]

Notes	Columns	Variables	Entry
(2)	1-10	T(1,1)	Thickness of layer 1
	11-20	PR(1)	Poisson's ratio of layer 1
	21-30	YM(1)	Young's modulus of layer 1
	31-40	T(1,2)	Thickness of layer 2
	41-50	PR(2)	Poisson's ratio of layer 2
	51-60	YM(2)	Young's modulus of layer 2

NOTES:

(1) If the number of layer is 1, stop the input at column 30.

(2) If thickness is not uniform, thicknesses different from T(1,I) will be read in later.

j. Item 10: Slab Thickness Card (5(I5, F10.5)).[1]

Note: If the thickness is uniform in the layer (i.e., NAT(1) = 0), place a blank card for that layer. Two blank cards are required if thicknesses in both layers are uniform (i.e., if NAT(2) also is zero).

Notes	Columns	Variables	Entry
(2)	1-5	NT(I)	Nodal number at which thickness is to be specified
(2)	6-10	T(NT(I))	Thickness at node NT(I)

NOTES:

(1) Continue the input for other thicknesses that are different from T(1,NLAYER) , until NAT(j) is satisfied, where j varies from 1 to 2. If the number of additional thicknesses is greater than 5, continue the input to next data card. If the number of additional thicknesses to be specified exceeds 25, the dimension of variable NT should be increased accordingly.

(2) If the number of layer is 2, continue to next data card using same format.

k. Item 11: Joint Information Cards (I5, F10.3, 3F10.5, 2F10.3, F10.5).[1]

Note: Use a blank card if the number of slab is 1, i.e., NSLAB = 1 . If the number of slab is greater than 1 and if LTR(I) for joint I is 0, use a blank card for joint I. For instance, if a pavement system has four joints and joints 1-3 have LTR(I) = 0 and joint 4 has LTR(I) = 2 , use three blank cards and specify the joint detail in the fourth card.

Notes	Columns	Variables	Entry
(2)	1-5	LTR(I)	Method for specifying shear transfer at joint I:
			EQ.0 efficiency of shear transfer is specified
			EQ.1 a spring constant is specified
			EQ.2 data on dowel bars are provided
(3)	6-15	SPCON(I)	Spring constant for aggregate interlock or key joint at joint I

Notes	Columns	Variables	Entry
(4)	16-25	BD(I)	Bar diameter at joint I
(4)	26-35	BS(I)	Bar spacing at joint I
(4)	36-45	WJ(I)	Width of joint I
(4)	46-55	SCKV(I,1)	Initial value for modulus of dowel support (or steel concrete k value) at joint I
(4)	56-65	SCKV(I,2)	Final value for modulus of dowel support at joint I
(5)	66-75	DCGF(I)	Deformation of concrete when good fit is obtained

NOTES:

(1) If the number of joint is greater than 1, continue to next data card using same format.

(2) The efficiency of shear transfer is defined as a ratio between the deflection of the unloaded, or less loaded, slab and the deflection of the loaded slab.

(3) If LTR is not specified to 1, SPCON may be assigned 0, blank, or any value. However, 0 or blank is preferred.

(4) If LTR is not equal to 2, BD , BS , WJ , SCKV(NJOINT,1) , SCKV(NJOINT,2) , or DCGF(I) may be left 0, blank, or any value. Zero or blank is preferred.

(5) When the deformation of concrete under dowel is smaller than DCGF , SCKV(NJOINT,1) is needed; when greater, SCKV(NJOINT,1) and SCKV(NJOINT,2) are input the same. Leave blank if LTR is not equal to 2. Detailed explanation on DCGF and SCKV can be found in Part II of Report 1 of this series. The normal range for SCKV is between 300,000 and 1,500,000 pci.

l. Item 12: Total Uniformly Applied Load Card (F12.2).

Note: Skip this card if there is no load uniformly applied on the slabs, i.e., NLOAD = 0 . A blank card is not needed.

Notes	Columns	Variables	Entry
(1)	1-12	RLOAD	Total uniformly applied load on the slab

NOTES:

(1) The total load refers to the uniformly applied load only. The total load should be divided by 2 or 4 if it is

symmetric with respect to one axis (X- or Y-axis) or both X- and Y-axis, respectively. Additional point loads applied at nodal points are excluded.

m. Item 13: Loading Cards (I5, 5F10.5).(1)

Note: Use a blank card if there is no load uniformly applied on the slabs, i.e., NLOAD = 0 .

Notes	Columns	Variables	Entry
(2)	1-5	NL(I)	Element number over which load is applied
(3)	6-15	XDA(I,1)	Lower limit of loaded area in element I in X-direction
(3)	16-25	XDA(I,2)	Upper limit of loaded area in element I in X-direction
(4)	26-35	YDA(I,1)	Lower limit of loaded area in element I in Y-direction
(4)	36-45	YDA(I,2)	Upper limit of loaded area in element I in Y-direction
	46-55	Q(I)	Uniformly applied pressure in element I

NOTES:

(1) If the number of loaded elements is greater than 1, continue to next data card using same format.

(2) Beginning from the first slab and ending at the last slab, the nodes and elements are numbered consecutively from bottom to top and then from left to right, as shown in Figure 2.

(3) Use -1 to +1 if the load covers the whole length of element.

(4) Use -1 to +1 if the load covers the whole width of element.

n. Item 14: Subgrade Contact Card (16I5).

Note: Use a blank card if the slabs are initially in full contact with the subgrade, i.e., NOTCON = 0 .

Notes	Columns	Variables	Entry
(1)	1-5	NODNC(I)	Nodal number at which reactive pressure is initially assumed 0, I = 1,NOTCON

NOTES:

(1) Continue the input until the number of NOTCON is satisfied. Continue to next data card if NOTCON is greater than 16.

o. Item 15: Stresses Print Card (16I5).[1]

Note: Use a blank card if stresses at all nodal points are printed, i.e., $NPRINT = \Sigma(NX(I) \times NY(I))$, I = 1 , NSLAL

Notes	Columns	Variables	Entry
(2)		NP(I)	Nodal number whose stresses are to be printed, I = 1 , NPRINT

NOTES:

(1) Deflections are printed for all nodal points.

(2) Continue the input until the number of NPRINT is satisfied. Continue to next data card if NPRINT is greater than 16.

p. Item 16: Symmetry Cards.

Card 1: symmetry on X-axis (16I5)

Note: Use a blank card if X-axis is not an axis of symmetry, i.e., NSX = 0 .

Notes	Columns	Variables	Entry
	1-5	NODSX(1)	First nodal number on X-axis
	6-10	NODSX(2)	Second nodal number on X-axis
		:	:
		:	:
		NODSX(NSX)	Last nodal number on X-axis

Card 2: symmetry on Y-axis (16I5)

Note: Use a blank card if Y-axis is not an axis of symmetry, i.e., NSY = 0 .

Notes	Columns	Variables	Entry
	1-5	NODSY(1)	First nodal number on Y-axis
	6-10	NODSY(2)	Second nodal number on Y-axis
		:	:
		:	:

Notes	Columns	Variables	Entry
		NODSY(NSY)	Last nodal number on Y-axis

q. Item 17: Thermal Stresses and Thermal Deflections Read In Card.

Note: Use a blank card if NSTORE is not equal to 1. One blank card takes care of both STRSTO and FSTORE .

Card 1: Stresses (6F10.5)

Notes	Columns	Variables	Entry
(1)	1-10	STRSTO(I,1,L)	Stress σ_x in node I, layer L = 1
(1)	11-20	STRSTO(I,2,L)	Stress σ_y in node I, layer L = 1
(1)	21-30	STRSTO(I,3,L)	Shear stress τ in node I, layer L = 1
(1)	31-40	STRSTO(I,4,L)	Major principal stress in node I, layer L = 1
(1)	41-50	STRSTO(I,5,L)	Minor principal stress in node I, layer L = 1
(1)	51-60	STRSTO(I,6,L)	Maximum shear stress in node I, layer L = 1

NOTES:

(1) Each data card includes the six stress components for a nodal point. Repeat the data card at the same format for other nodal points, starting from node 1 to the last node (LNP). If the slab has a second layer, repeat the data cards with the same format for L = 2 .

Card 2: vertical deflections (8F10.5)

Notes	Columns	Variables	Entry
(1)	1-10	FSTORE(1)	Vertical deflection at node 1
(1)	11-20	FSTORE(2)	Vertical deflection at node 2
		:	:
		:	:
(1)		FSTORE(LNP)	Vertical deflection at node LNP

NOTES:

(1) LNP is the total number of nodal points for all the slabs considered.

r. Item 18: Gaps Read In Card (5(I5, F10.5)).

Note: Use a blank card if NGAP = 0 .

Notes	Columns	Variables	Entry
(1)	1-5	NG(I)	Nodal number at which gap between slab and subgrade is specified
(2)	6-15	CURL(NG(I))	Amount of gap at node NG(I)

NOTES:

(1) Continue the input for other nodes at which the gap between slab and subgrade is specified until the number of NGAP is satisfied. If NGAP is greater than 5, continue the input to next data card.

(2) Gap is positive and precompression is negative.

s. Item 19: Concentrated Forces or Moments Card (4(I5, I5, F10.2)).

Note: Use a blank card if there are no concentrated forces or moments, i.e., NMCF = 0 .

Notes	Columns	Variables	Entry
	1-5	NFF(I)	Nodal number at which concentrated forces or moments are specified
(1)	6-10	NFI(I)	Nature of specified force at node I
(2)	11-20	FO(NFF(I)-1)×3 +NFI(I)	Concentrated force or moment at node I

NOTES:

(1) NFI(I) = 1 for vertical force, 2 for moment about X-axis, and 3 for moment about Y-axis.

(2) The magnitude of concentrated force or moment is input in. The equation number is related to nodal number by (NFF(I)-1)) × 3 + NFI(I) . For instance, if a moment about Y-axis is applied at node 13, the equation number will be (13-1) × 3 + 3 = 39 . Note that the nodes are numbered consecutively from bottom to top and then from left to right beginning from the first slab and ending at the last slab.

t. Item 20: Moments at Joints Read In Cards (6F12.3).(1)

Note: Use a blank card if NREAD is equal to 0.

Notes	Columns	Variables	Entry
(2)	1-12	FAJ(I,1)	Moment at first node at joint I computed in the previous run with 100 percent moment transfer
(2)	13-24	FAJ(I,2)	Moment at second node at joint I computed in the previous run with 100 percent moment transfer
(2)	25-36	FAJ(I, NX(NJOINT) or NY(NJOINT))	Moment at the last node at joint I computed in the previous run with 100 percent moment transfer

NOTES:

(1) If the number of joints is greater than 1, continue to next data card using same format.

(2) This card is needed only when the efficiency of moment transfer is not equal to 0 or 1; otherwise, this card should be skipped. For instance, if the efficiencies of moment transfer at joints 1, 2, 3, and 4 are 0.3, 0, 1, and 0.7, respectively, only joint 1 and joint 4 data cards are needed.

u. Item 21: Efficiency of Moment Card (8(F10.5)).

Note: Use a blank card if efficiencies of moment transfer are zeros, i.e., EFF(I,2) = 0 .

Notes	Columns	Variables	Entry
(1)	1-10	CM(1)	Multiplying factor for efficiency of moment transfer for case 1
(1)		CN(NMT)	Multiplying factor for efficiency of moment transfer for case NMT

NOTES:

(1) The use of CM in the program is to facilitate the input format when several efficiencies of moment transfer are involved. For instance, if efficiencies of 0.5, 0.25, and 0.1 are to be computed, an efficiency of 1 should first be computed in the first run with NREAD = 0 . In the second run, NREAD is still 0 and the values of EFF in Item 5 should be set to 0.5, and CM's in this table should be set as 1, 0.5, and 0.2 because the products of 0.5×1 , 0.5×0.5 , and 0.5×0.2 are 0.5, 0.25, and 0.1, respectively, which are the efficiencies to be computed. The program is

developed in such a way that erroneous results will be computed if EFF in the second run is set as 1.0, and the CM's are set as 0.5, 0.25, and 0.1. If the results of a particular run are not used in the following run, CM must be set to 0.

v. Item 22: Subgrade Stresses Card

Note: Use a blank card if computation of subgrade stresses and deflections is not needed, i.e., YMSS = 0 . One blank card takes care of NZ , NR , ZZ(I) , XR(I) , and YR(I) .

Card 1: values of modulus and Poisson's ratio (4(F10.2, F5.1)).

Notes	Columns	Variables	Entry
	1-10	E(1)	Elastic modulus of the subgrade for the first computation
	11-15	$\nu(1)$	Poisson's ratio of the subgrade for the first computation
		:	:
		:	:
		E(NCOMP)	Elastic modulus of the subgrade for the $NCOMP^{th}$ computation
		$\nu(NCOMP)$	Poisson's ratio of the subgrade for the $NCOMP^{th}$ computation

Card 2: number of computations (2I10)

Notes	Columns	Variables	Entry
	1-10	NZ	Number of depths to be computed
	11-20	NR	Number of offsets at each depth to be computed

Card 3: depth card (8F10.5)

Notes	Columns	Variables	Entry
	1-10	ZZ(1)	Depth of first computation
	11-20	ZZ(2)	Depth of second computation
	:	:	
	:	:	

Notes	Columns	Variables	Entry
		ZZ(NZ)	Depth of the last computation

Card 4: offset card (8F10.5)

Notes	Columns	Variables	Entry
(1)	1-10	XR(1)	X-coordinate of first computation
	11-20	YR(1)	Y-coordinate of first computation
	21-30	XR(2)	X-coordinate of second computation
	31-40	YR(2)	Y-coordinate of second computation
	:	:	
	:	:	
		XR(NR)	X-coordinate of last computation
		YR(NR)	Y-coordinate of last computation

NOTES:

(1) Computations at each offset point are made at all the NZ depths. The origin of the coordinates is at nodal point 1, i.e., node 1 of slab 1. Referring to the nodal numbers shown in Figure 2, if stresses and deflections in the subgrade soil at various depths at three locations are to be computed, the first location is directly under node 1, the second location is the midpoint between nodes 5 and 8, and the third location is at the center of element 13. The input values of XR(1) , YR(1) , XR(2) , YR(2) , XR(3) , and YR(3) should thus be 0., 0., 135., 90., -135., and -135. Note that nodes 1, 16, 21, and 36 shear the same location.

w. Item 23: Subgrade Stress Directly under a Node and Joint Card.

Card 1: number of locations and information (8I5)

Notes	Columns	Variables	Entry
(1)	1-5	NAJ	Number of locations directly under a node and along a joint
(2)	6-10	NJP(1)	Number of nodal points share the same location, first location

Notes	Columns	Variables	Entry
(2)	11-15	NJP(2)	Number of nodal points share the same location, second location
	:	:	:
	:	:	:
(2)		NJP(NAJ)	Number of nodal points share the same location, NAJth location

Card 2: nodal points sharing the same locations (4I5)

Note: Skip this card if computation is not made at locations along the joint, i.e., NAJ = 0 .

Notes	Columns	Variables	Entry
(3)	1-5	JON(1,1)	Nodal number at one side of the joint that has the smallest nodal number, first location
(3)	6-10	JON(1,2)	Nodal number at the other side of a joint of node JON(1,1) that shares the same location with node JON(1,1) , second location
(4)	11-15	JON(1,3)	Nodal number at the other side of a joint of either node JON(1,1) or node JON(1,2) that shares the same location with nodes JON(1,1) and JON(1,2) , first location
(4)	16-20	JON(1,4)	Nodal number at the other side of a joint of either node JON(1,1) or node JON(1,2) or node JON(1,3) that shares the same location with these three nodes, first location

Note: If there are more computations at locations along the joint, i.e., NAJ is greater than 1, repeat the data cards with the same format for the second location: JON(2,1) , JON(2,2) , JON(2,3) , and JON(2,4) ; the third location: JON(3,1) , JON(3,2) , JON(3,3) , and JON(3,4) ; ... the last (NAJ) location: JON(NAJ,1) , JON(NAJ,2) , JON(NAJ,3) , and JON(NAJ,4) .

NOTES:

(1) For a single slab, i.e., NSLAB = 1 , NAJ should be input as zero. If NSLAB is greater than 1 and if the computation is made at locations directly under a node and also along a joint, NAJ is the total number of such locations.

(2) For NSLAB = 1 , NJP(I) should be skipped. If NSLAB is greater than 1 and NAJ is greater than zero, NJP(I) is the number of nodal points sharing the same location. The sequential order of inputting nodal information for nodes located along the joints is of vital importance. A slight mistake in the order will result in erroneous results. The basic rule is to input nodal information of nodes of smaller numbers prior to larger numbers. This can best be illustrated by an example. For the four-slab pavement system shown in Figure 2, if the stresses and deflections under nodes 1, 2, 3, 4, 6, 10, 19, 20, 23, and 25 at various depths are to be computed, NAJ should be input as 7, as only 7 nodal points are located along the joint, i.e., 1, 2, 3, 4, 10, 19, and 20. The sequential order for inputting NJP(I) , (I21,NAJ) should be 1, 2, 3, 4, 10, 19, and 20. At the location of nodal point 1, since nodes 16, 21, and 36 share the same location with node 1, NJP(1) should thus be input as 4. At nodal point 2, node 17 shares the same location with node 2 and thus NJP(2) is equal to 2. Similarly, the values of NJP(3) , NJP(4) , NJP(5) , NJP(6) , and NJP(7) should all be 2. It should be pointed out that if computations at node 24 are desired, node 4 should be used in the input to replace node 24, as 4 is smaller than 24 and also as nodes 4 and 24 share the same location.

(3) Since NAJ = 7 , seven separate data cards are needed to indicate the nodal numbers of these 7 special computation locations. The first card corresponding to NJP(1) should be input as 1, 21, 36, and 16. It is of vital importance to input first nodal number 1; the order of the other three nodal numbers is of no importance. In other words, this card can be input as either 1 16 2 36 or 1 36 21 16 , or 1 2 16 36 , or 1 16 36 21 , or 1 36 16 21 . The important rule is to input first the smallest nodal number of the form nodal numbers.

The second card (of card 2) corresponding to NJP(2) should be input as 2 17 . Nodal number 2 is input prior to nodal number 17 as 2 is smaller than 17. Similarly, the third card (of card 2) corresponding to NJP(3) is 3 18 ; the fourth card (of card 2) corresponding to NJP(4) is 4 24 ; the fifth card (of card 2) corresponding to NJP(5) is 10 30 ; the sixth card (of card 2) corresponding to NJP(6) is 19 34 ; and the seventh card (of card 2) corresponding to NJP(7) is 20 35 .

(4) JON(1,3) and JON(1,4) are not needed if NJP equals 2; JON(1,4) is not needed if NJP equals 3. Both JON(1,3) and JON(1,4) are needed if NJP equals 4.

PART V: EXAMPLE PROBLEMS

45. In this Part of the report, the input data of five example problems are presented. Printouts of the computer output for three example problems are presented and explained.

Example Problem 1: A Single Slab with Many Input Options

46. Figure 7 shows the finite element grid of a single slab. The nodes and elements are numbered consecutively from bottom to top and then from left to right. The input data consist of the following information:

a. The concrete slab is 10 in. thick with a Young's modulus of 6,000,000 psi and a Poisson's ratio of 0.2. The slab is underlain with a 4-in. stabilized layer,

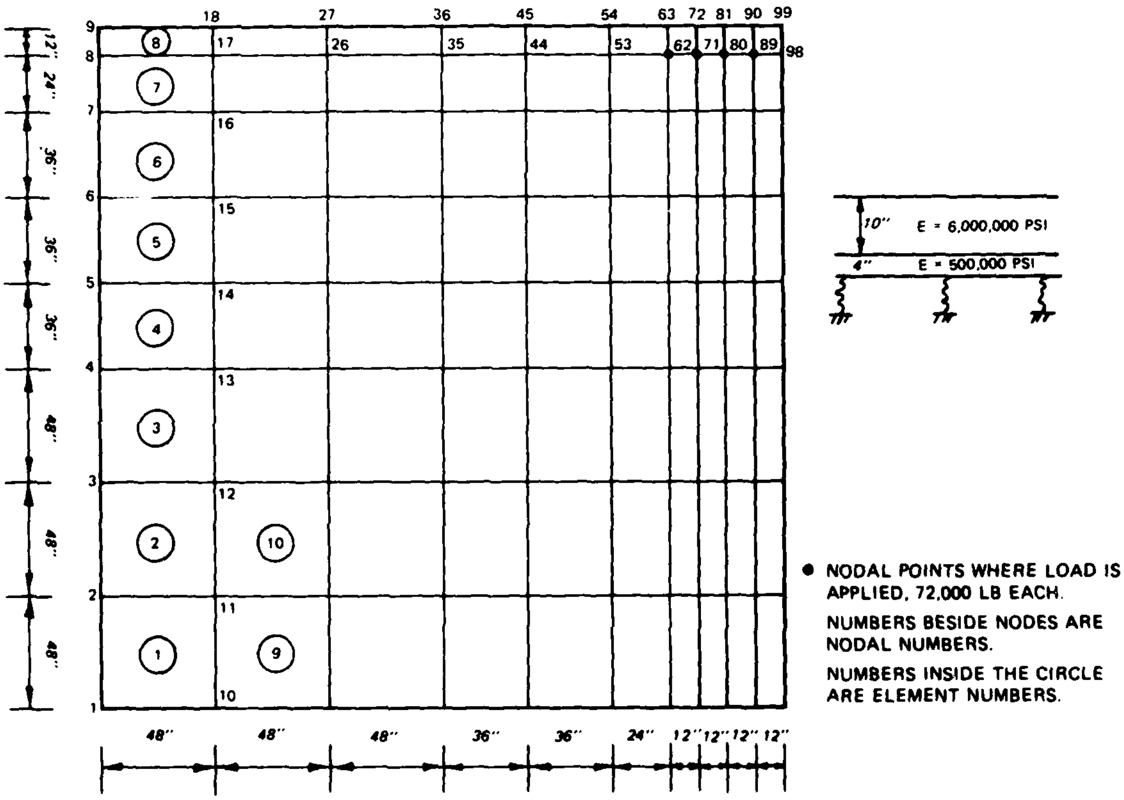

Figure 7. Finite element layout for Example Problem 1

which has a modulus of 500,000 psi and a Poisson's ratio of 0.2. The condition of the interface between the layers is bonded. The subgrade has a k value of 100 pci.

b. The thickness of the layers and the modulus of subgrade reaction k are not uniform throughout the slab. Table 3 gives the additional k values and thicknesses at particular nodal points.

c. Gaps exist under the pavement at 22 nodal points. The amounts of gaps are 0.5 in. at nodes 1 to 9 and 0.25 in. at nodes 10 to 18, and also at nodes 82, 83, 91, and 92.

d. The slab is subjected to four concentrated loads, 72,000 lb each, at nodes 62, 71, 80, and 89. There is no uniformly applied load.

e. Stresses at all nodes (99) are printed.

Table 3

Additional Subgrade k Values and Thicknesses

Node	Layer Thicknesses, in.		Subgrade k Value, pci
	Top Layer	Bottom Layer	
1	12	2	65
2	3	3	65
3	13	1	65
4	9	5	65
5	8	4	65
6	--	10	--

47. The input data for Example Problem 1 are given in Table 4. The readers should refer to the input guide, as necessary.

Example Problem 2: A Single Slab With Separate Runs for Computing the Stresses and Deflections Due to the Applied Load Alone

48. The purpose of Example Problem 2 is to illustrate the input procedure to compute stresses and deflections induced by the applied load alone. The reason for the need of this computation is explained in the input variable NSTORE (Item 6 of Table 2).

49. The finite element grid shown in Figure 7 is also used in this example problem. Input data used in Example Problem 7 are used except for the following differences:

Table 4. Example Problem 1--Input Data for Single Slab with Many Options

```
C-COMMENT
STATEMENT  CONTIN-
NUMBER     UATION                         FORTRAN STATEMENT
1    5 6 7  10   15   20   25   30   35   40   45   50   55   60   65   70   72   73-80 IDENTIFICATION
    1
SINGLE SLAB FOUR CONCENTRATED LOADS, TWO LAYERS BONDED.  TEMPERATURE IS NOT CONSIDERED.
    1     0 9801  100  100  200  130

  1.1     9    0    0    0    0
BLANK CARD: NO JOINTS
    2     1    0   22   20    0    0    1   99
    0     0    0    0    0    1    1    0    0
    1     1    1    1   49  199    0   15        10000
    5     5    6    0    0    0
 100.          0.        0.25      1.000E-02 1.000E-03 3.000E-07 0.2
    1    65         2   65.       3   65.       4 65.     5   65.
         0.        48.       96.      144.      180.      216.      240.      252.
       264.       276.      288.
         0.        48.       96.      144.      180.      216.      252.      276.
       288.
         10        0.2  0.600E+07       4        0.2  0.500E+06
    1    12         2    3    3   13    4    9    5    8.
    1     2         2    3    3    1    4    5    5    4.
    6    10
BLANK CARD: NO JOINTS
BLANK CARD: NO UNIFORMLY APPLIED LOAD
BLANK CARD: NOTCON = 0
BLANK CARD: STRESSES AT ALL NODES ARE PRINTED
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Table 4 (Concluded)

Statement Number	FORTRAN STATEMENT										Identification
BLANK CARD:	NO SYMMETRY ON X-AXIS										
BLANK CARD:	NO SYMMETRY ON Y-AXIS										
BLANK CARD:	ESTORE IS NOT EQUAL TO 1										
1	0.5	2	0.5	3	0.5	4	0.5	5	0.5		
6	0.5	7	0.5	8	0.5	9	0.5	10	0.25		
11	0.25	12	0.25	13	0.25	14	0.25	15	0.25		
16	0.25	17	0.25	18	0.25	82	0.25	83	0.25		
91	0.25	92	0.25								
62	1	72,000.00	71	1	72,000.00	80	1	72,000.00	89	1	72,000.00
BLANK CARD:	NREAD = 9										
0.00000											

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a. The concrete slab is 15 in. thick and the slab is not underlain with a stabilized layer. Also, there is no gap under the pavement. The thickness of the slab and the subgrade k values are uniform throughout the pavement.

b. A positive temperature differential of +3°F per in. of pavement is assumed. For a 15-in. concrete slab, the total difference between the top and the bottom of the slab is +45°F.

c. The slab is subjected to a uniformly applied load at the corner of the slab, i.e., element 50.

d. There are only 20 nodal points where the stresses are computed and printed.

50. The input data for this problem are given in Table 5. In the first run, the stresses and deflections due to temperature, slab weight, and gaps are computed. This is done by defining the following variables in the input data as follows:

a. NLOAD = 0 , NMCF = 0 , NWT = 1 , NTEMP = 1 , TEMP = 45 , NCYCLE $\geq$ 10 , and NGAP equals the exact number of nodes where gaps exist.

b. NSTORE = 0 because thermal stresses and deflections are not read in from data cards.

c. INDP = 1 because the computation does not depend on the results of the previous run.

51. In the second run, the stresses and deflections due to the applied load, temperature, and gaps are computed. This is done by defining the following variables in the input data as follows:

a. NMCF = 0 , NWT = 1 , NTEMP = 1 , TEMP = 45 , NCYCLE $\geq$ 10 , and NLOAD and NGAP equal the exact number of nodes where gaps exist.

b. NSTORE = 2 because the stresses and deflections due to the thermal effect computed in the first run should be used in the second run.

c. INDP = 0 because this run is not independent of the previous run.

52. Once the stresses and deflections due to the applied load and temperature are computed, the differences between the results computed in the first and second runs are those due to the applied load alone. Such a computation was made and the computer output is presented later in this section in Computer Output 3 with detailed explanation.

Table 5. Example Problem 2--Input Data for Computing Stresses and Deflections Due to Applied Loads Alone

FORTRAN STATEMENT

```
       2
TEMPERATURE AND SLAB WT. (LOAD IS NOT CONSIDERED, FIRST RUN)
       1       0    9801     500     500     200     130
      11       9       0       0       0       0
BLANK CARD: NJOINT = 0, SO NO JOINT EFFICIENCY IS NEEDED.
       1       1       0       0       0       0       0       1      20
       1       1       1       0       0       1       0       0       0
       0       0       0       0      49     199       0      15   10000
    100.             45.            0.25       1.000E-02    1.000E-03   3.000E+07     0.2
BLANK CARD: NO ADDITIONAL SUBGRADE MODULUS TO BE READ IN.
              0.              48.             96.            144.            180.            216.            240.            252.
            264.             276.            288.
              0.              48.             96.            144.            180.            216.            252.            276.
            288.
             15.             0.2       0.600E+07
BLANK CARD: NO ADDITIONAL THICKNESS TO BE READ IN.
BLANK CARD: NJOINT = 0
BLANK CARD: NLOAD = 0
BLANK CARD: NOTCON = 0
      60      61      62      63      69      70      71      72      78      79      80      81      87      88      89      90
      96      97      98      99
BLANK CARD: NO SYMMETRY ON X-AXIS.
BLANK CARD: NO SYMMETRY ON Y-AXIS.
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Table 5 (Continued)

FORTRAN STATEMENT

```
BLANK CARD: NSTORE NOT EQUAL TO ONE.
BLANK CARD: NGAD = 0
BLANK CARD: NO CONCENTRATED FORCE OR MOMENT APPLIED AT NODES.
BLANK CARD: NREAD = 0
    0.
LOAD, TEMPERATURE, AND SLAB WEIGHT (SECOND RUN, LOAD CONSIDERED).
    1    0   9801   500   500   200   130
   11    9      0     0     0     0
BLANK CARD: NJOINT = 0
    1    1      0     0    20     2     0     1    20
    1    1      1     1     0     1     0     0     0
    0    0      0     0    49   149     0    19    10,000
    0    0      0     0     0     0
  100.        45.        0.25      1.000E-02   1.00E-03   3.000E+07   0.2    0
BLANK CARD: NO ADDITIONAL SUBGRADE MODULUS.
         0.        48.        96.       144.       180.       216.       240.       252.
       264.       276.       288.
         0.        48.        96.       144.       180.       216.       252.       276.
       288.                  0.600E+07
        15.        0.2
BLANK CARD: NO ADDITIONAL THICKNESS.
BLANK CARD: NJOINT = 0
```

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(Continued)

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Table 5 (Concluded)

FORTRAN STATEMENT

```
    14400.00
       80        -1.         1.         -1.        1.         100.
BLANK CARD:  NOTCON = 0.
       60    61    62    63    69    70    71    72    78    79    80    81    87    88    89    90
       96    97    98    99
BLANK CARD:  NO SYMMETRY ON X-AXIS.
BLANK CARD:  NO SYMMETRY ON Y-AXIS.
BLANK CARD:  NSTORE NOT EQUAL TO ONE.
BLANK CARD:  NGAP = 0.
BLANK CARD:  NO CONCENTRATED FORCE OR MOMENT APPLIED AT NODES.
BLANK CARD:  NREAD = 0
        0.
BLANK CARD: SUBGRADE STRESSES COMPUTATION NOT NEEDED
```

(Sheet 3 of 3)

Example Problem 3: A Two-Slab Pavement System, Symmetrical Along the X-Axis

53. The slabs involved are 15 by 12.5 ft. A uniformly applied load with a 7.5- by 10-in. rectangular imprint is applied near the center of the joint. Because of symmetry, it is only necessary to use half of the slabs for the computations. Figure 4 shows the finite element grid for the problem. According to the principle that the slab carrying the heaviest load is numbered first, the left slab is designated as slab 1 and the right slab as slab 2. Beginning from the first slab and ending at the last slab, the nodes and elements are numbered consecutively from bottom to top and then from left to right. The input data for the problem are presented in Table 6, with the special features listed below:

- a. The efficiency of shear transfer across the joint is assumed to be 100 percent and the efficiency of moment transfer is zero percent.
- b. Assuming good fit between the steel and the concrete, the initial and final values for the modulus of dowel support K are equal. The value of DCGF (item 11) is arbitrarily assumed to be 1 in. Since the deformation of concrete does not exceed 1 in., initial K value is always used in the computation.
- c. Because of symmetry, half of the total load is used in the problem, which is applied at element 43.
- d. Because the problem is symmetrical about the X-axis, the nodal numbers lying on the X-axis of symmetry are 1, 8, 15, 22, 29, 36, 43, 50, 57, 64, 71, 78, 85, 92, 99, 106, and 113.
- e. Nodal points 57, 58, and 59 are used for checking the convergence. Nodal point 57 is used for determining whether the relaxation factor RFI should be reduced. Accordingly, the values of NBCK , NECK , and NNCK should be 1, 3, and 1, respectively.

Example Problem 4: A Nine-Slab Pavement System

54. Figure 8 shows the finite element grid for a nine-slab pavement system. The system has a total of 196 nodal points, 122 elements, and 12 joints. In the real case, the number of elements may

Table 6. Example Problem 3--Input Data for a Two-Slab System, Symmetrical Along the X-Axis

```
C-COMMENT / STATEMENT NUMBER | CONTINUATION | FORTRAN STATEMENT | IDENTIFICATION
1   5 6 7  10   15   20   25   30   35   40   45   50   55   60   65   70 72 73   80
    1
TWO-SLAB SYSTEM, SYMMETRICAL ALONG X-AXIS, TYNDALL AFB, FLORIDA.
    2    1 9639  200  200  200  130
    9    7    0    1    0    0
    8    7    1    0    0    0
 1.00000       0.00000
    1    1    0    0    1    0    0    1   26
    0    0    0    1    0    0    1   17    0
    1    1    3    1   49  199    0   15 7500
    0    0    0    0    0    0
160.00000      0.00000   0.25000   1.000E-02 1.000E-03 3.00E-07  0.20000   0
BLANK CARD:  NO ADDITIONAL SUBGRADE MODULUS.
          0.        25.       50.       75.       95.      115.      130.      142.5
      150.
          0.        10.       20.       35.       50.       70.       90.
          0.        10.       25.       45.       65.       90.      115.      150.
          0.        10.       20.       35.       50.       70.       90.
          8.      0.15  0.500E+07
BLANK CARD:  NO ADDITIONAL THICKNESS.
    2              1.00000  12.00000   0.03125 1.500E+06 1.500E+06   1.00000
      7500.00
   43   0.00000    1.00000  -1.00000   0.00000   0.00000 200.00000
BLANK CARD:  ALL NODES HAVE FULL CONTACT WITH SUBGRADE.

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(Continued)

Table 6 (Concluded)

FORTRAN STATEMENT

```
C-COMMENT
STATEMENT  CONTIN-
NUMBER     UATION   FORTRAN STATEMENT                                                     IDENTIFICATION
1     5    6        7   10        15        20        25        30        35        40        45        50        55        60        65        70  72 73      80
    1                  8         15        22        29        36        43        50        57        58        59        60        61        63      64      65
   66                 67         68        69        70        71        78        85        92        99
    1                  8         15        22        29        36        43        50        57        64        71        78        85        92      99     106
  113
BLANK CARD:  NO SYMMETRY ON Y-AXIS.
BLANK CARD:  NREAD  IS NOT EQUAL TO ONE.
BLANK CARD:  NO GAPS TO BE READ IN.
BLANK CARD:  NO CONCENTRATED FORCES OR MOMENTS.
BLANK CARD:  NREAD  = 0.
    0.00000
    0.
```

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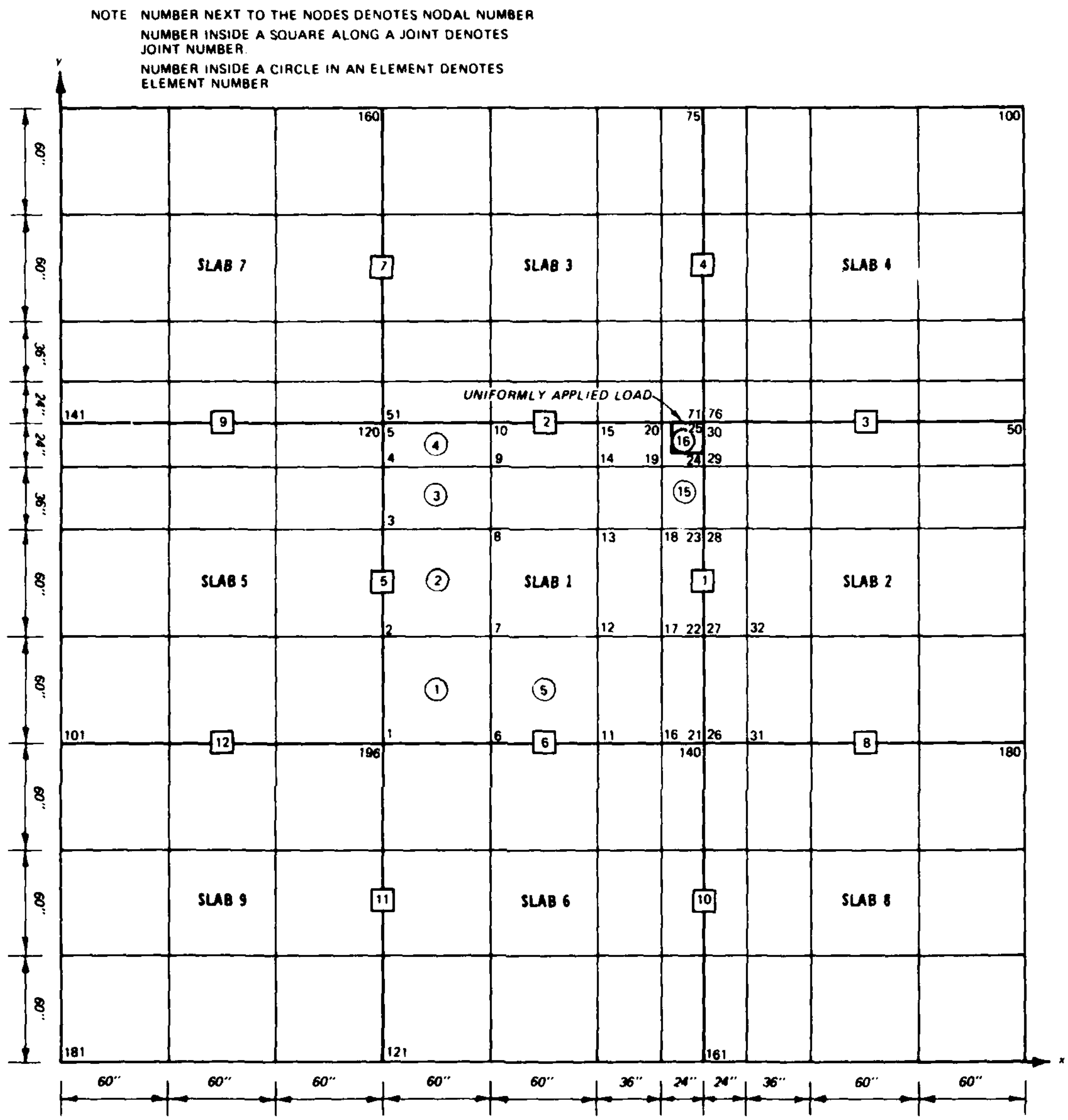

Figure 8. Finite element layout for Example Problem 4

need to be more to obtain more accurate results, but the dimensions of several variables have to be increased in the program.

55. In Figure 8, the slab is numbered according to the magnitude of load and the expected magnitude of shear forces transmitted across the joint. Since the load is applied at the center slab, it is numbered slab 1. Because the load is applied at the upper right corner of the

slab, greatest shear forces will be transferred to the right middle and upper middle slabs; therefore, they are numbered slabs 2 and 3, respectively. The choice between slabs 2 and 3 is arbitrary because the shear forces transferred from slab 1 to these two slabs are expected to be the same in magnitude. For the same reason, the right upper slab is numbered slab 4 and the left middle and lower middle slabs are numbered slabs 5 and 6, respectively. Similar to slabs 2 and 3, the choice between slabs 5 and 6 is arbitrary. Similarly, slabs 7, 8, and 9 are numbered.

56. Beginning with slab 1 and ending at slab 9, the nodes and elements are numbered consecutively from bottom to top and then from left to right as shown in Figure 8.

57. The joints can be numbered arbitrarily. However, the joints shown in Figure 8 are numbered according to the magnitude of shear transfer across the joint. For illustrative purposes, the use of the element coordinates card for slab 1 is explained. Slab 1 has five nodal points in the X-direction and five nodal points in the Y-direction, and the slab is surrounded by joint 5 on the left, joint 1 on the right, joint 6 at the bottom, and joint 2 at the top. The *element coordinates card* in Item 4 of Table 2 should then be input as 5 1 6 2 . The same logic is used in the input for the other slabs.

58. The input data for the problem are presented in Table 7. Special features of the input are listed below:

- a. At joints 1 to 10, the efficiency of shear transfer across the joint is assumed to be 100 percent and the efficiency of moment transfer is zero percent. At joint 11, a spring constant of 1000 psi is specified for shear transfer and zero percent for moment transfer. At joint 12 dowel bars are used for a shear transfer device and, similar to all other joints, moment transfer is assumed to be zero percent. The bars have a diameter of 1 in. and are spaced 18 in. apart. The final value for modulus of dowel support SCKV(12,2) is assumed to be 1,500,000 psi but the initial value SCKV(12,1) is assumed to be 600,000 psi when the deformation of concrete DCGF(12) is less than 0.01 in. It should be pointed out that the unusual and varied combination of load transfer options across the joints used in this problem is merely for illustrative purposes.

Table 7. Example Problem 4--Input Data for a Nine-Slab Pavement System

FORTRAN STATEMENT

Statement Number (1–5)	6–10	11–15	16–20	21–25	26–30	31–35
1						
NINE-SLAB PAVEMENT WITH JOINTS, SINGLE-WHEEL LOAD.						
9	12	11850	1000	1000	200	130
5	5	5	1	6	2	
5	5	1	0	8	3	
5	5	7	4	2	0	
5	5	4	0	3	0	
4	5	0	5	12	9	
5	4	11	10	0	6	
4	5	0	7	9	0	
5	4	10	0	0	8	
4	4	0	11	0	12	
	1.		0.			
	1.		0.			
	1.		0.			
	1.		0.			
	1.		0.			
	1.		0.			
	1.		0.			
	1.		0.			
	1.		0.			
	1.		0.			
	1.		0.			

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(Continued)

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Table 7 (Continued)

C-COMMENT / STATEMENT NUMBER (1–5)	CONTINUATION (6)	7–10	11–15	16–20	21–25	26–30	31–35	36–40	41–45	46–50	51–55	56–60	61–65	66–72	IDENTIFICATION (73–80)
1.00000			0.00000												
1		1	0	0	1	0	0	1	35.						
0		0	0	1	0	0	1	0	0						
1		3	5	5	49	199	0	15		.60000					
0		0	0	0	0	0									
100.			0.		0.125			1.000E-02		1.000E-03		3.000E+07	0.2	Q	
BLANK CARD: NO ADDITIONAL SUBGRADE MODULUS.															
		0.		60.		120.		156.		180.					
		0.		60.		120.		156.		180.					
		0.		24.		60.		120.		180.					
		0.		60.		120.		156.		180.					
		0.		60.		120.		156.		180.					
		0.		24.		60.		120.		180.					
		0.		24.		60.		120.		180.					
		0.		24.		60.		120.		180.					
		0.		60.		120.		180.							
		0.		60.		120.		156.		180.					
		0.		60.		120.		156.		180.					
		0.		60.		120.		180.							
		0.		60.		120.		180.							
		0.		24.		60.		120.		180.					
		0.		24.		60.		120.		180.					
		0.		60.		120.		180.							

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(Continued)

(Sheet 2 of 3)

Table 7 (Concluded)

FORTRAN STATEMENT

```
    0.00000      60.00000     120.00000     180.00000
    0.00000      60.00000     120.00000     180.00000
   15.00000       0.15000     0.400E+07
BLANK CARD:  NO ADDITIONAL THICKNESS.
TEN BLANK CARDS:  JOINTS 1 TO 10 HAVE LTR(I) = 0
    1 1.000E+03
    2             1.00000      18.00000       0.01325     0.600E+06     0.150E+07     0.01000
60000.00
   16  -0.87500   1.00000      -0.87500       1.00000     118.51851
BLANK CARD:  NUMBER OF SUBGRADE NO CONTACT NOTCON = 0
    1    2    3    4    5    6    7    8    9   10   11   12   13   14      15   16
   17   18   19   20   21   22   23   24   25   26   27   28   29   30      51   56
   61   66   71
BLANK CARD:  NO SYMMETRY ON X-AXIS.
BLANK CARD:  NO SYMMETRY ON Y-AXIS.
BLANK CARD:  NREAD NOT EQUAL TO ONE.
BLANK CARD:  NO GAP.
BLANK CARD:  NO CONCENTRATED FORCES OR MOMENTS APPLIED AT NODES.
BLANK CARD:  NREAD1 = 0.
    1.
    0.
```

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b. A 60,000-lb single-wheel load with a contact area of 500 sq in. is applied at element 16. The loading card in Item 13 of Table 12 should thus be from -0.875 to 1 in both X- and Y-directions. With such a division of contact area in the element, the actual tire imprint has a contact area of 506.25 sq in. and a contact pressure of 118.51851 psi.

c. Nodal points 23, 24, and 25 at joint 1 are used for checking convergence and nodal point 25 is used for determining whether the relaxation factor RFI should be reduced. Therefore, JNCK , NBCK , NECK , and NNCK in Item 4 of Table 2 are input as 1, 3, 5, and 5, respectively.

Example Problem 5: A Four-Slab Pavement System with 50 and Zero Percent Moment Transfer Along the Joints

59. As was explained in the input guide (Table 2), when moment transfer is other than 100 or zero percent, a separate computer run with 100 percent moment transfer must first be made and the computed moments along the joints are then used in the following run. Example Problem 5 presents the input data for such a case.

60. Figure 2 shows the finite element layout for the problem. Two uniformly applied loads are placed at the two upper slabs near the corner joints. Each load has a magnitude of 51,840 lb and a dimension of 36 by 36 in. Because the loads are equal in magnitude, the designation of slab 1 and slab 2 is arbitrary. Similarly, the designation of slab 3 and slab 4 is also arbitrary. Once the slab numbers are determined, beginning from slab 1 and ending at slab 4, the nodes and elements are numbered consecutively from bottom to top and then from left to right as shown in Figure 2. It should be pointed out that, for the convenience of presenting and explaining the output results of the computations, a minimum number of elements is used in this problem. The presentation and discussion of the computer output is at the end of this part.

61. The input data for the problem are presented in Table 8, with special features of the problem described below.

Table 8. Example Problem 5--Input Data for a Four-Slab Pavement System

FORTRAN STATEMENT

```
    2
FIRST RUN TO OBTAIN RESULTS FOR 100 PERCENT MOMENT TRANSFER, FOUR SLABS.
    4    4 9801      500  500  200  130
    3    3    3    0    2    0
    3    3    0    3    1    0
    3    3    4    0    0    2
    3    3    0    4    0    1
         1.        1.
         1.        1.
         1.        1.
         1.        1.
    1    1    0    0    1    0    0    1   20
    0    0    0    2    0    0    1    0    0
    2    1    2    1   49  199    0   15     70000
    0    0    0    0    0    0
 109.         0.        0.25       1.000E-02 1.000E-03 3.000E-07  0.2    0
BLANK CARD:  NO ADDITIONAL SUBGRADE MODULUS.
         0.       90.       180.
         0.       90.       180.
         0.       90.       180.
         0.       90.       180.
         0.       90.       180.
         0.       90.       180.
```

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(Continued)

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Table 8 (Continued)

FORTRAN STATEMENT

```
    0.00000     90.00000                180.00000
    0.00000     90.00000                180.00000
    8.00000      0.15000                  0.400E+07
BLANK CARD:  NO ADDITIONAL THICKNESS.
        2                      0.5             36.          0.08125    0.150E+07    0.150E+07        1.
        2                      0.5             36.          0.08125    0.150E+07    0.150E+07        1.
        2                      1.0             12.          0.12500    0.150E+-7    0.150E+07        1.
        2                      1.0             12.          0.12500    0.150E+07    0.150E+07        1.
   103680.00
        1     -1.             -0.2             -1.          -0.2          40.
        7      0.2             1.0             -1.          -0.2          40.
BLANK CARD:  NUMBER OF SUBGRADE NO CONTACT NOTCON = 0
        2     3      5         6        8       11    13    14    15    17    20    22    23    24     26   29
       31    32     33        35
BLANK CARD:  NO SYMMETRY ON X-AXIS.
BLANK CARD:  NO SYMMETRY ON Y-AXIS.
BLANK CARD:  NREAD NOT EQUAL TO ONE.
BLANK CARD:  NO GAP.
BLANK CARD:  NO CONCENTRATED FORCES OR MOMENTS APPLIED AT NODES.
BLANK CARD:  NREAD = 0
    1.00000
SECOND RUN TO OBTAIN RESULTS FOR ZERO AND 50 PERCENT MOMENT TRANSFER, FOUR SLABS.
        4     4     9801     500      500      200    130
```

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(Continued)

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Table 8 (Continued)

FORTRAN STATEMENT

```
    3     3    3   0    2    0
    3     3    0   3    1    0
    3     3    4   0    0    2
    3     3    0   4    0    1
        1.0      0.5
        1.0      0.5
        1.0      0.5
        1.0      0.5
    1     1    0   0    1    0    0    0   20
    0     0    0   2    0    0    2    0    0
    2     1    2   1   49  199    0   15      1000
    0     0    0   0    0    0
 100.00000     0.00000   0.25000   1.000E-02 1.000E-03 3.000E-07 0.20000
BLANK CARD: NO ADDITIONAL SUBGRADE MODULUS.
         9.       90.       180.
         9.       90.       180.
         9.       90.       180.
         9.       90.       180.
         9.       90.       180.
         9.       90.       180.
         9.       90.       180.
         9.       90.       180.
         8.       0.15      0.100E+07
```

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(Continued)

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Table 8 (Concluded)

FORTRAN STATEMENT

```
BLANK CARD:  NO ADDITIONAL THICKNESS.
    2    0.000E+00     0.5            36.        0.03125    0.150E+07   0.150E+07     1.
    2    0.000E+00     0.5            36.        0.03125    0.150E+07   0.150E+07     1.
    2    0.000E+00     1.0            12.        0.03125    0.150E+07   0.150E+07     1.
    2    0.000E+00     1.0            12.        0.03125    0.150E+07   0.150E+07     1.
  103600.00
    1           -1.0        -0.2         -1.0         -0.2          40.0
    7            0.2         1.0         -1.0         -0.2          40.0
BLANK CARD:  NUMBER OF SUBGRADE NO CONTACT NOTCON = 0.
    2    3    5    6    8    11    13    14    15    17    20    22    23    24    26    29
   31   32   33   35
BLANK CARD:  NO SYMMETRY ON X-AXIS.
BLANK CARD:  NO SYMMETRY ON Y-AXIS.
BLANK CARD:  NREAD NOT EQUAL TO ONE.
BLANK CARD:  NO GAP
BLANK CARD:  NO CONCENTRATED FORCES OR MOMENTS APPLIED AT NODES.
BLANK CARD:  NREAD = 0
   1.    0.
   0.
```

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a. Slab 1 has three nodal points in both X- and Y-directions, and has joint 3 on the left and joint 2 at the bottom. The slab coordinates card in Item 4 of Table 2 for slab 1 should thus be read as 3 3 3 0 2 . The same reasoning is used for the other three slabs.

b. The difference in the input data between the first and second run lies in the following variables: (1) EFF(I,2) of the joint efficiency card in Item 5 of Table 2, (2) NMT , number of cases to be solved for moment transfer in card 2 of Item 4 of Table 2, (3) INDP in card 1 of Item 4 of Table 2, and (4) CM(j) of the efficiency of moment card in Item 21 of Table 2. They are discussed separately as follows:

   (1) In the first run EFF(I,2) is input as 1.0, i.e., 100 percent efficiency, and the number of cases to be solved NMT and multiplying factor CM(1) are both 1. INDP is also equal to 1.

   (2) In the second run, EFF(I,2) should be input as 0.5 and NMT = 2 (50 percent and zero percent moment transfers). INDP = 0 because moments computed at 100 percent moment transfer computed in the first run are used in this run. CM(1) and CM(2) are input as 1.0 and 0, respectively, because 1.0(CM(1)) × 0.5(EFF(I,2)) = 0.5 , i.e., 50 percent moment transfer, and 0(CM(2)) × 0.5(EFF(I,2)) = 0 , i.e., zero percent and moment transfer. Provisions are made in the program that other combinations of EFF and CM can be used. For instance, EFF(I,2) can be 0.25 and CM(1) and CM(2) can be 2.0 and 0, respectively. However, erroneous results will be computed if EFF is set as 1.0.

   The moments along the joints computed in the first run are stored automatically in the memory. They are multiplied by the coefficient 0.5 or 0 and are used at the joints in the second run.

c. Nodes 1 and 4 at joint 2 are used to check convergence, and node 1 is used for determining whether the relaxation factor RFI should be reduced. Therefore, JNCK , NBCK , NECK , and NNCK should be input as 2, 1, 2, and 1, respectively, in card 3 of Item 4 of Table 2.

d. Dowel bars are used in all four joints to transfer shear forces. Bars 0.5 in. thick spaced 36 in. center-to-center are used in joints 1 and 2, and 1.0-in. bars spaced 12 in. center-to-center are used in joints 3 and 4. A good fit is assumed for all four joints and thus DCBF(j) is arbitrarily selected as 1 in. in Item 11 of Table 2, i.e., a very large value.

62. If it is desired to determine the stresses and deflections due to load alone and the coefficients of moment transfer across the joints are between 0 and 100 percent, the procedure of using NSTORE = 2 in card 1 of Item 5 of Table 2 becomes rather complicated. It is suggested that the stresses due to temperature alone and the stresses due to temperature and load be computed separately. The stress from the temperature alone may be subtracted from the stress from the temperature and load to give the stresses due to load alone.

63. The use of four slabs in this example is for illustration only. Because of symmetry with respect to the Y-axis, only the right half, or slabs 1 and 3, need actually be considered.

Computer Output 1

64. Table 9 shows the Computer Output 1 printout for Example Problem 5. For clarification, the input data for each run are first printed. Therefore, any mistakes in the input data can be easily checked. For convenience of explanation, entry numbers are used in places where explanations are needed. In many places the output print-out is self-explanatory.

Entry 1

65. IFF(I,1) is input as 1.0 because LRT = 2 (Item 11 of Table 2). EFF(I,2) is also input as 1.0 because the efficiency of moment transfer in the first run is 100 percent.

Entry 2

66. Referring to joint 1 of Figure 2, the initial starting nodal numbers at the left side of the joint are nodes 10 and 30, and the last nodes at the right are nodes 16 and 36. For joint 3 in the up-and-down direction, the starting nodal numbers at the bottom are nodes 1 and 16, and the last nodes at the top are nodes 3 and 18. The information printed out can be useful to verify whether the finite element grid coordinate system is input correctly.

Entry 3

67. Unless all joints are 100 percent efficient, a problem

Table 9. Computer Output 1 Printout for Example Problem 5

```
                                                                          Item
  2
          INPUT DATA
FIRST RUN TO OBTAIN RESULTS FOR 100 PERCENT MOMENT TRANSFER,4 SLABS          2
   4     4 9601   500   500   200   130                                      3
   3     3     3     0     2     0
   3     3     0     3     1     0
   3     3     4     0     0     2                                           4
   3     3     0     4     0     1
  1.00000   1.00000
  1.00000   1.00000
  1.00000   1.00000                                                          5
  1.00000   1.00000
   1     1     0     0     1     0     0     1    20
   0     0     0     2     0     0     1     0     0                         6
   2     1     2     1    49   199     0   1570000
   0     0     0     0     0     0
100.00000   0.        0.25000 0.100E-01 0.100E-02 0.380E 08   0.28000  0
BLANK CARD  NO ADDIT. SUBG. MODU. TO BE READ IN                              7
  0.        90.00000 180.00000
  0.        90.00000 180.00000
  0.        90.00000 180.00000
  0.        90.00000 180.00000
  0.        90.00000 180.00000                                               8
  0.        90.00000 180.00000
  0.        90.00000 180.00000
  0.        90.00000 180.00000
  8.00000   0.15000 0.400E 07                                                9
BLANK CARD NO ADDI.THICKNESS TO BE READ IN                                   10
  2 0.            0.50000  36.00000   0.03125 0.150E 07 0.150E 07   1.00000
  2 0.            0.50000  36.00000   0.03125 0.150E 07 0.150E 07   1.00000
  2 0.            1.00000  12.00000   0.12500 0.150E 07 0.150E 07   1.00000  11
  2 0.            1.00000  12.00000   0.12500 0.150E 07 0.150E 07   1.00000
  103680.00                                                                  12
  1  -1.00000  -0.20000  -1.80000  -0.20000  40.80000
  7   0.20000   1.00000  -1.80000  -0.20000  40.80000                        13
BLANK CARD NO. OF NO SUBGRADE CONTACT,NOTEON=0                               14
  2    3    5    6    8   11   13   14   15   17   20   22   23   24   26   29   15
  31   32   33   35
BLANK CARD NO SYMMETRY ON X-AXIS
BLANK CARD NO SYMMETRY ON Y-AXIS                                             16
BLANK CARD NREAD NOT EQUAL ONE                                               17
BLANK CARD NO GAP TO BE READ IN                                              18
BLANK CARD NO CONC. FORCE OR MOMENT APPLIED AT NODES                         19
BLANK CARD NREAD1=0                                                          20
  1.00000                                                                    21
  0.                                                                         22
```

(Continued)

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Table 9 (Continued)

```
FIRST RUN TO OBTAIN RESULTS FOR 100 PERCENT MOMENT TRANSFER,4 SLABS
             FINITE ELEMENT ANALYSIS OF CONCRETE PAVEMENTS

          NSLAB=    4     NJOINT=    4     LNOBD= 9801     LCUD=  300     LCLD=  500     NMPD=  200     NEWD=  130
         FOR SLAB NO. 1 #  NX=    5     NY=    3     JOND=          3          0          2          0
         FOR SLAB NO. 2 #  NX=    5     NY=    3     JOND=          0          3          1          0
         FOR SLAB NO. 3 #  NX=    5     NY=    3     JOND=          4          0          0          2
         FOR SLAB NO. 4 #  NX=    5     NY=    3     JOND=          0          4          0          1
         FOR JOINT NO. 1  JOINT EFFICIENCY EFFS       1.00000       1.00000
Entry 1  FOR JOINT NO. 2  JOINT EFFICIENCY EFFS       1.00000       1.00000
         FOR JOINT NO. 3  JOINT EFFICIENCY EFFS       1.00000       1.00000
         FOR JOINT NO. 4  JOINT EFFICIENCY EFFS       1.00000       1.00000
Entry 2  JOINT NO, INITIAL STARTING NODAL NO. (ISNN) AND LAST FINAL NODAL NO. (LFNN) ON BOTH SIDES OF JOINT ARE
          1     10   30   16   36      2      1   21    9   27      3      1   16    3   18      4      19   34   21   36
       (joint 1)                    (joint 2)                    (joint 3)                     (joint 4)
         JOINT NO. AND VALUES OF IST ARE
          1    1    1      2    2    1      3    2    1      4    1    0  <- IST for the top node of joint 4
       (joint 1)       (joint 2)       (joint 3)       (joint 4)  ^-- IST for the bottom node of joint 4
Entry 3  JOINT NO. AND VALUES OF NUT ARE
          1    0    0      2    5    0      3    1    0      5    0    0

         JOINT NO. AND VALUES OF NMT ARE
          1    0    0      2    5    0      3    3    0      5    0    0

Entry 4  COMPUTED DIMEN. OF STIFFNESS MATRICES C AND G, LNOBF    1620          COMP. DIMEN. OF MATRIX CU,LCUDF    147
         COMP.DIMEN. OF MATRIX CL,LCLDS     245        TOTAL NO OF EQUATIONS,LNO=  108       TOTAL NO. OF NODAL RTS.,LUPF   36

         NLAYER=    1     NBOND=    1     NOTBON=    0     NGAP=    0     NCYCLE=    1     NSTORE=   0     NREAD =    0
           INDP=    1    NPRINT=   20      NTEMP=    0      ICX=    0        ICY=    0      NLOAD=   2       NUCK=    0
            NWT=    0       NMT=    1        NSX=    0      NSY=    0       JNCK=    2       NBCK=   1       NECK=    0
           NNCK=    1       ICL=   49       IBLF=  199    IGNOR=    0      MNRFR=   15    MAXFAJ=70000        NAS=    0
           NAT1=    0      NAT2=    0       IPPR=    0     ILBR=    0     NPUNCH=    0      NCOMP=  0

         SUBG. MODULUS SUBMOD= 100.00000        TEMPS=   0.       RELAXATION FACTOR RFL=   0.25000    TOLERANCE DEL= 0.100E-01
            FINAL TOLER. DELF= 0.100E-02      MODL. OF DOWEL YMSB= 0.300E 08          POISSON S RATIO OF DOWEL PRSB=   0.20000

         FOR SLAB NO. 1 #  X=   0.         90.00000 180.00000
                           Y=   0.         90.00000 180.00000

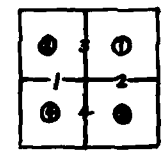
         FOR SLAB NO. 2 #  X=   0.         90.00000 180.00000
                           Y=   0.         90.00000 180.00000

         FOR SLAB NO. 3 #  X=   0.         90.00000 180.00000
                           Y=   0.         90.00000 180.00000

         FOR SLAB NO. 4 #  X=   0.         90.00000 180.00000
                           Y=   0.         90.00000 180.00000

         FOR LAYER NO. 1          THICKNESS T=    8.00000      POISSON'S RATIO PR=   0.15000     MODULUS YM= 0.400E 07

         FOR JOINT NO. 1
```



① ② ③ ④ : Slab No.

1 2 3 4 : Joint No.

(Continued)

Table 9 (Continued)

```
             SHEAR TRANSFER COEF,LTR=          2            SPB. CONST.,SPCON= 0.                        BAR DIAM.,BD=   0.50000
                      BAR SPACING,BS=   36.00000              JOINT WIDTH,WJ=   0.08125   INI MOD OF DOW SUP,SCKV1= 0.150E 07
   FINAL MODULUS OF DOWEL SUPPORT,SCKV2= 0.150E 07           DEFORMATION OF CONCRETE WHEN GOOD FIT IS OBTAINED,DCGF=   1.00000

FOR JOINT NO. 2
             SHEAR TRANSFER COEF,LTR=          2            SPB. CONST.,SPCON= 0.                        BAR DIAM.,BD=   0.50000
                      BAR SPACING,BS=   36.00000              JOINT WIDTH,WJ=   0.08125   INI MOD OF DOW SUP,SCKV1= 0.150E 07
   FINAL MODULUS OF DOWEL SUPPORT,SCKV2= 0.150E 07           DEFORMATION OF CONCRETE WHEN GOOD FIT IS OBTAINED,DCGF=   1.00000

FOR JOINT NO. 3
             SHEAR TRANSFER COEF,LTR=          2            SPB. CONST.,SPCON= 0.                        BAR DIAM.,BD=   1.00000
                      BAR SPACING,BS=   12.00000              JOINT WIDTH,WJ=   0.12500   INI MOD OF DOW SUP,SCKV1= 0.150E 07
   FINAL MODULUS OF DOWEL SUPPORT,SCKV2= 0.150E 07           DEFORMATION OF CONCRETE WHEN GOOD FIT IS OBTAINED,DCGF=   1.00000

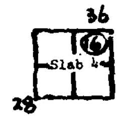
FOR JOINT NO. 4
             SHEAR TRANSFER COEF,LTR=          2            SPR. CONST.,SPCON= 0.                        BAR DIAM.,BD=   1.00000
                      BAR SPACING,BS=   12.00000              JOINT WIDTH,WJ=   0.12500   INI MOD OF DOW SUP,SCKV1= 0.150E 07
   FINAL MODULUS OF DOWEL SUPPORT,SCKV2= 0.150E 07           DEFORMATION OF CONCRETE WHEN GOOD FIT IS OBTAINED,DCGF=   1.00000

LOADS ARE APPLIED ON THE ELEMENT NO.(NL) WITH COORDINATES(XDA , YDA) AND INTENSITY(Q) AS SHOWN
      2       -1.00000      -0.20000       -1900000       -0.20000       40.00000
      7        0.20000       1.00000       -1900000       -0.20000       40.00000

NODAL NO. AT WHICH STRESSES ARE PRINTED
    2    3    5    6    8   11   13   14   15   17   20   22   23   24   26   29   31   32   33   35

SLAB NO., INITIAL NODAL NUMBER(INITNP), LAST NODAL NUMBER(LASTNP), AND LAST ELEMENT NUMBER(LASTENT ARE
1    1    9    4    8   10   18    8    3   19   27   12    9   28   36   16
                                                          Slab 4
AMOUNT OF INITIAL CURLING AND GAP AT THE NODES IS
  1  0.        2  0.        3  0.        4  0.        5  0.        6  0.        7  0.        8  0.
  9  0.       10  0.       11  0.       12  0.       13  0.       14  0.       15  0.       16  0.
 17  0.       18  0.       19  0.       20  0.       21  0.       22  0.       23  0.       24  0.
 25  0.       26  0.       27  0.       28  0.       29  0.       30  0.       31  0.       32  0.
 33  0.       34  0.       35  0.       36  0.

THE MULTIPLYING FACTOR FOR EFFICIENCY OF MOMENT TRANSFER, CM , IS       1.00000
```



Entry 5

```
TOTAL UNIFORMLY APPLIED LOAD INPUT=   103680.00                       TOTAL LOAD CALCULATED=   103680.00
```

Entry 6

Entry 7

```
NO. OF ITERATION CYCLE FOR CHECKING CONTACT,ICC =         1
    CASE NO. FOR MOMENT TRANSFER,KMT=     1                     MULTIPLYING FACTOR FOR EFFICIENCY OF MOMENT TRANSFER,CM=     1.00000

THE DIFFERENCES BETWEEN TWO ITERATIONS ARE TABULATED BELOW,THE LAST INTEGER BEING THE ITERATION NO. IC

   NODE       SHEAR        MOMENT
     1      0.            0.                2   0.            0.             1
     1     -0.130E 05    -0.286E 04         2   0.326E 04     0.113E 06      2
     1      0.244E 04     0.581E 05         2   0.798E 03     0.235E 05      3
     1      0.109E 04     0.171E 05         2   0.751E 03     0.135E 04      4
     1     -0.933E 02    -0.947E 03         2   0.491E 02     0.293E 04      5
     1      0.196E 01     0.289E 03         2   0.318E 02     0.125E 04      6
     1      0.306E 02     0.584E 03         2   0.286E 02     0.186E 04      7
     1      0.107E 02     0.170E 03         2   0.144E 02     0.625E 03      8
```

Entry 8

```
NO. OF ITERATION CYCLE FOR CHECKING CONVERGENCE,          IC=        8
```

Entry 9

(Continued)

(Sheet 3 of 18)

Table 9 (Continued)

Entry 10

```
                                                                    Node No.   Shear       Moment
a.
FOR JOINT NO. 1 SHEAR AND MOMENT AT THE NODES ARE
 10      192.929    -2696.591       13    -3894.981   -837977.452      16   -9499.944 -1414447363
b.
FOR JOINT NO. 1 DIFFERENCE IN DEFLECTION BETWEEN TWO SLABS,SHEAR DEFORMATION OF DOWEL AND ELASTIC DEFORMATION
OF THE CONCRETE AT THE NODES ARE
 10  0.107E-02  0.629E-04  0.501E-05      13 -0.108E-01 -0.635E-03 -0.506E-02      16 -0.524E+01 -0.310E-02 -0.247E-01
                                                                                    Δ = Δst 2Δc       Δs          Δc
c.
FOR JOINT NO. 1 SHEAR AND MOMENT IN ONE DOWEL BAR AT THE NODES ARE
 10      154.343    -2125.225       13    -1557.968   833518.981      16   -7599.956 -1131957490
d.
FOR JOINT NO. 1 BEARING STRESS OF CONCRETE AND SHEAR AND BENDING STRESSES OF DOWELS AT THE NODES ARE
 10           751.681           786.080        -1734877.734      13          -7587.618          -79342.652       -2730243.344
 16         -37013.305        -38706.179       -92371827.875

FOR JOINT NO. 2 SHEAR AND MOMENT AT THE NODES ARE
  1    -9517.088 -140785.621        4    -3876.892   -845767.633       7      194.017   -27937942
```

Joint 1

```
FOR JOINT NO. 2 DIFFERENCE IN DEFLECTION BETWEEN TWO SLABS,SHEAR DEFORMATION OF DOWEL AND ELASTIC DEFORMATION
OF THE CONCRETE AT THE NODES ARE
  1 -0.525E-01 -0.310E-02 -0.247E-01      4 -0.187E-01 -0.632E-03 -0.503E-02       7  0.107E+02  0.632E-04  0.504E-03

FOR JOINT NO. 2 SHEAR AND MOMENT IN ONE DOWEL BAR AT THE NODES ARE
  1    -7613.664 -112628.497        4    -1550.741   -433830.653       7      155.213   -22857153

FOR JOINT NO. 2 BEARING STRESS OF CONCRETE AND SHEAR AND BENDING STRESSES OF DOWELS AT THE NODES ARE
  1         -37080.068        -38775.995       -91941631.000       4          -7552.419          -7897.843       -2761685.969
  7            755.921           790.494        -1824617.502

FOR JOINT NO. 3 SHEAR AND MOMENT AT THE NODES ARE
  1        8.933  209735.093        2      -22.359   137457.797       3       -5.206    74887192
```

Joint 2

```
FOR JOINT NO. 3 DIFFERENCE IN DEFLECTION BETWEEN TWO SLABS,SHEAR DEFORMATION OF DOWEL AND ELASTIC DEFORMATION
OF THE CONCRETE AT THE NODES ARE
  1  0.496E-05  0.243E-06  0.236E-05      2 -0.620E-05 -0.304E-06 -0.295E-05       3 -0.289E-05 -0.141E-06 -0.137E-05

FOR JOINT NO. 3 SHEAR AND MOMENT IN ONE DOWEL BAR AT THE NODES ARE
  1        2.382   55929.347        2      -2.981   10327.706       3       -1.388    19957518

FOR JOINT NO. 3 BEARING STRESS OF CONCRETE AND SHEAR AND BENDING STRESSES OF DOWELS AT THE NODES ARE
  1              3.536             3.083         5787077.625       2             -4.426             -3.796         187017.410
  3             -2.061            -1.767          2815897.345

FOR JOINT NO. 4 SHEAR AND MOMENT AT THE NODES ARE
 19       -2.360   -2327.795       20       14.492    29246.189      21        0.       71686.7854
```

Joint 3

```
FOR JOINT NO. 4 DIFFERENCE IN DEFLECTION BETWEEN TWO SLABS,SHEAR DEFORMATION OF DOWEL AND ELASTIC DEFORMATION
OF THE CONCRETE AT THE NODES ARE
 19 -0.131E-05 -0.641E-07 -0.623E-06      20  0.402E-05  0.197E-06  0.191E-05      21  0.         0.         0.

FOR JOINT NO. 4 SHEAR AND MOMENT IN ONE DOWEL BAR AT THE NODES ARE
 19       -0.629    -620.721       20        1.932     3899.492      21        0.       19183.7161

FOR JOINT NO. 4 BEARING STRESS OF CONCRETE AND SHEAR AND BENDING STRESSES OF DOWELS AT THE NODES ARE
 19             -0.934            -0.801          -63337.890      20              2.868              2.460          39790.733
 21              0.                0.             194930.215
```

Joint 4

NODE	DEFLEC.	ROTAT.X	ROTAT.Y	NODE	DEFLEC.	ROTAT.X	ROTAT.Y	NODE	DEFLEC.	ROTAT.X	ROTAT.Y
1	0.8146E-01	0.2349E-03	-0.6494E-06	2	0.2450E-01	0.5668E-03	-0.1404E-05	3	-0.1183E-02	0.1706E-03	-0.5538E-06
4	0.2075E-01	0.2242E-04	-0.6369E-05	5	0.7681E-02	0.1724E-03	-0.2235E-03	6	-0.1580E-02	0.5830E-08	-0.1898E-04
7	-0.1972E-02	-0.2872E-05	-0.9274E-06	8	-0.1905E-02	0.1039E-04	-0.3559E-04	9	-0.2237E-02	-0.2302E-05	0.2845E-05
10	-0.1979E-02	-0.2704E-05	0.9260E-06	11	-0.1915E-02	0.1014E-04	0.3563E-04	12	-0.2239E-02	-0.2282E-05	-0.2798E-05
13	0.2076E-01	0.2429E-04	0.6374E-08	14	0.7690E-02	0.1721E-03	0.2241E-03	15	-0.1865E-02	0.5828E-04	0.1937E-04

(Continued)

(Sheet 4 of 18)

Table 9 (Continued)

```
16  0.8146E-01  0.2318E-03 -0.6454E-06     17  0.2450E-01  0.5873E-03 -0.1404E-03     18 -0.1186E-02  0.1703E+03 -0.3538E-06
19 -0.1729E-02 -0.6357E-09  0.1264E-07     20  0.6254E-02 -0.2862E-03  0.1104E-06     21  0.2801E-01  0.2844E-03  0.1902E-05
22 -0.1100E-02 -0.2968E-09  0.4811E-08     23  0.2647E-02 -0.1089E-03 -0.5659E-04     24  0.1005E+01  0.2242E+04 -0.2159E-03
25 -0.8317E-03  0.3279E-09  0.2708E-08     26 -0.5568E-03 -0.4339E-05 -0.2072E-04     27 -0.9013E+03 -0.2872E+05 -0.8444E-04
28 -0.8311E-03  0.3238E-09 -0.2712E-08     29 -0.5532E-03 -0.4389E-05  0.2061E-04     30 -0.9134E+03 -0.2704E+05  0.8386E-04
31 -0.1101E-02 -0.2948E-09 -0.4817E-08     32  0.2644E-02 -0.1084E-03  0.5650E-04     33  0.1000E+01  0.2429E+04  0.2161E-03
34 -0.1731E-02 -0.6313E-09  0.1264E-07     35  0.6258E-02 -0.2866E-03  0.1104E-06     36  0.2901E-01  0.2816E-03  0.1902E-05

THE DIFFERENCES BETWEEN TWO ITERATIONS ARE TABULATED BELOW,THE LAST INTEGER BEING THE ITERATION NO. 18

  NODE     SHEAR       MOMENT
    1    0.294E 01   0.580E 02       2  -0.695E 01   0.325E 03        9
    1    0.151E 01   0.337E 02       2  -0.381E 01   0.220E 03       10
    1    0.739E 00   0.176E 02       2  -0.214E 01   0.128E 03       11
    1    0.297E 00   0.931E 01       2  -0.119E 01   0.746E 02       12

     NO. OF ITERATION CYCLE FOR CHECKING CONVERGENCE,              IC=        12

FOR JOINT NO. 1 SHEAR AND MOMENT AT THE NODES ARE=
 10     192.529    -2690.185      13    -3892.457  483687.058       16    -9510.260 -1407437982

FOR JOINT NO. 1 DIFFERENCE IN DEFLECTION BETWEEN TWO SLABS,SHEAR DEFORMATION OF DOWEL AND ELASTIC DEFORMATION
OF THE CONCRETE AT THE NODES ARE =
 10  0.106E-02  0.628E-04  0.500E-03      13 -0.107E-01 -0.634E-03 -0.506E-02      16 -0.929E+01 -0.310E-02 -0.247E-01

FOR JOINT NO. 1 SHEAR AND MOMENT IN ONE DOWEL BAR AT THE NODES ARE=
 10     154.023    -2180.168      13    -1556.963  833424.623       16    -7608.208 -1125947882

FOR JOINT NO. 1 BEARING STRESS OF CONCRETE AND SHEAR AND BENDING STRESSES OF DOWELS AT THE NODES ARE
 10          750.123          784.432        -1730737.316       13          -7982.819         -79292.633       -2732688.625
 16        -37853.495       -38748.287        -91984127.375

FOR JOINT NO. 2 SHEAR AND MOMENT AT THE NODES ARE=
  1   -9511.590 -140698.982       4    -3890.944  583727.840        7      192.789    -26737287

FOR JOINT NO. 2 DIFFERENCE IN DEFLECTION BETWEEN TWO SLABS,SHEAR DEFORMATION OF DOWEL AND ELASTIC DEFORMATION
OF THE CONCRETE AT THE NODES ARE =
  1 -0.525E-01 -0.310E-02 -0.247E-01       4 -0.107E-01 -0.634E-03 -0.505E-02       7  0.106E-02  0.628E-04  0.501E-03

FOR JOINT NO. 2 SHEAR AND MOMENT IN ONE DOWEL BAR AT THE NODES ARE=
  1   -7609.272 -112585.122       4    -1556.378  433511.136        7      154.231    -21887590

FOR JOINT NO. 2 BEARING STRESS OF CONCRETE AND SHEAR AND BENDING STRESSES OF DOWELS AT THE NODES ARE
  1        -37058.678       -38753.627        -91865407.500       4          -7579.871          -7926.551       -2735682.906
  7           751.136          785.491         -1745787.771

FOR JOINT NO. 3 SHEAR AND MOMENT AT THE NODES ARE=
  1        0.659  209935.480       2       12.415  138183.115        3       -1.053    76817695

FOR JOINT NO. 3 DIFFERENCE IN DEFLECTION BETWEEN TWO SLABS,SHEAR DEFORMATION OF DOWEL AND ELASTIC DEFORMATION
OF THE CONCRETE AT THE NODES ARE =
  1  0.365E-06  0.179E-07  0.174E-06       2 -0.670E-06 -0.328E-07 -0.319E-06       3 -0.585E+06 -0.286E-07 -0.278E-06

FOR JOINT NO. 3 SHEAR AND MOMENT IN ONE DOWEL BAR AT THE NODES ARE=
  1        0.176   59902.781       2       10.322   10424.415        3       -0.281    20277188

FOR JOINT NO. 3 BEARING STRESS OF CONCRETE AND SHEAR AND BENDING STRESSES OF DOWELS AT THE NODES ARE
  1            0.261            0.284          5732527.867      2             -0.478             -0.410         188084.236
  3           -0.417           -0.388           2860841.776

FOR JOINT NO. 4 SHEAR AND MOMENT AT THE NODES ARE=
```

(Continued)

(Sheet 5 of 18)

Table 9 (Continued)

```
19     -0.116   -2335.386     20     1.319   29106.093     21     0.     713907722
```

FOR JOINT NO. 4 DIFFERENCE IN DEFLECTION BETWEEN TWO SLABS,SHEAR DEFORMATION OF DOWEL AND ELASTIC DEFORMATION OF THE CONCRETE AT THE NODES ARE =

```
19 -0.646E-07 -0.316E-08 -0.307E-09    20  0.366E-06  0.179E-07  0.174E-06    21  0.    0.    0.
```

FOR JOINT NO. 4 SHEAR AND MOMENT IN ONE DOWEL BAR AT THE NODES ARE=

```
19    -0.031    -682.768    20    0.176    3880.812    21    0.    190877526
```

FOR JOINT NO. 4 BEARING STRESS OF CONCRETE AND SHEAR AND BENDING STRESSES OF DOWELS AT THE NODES ARE

```
19       -0.046        -0.039       -63547575     20        0.261        0.224        39680.126
21        0.            0.           194260467
```

Entry 11

NODE	DEFLEC.	ROTAT.X	ROTAT.Y	NODE	DEFLEC.	ROTAT.X	ROTAT.Y	NODE	DEFLEC.	ROTAT.X	ROTAT.Y
1	0.8144E-01	0.2348E-06	0.4925E-07	2	0.2451E-01	0.5664E-03	-0.1761E-04	3	-0.1168E-02	0.1707E-03	-0.1072E-06
4	0.2075E-01	0.2408E-06	-0.6370E-03	5	0.7681E-02	0.1720E-03	-0.2239E-03	6	-0.1869E-02	0.5832E-04	-0.1929E-04
7	-0.1976E-02	-0.2649E-09	-0.9270E-04	8	-0.1914E-02	0.1020E-04	-0.3556E-04	9	-0.2238E-02	-0.2807E-05	0.2837E-05
10	-0.1977E-02	-0.2591E-09	0.9270E-04	11	-0.1915E-02	0.1016E-04	0.3557E-04	12	-0.2238E-02	-0.2305E-05	-0.2829E-05
13	0.2075E-01	0.2423E-04	0.6371E-03	14	0.7683E-02	0.1719E-03	0.2240E-03	15	-0.1867E-02	0.5831E-04	0.1935E-04
16	0.8144E-01	0.2339E-06	0.4925E-07	17	0.2451E-01	0.5665E-03	-0.1761E-04	18	-0.1168E-02	0.1707E-03	-0.1072E-06
19	-0.1726E-02	-0.6035E-09	-0.4621E-08	20	0.6243E-02	-0.2064E-03	0.6250E-07	21	0.2093E-01	0.2843E-03	0.1159E-06
22	-0.1100E-02	-0.2929E-09	0.4799E-05	23	0.8646E-02	-0.1089E-03	-0.5643E-04	24	0.1001E-01	0.2402E-04	-0.2158E-03
25	-0.8308E-03	0.3229E-09	0.2698E-05	26	-0.5523E-03	-0.4372E-05	-0.2068E-04	27	-0.9119E-03	-0.2645E-05	-0.8404E-04
28	-0.8307E-03	0.3229E-09	-0.2698E-05	29	-0.5517E-03	-0.4381E-05	0.2066E-04	30	-0.9139E-03	-0.2591E-05	0.8399E-04
31	-0.1100E-02	-0.2928E-09	-0.4807E-05	32	0.2646E-02	-0.1085E-03	0.5640E-04	33	0.1001E+01	0.2623E-04	0.2158E-03
34	-0.1726E-02	-0.6039E-09	-0.4621E-08	35	0.6243E-02	-0.2064E-03	0.6250E-07	36	0.2094E+01	0.2839E-03	0.1159E-06

NODE	LAYER	STRESS X	STRESS Y	STRESS XY	MAJOR	MINOR	SHEAR	REACTION
2	1	0.958248E 02	-0.159508E 03	0.901663E 01	-0.159818E 03	0.961422E 02	0.127980E 03	0.295138E 01
3	1	-0.182979E 03	0.	0.	-0.182976E 03	0.	0.914882E 02	-0.166772E 00
5	1	-0.547658E 02	-0.372412E 02	0.553813E 02	-0.102073E 03	0.100678E 02	0.560701E 02	0.768142E 00
6	1	0.332488E 01	0.	0.	0.	0.332486E 01	0.166240E 01	-0.136886E 00
8	1	0.	0.931179E 00	0.	0.	0.931179E 00	0.465588E 00	-0.191364E 00
11	1	0.	0.929278E 00	0.	0.	0.929278E 00	0.464635E 00	-0.191498E 00
13	1	-0.235264E 03	0.412329E 02	-0.331881E 02	-0.239192E 03	0.451608E 02	0.142176E 03	0.287512E 01
14	1	-0.547998E 02	-0.372088E 02	-0.553843E 02	-0.102083E 03	0.100745E 02	0.560783E 02	0.768250E 00
15	1	0.331656E 01	0.	0.	0.	0.331656E 01	0.165828E 01	-0.136653E 00
17	1	0.960247E 02	-0.159531E 03	-0.985367E 01	-0.159851E 03	0.963456E 02	0.128098E 03	0.295131E 01
20	1	0.318049E 01	-0.129488E 03	-0.107144E 02	-0.130340E 03	0.404028E 01	0.671899E 02	0.624263E 00
22	1	0.208468E 01	0.	0.	0.	0.208468E 01	0.104230E 01	-0.109952E 00
23	1	-0.102067E 02	-0.277831E 02	-0.256544E 02	-0.460996E 02	0.812977E 01	0.271147E 02	0.204644E 00
24	1	-0.537003E 02	0.577828E 02	0.134689E 02	-0.553049E 02	0.593479E 02	0.573262E 02	0.180106E 01
26	1	0.	0.445478E 01	0.	0.	0.445474E 01	0.222737E 01	-0.592257E-01
29	1	0.	0.446180E 01	0.	0.	0.446180E 01	0.223090E 01	-0.591679E-01
31	1	0.207903E 01	0.	0.	0.	0.207908E 01	0.103952E 01	-0.109981E 00
32	1	-0.101958E 02	-0.277778E 02	0.256530E 02	-0.461042E 02	0.813067E 01	0.271174E 02	0.204594E 00
33	1	-0.537188E 02	0.578458E 02	-0.184380E 02	-0.553145E 02	0.594418E 02	0.573779E 02	0.180064E 01
35	1	0.311179E 01	-0.129478E 03	0.107243E 02	-0.130332E 03	0.397368E 01	0.671527E 02	0.624299E 00

```
1   0.118E 00   0.594E 01      2  -0.663E 00   0.432E 02      13
```

K × def = lb/ft²

NO. OF ITERATION CYCLE FOR CHECKING CONVERGENCE,   IC=   13

FOR JOINT NO. 1 SHEAR AND MOMENT AT THE NODES ARE=

```
10     192.532    -2690.791      13    -3892.433   483682339      16    -9510.755  -1407057160
```

$K = \frac{P}{def}$

FOR JOINT NO. 1 DIFFERENCE IN DEFLECTION BETWEEN TWO SLABS,SHEAR DEFORMATION OF DOWEL AND ELASTIC DEFORMATION OF THE CONCRETE AT THE NODES ARE =

```
10  0.106E-02  0.628E-04  0.500E-03    13 -0.107E-01 -0.634E-03 -0.506E-02    16 -0.525E-01 -0.310E-02 -0.247E-01
```

FOR JOINT NO. 1 SHEAR AND MOMENT IN ONE DOWEL BAR AT THE NODES ARE=

```
10     154.025    -2120.625      13    -1596.973   433412936      16    -7608.604  -1125447128
```

(Continued)

Table 9 (Continued)

```
FOR JOINT NO. 1 BEARING STRESS OF CONCRETE AND SHEAR AND BENDING STRESSES OF DOWELS AT THE NODES ARE
 10        750.135        784.444      -173112.230     13        -7582.771       -79292584      -2732484.531
 16      -37055.425     -38750.226     -9188908.375

FOR JOINT NO. 2 SHEAR AND MOMENT AT THE NODES ARE=
  1   -9511.472 -140663.367      4   -3891.608  -83754.604      7     192.695   -2664786

FOR JOINT NO. 2 DIFFERENCE IN DEFLECTION BETWEEN TWO SLABS,SHEAR DEFORMATION OF DOWEL AND ELASTIC DEFORMATION
OF THE CONCRETE AT THE NODES ARE =
  1 -0.525E-01 -0.310E-02 -0.247E-01      4 -0.107E-01 -0.634E-03 -0.505E-02      7  0.104E+02  0.628E-04  0.508E-03

FOR JOINT NO. 2 SHEAR AND MOMENT IN ONE DOWEL BAR AT THE NODES ARE=
  1   -7609.178 -112580.693      4   -1596.643  -33493.841      7     154.156   -2181894

FOR JOINT NO. 2 BEARING STRESS OF CONCRETE AND SHEAR AND BENDING STRESSES OF DOWELS AT THE NODES ARE
  1      -37058.220     -38753.187     -9186179.000     4        -7581.164       -79272903      -2734191.125
  7        750.769        785.187      -174032.172

FOR JOINT NO. 3 SHEAR AND MOMENT AT THE NODES ARE=
  1       0.377  209985.982      2      -1.415  -38223.561      3      -0.681    7666160

FOR JOINT NO. 3 DIFFERENCE IN DEFLECTION BETWEEN TWO SLABS,SHEAR DEFORMATION OF DOWEL AND ELASTIC DEFORMATION
OF THE CONCRETE AT THE NODES ARE =
  1  0.210E-06  0.103E-07  0.996E-07      2 -0.393E-06 -0.192E-07 -0.187E-06      3 -0.878E-06 -0.185E-07 -0.388E-06

FOR JOINT NO. 3 SHEAR AND MOMENT IN ONE DOWEL BAR AT THE NODES ARE=
  1       0.101   55992.989      2      -0.189   18429.808      3      -0.182    2080986

FOR JOINT NO. 3 BEARING STRESS OF CONCRETE AND SHEAR AND BENDING STRESSES OF DOWELS AT THE NODES ARE
  1           0.149          0.128       5712547.375     2           -0.260          -0.240       186089.266
  3          -0.270         -0.231       2072427.244

FOR JOINT NO. 4 SHEAR AND MOMENT AT THE NODES ARE=
 19      -0.049   -2385.990     20       0.751   29091.855     21       0.      7138372B2

FOR JOINT NO. 4 DIFFERENCE IN DEFLECTION BETWEEN TWO SLABS,SHEAR DEFORMATION OF DOWEL AND ELASTIC DEFORMATION
OF THE CONCRETE AT THE NODES ARE =
 19 -0.270E-07 -0.132E-08 -0.128E-07     20  0.288E-06  0.102E-07  0.991E-07     21  0.         0.         0.

FOR JOINT NO. 4 SHEAR AND MOMENT IN ONE DOWEL BAR AT THE NODES ARE=
 19      -0.013    -682.987     20       0.180    3878.914     21       0.      1908557929

FOR JOINT NO. 4 BEARING STRESS OF CONCRETE AND SHEAR AND BENDING STRESSES OF DOWELS AT THE NODES ARE
 19          -0.019         -0.017        -6356.192     20            0.149           0.128        39580.759
 21           0.             0.          1942407.088
```

NODE	DEFLEC.	ROTAT.X	ROTAT.Y	NODE	DEFLEC.	ROTAT.X	ROTAT.Y	NODE	DEFLEC.	ROTAT.X	ROTAT.Y
1	0.8144E-01	0.2343E-08	0.3763E-07	2	0.2451E-01	0.5664E-03	-0.1031E-06	3	-0.1167E-02	0.1707E+03	-0.6991E-07
Entry 12 4	0.2075E-01	0.2413E-04	-0.6370E-03	5	0.7681E-02	0.1720E-03	-0.2240E-03	6	-0.1868E-02	0.5331E+04	-0.1931E-04
7	-0.1976E-02	-0.2629E-09	-0.9270E-04	8	-0.1914E-02	0.1019E-04	-0.3556E-04	9	-0.2838E-02	-0.2808E+05	0.2836E-05
10	-0.1977E-02	-0.2589E-09	0.9270E-04	11	-0.1915E-02	0.1017E-04	0.3557E-04	12	-0.2230E-02	-0.2806E+05	-0.2831E-05
13	0.2075E-01	0.2424E-08	0.6370E-03	14	0.7682E-02	0.1719E-03	0.2240E-03	15	-0.1867E-02	0.5331E+04	0.1939E-04
16	0.8144E-01	0.2341E-08	0.3763E-07	17	0.2451E-01	0.5665E-03	-0.1031E-06	18	-0.1167E-02	0.1707E+03	-0.6991E-07
19	-0.1726E-02	-0.6022E-09	-0.2482E-08	20	0.6242E-02	-0.2864E-03	0.3916E-07	21	0.2893E-01	0.2843E+03	0.5920E-07
22	-0.1100E-02	-0.2924E-09	0.4800E-08	23	0.2646E-02	-0.1085E-03	-0.5642E-04	24	0.1001E-01	0.2811E+04	-0.2158E-03
25	-0.8308E-03	0.3220E-09	0.2697E-08	26	-0.5520E-03	-0.4374E-05	-0.2067E-04	27	-0.9226E-03	-0.2824E+05	-0.8402E-04
28	-0.8307E-03	0.3224E-09	-0.2697E-08	29	-0.5516E-03	-0.4380E-05	0.2067E-04	30	-0.9238E-03	-0.2589E+05	0.8390E-04
31	-0.1100E-02	-0.2922E-09	-0.4805E-08	32	0.2646E-02	-0.1085E-03	0.5640E-04	33	0.1001E-01	0.2823E+04	0.2158E-03
34	-0.1726E-02	-0.6029E-09	-0.2482E-08	35	0.6242E-02	-0.2864E-03	0.3916E-07	36	0.2894E-01	0.2841E+03	0.5929E-07

NODE	LAYER	STRESS X	STRESS Y	STRESS XY	MAJOR	MINOR	SHEAR	REACTION
2	1	0.958763E 02	-0.159498E 03	0.982193E 01	-0.159809E 03	0.961946E 02	0.128002E 03	0.245144E 01

(Continued)

(Sheet 7 of 18)

AD-A104 546 ARMY ENGINEER WATERWAYS EXPERIMENT STATION VICKSBURG--ETC F/G 13/13
STRUCTURAL ANALYSIS COMPUTER PROGRAMS FOR RIGID MULTICOMPONENT --ETC(U)
MAY 81 Y T CHOU
UNCLASSIFIED WES/TR/GL-81-6-2 NL

2 of 2

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Table 9 (Continued)

3	1	-0.180622E 03	0.	0.	-0.180622E 03	0.	0.983125E 00	[illegible]
5	1	-0.547769E 03	-0.372300E 02	0.553800E 02	-0.102074E 03	0.180669E 02	0.560706E 02	0.778145E 00
6	1	0.332010E 03	0.	0.	0.	0.332010E 02	0.186009E 01	-0.136811E 00
8	1	0.	0.930228E 00	0.	0.	0.930220E 00	0.465114E 00	-0.191417E 00
11	1	0.	0.929592E 00	0.	0.	0.929592E 00	0.464796E 00	-0.191497E 00
13	1	-0.235264E 03	0.412406E 02	-0.382000E 02	-0.239194E 03	0.451711E 02	0.142183E 03	0.287511E 01
14	1	-0.547969E 03	-0.372126E 02	-0.553813E 02	-0.102080E 03	0.100702E 02	0.560749E 02	0.760809E 00
15	1	0.331397E 03	0.	0.	0.	0.331309E 02	0.185698E 01	-0.136666E 00
17	1	0.959939E 02	-0.159503E 03	-0.984595E 01	-0.159827E 03	0.963130E 02	0.188070E 03	0.295140E 01
20	1	0.316197E 03	-0.129486E 03	-0.107179E 02	-0.130347E 03	0.402239E 03	0.671846E 02	0.624225E 00
22	1	0.208278E 03	0.	0.	0.	0.208273E 03	0.184134E 01	-0.189956E 00
23	1	-0.102022E 03	-0.277662E 02	-0.256543E 02	-0.461000E 02	0.813168E 01	0.271158E 02	0.264642E 00
24	1	-0.537010E 02	0.577600E 02	0.134468E 02	-0.553055E 02	0.593849E 02	0.573450E 02	0.100087E 01
26	1	0.	0.445756E 01	0.	0.	0.445756E 01	0.282878E 01	-0.751979E-01
29	1	0.	0.446334E 01	0.	0.	0.446149E 01	0.283073E 01	-0.751630E-01
31	1	0.207938E 03	0.	0.	0.	0.207938E 01	0.183965E 01	-0.189974E 00
32	1	-0.101950E 03	-0.277740E 02	0.256535E 02	-0.461025E 02	0.813268E 01	0.271176E 02	0.264613E 00
33	1	-0.537129E 03	0.578400E 02	-0.134485E 02	-0.553108E 02	0.594389E 02	0.573747E 02	0.100064E 01
35	1	0.311833E 03	-0.129480E 03	0.187224E 02	-0.130342E 03	0.397979E 01	0.671600E 02	0.624246E 00

(Continued)

(Sheet 8 of 18)

Table 9 (Continued)

```
                                                                                Item
      INPUT DATA
SECOND RUN TO OBTAIN RESULTS FOR ZERO & FIFTY PERC. MOMENT TRANSFER,4 SLABS      2
   4     4  9801   500   500   200   130                                          3
   3     3     3     0     2     0
   3     3     0     3     1     0
   3     3     4     0     0     2                                                4
   3     3     0     4     0     1
  1.00000   0.50000
  1.00000   0.50000                                                               5
  1.00000   0.50000
  1.00000   0.50000
   1     1     0     0     1     0     0     0    20
   0     0     0     2     0     0     2     0     0
   2     1     2     1    49   199     0   1570000                                  6
   0     0     0     0     0     0
100.00000   0.         0.29000 0.1000E-01 0.100E-02 0.300E 08   0.20000   0
BLANK CARD  NO ADDIT. SUBG. MODU. TO BE READ IN                                   7
  0.          90.00000 180.00000
  0.          90.00000 180.00000
  0.          90.00000 180.00000
  0.          90.00000 180.00000
  0.          90.00000 180.00000                                                  8
  0.          90.00000 180.00000
  0.          90.00000 180.00000
  0.          90.00000 180.00000
  8.00000   0.15000 0.400E 07                                                     9
BLANK CARD NO ADDI.THICKNESS TO BE READ IN                                        10
   2 0.           0.50000  36.00000   0.03125 0.150E 07 0.150E 07   1.00000
   2 0.           0.50000  36.00000   0.03125 0.150E 07 0.150E 07   1.00000
   2 0.           1.00000  12.00000   0.03125 0.150E 07 0.150E 07   1.00000       11
   2 0.           1.00000  12.00000   0.03125 0.150E 07 0.150E 07   1.00000
  103680.00                                                                       12
   1  -1.00000  -0.20000  -1.00000  -0.20000  40.00000
   7   0.20000   1.00000  -1.00000  -0.20000  40.00000                            13
BLANK CARD NO. OF NO SUBGRADE CONTACT,NOTBON=0                                    14
   2     3     5     6     8    11    13    14    15    17    20    22    23    24    26    29
  31    32    33    35                                                          15
BLANK CARD NO SYMMETRY ON X-AXIS
BLANK CARD NO SYMMETRY ON Y-AXIS                                                  16
BLANK CARD NREAD NOT EQUAL ONE                                                    17
BLANK CARD NO GAP TO BE READ IN                                                   18
BLANK CARD NO CONC. FORCE OR MOMENT APPLIED AT NODES                              19
BLANK CARD NREAD1=0                                                               20
  1.00000   0.                                                                    21
  0.                                                                              22
```

(Continued)

(Sheet 9 of 18)

Table 9 (Continued)

```
SECOND RUN TO OBTAIN RESULTS FOR ZERO & FIFTY PERC. MOMENT TRANSFER.4 S
                 FINITE ELEMENT ANALYSIS OF CONCRETE PAVEMENTS

  NSLAB=    4     NJOINT=    4     LNOBD= 9801     LCUD=  500     LCLD=  500     NMPD=  200     NEED=  130

  FOR SLAB NO. 1 #  NX=    8     NY=    3     JOAO=       3        0        2        0

  FOR SLAB NO. 2 #  NX=    6     NY=    3     JOAO=       0        3        1        0

  FOR SLAB NO. 3 #  NX=    8     NY=    3     JOAO=       4        0        0        2

  FOR SLAB NO. 4 #  NX=    8     NY=    3     JOAO=       0        4        0        1

  FOR JOINT NO. 1  JOINT EFFICIENCY EFF=       1.00000       0.50000

  FOR JOINT NO. 2  JOINT EFFICIENCY EFF=       1.00000       0.50000

  FOR JOINT NO. 3  JOINT EFFICIENCY EFF=       1.00000       0.50000

  FOR JOINT NO. 4  JOINT EFFICIENCY EFF=       1.00000       0.50000

  JOINT NO. INITIAL STARTING NODAL NO. (ISNN) AND LAST FINAL NODAL NO. (LFNN) ON BOTH SIDES OF JOINT ARE
   1    10   30   16   36      2      1   21    7   27       3      1   16    3   18     4     19   34   21   36

  JOINT NO. AND VALUES OF IST ARE
   1    1    1      8    2    1       3    2    1       4    1    0

  JOINT NO. AND VALUES OF NUT ARE
   1    0    0      2    0    0       3    1    0       4    0    0

  JOINT NO. AND VALUES OF NNT ARE
   1    0    0      8    0    0       3    3    0       4    0    0

  COMPUTED DIMEN. OF STIFFNESS MATRICES C AND G, LNOB=    1620            COMP. DIMEN. OF MATRIX CU,LCUD=     81
  COMP.DIMEN. OF MATRIX CL,LCLD=    108        TOTAL NO OF EQUATIONS,LNO=  108       TOTAL NO. OF NODAL RTS.,LNP=   36

  NLAYER=    1      NBORD=    1     NOTSON=    8       NGAP=    0     NCYCLE=    1     NSTORE=    0     NREAD =    8
    INDP=    0    NPRINT=   20      NTEMP=    8        ICK=    0        ICY=    0      NLOAD=    2       NOCF=    8
     NWT=    0       NBT=    2        RSX=    8        NSY=    0       JNCK=    2       NBCK=    1       NECK=    2
    NNCK=    1       ICL=   99       IBLF=  199      IGNOR=    0      MNRFR=   15     MAXFAJ=70000      NAS=    8
    NATI=    0      NATZ=    0       IFPR=    8       ILBR=    0     NPUNCH=    0     NCOMP=   0

  SUBG. MODULUS SUBMOD= 100.00000          TEMP=   0.       RELAXATION FACTOR RFI=   0.25000    TOLERANCE DEL= 0.100E-01
     FINAL TOLER. DELF= 0.100E-02        MODL. OF DOWEL YMSB= 0.300E 08          POISSON S RATIO OF DOWEL PRSB=   0.20000

  FOR SLAB NO. 1 #  X=   0.        90.00000 180.00000
                    Y=   0.        90.00000 180.00000

  FOR SLAB NO. 2 #  X=   0.        90.00000 180.00000
                    Y=   0.        90.00000 180.00000

  FOR SLAB NO. 3 #  X=   0.        90.00000 180.00000
                    Y=   0.        90.00000 180.00000

  FOR SLAB NO. 4 #  X=   0.        90.00000 180.00000
                    Y=   0.        90.00000 180.00000

  FOR LAYER NO. 1         THICKNESS T=   8.00000     POISSON S RATIO PR=   0.15000     MODULUS YM= 0.400E 07

  FOR JOINT NO. 1
```

(Continued)

(Sheet 10 of 18)

Table 9 (Continued)

```
                    SHEAR TRANSFER CODE,LTB=          2        SPB. CONST.,SPCON= 0.                               BAR DIAM.,BD=   0.50000
                          BAR SPACING,BS=   36.00000              JOINT WIDTH,WJ=    0.08125   INI MOD OFDOW SUP;SCKY1= 0.150E 07
   FINAL MODULUS OF DOWEL SUPPORT,SCKY2= 0.150E 07         DEFORMATION OF CONCRETE WHEN GOOD FIT IS OBTAINED,DCOF=   1.00000

FOR JOINT NO. 2
                    SHEAR TRANSFER CODE,LTB=          2        SPB. CONST.,SPCON= 0.                               BAR DIAM.,BD=   0.50000
                          BAR SPACING,BS=   36.00000              JOINT WIDTH,WJ=    0.08125   INI MOD OFDOW SUP,SCKY1= 0.150E 07
   FINAL MODULUS OF DOWEL SUPPORT,SCKY2= 0.150E 07         DEFORMATION OF CONCRETE WHEN GOOD FIT IS OBTAINED,DCOF=   1.00000

FOR JOINT NO. 3
                    SHEAR TRANSFER CODE,LTB=          2        SPB. CONST.,SPCON= 0.                               BAR DIAM.,BD=   1.00000
                          BAR SPACING,BS=   12.00000              JOINT WIDTH,WJ=    0.08125   INI MOD OFDOW SUP;SCKY1= 0.150E 07
   FINAL MODULUS OF DOWEL SUPPORT,SCKY2= 0.150E 07         DEFORMATION OF CONCRETE WHEN GOOD FIT IS OBTAINED,DCOF=   1.00000

FOR JOINT NO. 4
                    SHEAR TRANSFER CODE,LTB=          2        SPB. CONST.,SPCON= 0.                               BAR DIAM.,BD=   1.00000
                          BAR SPACING,BS=   12.00000              JOINT WIDTH,WJ=    0.08125   INI MOD OFDOW SUP;SCKY1= 0.150E 07
   FINAL MODULUS OF DOWEL SUPPORT,SCKY2= 0.150E 07         DEFORMATION OF CONCRETE WHEN GOOD FIT IS OBTAINED,DCOF=   1.00000

LOADS ARE APPLIED ON THE ELEMENT NO.(BL) WITH COORDINATES(XDA - YDA) AND INTENSITY(Q) AS SHOWN=
        1       -1.00000      -0.20000       -1700000      -0.20000       40.00000
        7        0.20000       1.00000       -1700000      -0.20000       40.00000

NODAL NO, AT WHICH STRESSES ARE PRINTED
    2   3   5   6   8   11   13   14   15   17   20   22   23   24   26   29   31   32   33   35

SLAB NO., INITIAL NODAL NUMBER(INITNP), LAST NODAL NUMBER(LASTNP), AND LAST ELEMENT NUMBER(LASTENT ARE=
1   1   9   4   2   30   18   8   3   19   27   12   9   20   36   16

AMOUNT OF INITIAL CURLING AND GAP AT THE NODES IS=
 1  0.        2  0.        3  0.        4  0.        5  0.        6  0.        7  0.        8  0.
 9  0.       10  0.       11  0.       12  0.       13  0.       14  0.       15  0.       16  0.
17  0.       18  0.       19  0.       20  0.       21  0.       22  0.       23  0.       24  0.
25  0.       26  0.       27  0.       28  0.       29  0.       30  0.       31  0.       32  0.
33  0.       34  0.       35  0.       36  0.

THE MULTIPLYING FACTOR FOR EFFICIENCY OF MOMENT TRANSFER, CM , IS      1.00000     0.

TOTAL UNIFORMLY APPLIED LOAD INPUT=   103680,00                          TOTAL LOAD CALCULATED=   103680.00


NO. OF ITERATION CYCLE FOR CHECKING CONTACT,ICC =       1

CASE NO. FOR MOMENT TRASFER,KMT=    1   (First)          MULTIPLYING FACTOR FOR EFFICIENCE OF MOMENT TRANSFER;CM=     1.00000

THE DIFFERENCES BETWEEN TWO ITERATIONS ARE TABULATED BELOW,THE LAST INTEGER BEING THE ITERATION NO, IC      50 percent moment transfer

NODE      SHEAR        MOMENT
  1   0.             0.             2   0.            0.          1
  1  -0.104E 05      0.             2  -0.233E 04     0.          2
  1  -0.495E 03      0.             2  -0.113E 04     0.          3
  1   0.451E 03      0.             2  -0.125E 03     0.          4
  1   0.330E 03      0.             2   0.107E 02     0.          5
  1   0.174E 03      0.             2   0.202E 02     0.          6
  1   0.818E 02      0.             2   0.198E 02     0.          7

      NO. OF ITERATION CYCLE FOR CHECKING CONVERGENCE,           IC=        7

FOR JOINT NO. 1 SHEAR AND MOMENT AT THE NODES ARE=
```

(Continued)

(Sheet 11 of 18)

Table 9 (Continued)

```
 10     162.460   -1325.391       13   -3507.998  -418661.169      16   -9869.921  -7039275.80

FOR JOINT NO. 1 DIFFERENCE IN DEFLECTION BETWEEN TWO SLABS,SHEAR DEFORMATION OF DOWEL AND ELASTIC DEFORMATION
OF THE CONCRETE AT THE NODES ARE =
 10  0.897E-03  0.530E-04  0.422E-03       13 -0.990E-02 -0.585E-03 -0.466E-02       16 -0.545E-01 -0.322E-02 -0.256E-01

FOR JOINT NO. 1 SHEAR AND MOMENT IN ONE DOWEL BAR AT THE NODES ARE=
 10     129.968   -2120.625       13   -1435.191  -334722.936      16   -7895.937 -1125447.128

FOR JOINT NO. 1 BEARING STRESS OF CONCRETE AND SHEAR AND BENDING STRESSES OF DOWELS AT THE NODES ARE
 10          632.970           661.980        -1751127.230      13          -6989.669          -7389.355       -2732484.531
 16        -38454.794        -40213.597       -91889087.375

FOR JOINT NO. 2 SHEAR AND MOMENT AT THE NODES ARE=
  1   -9847.279  -70351.694        4   -3593.698  -418467.302       7     161.656   -1382748.4

FOR JOINT NO. 2 DIFFERENCE IN DEFLECTION BETWEEN TWO SLABS,SHEAR DEFORMATION OF DOWEL AND ELASTIC DEFORMATION
OF THE CONCRETE AT THE NODES ARE =
  1 -0.544E-01 -0.321E-02 -0.256E-01       4 -0.989E-02 -0.584E-03 -0.465E-02       7  0.892E-03  0.527E-04  0.420E-03

FOR JOINT NO. 2 SHEAR AND MOMENT IN ONE DOWEL BAR AT THE NODES ARE=
  1   -7877.823 -112580.693        4   -1433.455  -334093.841       7     129.325   -2181789.4

FOR JOINT NO. 2 BEARING STRESS OF CONCRETE AND SHEAR AND BENDING STRESSES OF DOWELS AT THE NODES ARE
  1        -38366.576        -40121.343       -91861797.000       4          -6981.215          -7300.514       -2738191.125
  7          629.839           658.686        -1740327.172

FOR JOINT NO. 3 SHEAR AND MOMENT AT THE NODES ARE=
  1      60.418  104987.991        2      29.350   691117.780       3      -0.722     3888708.0

FOR JOINT NO. 3 DIFFERENCE IN DEFLECTION BETWEEN TWO SLABS,SHEAR DEFORMATION OF DOWEL AND ELASTIC DEFORMATION
OF THE CONCRETE AT THE NODES ARE =
  1  0.325E-04  0.164E-05  0.154E-04       2  0.790E-05  0.399E-06  0.375E-05       3 -0.889E-06 -0.196E-07 -0.384E-06

FOR JOINT NO. 3 SHEAR AND MOMENT IN ONE DOWEL BAR AT THE NODES ARE=
  1      16.112   55992.929        2       3.983   10429.808       3      -0.193     2080798.6

FOR JOINT NO. 3 BEARING STRESS OF CONCRETE AND SHEAR AND BENDING STRESSES OF DOWELS AT THE NODES ARE
  1           23.155            20.514         5712547.375      2              5.624             4.983         180089.266
  3           -0.277            -0.289         2872477.244

FOR JOINT NO. 4 SHEAR AND MOMENT AT THE NODES ARE=
 19       0.707   -1187.950       20      -2.596    1454579.27     21       0.        3569176.16

FOR JOINT NO. 4 DIFFERENCE IN DEFLECTION BETWEEN TWO SLABS,SHEAR DEFORMATION OF DOWEL AND ELASTIC DEFORMATION
OF THE CONCRETE AT THE NODES ARE =
 19  0.380E-06  0.192E-07  0.181E-06      20 -0.698E-06 -0.353E-07 -0.332E-06      21  0.         0.         0.

FOR JOINT NO. 4 SHEAR AND MOMENT IN ONE DOWEL BAR AT THE NODES ARE=
 19       0.188    -682.987       20      -0.346    3878.914       21       0.        1908875.29

FOR JOINT NO. 4 BEARING STRESS OF CONCRETE AND SHEAR AND BENDING STRESSES OF DOWELS AT THE NODES ARE
 19            0.271             0.250         -6356.7192      20             -0.497            -0.441          39500.795
 21            0.                0.            19424070.88

NODE    DEFLEC.     ROTAT.X     ROTAT.Y   NODE    DEFLEC.     ROTAT.X     ROTAT.Y   NODE    DEFLEC.     ROTAT.X     ROTAT.Y
   1  0.8899E-01  0.5579E-05 -0.4924E-03     2  0.2509E-01  0.5930E-03 -0.1353E-03     3 -0.6921E-03  0.1775E-03 -0.1293E-04
   4  0.1997E-01  0.9916E-06 -0.5917E-03     5  0.5833E-02  0.1481E-03 -0.1915E-03     6 -0.1871E-02  0.4809E-04 -0.1586E-04
   7 -0.1599E-02  0.1918E-05 -0.9347E-04     8 -0.1963E-02  0.8487E-05 -0.2260E-04     9 -0.2018E-02 -0.5823E-05  0.8509E-05
  10 -0.1598E-02  0.1933E-05  0.9353E-04    11 -0.1964E-02  0.8685E-05  0.2257E-04    12 -0.2012E-02 -0.5422E-05 -0.8510E-05
  13  0.1997E-01  0.9916E-06  0.5917E-03    14  0.5832E-02  0.1480E-03  0.1915E-03    15 -0.1871E-02  0.4809E-04  0.1586E-04
  16  0.8903E-01  0.5581E-05  0.4929E-03    17  0.2509E-01  0.5940E-03  0.1354E-03    18 -0.6925E-03  0.1775E-03  0.1293E-04
```

(Continued)

Table 9 (Continued)

```
19 -0.1651E-02  0.2303E-03  0.5996E-08     20  0.5080E-02 -0.2403E-03 -0.1442E-04     21  0.3463E+01 -0.1194E+03  0.1868E-03
22 -0.1016E-02  0.5927E-09  0.4147E-08     23  0.1563E-02 -0.8623E-04 -0.4537E-04     24  0.1008E+01 -0.5867E+03  0.2224E-03
25 -0.6889E-03  0.6368E-09  0.3371E-08     26 -0.7211E-03 -0.3059E-05 -0.1123E-04     27 -0.7065E+03 -0.4703E+03  0.7969E-04
28 -0.6881E-03  0.6349E-09 -0.3367E-08     29 -0.7194E-03 -0.3069E-05  0.1124E-04     30 -0.7019E+03 -0.4842E+03  0.7957E-04
31 -0.1015E-02  0.5878E-09 -0.4155E-08     32  0.1563E-02 -0.8612E-04  0.4339E-04     33  0.1006E+01 -0.5852E+04  0.2219E-03
34 -0.1651E-02  0.2110E-09 -0.5991E-08     35  0.5079E-02 -0.2978E-03  0.1444E-04     36  0.3454E+01 -0.1181E+03  0.1858E-03

THE DIFFERENCES BETWEEN TWO ITERATIONS ARE TABULATED BELOW,THE LAST INTEGER BEING THE ITERATION NO. IS

NODE     SHEAR      MOMENT
  1   0.363E 02   0.              2   0.793E 01   0.              8
  1   0.154E 02   0.              2   0.362E 01   0.              9
  1   0.625E 01   0.              2   0.156E 01   0.             10

     NO. OF ITERATION CYCLE FOR CHECKING CONVERGENCE,           IC=      10

FOR JOINT NO. 1 SHEAR AND MOMENT AT THE NODES ARE=
 10     159.019   -1325.391       13   -3521.086  841861.169       16   -9791.775  -7035275800

FOR JOINT NO. 1 DIFFERENCE IN DEFLECTION BETWEEN TWO SLABS,SHEAR DEFORMATION OF DOWEL,AND ELASTIC DEFORMATION
OF THE CONCRETE AT THE NODES ARE =
 10  0.878E-03  0.518E-04  0.413E-03       13 -0.984E-02 -0.582E-03 -0.464E-02       16 -0.941E+01 -0.319E-02 -0.856E-01

FOR JOINT NO. 1 SHEAR AND MOMENT IN ONE DOWEL BAR AT THE NODES ARE=
 10     127.216   -2180.625       13   -1420.484  833472.936       16   -7833.480 -1129847128

FOR JOINT NO. 1 BEARING STRESS OF CONCRETE AND SHEAR AND BENDING STRESSES OF DOWELS AT THE NODES ARE
 10          619.565           647.982        -1731127230      13           -6956.761           -7274.942        -2732484.531
 16        -38150.325        -39895.282        891889087375

FOR JOINT NO. 2 SHEAR AND MOMENT AT THE NODES ARE=
  1   -9789.347  -70331.684        4   -3520.552  841887.302        7     158.931   -13827484

FOR JOINT NO. 2 DIFFERENCE IN DEFLECTION BETWEEN TWO SLABS,SHEAR DEFORMATION OF DOWEL,AND ELASTIC DEFORMATION
OF THE CONCRETE AT THE NODES ARE =
  1 -0.540E-01 -0.319E-02 -0.254E-01        4 -0.984E-02 -0.582E-03 -0.464E-02        7  0.877E-03  0.518E-04  0.413E-03

FOR JOINT NO. 2 SHEAR AND MOMENT IN ONE DOWEL BAR AT THE NODES ARE=
  1   -7831.479 -112580.673        4   -1420.283  833493.881        7     127.145   -21817894

FOR JOINT NO. 2 BEARING STRESS OF CONCRETE AND SHEAR AND BENDING STRESSES OF DOWELS AT THE NODES ARE
  1        -38140.862        -39885.387        891861797000        4           -6955.682           -7273.813        -2735191.125
  7          619.220           647.581        -1740327172

FOR JOINT NO. 3 SHEAR AND MOMENT AT THE NODES ARE=
  1       2.126  104987.971        2       3.289   69111780         3      -0.041    38887080

FOR JOINT NO. 3 DIFFERENCE IN DEFLECTION BETWEEN TWO SLABS,SHEAR DEFORMATION OF DOWEL,AND ELASTIC DEFORMATION
OF THE CONCRETE AT THE NODES ARE =
  1  0.114E-05  0.577E-07  0.543E-06        2  0.885E-06  0.447E-07  0.420E-06        3 -0.328E-07 -0.166E-08 -0.156E-07

FOR JOINT NO. 3 SHEAR AND MOMENT IN ONE DOWEL BAR AT THE NODES ARE=
  1       0.567   59982.929        2       0.438   18429.808        3      -0.016    20807936

FOR JOINT NO. 3 BEARING STRESS OF CONCRETE AND SHEAR AND BENDING STRESSES OF DOWELS AT THE NODES ARE
  1            0.815             0.782          5712547375      2               0.630               0.598          188089.266
  3           -0.023            -0.021           287247244

FOR JOINT NO. 4 SHEAR AND MOMENT AT THE NODES ARE=
 19       0.309   -1147.990       20      31.108   14545.927       21       0.       356917616
```

(Continued)

Table 9 (Continued)

FOR JOINT NO. 4 DIFFERENCE IN DEFLECTION BETWEEN TWO SLABS,SHEAR DEFORMATION OF DOWEL AND ELASTIC DEFORMATION
OF THE CONCRETE AT THE NODES ARE =
19 0.166E-06 0.838E-08 0.789E-07 20 -0.200E-06 -0.150E-07 -0.142E-06 21 0. 0. 0.

FOR JOINT NO. 4 SHEAR AND MOMENT IN ONE DOWEL BAR AT THE NODES ARE=
19 0.082 -682.987 20 30.146 3878.914 21 0. 19085.529

FOR JOINT NO. 4 BEARING STRESS OF CONCRETE AND SHEAR AND BENDING STRESSES OF DOWELS AT THE NODES ARE
19 0.118 0.189 -63567.192 20 -0.212 -0.186 39580.755
21 0. 0. 1942407.088

NODE	DEFLEC.	ROTAT.X	ROTAT.Y	NODE	DEFLEC.	ROTAT.X	ROTAT.Y	NODE	DEFLEC.	ROTAT.X	ROTAT.Y
1	0.8899E-01	0.5580E-08	-0.4919E-03	2	0.2504E-01	0.5930E-03	-0.1346E-03	3	-0.6609E-03	0.1268E-03	-0.1276E-04
4	0.2000E-01	0.9958E-08	-0.5917E-03	5	0.5831E-02	0.1482E-03	-0.1912E-03	6	-0.1870E-02	0.3996E-04	-0.1581E-04
7	-0.1602E-02	0.1898E-07	-0.9415E-04	8	-0.1963E-02	0.6650E-05	-0.2269E-04	9	-0.2011E-02	-0.5648E-05	0.8470E-05
10	-0.1602E-02	0.1917E-07	0.9413E-04	11	-0.1963E-02	0.6951E-05	0.2268E-04	12	-0.2011E-02	-0.5648E-05	-0.8472E-05
13	0.2000E-01	0.9964E-08	0.5917E-03	14	0.5830E-02	0.1482E-03	0.1912E-03	15	-0.1870E-02	0.3996E-04	0.1581E-04
16	0.8899E-01	0.5587E-08	0.4919E-03	17	0.2504E-01	0.5938E-03	0.1346E-03	18	-0.6610E-03	0.1268E-03	0.1276E-04
19	-0.1664E-02	0.2317E-07	0.6098E-08	20	0.5114E-02	-0.2022E-03	-0.1679E-04	21	0.3494E-01	-0.1230E-03	-0.1899E-03
22	-0.1023E-02	0.6028E-07	0.4181E-08	23	0.1505E-02	-0.8963E-04	-0.4364E-04	24	0.1014E-01	-0.5141E-04	-0.2243E-03
25	-0.6922E-03	0.6428E-07	0.3410E-08	26	-0.7290E-03	-0.2988E-05	-0.1122E-04	27	-0.7890E-03	-0.4847E-05	-0.8018E-04
28	-0.6921E-03	0.6417E-07	-0.3411E-08	29	-0.7290E-03	-0.2982E-05	0.1122E-04	30	-0.7840E-03	-0.4876E-05	0.8017E-04
31	-0.1023E-02	0.6029E-07	-0.4181E-08	32	0.1505E-02	-0.8961E-04	0.4363E-04	33	0.1014E-01	-0.5149E-04	0.2242E-03
34	-0.1664E-02	0.2308E-07	-0.6094E-08	35	0.5114E-02	-0.2021E-03	0.1679E-04	36	0.3493E-01	-0.1228E-03	0.1898E-03

NODE	LAYER	STRESS X	STRESS Y	STRESS XY	MAJOR	MINOR	SHEAR	REACTION
2	1	0.410559E 02	-0.152038E 03	0.443592E 02	-0.161096E 03	0.495162E 02	0.105306E 03	0.250368E 01
3	1	-0.271149E-01	0.	0.	-0.271148E-01	0.	0.135574E-01	-0.680934E-01
5	1	-0.532759E 02	-0.368989E 02	0.483296E 02	-0.941056E 02	0.393108E 01	0.490183E 02	0.583050E 00
6	1	-0.138539E 01	0.	0.	-0.138535E 01	0.	0.692677E 00	-0.167013E 00
8	1	0.	-0.182832E 01	0.	-0.182832E 01	0.	0.914162E 00	-0.196312E 00
11	1	0.	-0.183018E 01	0.	-0.183010E 01	0.	0.915052E 00	-0.196339E 00
13	1	-0.208143E 03	0.131828E 02	-0.583231E 02	-0.219048E 03	0.240488E 02	0.121548E 03	0.199974E 01
14	1	-0.532788E 02	-0.368098E 02	-0.483315E 02	-0.941093E 02	0.393719E 01	0.490212E 02	0.583019E 00
15	1	-0.138538E 01	0.	0.	-0.138538E 01	0.	0.692689E 00	-0.167017E 00
17	1	0.410549E 02	-0.152658E 03	-0.413011E 02	-0.161112E 03	0.495164E 02	0.105314E 03	0.250377E 01
20	1	-0.256299E 03	-0.114088E 03	-0.204402E 02	-0.118296E 03	0.104728E 03	0.596716E 02	0.511417E 00
22	1	0.753270E 00	0.	0.	0.	0.753276E 00	0.376638E 00	-0.182298E 00
23	1	-0.104823E 03	-0.208898E 02	-0.219595E 02	-0.421010E 02	0.476879E 03	0.284349E 02	0.186502E 00
24	1	-0.592429E 02	0.254048E 02	-0.114439E 02	-0.607676E 02	0.269298E 02	0.438486E 02	0.181416E 01
26	1	0.	0.119858E 01	0.	0.	0.119858E 01	0.599251E 00	-0.728959E-01
29	1	0.	0.119698E 01	0.	0.	0.119698E 01	0.598491E 00	-0.728969E-01
31	1	0.754284E 00	0.	0.	0.	0.754284E 00	0.377142E 00	-0.182274E 00
32	1	-0.104819E 03	-0.208364E 02	0.219514E 02	-0.420879E 02	0.476988E 03	0.284289E 02	0.186474E 00
33	1	-0.592228E 02	0.253651E 02	0.114417E 02	-0.607423E 02	0.268868E 02	0.438142E 02	0.181398E 01
35	1	-0.256067E 03	-0.114665E 03	0.204348E 02	-0.118274E 03	0.104808E 03	0.596612E 02	0.561387E 00

1 0.242E 01 0. 2 0.639E 00 0. 11

NO. OF ITERATION CYCLE FOR CHECKING CONVERGENCE, IC= 11

FOR JOINT NO. 1 SHEAR AND MOMENT AT THE NODES ARE=
10 158.851 -1385.391 13 -3920.194 441861.169 16 -9788.034 -703927580

FOR JOINT NO. 1 DIFFERENCE IN DEFLECTION BETWEEN TWO SLABS,SHEAR DEFORMATION OF DOWEL AND ELASTIC DEFORMATION
OF THE CONCRETE AT THE NODES ARE =
10 0.877E-03 0.518E-04 0.413E-05 13 -0.986E-02 -0.582E-03 -0.464E-02 16 -0.540E-01 -0.319E-02 -0.259E-01

FOR JOINT NO. 1 SHEAR AND MOMENT IN ONE DOWEL BAR AT THE NODES ARE=
10 127.801 -2180.625 13 -1428.062 8334727.936 16 -7830.427 -1125647188

FOR JOINT NO. 1 BEARING STRESS OF CONCRETE AND SHEAR AND BENDING STRESSES OF DOWELS AT THE NODES ARE
10 618.909 647.216 -1731127.230 13 -6954.946 -7273.044 -2732484.531

(Continued)

Table 9 (Continued)

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16        -38135.748       -39829.988       -51889887375

FOR JOINT NO. 2 SHEAR AND MOMENT AT THE NODES ARE=
 1   -9786.928  -70381.694       4   -3589.897  -41867382       7     136.811   -13827484

FOR JOINT NO. 2 DIFFERENCE IN DEFLECTION BETWEEN TWO SLABS,SHEAR DEFORMATION OF DOWEL,AND ELASTIC DEFORMATION
OF THE CONCRETE AT THE NODES ARE =
 1 -0.540E-01 -0.319E-02 -0.254E-01       4 -0.985E-02 -0.582E-03 -0.464E-02       7  0.877E-03  0.510E-04  0.412E-03

FOR JOINT NO. 2 SHEAR AND MOMENT IN ONE DOWEL BAR AT THE NODES ARE=
 1   -7829.542 -112980.673       4   -1427.959  433493.861       7     137.049   -21817894

FOR JOINT NO. 2 BEARING STRESS OF CONCRETE AND SHEAR AND BENDING STRESSES OF DOWELS AT THE NODES ARE
 1        -38131.439        -39875.482        -71961797000        4          -4954.445        -72722520        -273419.185
 7           618.753           647.083        -1740327172                             0

FOR JOINT NO. 3 SHEAR AND MOMENT AT THE NODES ARE=
 1        0.319  104987.971        2       1.087    67121780        3        -0.025     38887000

FOR JOINT NO. 3 DIFFERENCE IN DEFLECTION BETWEEN TWO SLABS,SHEAR DEFORMATION OF DOWEL,AND ELASTIC DEFORMATION
OF THE CONCRETE AT THE NODES ARE =
 1  0.172E-06  0.808E-08  0.816E-07       2  0.432E-06  0.218E-07  0.208E-06       3 -0.336E-07 -0.684E-09 -0.644E-08

FOR JOINT NO. 3 SHEAR AND MOMENT IN ONE DOWEL BAR AT THE NODES ARE=
 1        0.085   59982.929        2       0.284   10429888        3        -0.007     20887906

FOR JOINT NO. 3 BEARING STRESS OF CONCRETE AND SHEAR AND BENDING STRESSES OF DOWELS AT THE NODES ARE
 1            0.122            0.188         5712547375        2            0.388            0.273          180089.246
 3           -0.010           -0.089          287247244

FOR JOINT NO. 4 SHEAR AND MOMENT AT THE NODES ARE=
19        0.180   -1197.978       20      -0.022    14545927       21         0.       356917686

FOR JOINT NO. 4 DIFFERENCE IN DEFLECTION BETWEEN TWO SLABS,SHEAR DEFORMATION OF DOWEL,AND ELASTIC DEFORMATION
OF THE CONCRETE AT THE NODES ARE =
19  0.966E-07  0.489E-08  0.460E-07      20 -0.167E-06 -0.844E-08 -0.794E-07      21  0.         0.         0.

FOR JOINT NO. 4 SHEAR AND MOMENT IN ONE DOWEL BAR AT THE NODES ARE=
19        0.048    -682.987       20      -0.083    3826914       21         0.       196887980

FOR JOINT NO. 4 BEARING STRESS OF CONCRETE AND SHEAR AND BENDING STRESSES OF DOWELS AT THE NODES ARE
19            0.069            0.081         -6356102         20           -0.119           -0.106           37590.755
21            0.               0.            1942407000
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NODE	DEFLEC.	ROTAT.X	ROTAT.Y	NODE	DEFLEC.	ROTAT.X	ROTAT.Y	NODE	DEFLEC.	ROTAT.X	ROTAT.Y
1	0.8899E-01	0.5587E-08	-0.4919E-03	2	0.8503E-01	0.5538E-03	-0.1349E-03	3	-0.4816E-03	0.1768E-03	-0.1279E-04
4	0.2080E-01	0.9760E-04	-0.4917E-03	5	0.5830E-02	0.1482E-03	-0.1912E-03	6	-0.1870E-02	0.3796E-04	-0.1581E-04
7	-0.1603E-02	0.1807E-09	-0.9417E-04	8	-0.1963E-02	0.8650E-05	-0.2269E-04	9	-0.2011E-02	-0.5649E-05	0.8468E-05
10	-0.1602E-02	0.1917E-09	0.9417E-04	11	-0.1963E-02	0.8649E-05	0.2269E-04	12	-0.2011E-02	-0.5650E-05	-0.8469E-05
13	0.2080E-01	0.9767E-04	0.4917E-03	14	0.5830E-02	0.1482E-03	0.1912E-03	15	-0.1870E-02	0.3795E-04	0.1581E-04
16	0.8899E-01	0.5580E-08	0.4919E-03	17	0.2503E-01	0.5538E-03	0.1349E-03	18	-0.4816E-03	0.1768E-03	0.1279E-04
19	-0.1665E-02	0.2203E-09	0.6103E-08	20	0.8117E-02	-0.2023E-03	-0.1677E-04	21	0.3496E-01	-0.1232E-03	-0.1901E-03
22	-0.1023E-02	0.6030E-09	0.4184E-08	23	0.4565E-02	-0.8060E-04	-0.4365E-04	24	0.1014E-01	-0.5144E-04	-0.2244E-03
25	-0.6924E-03	0.6923E-09	0.3413E-08	26	-0.7274E-03	-0.2989E-05	-0.1122E-04	27	-0.7850E-03	-0.4642E-05	-0.8021E-04
28	-0.6923E-03	0.6923E-09	-0.3413E-08	29	-0.7295E-03	-0.2978E-05	0.1122E-04	30	-0.7851E-03	-0.4669E-05	0.8021E-04
31	-0.1023E-02	0.6030E-09	-0.4184E-08	32	0.4565E-02	-0.8064E-04	0.4365E-04	33	0.1014E-01	-0.5150E-04	0.2243E-03
34	-0.1664E-02	0.2207E-09	-0.6101E-08	35	0.5116E-02	-0.2022E-03	0.1677E-04	36	0.3498E-01	-0.1230E-03	0.1980E-03

NODE	LAYER	STRESS X	STRESS Y	STRESS XY	MAJOR	MINOR	SHEAR	REACTION
2	1	0.410548E 02	-0.182050E 02	0.413962E 02	-0.181111E 03	0.495138E 02	0.185316E 03	0.720338E 01
3	1	-0.250867E-03	0.	0.	-0.250867E-01	0.	0.125435E-01	-0.766160E-01
5	1	-0.532684E 02	-0.369828E 02	0.483308E 02	-0.994104E 02	0.393308E 02	0.490187E 02	0.583832E 00

(Continued)

(Sheet 15 of 18)

6	1	-0.138450E 03	0.	0.	-0.113845E 01	0.	0.692248E 00	-0.716781E 00
8	1	0.	-0.102700E 01	0.	-0.102780E 01	0.	0.913944E 00	-0.719631E 00
11	1	0.	-0.102740E 01	0.	-0.102940E 01	0.	0.914702E 00	-0.719634E 00
13	1	-0.208139E 03	0.131610E 02	-0.583202E 02	-0.219042E 03	0.240508E 02	0.121546E 03	0.719994E 01
14	1	-0.532708E 02	-0.368940E 02	-0.403582E 02	-0.994103E 02	0.393872E 03	0.490810E 02	0.750300E 00
15	1	-0.138458E 03	0.	0.	-0.138452E 01	0.	0.692258E 00	-0.716701E 00
17	1	0.410529E 02	-0.152673E 03	-0.443605E 02	-0.161134E 03	0.495137E 02	0.105324E 03	0.280342E 01
20	1	-0.256340E 03	-0.114710E 03	-0.204529E 02	-0.110330E 03	0.104809E 03	0.596091E 02	0.758165E 00
22	1	0.753950E 00	0.	0.	0.	0.753950E 00	0.386975E 00	-0.710233E 00
23	1	-0.104089E 03	-0.208970E 02	-0.219668E 02	-0.421151E 02	0.476891E 03	0.284420E 02	0.710692E 00
24	1	-0.592409E 02	0.254022E 02	-0.184770E 02	-0.600796E 02	0.209308E 02	0.480634E 02	0.710144E 01
26	1	0.	0.119726E 01	0.	0.	0.119926E 01	0.599600E 00	-0.772935E-01
29	1	0.	0.119781E 01	0.	0.	0.119781E 01	0.598906E 00	-0.772951E-01
31	1	0.754339E 00	0.	0.	0.	0.754339E 00	0.377170E 00	-0.710232E 00
32	1	-0.104083E 03	-0.208670E 02	0.219655E 02	-0.481071E 02	0.477128E 03	0.234392E 02	0.710649E 00
33	1	-0.592599E 02	0.258610E 02	0.114012E 02	-0.600784E 02	0.208860E 02	0.480355E 02	0.710144E 01
35	1	-0.256700E 03	-0.114716E 03	0.204519E 02	-0.110329E 03	0.104810E 03	0.596085E 02	0.751163E 00

CASE NO. FOR MOMENT TRASFER,KMT= 2 (Second) MULTIPLYING FACTOR FOR EFFICIENCE OF MOMENT TRANSFER,CM= 0.

THE DIFFERENCES BETWEEN TWO ITERATIONS ARE TABULATED BELOW,THE LAST INTEGER BEING THE ITERATION NO. 10 Zero percent moment transfer

NODE	SHEAR	MOMENT				
1	0.	0.	2	0.	0.	1
1	-0.106E 05	0.	2	-0.203E 04	0.	2
1	-0.517E 03	0.	2	-0.111E 04	0.	3
1	0.448E 03	0.	2	-0.124E 03	0.	4
1	0.330E 03	0.	2	0.108E 02	0.	5
1	0.174E 03	0.	2	0.252E 02	0.	6
1	0.818E 02	0.	2	0.158E 02	0.	7
1	0.363E 02	0.	2	0.793E 01	0.	8
1	0.154E 02	0.	2	0.362E 01	0.	9
1	0.625E 01	0.	2	0.156E 01	0.	10

NO. OF ITERATION CYCLE FOR CHECKING CONVERGENCE, IC= 10

FOR JOINT NO. 1 SHEAR AND MOMENT AT THE NODES ARE=

10 125.223 0. 13 -3248.280 0. 16 -10046.009 0. Moment equal = zero because of zero percent moment transfer

FOR JOINT NO. 1 DIFFERENCE IN DEFLECTION BETWEEN TWO SLABS,SHEAR DEFORMATION OF DOWEL,AND ELASTIC DEFORMATION OF THE CONCRETE AT THE NODES ARE =

10 0.691E-03 0.408E-04 0.325E-03 13 -0.897E-02 -0.529E-03 -0.422E-02 16 -0.594E-01 -0.328E-02 -0.261E-01

FOR JOINT NO. 1 SHEAR AND MOMENT IN ONE DOWEL BAR AT THE NODES ARE=

10 100.178 0. 13 -1299.288 0. 16 -8052.807 0.

FOR JOINT NO. 1 BEARING STRESS OF CONCRETE AND SHEAR AND BENDING STRESSES OF DOWELS AT THE NODES ARE

10 487.887 510.281 0. 13 -6327.794 -8617.207 0.

16 -39218.781 -41812.526 0.

FOR JOINT NO. 2 SHEAR AND MOMENT AT THE NODES ARE=

1 -10063.668 0. 4 -3247.695 0. 7 125.135 0.

FOR JOINT NO. 2 DIFFERENCE IN DEFLECTION BETWEEN TWO SLABS,SHEAR DEFORMATION OF DOWEL,AND ELASTIC DEFORMATION OF THE CONCRETE AT THE NODES ARE =

1 -0.596E-01 -0.328E-02 -0.261E-01 4 -0.896E-02 -0.529E-03 -0.422E-02 7 0.691E-03 0.408E-04 0.325E-03

FOR JOINT NO. 2 SHEAR AND MOMENT IN ONE DOWEL BAR AT THE NODES ARE=

1 -8050.934 0. 4 -1299.070 0. 7 100.108 0.

FOR JOINT NO. 2 BEARING STRESS OF CONCRETE AND SHEAR AND BENDING STRESSES OF DOWELS AT THE NODES ARE

(Continued)

Table 9 (Continued)

```
 1      -39209.601       -41002.989       0.      4      -6326.730      -8616.095      0.
 9         487.548          509.847       0.

FOR JOINT NO. 3 SHEAR AND MOMENT AT THE NODES ARE=
 1      2.297      0.      2      3.194      0.      3      -0.050      0.

FOR JOINT NO. 3 DIFFERENCE IN DEFLECTION BETWEEN TWO SLABS,SHEAR DEFORMATION OF DOWEL,AND ELASTIC DEFORMATION
OF THE CONCRETE AT THE NODES ARE =
 1  0.123E-05  0.619E-07  0.582E-06     2  0.854E-06  0.431E-07  0.406E-06     3 -0.267E-07 -0.135E-08 -0.127E-07

FOR JOINT NO. 3 SHEAR AND MOMENT IN ONE DOWEL BAR AT THE NODES ARE=
 1      0.607      0.      2      0.423      0.      3      -0.013      0.

FOR JOINT NO. 3 BEARING STRESS OF CONCRETE AND SHEAR AND BENDING STRESSES OF DOWELS AT THE NODES ARE
 1           0.873           0.773       0.      2      0.608      0.539      0.
 3          -0.019          -0.057       0.

FOR JOINT NO. 4 SHEAR AND MOMENT AT THE NODES ARE=
 19     0.317      0.      20     -1.209     0.      21      0.      0.

FOR JOINT NO. 4 DIFFERENCE IN DEFLECTION BETWEEN TWO SLABS,SHEAR DEFORMATION OF DOWEL,AND ELASTIC DEFORMATION
OF THE CONCRETE AT THE NODES ARE =
 19  0.170E-06  0.860E-08  0.809E-07     20 -0.325E-06 -0.164E-07 -0.154E-06     21  0.      0.      0.

FOR JOINT NO. 4 SHEAR AND MOMENT IN ONE DOWEL BAR AT THE NODES ARE=
 19     0.084      0.      20     -0.161     0.      21      0.      0.

FOR JOINT NO. 4 BEARING STRESS OF CONCRETE AND SHEAR AND BENDING STRESSES OF DOWELS AT THE NODES ARE
 19          0.121           0.108       0.      20     -0.232     -0.205      0.
 21          0.              0.          0.
```

NODE	DEFLEC.	ROTAT.X	ROTAT.Y	NODE	DEFLEC.	ROTAT.X	ROTAT.Y	NODE	DEFLEC.	ROTAT.X	ROTAT.Y
1	0.9654E-01	0.8838E-05	-0.9839E-03	2	0.2555E-01	0.5412E-03	-0.2689E-03	3	-0.1801E-03	0.1028E-03	-0.2539E-04
4	0.1925E-01	0.1751E-05	-0.5464E-03	5	0.3979E-02	0.1249E-03	-0.1584E-03	6	-0.1973E-02	0.2659E-04	-0.1228E-04
7	-0.1228E-02	0.6419E-09	-0.9564E-04	8	-0.2012E-02	0.7132E-05	-0.9819E-05	9	-0.1784E-02	-0.8593E-05	0.1410E-04
10	-0.1228E-02	0.6414E-09	0.9563E-04	11	-0.2012E-02	0.7132E-05	0.9815E-05	12	-0.1784E-02	-0.8593E-05	-0.1410E-04
13	0.1925E-01	0.1751E-05	0.5464E-03	14	0.3979E-02	0.1249E-03	0.1584E-03	15	-0.1973E-02	0.2659E-04	0.1228E-04
16	0.9654E-01	0.8838E-05	0.9839E-03	17	0.2555E-01	0.5412E-03	0.2689E-03	18	-0.1801E-03	0.1028E-03	0.2539E-04
19	-0.1603E-02	0.1068E-06	0.1220E-04	20	0.3991E-02	-0.2380E-03	-0.3360E-04	21	0.4098E-01	-0.4806E-03	-0.3801E-03
22	-0.9470E-03	0.1497E-06	0.3567E-05	23	0.4830E-03	-0.6481E-04	-0.3089E-04	24	0.1028E-01	-0.1273E-03	-0.2329E-03
25	-0.5539E-03	0.9627E-09	0.4130E-05	26	-0.9076E-03	-0.1980E-05	-0.1763E-05	27	-0.5867E-03	-0.6747E-05	-0.7643E-04
28	-0.5538E-03	0.9629E-09	-0.4130E-05	29	-0.9073E-03	-0.1982E-05	0.1763E-05	30	-0.5862E-03	-0.6750E-05	0.7641E-04
31	-0.9468E-03	0.1498E-06	-0.3567E-05	32	0.4830E-03	-0.6479E-04	0.3088E-04	33	0.1028E-01	-0.1272E-03	0.2328E-03
34	-0.1603E-02	0.1059E-06	-0.1220E-04	35	0.3991E-02	-0.2380E-03	0.3360E-04	36	0.4096E-01	-0.4805E-03	0.3800E-03

NODE	LAYER	STRESS X	STRESS Y	STRESS XY	MAJOR	MINOR	SHEAR	REACTION
2	1	0.	-0.145842E 03	0.736945E 02	-0.176595E 03	0.307533E 02	0.103674E 03	0.255504E 01
3	1	0.	0.	0.	0.	0.	0.	-0.160063E-01
5	1	-0.517549E 02	-0.365778E 02	0.412837E 02	-0.861411E 02	-0.219031E 01	0.419754E 02	0.397902E 00
6	1	-0.608157E 01	0.	0.	-0.608157E 01	0.	0.304078E 01	-0.197250E 00
8	1	0.	-0.458858E 01	0.	-0.458858E 01	0.	0.229429E 01	-0.201193E 00
11	1	0.	-0.458902E 01	0.	-0.458902E 01	0.	0.229451E 01	-0.201192E 00
13	1	-0.181003E 03	0.	-0.674579E 02	-0.203378E 03	0.223749E 02	0.112876E 03	0.192479E 01
14	1	-0.517560E 02	-0.365749E 02	-0.412842E 02	-0.861421E 02	-0.218946E 01	0.419763E 02	0.397899E 00
15	1	-0.608152E 01	0.	0.	-0.608152E 01	0.	0.304076E 01	-0.197253E 00
17	1	0.	-0.145841E 03	-0.736968E 02	-0.176596E 03	0.307551E 02	0.103675E 03	0.255512E 01
20	1	0.	-0.999318E 02	-0.381828E 02	-0.108340E 03	0.840877E 01	0.583743E 02	0.399090E 00
22	1	-0.574059E 00	0.	0.	-0.574054E 00	0.	0.287027E 00	-0.946958E-01
23	1	-0.107770E 02	-0.259538E 02	-0.182766E 02	-0.381409E 02	0.142993E 01	0.197854E 02	0.483028E-01
24	1	-0.648280E 02	0.	-0.364109E 02	-0.811631E 02	0.163344E 02	0.487488E 02	0.102838E 01
26	1	0.	-0.206535E 01	0.	-0.206535E 01	0.	0.103267E 01	-0.907567E-01
29	1	0.	-0.206557E 01	0.	-0.206557E 01	0.	0.103278E 01	-0.907303E-01

(Continued)

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Table 9 (Concluded)

31	1	-0.573038E 08	0.	0.	-0.573032E 00	0.	0.286516E 00	-0.946768E-01
32	1	-0.107768E 02	-0.259278E 02	0.182713E 02	-0.381313E 02	0.142777E 03	0.197795E 02	0.483020E-01
33	1	-0.648076E 02	0.	0.363991E 02	-0.811367E 02	0.163292E 02	0.487330E 02	0.182814E 01
35	1	0.	-0.998761E 02	0.381738E 02	-0.108303E 03	0.840662E 03	0.583547E 02	0.399098E 00

(Sheet 18 of 18)

exists at the junction of four slabs. In Figure 9, both nodes 16 and 21 impose a deflection to node 36. A question then immediately arises as to which node, 16 or 21, should be used. To facilitate the analysis, it is assumed that the node having a smaller nodal number should be used. In this case, only node 16 can impose a deflection on node 36, while node 21 is not connected to node 36. This is shown in Figure 9 where slabs 3 and 4 are not connected at the junction. The omission of shear transfer between nodes 21 and 36 yields greater stresses and displacements in the pavement and is therefore on the safe side.

68. Another problem exists at node 16 because a deflection is imposed from node 1 and at the same time a reactive force from node 36 (due to the deflection of slab 4). Because the deflection is fixed at node 16, the imposed reactive force actually has no effect on the solution. Since node 16 and node 1 are connected by a dowel bar, the reactive force at node 36 is not imposed to node 16 but is transferred to node 1, or the first node on joint 3.

69. The output information in Entry 3 explains how the shear forces are transferred across the joints. Before going into detail, the definitions of IST, NJT , and NKT are explained as follows:

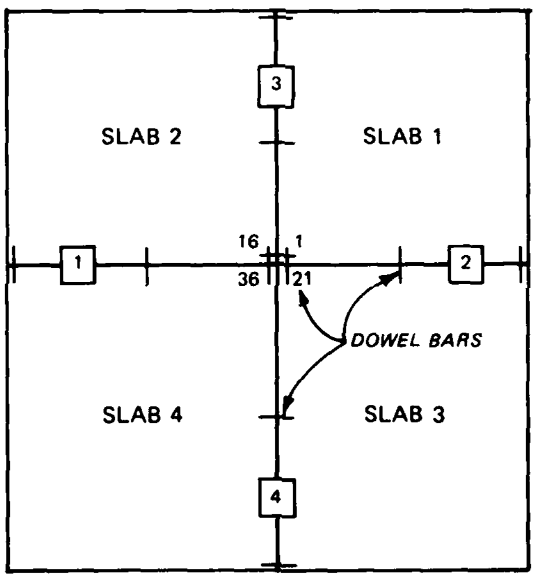

Figure 9. Shear transfer at the junction of four slabs

a. IST is an identification for shear transfer at corners of the slabs. It is two-dimensional in the program as IST(NJOINT,i) , where i = 1 and 2. The left or bottom node on the given joint is indicated by setting i = 1 and the right or top node by setting i = 2 . An IST of 0 indicates that there is no shear transfer at the node across the joint; 1 indicates that there is a regular shear transfer, and 2 indicates that the shear force at node NKT of joint NJT must be transferred here.

b. NJT is the joint number from which shear is transferred. NJT is also two-dimensional in the program as NJT(NJOINT,i) , where i = 1,2 . The meaning of the indexes is the same as in IST . The program will print 0 if IST(NJOINT,i) = 0 or 1 .

c. NKT is the nodal number of joint NJT from which shear is transferred. It should be noted that the nodal number here is defined differently from those shown in Figure 1. Node 1 is the node either at far left or at the very bottom, then counting from left to right or from bottom to top. NKT is also two-dimensional in the program similar to NJT(NJOINT,i) . Also, the program will print 0 if IST(JOINT,i) = 0 or 1 .

70. In Entry 3, two values of IST , NJT , and NKT are printed for each joint. The first number refers to the node either at the left or at the bottom of the joint; the second number refers to the node either at the right or at the top of the joint.

71. Referring to Figure 2, the shear transfer at two end nodes of joint 1 is regular, so the values of IST are both printed as 1 and consequently the values of NJT and NKT are all zeros. The shear transfer at the bottom node of joint 3 is more complicated. At node 16, it is not necessary to impose a reactive force from node 36 because a deflection is imposed from node 1 so that the force at node 36 of joint 1 is directly transferred to node 1. Note that node 36 is the third node (counting from the left) at joint 1; the values of IST , NJT , and NKT at the lower end of joint 3 are thus 2, 1, and 3, respectively. This means that the shear force at node 36 of joint 1 is transferred to the node at the lower end of joint 3.

72. The information printed out in Entry 3 is quite involved and is difficult to understand. Fortunately, complete appreciation of

Entry 3 by the user is not required because such an understanding is not a prerequisite to the use of other output data.

Entry 4

73. Entry 4 prints out the computed dimensions of matrices and other information. Note that the computed values are less than those declared.

Entry 5

74. Initial curlings and gaps are deformations due to temperature and gaps. Initial curlings are computed solely based on the temperature differential, and the concrete weight and subgrade reactive forces are not considered. Since temperature and gaps are not considered in the example problem, the values printed out in Entry 5 are all zeros. Note that when temperature is considered, the initial curling of the slabs should be symmetrical, provided that the thicknesses of the slabs are uniform and the finite element grid patterns are not far off from being symmetrical. When the user is skeptical about the computed stresses and deflections, the output shown in Entry 5 should first be checked.

Entry 6

75. Because of the method used in specifying the uniformly applied load, a small difference may exist between the actual load and the input (or calculated) load. The printout in Entry 6 is presented for visual inspection. In the program, the operation will be terminated for the particular run when the difference between the actual and the calculated load exceeds 3 percent.

Entry 7

76. The variable ICC in the program refers to the number of iteration cycle for checking the subgrade contact. In this example computer output NCYCLE = 1 , so ICC is limited to 1.

Entry 8

77. The differences between the two iterations are generally decreasing, indicating the solution is converging. The iteration continues until the ratio of the difference in values becomes smaller than the specified DEL or DELF .

Entry 9

78. The variable IC in the program refers to the number of iteration cycles for checking the convergence of shear forces for a given subgrade contact condition.

Entry 10

79. The values printed out in Entry 10 are self-explanatory. Negative shear force indicates that the force is acting upward. The sign convention for moment is shown in Figure 1 of Report 1 of this series. The definition of difference in deflection Δ is expressed in Equation 17 of Report 1 of this series. It is seen that the magnitude of elastic deformation of the concrete is much greater than that of the shear deformation of the dowel bar.

Entry 11

80. The displacements and stresses are printed when the convergence requirements are met. Positive stress indicates that the slab has compression at the top and tension at the bottom and negative stress indicates the opposite. The symbols of stress XY, major, minor, shear, and reaction stand for shear stress, major principal stress, minor principal stress, maximum shear stress, and subgrade reactive stress, respectively. The subgrade reactive stress is computed as the product of modulus of subgrade reaction k (pci) and slab deflection (in.), so it has a unit of psi. To obtain the total reactive force acting at the node, the subgrade reactive stress should be multiplied by the affected area.

Entry 12

81. The stresses and displacements are computed for one more iteration for inspection of convergence by the user. When the solution correctly converges, the differences in the computed results between two iterations should be insignificant. Otherwise, the solution is not convergent.

Computer Output 2

82. Table 10 shows the Computer Output 2 printout for an example

Table 10. Computer Output 2 Printout

```
SNUMB = R0752, ACTIVITY # = 02, REPORT CODE = 06, RECORD COUNT = 000260

  1
         INPUT DATA
SINGLE SLABS GAP AND TEMPERATURE CONSIDERED
  1     0 4000   500   500   200   130
  7     7     0     0     0     0
 BLANK HERE;NO. OF JOINT NJOINT=0,BE NO JOINT SIF, NEEDED
  1     1     0     9    10     0     0     1    14
  1     1     1     1     0     1     1     7     7
  0     0     0     0    45   100     0     6          0
  0     0     0     0     0     0
100.00000  45.00000   0.25000 0.100E-01 0.100E-02 0.300E 08   0.20000
BLANK CARD  NO ADDIT. SUBG. MODU. TO BE READ IN
 0.        10.00000  30.00000  60.00000  90.00000 120.00000 150.00000
 0.        10.00000  30.00000  60.00000  90.00000 120.00000 150.00000
 12.00000   0.15000 0.600E 07
BLANK CARD NO ADDI.THICKNESS TO BE READ IN
BLANK CARD  NO. OF JOINT NJOINT=0
  20000.00
  1  -1.00000   1.00000  -1.00000   1.00000 200.00000
BLANK CARD NO. OF NO SUBGRADE CONTACT,NOTCOH=0
  1     8    15    22    29    36    43     1     9    17    25    33    41    49
  1     8    15    22    29    36    43
  1     2     3     4     5     6     7
BLANK CARD NREAD NOT EQUAL ONE
  1   1.00000     2   0.80000     8   0.80000     9   0.75000     3   0.50000
 15   0.48000    17   0.40000    10   0.48000    16   0.48000
BLANK CARD NO CONC. FORCE OR MOMENT APPLIED AT NODES
BLANK CARD NREAD1=0
 0.
```


(Continued)

(Sheet 1 of 5)

Table 10 (Continued)

```
SINGLE SLAB* GAP AND TEMPERATURE CONSIDERED
              FINITE ELEMENT ANALYSIS OF CONCRETE PAVEMENTS

   NSLAB=    1     NJOINT=    C     LNOBD= 4000   LCUD=  500    LCLD=  500    NNPD=  208    NELD=  138

   FOR SLAB NO. 1 #  NX=    7     NY=    7     JONE=          0          0          0          0

   JOINT NO. INITIAL STARTING NODAL NO. (ISNN) AND LAST FINAL NODAL NO. (LFAN) ON BOTH SIDES OF JOINT ARE
    1       0     0     0     0

   JOINT NO. AND VALUES OF IST ARE
    1     0     0

   JOINT NO. AND VALUES OF NJT ARE
    1     0

   JOINT NO. AND VALUES OF NKT ARE
    1     0     0                                                          COMP. DIMEN. OF MATRIX CU.LCUD=      1
                                                                              TOTAL NO. OF NODAL PTS.,LNP=   49
   COMPUTED DIMEN. OF STIFFNESS MATRICES C AND G. LNCB=    3969
   COMP.DIMEN. OF MATRIX CL,LCLC=       1            TOTAL NO OF EQUATIONS,LNO=  147

                                                   NGAP=     9     NCYCLE=   10     NSTORE=    0     NREAD =   0
   NLAYER=    1     NBOND=    1     NOTCON=    0    ICX=     1        ICY=    1     NLOAD=     1      NNOP=    0
     INDP=    1     NPRINT=  14     NTEMP=     1    NSY=     7       JNCK=    0      NBCK=     0      NECK=    0
      NNT=    1       NNT=    1       NSX=     7  IGNOR=     0      NNRFR=    0       NAS=     0    MAXFAJ=          0
    NUCK=    0       ICL=   49      ICLF=   199    ILPR=     0     NPUNCH=    0     NCOMP=     0
    NATI=    0      NAT2=    0      IFPR=     0
                                             TEMP1=  45.00000    RELAXATION FACTOR RFI=   0.25000   TOLERANCE DEL= 0.100E-03
   SUBG. MODULUS SUBMOD= 100.00000         MODULUS OF DOWEL YMSG= 0.300E 08     POISSON S RATIO OF DOWEL PRSG=   0.20000
      FINAL TOLER. DELF= 0.100E-02

   FOR SLAB NO. 1 #  X=    0.         10.00000  30.00000  60.00000  90.00000 120.00000 150.00000
                     Y=    0.         10.00000  30.00000  60.00000  90.00000 120.00000 150.00000

   FOR LAYER NO. 1          THICKNESS TS  12.00000     POISSSON S RATIO PR=   0.15000     MODULUS YM= 5.000E 07

   LOADS ARE APPLIED ON THE ELEMENT NC.(AL) WITH COORDINATES(XDA + YDA) AND INTENSITY(U) AS SHOWN*
          2           -1.00000          1.00000         -1.00000          1.00000       200.00000

   NODAL NO. AT WHICH STRESSES ARE PRINTED
       1     8    15    22    29    36    43     1     9    17    25    33    41    49

   NODAL NO. SYMMETRICAL ON X-AXIS.NOCSX=     1     8    15    22    29    36    43

   NODAL NO. SYMMETRICAL ON Y-AXIS.NOCSY=     1     2     3     4     5     6     7              (Entry 1)

   SLAB NO., INITIAL NODAL NUMBER(INITNP), LAST NODAL NUMBER(LASTNP), AND LAST ELEMENT NUMBER(LASTEN) ARE
    1     1    49    36

   NODAL NUMBERS AND INITIAL GAPS ARE TABULATED AS FOLLOWS...
    1    1.00000     2   0.80000     8   0.80000     9   0.75000     3   0.50000    15   0.40000    17   0.40000    10   0.40000   (Entry 2)
   16    0.48000

   AMOUNT OF INITIAL CURLING AND GAP AT THE NODES ARE
    1    1.00000     2   0.80094     3   0.50844     4   0.03375     5   0.07594     6   0.13500     7   0.21094     8   0.80094
    9    0.75188    10   0.48938    11   0.03469    12   0.07688    13   0.13594    14   0.21187    15   0.48844    16   0.00938
   17    0.41687    18   0.04219    19   0.08438    20   0.14344    21   0.21938    22   0.03375    23   0.03469    24   0.04219   (Entry 3)
   25    0.06750    26   0.10969    27   0.16875    28   0.24469    29   0.07594    30   0.07688    31   0.08438    32   0.10969
   33    0.15188    34   0.21094    35   0.28687    36   0.13500    37   0.13594    38   0.14344    39   0.16875    40   0.21094
   41    0.27000    42   0.34884    43   0.21094    44   0.21187    45   0.21938    46   0.24469    47   0.28687    48   0.34884
```

(Continued)

(Sheet 2 of 5)

Table 10 (Continued)

49 0.42183

THE MULTIPLYING FACTOR FOR EFFICIENCY OF MOMENT TRANSFER, CM , IS 0.

Entry 4 TOTAL UNIFORMLY APPLIED LOAD INPUT= 20000.00 TOTAL LOAD CALCULATED= 20000.00

NO. OF ITERATION CYCLE FOR CHECKING CONTACT,ICC = 1

CASE NO. FOR MOMENT TRASFER,MMT= 3 MULTIPLYING FACTOR FOR EFFICIENCY OF MOMENT TRANSFER,CM= 0.

Entry 5

NODE	DEFLEC.	ROTAT,X	ROTAT,Y	NODE	DEFLEC.	ROTAT,X	ROTAT,Y	NODE	DEFLEC.	ROTAT,X	ROTAT,Y
1	0.2232E 00	0.1495E-14	-0.1767E-14	2	0.2218E 00	0.2650E-03	-0.4414E-14	3	0.2129E 00	0.5793E-03	-0.4585E-14
4	0.1947E 00	0.5219E-03	-0.1776E-14	5	0.1848E 00	0.1396E-03	0.7571E-15	6	0.1855E 00	-0.1527E-03	0.1998E-14
7	0.1918E 00	[illegible]	[illegible]	8	0.2216E 00	0.3794E-14	-0.2137E-03	9	[illegible]	[illegible]	[illegible]
10	0.2118E 00	0.5533E-03	-0.2018E-03	11	0.1944E 00	0.5028E-03	-0.6973E-04	12	0.1049E 00	0.2204E-03	0.1797E-04
13	0.1858E 00	-0.1594E-03	0.6850E-04	14	0.1923E 00	-0.2314E-03	0.1039E-03	15	0.2113E 00	0.8753E-14	-0.6344E-03
16	0.2105E 00	0.1591E-03	-0.4113E-03	17	0.2048E 00	0.3926E-03	-0.4611E-03	18	[illegible]	[illegible]	[illegible]
19	0.1857E 00	0.4499E-04	0.6762E-04	20	0.1866E 00	-0.2097E-03	0.2053E-03	21	0.1964E 00	-0.2728E-03	0.2993E-03
22	0.1927E 00	0.1123E-14	-0.5204E-03	23	0.1924E 00	0.4875E-04	-0.5045E-03	24	0.1907E 00	0.1141E-03	-0.3886E-03
25	0.1877E 00	0.4319E-04	-0.7813E-04	26	0.1896E 00	-0.1742E-03	0.2056E-04	27	[illegible]	[illegible]	[illegible]
28	0.2092E 00	-0.3892E-03	0.5430E-03	29	0.1828E 00	-0.1044E-14	-0.1358E-03	30	0.1829E 00	-0.7072E-04	[illegible]
31	0.1841E 00	-0.9143E-04	-0.4960E-04	32	0.1888E 00	-0.2343E-03	0.1567E-03	33	[illegible]	[illegible]	[illegible]
34	0.2123E 00	-0.5161E-03	0.5506E-03	35	0.2281E 00	-0.9319E-03	0.6987E-03	36	[illegible]	[illegible]	[illegible]
37	0.1839E 00	-0.7377E-04	0.1553E-03	38	0.1869E 00	-0.2196E-03	0.2065E-03	39	0.1966E 00	-0.4232E-03	0.3390E-03
40	0.2118E 00	-0.5780E-03	0.4953E-03	41	0.2304E 00	-0.6459E-03	0.6298E-03	42	0.2500E 00	-0.6952E-03	0.7339E-03
43	0.1898E 00	-0.1310E-14	0.2226E-03	44	0.1904E 00	-0.1074E-03	0.2284E-03	45	[illegible]	[illegible]	[illegible]
46	0.2077E 00	-0.5588E-03	0.3803E-03	47	0.2272E 00	-0.7153E-03	0.5192E-03	48	0.2495E 00	[illegible]	[illegible]
49	0.2717E 00	-0.7354E-03	0.7208E-03								

THE GAP OR PRECOMPRESSION OF THE NODES IS=

Entry 6

1	0.77679	2	0.57910	3	0.29558	4	-0.14100	5	-0.10885	6	-0.05050	7	[illegible]	8	[illegible]
9	0.58156	10	0.27794	11	-0.19971	12	-0.10800	13	-0.04991	14	0.01957	15	0.27713	16	-0.20110
17	0.21206	18	-0.14977	19	-0.10180	20	-0.04515	21	0.02302	22	-0.15891	23	-0.17778	24	-0.14840
25	-0.12825	26	-0.07990	27	-0.02099	28	-0.03551	29	-0.10606	30	-0.10605	31	[illegible]	32	[illegible]
33	-0.04653	34	-0.00139	35	0.05875	36	-0.04858	37	-0.04801	38	-0.04345	39	-0.02785	40	-0.08806
41	0.03961	42	0.09599	43	0.02112	44	0.02152	45	0.02484	46	0.03694	47	0.05968	48	0.09643
49	0.15821														

Entry 7 NO. OF ITERATION CYCLE FOR CHECKING CONTACT,ICC = 2

CASE NO. FOR MOMENT TRASFER,MMT= 1 MULTIPLYING FACTOR FOR EFFICIENCY OF MOMENT TRANSFER,CM= 0.

Entry 8

NODE	DEFLEC.	ROTAT,X	ROTAT,Y	NODE	DEFLEC.	ROTAT,X	ROTAT,Y	NODE	DEFLEC.	ROTAT,X	ROTAT,Y
1	0.1276E 00	0.4527E-15	-0.5040E-15	2	0.1272E 00	0.6862E-04	-0.1079E-14	3	[illegible]	[illegible]	[illegible]
4	0.1255E 00	-0.1013E-03	[illegible]	5	[illegible]	-0.3069E-03	0.1570E-14	6	[illegible]	[illegible]	[illegible]
7	0.1550E 00	-0.4064E-03	0.6735E-15	8	0.1272E 00	0.9294E-15	-0.8041E-04	9	0.1268E 00	0.5800E-04	-0.7007E-04
10	0.1254E 00	0.6293E-04	-0.2235E-04	11	0.1257E 00	-0.1077E-03	0.2833E-04	12	0.1321E 00	-0.8097E-03	0.5394E-04
13	0.1432E 00	-0.4028E-03	0.6373E-04	14	0.1554E 00	-0.4009E-03	0.6497E-04	15	[illegible]	[illegible]	[illegible]
16	0.1250E 00	0.1202E-04	-0.7735E-04	17	0.1249E 00	-0.5482E-05	-0.1146E-04	18	[illegible]	[illegible]	[illegible]
19	0.1343E 00	-0.3296E-03	0.1599E-03	20	0.1457E 00	-0.4088E-03	0.1845E-03	21	[illegible]	[illegible]	[illegible]
22	0.1250E 00	-0.1056E-14	[illegible]	23	0.1258E 00	-0.3353E-04	0.1060E-03	24	[illegible]	[illegible]	[illegible]
25	0.1318E 00	-0.2480E-03	0.2384E-03	26	0.1413E 00	-0.3752E-03	0.3031E-03	27	0.1535E 00	-0.4213E-03	0.3273E-03
28	0.1660E 00	-0.4114E-03	0.3325E-03	29	0.1313E 00	-0.1643E-14	0.3050E-03	30	0.1316E 00	-0.5633E-04	0.3003E-03
31	0.1538E 00	-0.1662E-03	0.3245E-03	32	0.1411E 00	-0.3112E-03	0.3691E-03	33	[illegible]	[illegible]	[illegible]
34	0.1646E 00	-0.4297E-03	0.3994E-03	35	0.1772E 00	-0.4159E-03	0.4016E-03	36	[illegible]	[illegible]	[illegible]
37	0.1426E 00	-0.6522E-04	0.4000E-03	38	0.1451E 00	-0.1666E-03	0.4054E-03	39	[illegible]	[illegible]	[illegible]
40	0.1644E 00	-0.4060E-03	[illegible]	41	0.1740E 00	-0.4222E-03	0.4160E-03	42	[illegible]	[illegible]	[illegible]

(Continued)

(Sheet 3 of 5)

Table 10 (Continued)

NODE	DEFLEC.	ROTAT,X	ROTAT,Y	NODE	DEFLEC.	ROTAT,X	ROTAT,Y	NODE	DEFLEC.	ROTAT,X	ROTAT,Y
43	0.1543E 00	-0.3692E-15	0.3967E-03	44	0.1547E 00	-0.6806E-04	0.3972E-03	45	0.1573E 00	-0.1947E-03	0.4063E-03
46	0.1655E 00	-0.3378E-03	0.4064E-03	47	0.1769E 00	-0.4076E-03	0.4102E-03	48	0.1894E 00	-0.4248E-03	0.4170E-03
49	0.2022E 00	-0.4265E-03	0.4204E-03								

THE GAP OR PRECOMPRESSION OF THE NODES IS=

Entry 9	1	0.87240	2	0.67372	3	0.38294	4	0.89179	5	-0.05594	6	-0.00786	7	0.05900	8	0.67378
	9	0.62503	10	0.36400	11	[illegible]	12	[illegible]	13	-0.00724	14	0.05640	15	[illegible]	16	[illegible]
	17	0.29199	18	-0.08470	19	-0.04991	20	0.00225	21	0.06138	22	-0.09125	23	-0.09048	24	-0.08437
	25	-0.06432	26	-0.03162	27	0.01524	28	0.07866	29	-0.05538	30	-0.05473	31	-0.04946	32	-0.03140
	33	-0.00012	34	0.04441	35	0.10965	36	[illegible]	37	-0.00664	38	-0.00160	39	[illegible]	40	[illegible]
	41	0.09309	42	0.15634	43	0.05461	44	0.05720	45	0.06205	46	0.07920	47	[illegible]	48	[illegible]
	49	0.21968														

NO. OF ITERATION CYCLE FOR CHECKING CONTACT,ICE = 3

CASE NO. FOR MOMENT TRASFER,KMT= 1 MULTIPLYING FACTOR FOR EFFICIENCY OF MOMENT TRANSFER,CM= 0.

NODE	DEFLEC.	ROTAT,X	ROTAT,Y	NODE	DEFLEC.	ROTAT,X	ROTAT,Y	NODE	DEFLEC.	ROTAT,X	ROTAT,Y
1	0.1276E 00	0.5514E-15	-0.8026E-15	2	0.1271E 00	0.8795E-04	-0.1379E-14	3	0.1246E 00	0.1319E-03	-0.9186E-15
4	0.1222E 00	0.6938E-05	0.1943E-15	5	0.1247E 00	-0.1597E-03	0.7690E-15	6	0.1309E 00	-0.2337E-03	0.8420E-15
7	0.1380E 00	-0.2345E-03	0.4145E-15	8	0.1271E 00	0.1229E-14	-0.9976E-04	9	0.1247E 00	[illegible]	[illegible]
10	0.1244E 00	0.1203E-03	-0.4291E-04	11	0.1222E 00	0.1200E-05	0.4470E-05	12	0.1244E 00	[illegible]	[illegible]
13	0.1310E 00	-0.2340E-03	0.3088E-04	14	0.1301E 00	-0.2346E-03	0.3142E-04	15	0.1243E 00	[illegible]	[illegible]
16	0.1241E 00	0.3256E-04	-0.1349E-03	17	[illegible]	0.5494E-04	-0.7907E-04	18	[illegible]	[illegible]	[illegible]
19	0.1258E 00	-0.1751E-03	0.7594E-04	20	0.1322E 00	-0.2360E-03	0.8886E-04	21	0.1394E 00	-0.2352E-03	0.9076E-04
22	0.1216E 00	-0.3530E-15	-0.8517E-05	23	0.1217E 00	-0.9732E-05	-0.3502E-05	24	0.1221E 00	-0.8795E-04	0.3095E-04
25	0.1244E 00	[illegible]	[illegible]	26	[illegible]	-0.2025E-03	0.1544E-03	27	[illegible]	[illegible]	[illegible]
28	0.1432E 00	-0.2377E-03	0.1638E-03	29	0.1241E 00	-0.8434E-15	0.1977E-03	30	[illegible]	[illegible]	[illegible]
31	0.1253E 00	-0.8337E-04	0.1711E-03	32	0.1290E 00	-0.1631E-03	0.1950E-03	33	[illegible]	[illegible]	[illegible]
34	0.1417E 00	-0.2376E-03	0.2109E-03	35	[illegible]	-0.2390E-03	0.2105E-03	36	[illegible]	[illegible]	[illegible]
37	0.1303E 00	-0.3242E-04	0.2302E-03	38	0.1316E 00	-0.9314E-04	0.2319E-03	39	0.1356E 00	-0.1698E-03	0.2325E-03
40	0.1415E 00	-0.2155E-03	0.2305E-03	41	0.1484E 00	-0.2372E-03	0.2298E-03	42	0.1556E 00	-0.2400E-03	0.2259E-03
43	0.1371E 00	-0.4308E-15	0.2296E-03	44	0.1373E 00	-0.3257E-04	0.2296E-03	45	[illegible]	[illegible]	[illegible]
46	0.1426E 00	-0.1696E-03	0.2316E-03	47	0.1489E 00	-0.2175E-03	0.2321E-03	48	0.1554E 00	[illegible]	[illegible]
49	0.1626E 00	-0.2497E-03	0.2334E-03								

THE GAP OR PRECOMPRESSION OF THE NODES IS=

	1	0.87239	2	0.67380	3	0.38380	4	[illegible]	5	-0.04872	6	0.00414	7	[illegible]	8	[illegible]
	9	0.62521	10	0.36495	11	-0.08752	12	0.04791	13	0.00492	14	0.07375	15	[illegible]	16	[illegible]
	17	0.29376	18	0.08029	19	-0.04143	20	0.01121	21	0.00802	22	-0.08709	23	[illegible]	24	[illegible]
Entry 10	25	-0.05687	26	[illegible]	27	[illegible]	28	[illegible]	29	[illegible]	30	[illegible]	31	[illegible]	32	[illegible]
	33	0.01731	34	0.06920	35	0.13795	36	0.00482	37	0.00560	38	0.01183	39	0.03315	40	0.06942
	41	0.12159	42	0.19035	43	0.07379	44	0.07457	45	0.08079	46	0.10209	47	0.13839	48	0.19057
	49	0.25932														

NO. OF ITERATION CYCLE FOR CHECKING CONTACT,ICE = 4

CASE NO. FOR MOMENT TRASFER,KMT= 1 MULTIPLYING FACTOR FOR EFFICIENCY OF MOMENT TRANSFER,CM= 0.

	NODE	DEFLEC.	ROTAT,X	ROTAT,Y	NODE	DEFLEC.	ROTAT,X	ROTAT,Y	NODE	DEFLEC.	ROTAT,X	ROTAT,Y
	1	0.1254E 00	0.5851E-15	-0.6370E-15	2	0.1249E 00	0.9454E-04	-0.1482E-14	3	0.1228E 00	[illegible]	[illegible]
	4	0.1189E 00	[illegible]	[illegible]	5	[illegible]	[illegible]	[illegible]	6	[illegible]	[illegible]	[illegible]
Entry 11a	7	0.1299E 00	-0.1020E-03	0.3538E-15	8	0.1249E 00	0.1331E-14	-0.1065E-03	9	0.1244E 00	0.8416E-04	-0.9636E-04
	10	0.1219E 00	0.1398E-03	-0.4981E-04	11	0.1188E 00	0.3960E-04	-0.2368E-05	12	0.1200E 00	-0.1079E-03	0.1901E-04
	13	0.1246E 00	-0.1776E-04	-0.2526E-04	14	0.1300E 00	-0.1823E-03	0.2718E-04	15	[illegible]	[illegible]	[illegible]
	16	0.1216E 00	0.3922E-04	-0.1559E-03	17	0.1203E 00	0.7455E-04	-0.9268E-04	18	0.1180E 00	0.3433E-07	[illegible]
	19	0.1208E 00	-0.1225E-03	0.5811E-04	20	0.1255E 00	-0.1810E-03	0.7339E-04	21	[illegible]	[illegible]	[illegible]
	22	0.1182E 00	[illegible]	[illegible]	23	[illegible]	[illegible]	[illegible]	24	[illegible]	[illegible]	[illegible]

(Continued)

(Sheet 4 of 5)

Table 10 (Concluded)

25	0.1198E 00	-0.5142E-04	0.6883E-04	26	0.1234E 00	-0.1545E-03	0.1177E-03	27	0.1287E 00	-0.1885E-03	0.1334E-03
28	0.1344E 00	-0.1099E-03	0.1392E-03	29	0.1192E 00	-0.6740E-15	0.1001E-03	30	0.1193E 00	-0.2193E-04	0.1018E-03
31	0.1291E 00	-0.6600E-04	0.1148E-03	32	0.1231E 00	-0.1289E-03	0.1440E-03	33	0.1277E 00	-0.1752E-03	0.1639E-03
34	0.1333E 00	-0.1246E-03	0.1717E-03	35	0.1392E 00	-0.1957E-03	0.1761E-03	36	0.1235E 00	-0.7532E-15	0.1692E-03
37	0.1236E 00	-0.2734E-04	0.1676E-03	38	0.1247E 00	-0.7925E-04	0.1724E-03	39	[illegible]	[illegible]	[illegible]
40	0.1330E 00	-0.1826E-03	0.1836E-03	41	0.1388E 00	-0.1980E-03	0.1869E-03	42	0.1447E 00	[illegible]	0.1897E-03
43	0.1287E 00	-0.3777E-15	0.1729E-03	44	0.1288E 00	-0.2887E-04	0.1731E-03	45	0.1299E 00	-0.8309E-04	0.1749E-03
46	0.1335E 00	-0.1478E-03	0.1784E-03	47	-0.1386E 00	-0.1866E-03	0.1848E-03	48	[illegible]	[illegible]	[illegible]
49	0.1505E 00	-0.2025E-03	0.1914E-03								

THE GAP OR PRECOMPRESSION OF THE NODES IS=

	1	0.67456	2	0.67600	3	0.38626	4	-0.08510	5	-0.04399	6	0.01857	7	0.08104	8	0.67607
	9	0.62745	10	0.36745	11	-0.08415	12	-0.04314	13	0.01138	14	0.08184	15	[illegible]	16	[illegible]
Entry 11b	17	0.29653	18	-0.07565	19	-0.03641	20	0.01789	21	0.08828	22	-0.08448	23	-0.08356	24	-0.07625
	25	-0.05233	26	-0.01375	27	0.04005	28	0.11027	29	-0.04322	30	-0.04239	31	-0.03577	32	-0.01341
	33	0.02415	34	0.07760	35	0.14766	36	0.01155	37	0.01235	38	0.01878	39	[illegible]	40	[illegible]
	41	0.13124	42	0.20119	43	0.08227	44	0.08306	45	0.08943	46	0.11122	47	0.14832	48	0.20152
	49	0.27140														

AMOUNT OF FINAL CURLING AND GAP AT THE NODES IS=

	1	0.67456	2	0.67600	3	0.38626	4	-0.08510	5	-0.04399	6	0.01857	7	0.08104	8	0.67607
	9	0.62745	10	0.36745	11	-0.08415	12	-0.04314	13	0.01138	14	0.08184	15	[illegible]	16	[illegible]
Entry 12	17	0.29653	18	-0.07565	19	-0.03641	20	0.01789	21	0.08828	22	-0.08448	23	-0.08356	24	-0.07625
	25	-0.05233	26	-0.01375	27	0.04005	28	0.11027	29	-0.04322	30	-0.04239	31	-0.03577	32	-0.01341
	33	0.02415	34	0.07760	35	0.14766	36	0.01155	37	0.01235	38	0.01878	39	[illegible]	40	[illegible]
	41	0.13124	42	0.20119	43	0.08227	44	0.08306	45	0.08943	46	0.11122	47	0.14832	48	0.20152
	49	0.27140														

NODE	LAYER	STRESS X	STRESS Y	STRESS XY	MAJOR	MINOR	SHEAR	REACTION
1	1	0.549635E 03	0.506663E 03	0.	0.506663E 03	0.549809E 03	0.215796E 02	0.125444E 02
8	1	0.358819E 03	0.412554E 03	0.	0.358819E 03	0.412554E 03	[illegible]	[illegible]
15	1	-0.523100E 02	0.155133E 03	0.	-0.523100E 02	0.155133E 03	0.103721E 03	0.121783E 02
22	1	-0.223624E 03	-0.448820E 02	0.	-0.223624E 03	-0.448820E 02	0.893711E 02	0.118234E 02
29	1	-0.157169E 03	-0.101782E 03	0.	-0.157169E 03	-0.101782E 03	[illegible]	[illegible]
35	1	-0.389944E 02	-0.104925E 03	0.	-0.104925E 03	-0.389944E 02	0.329652E 02	0.123451E 02
43	1	0.	-0.104521E 03	0.	-0.104521E 03	0.	0.522607E 02	0.128667E 02
1	1	0.549805E 03	0.506663E 03	0.	0.506663E 03	0.549808E 03	[illegible]	[illegible]
9	1	0.329134E 03	0.293392E 03	0.545477E 02	0.254190E 03	0.368836E 03	0.573232E 02	0.124423E 02
17	1	-0.479575E 01	0.700636E 01	0.111403E 03	-0.111464E 03	0.111744E 03	0.111614E 03	0.120343E 02
25	1	[illegible]	-0.122411E 03	[illegible]	-0.196012E 03	-0.527032E 02	[illegible]	[illegible]
33	1	-0.463194E 02	-0.457597E 02	0.130644E 02	-0.591049E 02	-0.329702E 02	0.130673E 02	0.127725E 02
41	1	-0.701291E 01	-0.888151E 01	0.260603E 01	-0.955401E 01	-0.434038E 01	0.260068E 01	0.130764E 02
49	1	0.	0.	0.	0.	0.	0.	[illegible]

problem, which is to compute stresses and deflections for a symmetrically loaded square slab subjected to both temperature warping and applied load. Gaps with a maximum magnitude of 1 in. exist in the subgrade near the load. Because of symmetry, only one quarter of the slab is computed. The 80,000-lb load (p = 200 psi) is applied at the center of the slab and the temperature differential is 3.75°F per inch of the slab, causing the slab to curl upward. Figure 10 shows the finite element grid pattern of the slab. The purpose of this example printout is to show the differences among the initial gap, deflection, and final gap. Similar to the previous example output, entry numbers are used in places where explanations are needed. In places where similar explanations are given in the previous example output, they are not repeated.

Entry 1

83. Because the uniformly applied load is applied at the center of the slab, the case is symmetrical with respect to both the X- and Y-axis. It is thus necessary to consider only one quarter of the slab in the computation. According to Figure 10, the nodal numbers that are symmetrical along the X-axis are 1, 8, 15, 22, 29, 36, and 43, and the nodal numbers that are symmetrical along the Y-axis are 1, 2, 3, 4, 5, 6, and 7. The computation is made on the quarter slab with $\sigma_x = 0$ and $\sigma_y = 0$ at each nodal point along the X- and Y-axis, respectively.

Entry 2

84. The initial gaps at each nodal point are printed as was input.

Entry 3

85. The initial curlings are computed based on the input temperature differential. The slabs are assumed to be weightless, and the subgrade reactive forces are not considered. The magnitude of the curling is measured from the initial subgrade surface to the warped bottom surface of the slab. Positive curling (or gap) indicates that the warped slab at the particular node is above the initial subgrade surface; i.e., the slab is warped upward. Negative curling indicates that

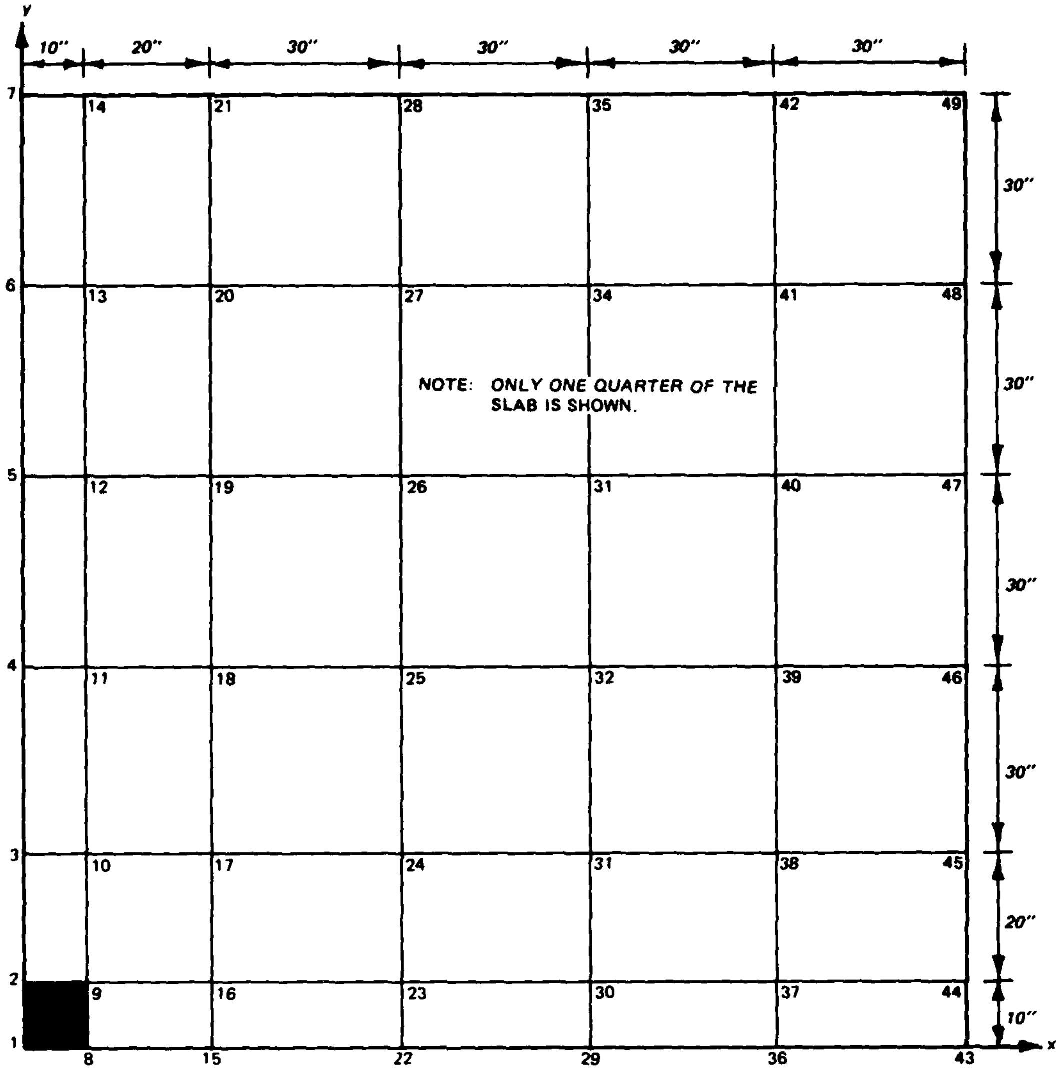

Figure 10. Finite element layout for Computer Output 2

the warped slab is below the initial subgrade surface; i.e., the slab at the particular node is sinking into the ground.

86. It should be noted that when gaps exist under the slab, the initial curlings are combined with the gaps. For instance, at node 1 the initial curling is zero because node 1 is located at the center of the slab. But because a 1-in. gap exists beneath node 1 and because curling is defined to be the distance from the initial subgrade surface to the warped slab, the initial curling at node 1 becomes 1 in., as shown in Entry 3. Similarly, the actual curling at node 2 is 0.00094 in.

curling upward and since the initial gap at node 2 is 0.8 in., the initial curling at node 2 becomes 0.80094, as shown in Entry 3.

Entry 4

87. The total load applied on the 300- by 300-in. slab is 8,000 lb. Because only one quarter of the slab is used in the computation, both the input load and calculated load are 20,000 lb in magnitude.

Entry 5

88. Displacements are induced by the load and the subgrade reactive forces and are measured from the initial warped surface to the new surface. Note that the applied load generally makes the slab move downward and the subgrade reactive forces push the slab upward. Positive deflection indicates downward movement, and negative deflection indicates upward movement. Entry 5 shows that all the deflections are positive, indicating the deflections are a downward movement from the warped up.

Entry 6

89. The gap or precompression is computed as the difference between the initial curling and the deflection. Sign convention used in the initial curling (Entry 3) is used in Entry 6. At node 1, the gap is 0.77679 in., which is computed as the difference between the upward initial curling of 1 in. (Entry 3) and the downward deflection of 0.2232 in. (Entry 5); a positive gap indicates that node 1 is 0.77679 in. above the initial subgrade surface. At node 5, the initial curling is 0.07594 in. (above the initial subgrade surface) and the deflection is 0.1848 in. (downward movement under the load and the subgrade reactive forces), so the precompression becomes -0.10885 in. sinking into the ground.

Entry 7

90. During the first cycle of iteration, a full subgrade contact condition is assumed, except at nodes where gaps are specified. The gaps shown in Entry 6 indicate that many nodal points have lost the subgrade support, i.e., the subgrade contact condition has changed. Therefore, computations start again based on the new subgrade contact

condition shown in Entry 6 and the deflected surface shown in Entry 3 (initial curling).

Entry 8

91. The deflections are measured from the initial curling (or precompression) shown in Entry 3.

Entry 9

92. The gaps or precompressions are the differences between the initial curlings (Entry 3) and the deflections (Entry 8). The sign at each node is compared with those shown in Entry 6, and since the signs at some nodes have changed, the computation starts again with the new subgrade contact condition shown in Entry 9. The iteration repeats until the sign of either the gap or the precompression at each node no longer changes.

Entry 10

93. Entry 10 shows the gaps and precompressions at the end of iteration cycle 3.

Entry 11

94. Entry 11b shows the gaps and precompressions at the end of iteration cycle 4. Since the signs at each node shown in Entry 11 do not change from those shown in Entry 10, the criterion for checking subgrade contact is satisfied and the computed deflections shown in Entry 11a and gaps and precompressions shown in Entry 11b are the final values. Note that the deflections in Entry 11a are measured from the initial warped surface in Entry 3.

Entry 12

95. The values shown in Entry 12 are the same as shown in Entry 11b computed during the last iteration cycle, but are different from those shown in Entries 6, 9, and 10 computed during the earlier cycles.

Sign notation used*

96. To clarify the sign notation used in this report, the values of initial curling, deflection, gap, and precompression computed after

* Readers should consult the sign conventions defined in paragraph 46 of Report 1 of this series.

the last iteration at nodes 1, 3, and 5 (Figure 10) are plotted in Figure 11. The initial curlings were computed based on the temperature differential and the assumptions that the slab is weightless and the subgrade reactive forces are inactive. <u>The force-induced deflections computed during each iteration were always measured from the initial curling,</u> not from the initial bottom surface of the slab. It should be noted that stresses in the slab are also computed based on the deflections measured from the initial curled surface, not from the initial surface of the slab. When temperature is not considered and the initial curling does not exist, the deflections are measured from the initial bottom surface of the slab.

97. At node 1, the sum of the deflection (0.1254 in. at Entry 11<u>a</u>) and the final gap (0.87456 in. at Entry 11<u>b</u>) is equal to the input initial gap (1 in.). At node 3, the sum of the final gap (0.38626 in.) and the deflection (0.1222 in.) less the input initial gap (0.5 in.) is equal to the difference between the computed initial curling (0.50844 in.) and the input initial gap (0.5 in.). Note a 0.00002-in. computer round-off error is involved.

Computer Output 3

98. Table 11 shows the Computer Output 3 printout for Example Problem 2, which is to compute stresses and deflections for a single slab due to the applied load alone. Two runs were conducted consecutively. The first run is made considering only the temperature, slab weight, and gaps, and the second run is made considering the temperature, slab weight, gaps, and the applied load all together. The differences in the computed results of the first and second runs are those due to the applied load alone. This option in the program is activated (in the second run) by setting the variable NSTORE = 2 (Item 6 of Table 2). The reason for the need to compute stresses due to the applied load alone is explained in the footnote of the variable NSTORE .

<u>Entry 1</u>

99. NGAP = 0 because no gap under the slab is assumed. NWT

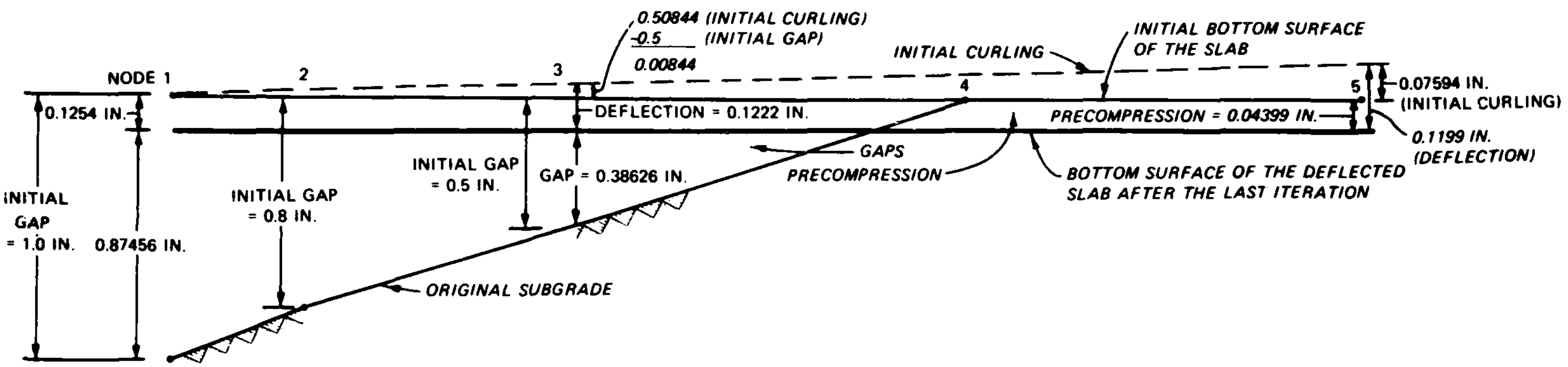

Figure 11. Illustration of initial curling, deflections, gaps, and precompression for Computer Output 2; values computed at last iteration

Table 11. Computer Output 3 Printout for Example Problem 2

```
   SNUMB = 80817, ACTIVITY # = 02, REPORT CODE = 06, RECORD COUNT = 000875

   2
          INPUT DATA
 TEMPERATURE AND SLAB WT,
   1    0 9801  500  500  200  130
  11    9    0    0    0    0
BLANK MEMS.NO. OF JOINT NJOINT=0,SC NO JOINT ELE, NEEDED
   1    1    0    0   20    0    0    1   20
   1    1    1    0    0    1    0    0    0
   0    0    0    0   49  199    0   19    100000
   0    0    0    0    0    0
100,00000  45,00000   0,25000 0,100E-01 0,100E-02 0,300E 08   0,20000
BLANK CARD  NO ADDIT, SUBG, MODU, TO BE READ IN
  0.        48,00000  96,00000 144,00000 180,00000 216,00000 240,00000 252,00000
264,00000 276,00000 288,00000
  0.        48,00000  96,00000 144,00000 180,00000 216,00000 252,00000 276,00000
288,00000
 15,00000   0,25000 0,600E 07
BLANK CARD NO ADDI.THICKNESS TO BE READ IN
BLANK CARD  NO, OF JOINT NJOINT=0
BLANK CARD NO OF LOAD NLOAD=0
BLANK CARD NO, OF NO SUBGRADE CONTACT,NOTCON=0
  60   61   62   63   69   70   71   72   78   79   80   81   87   88   89   90
  96   97   98   99
BLANK CARD NO SYMMETRY ON X-AXIS
BLANK CARD NO SYMMETRY ON Y-AXIS
BLANK CARD NSTORE NOT EQUAL ONE
BLANK CARD NO GAP TO BE READ IN
BLANK CARD NO CONC. FORCE OR MOMENT APPLIED AT NODES
BLANK CARD NREAD=0
  0.
```

(Continued)

(Sheet 1 of 16)

```
TEMPERATURE AND SLAB WT,
                    FINITE ELEMENT ANALYSIS OF CONCRETE PAVEMENTS

   NSLAB=    1     NJOINT=    0     LNOBD= 9801     LCUD=  500     LCLD=  500     NNPD=  200     NELD=  130

   FOR SLAB NO, 1 #  NX=   11      NY=    9     JOBS=          0            0            0           0

   JOINT NO, INITIAL STARTING NODAL NO. (ISNN) AND LAST FINAL NODAL NO, (LFNN) ON BOTH SIDES OF JOINT ARE
    1       0     0     0     0

   JOINT NO, AND VALUES OF 1ST ARE
    1     0     0

   JOINT NO, AND VALUES OF NJT ARE
    1     0     0

   JOINT NO, AND VALUES OF NKT ARE
    1     0     0

   COMPUTED DIMEN. OF STIFFNESS MATRICES C AND G; LNOB=     9801                COMP; DIMEN; OF MATRIX CU,LCUD=       1
   COMP.DIMEN. OF MATRIX CL,LCLI=        1          TOTAL NO OF EQUATIONS,LNO=  297         TOTAL NO. OF NODAL PTS.,LNP=    99

   NLAYER=    1       NBOND=    1      NOTCON=    0         NGAP=     0       NCYLE=    20        NSTORE=     0       NREAD=    0
Entry 1.
    INDP=    1      NPRINT=   20       NTEMP=     1          ICX=     1         ICX=     1         NLOOP=     1        NNCF=    0
    NNT=     1         NNT=    1         NSX=     0          NSY=     0        JNCK=     0          NWCK=     0        NECK=    0
   NNCK=     0         ICL=   45        ICLF=   297        IGNOR=     0       UNRFR=    19          NAS=     0      MAXFAJ=  100000
   NAT1=     0        NAT2=    0        IFRR=     0         ILPR=     0      NPUNCH=     0        NCOMP =    0

   SUMG, MODULUS SUBMOD= 100,00000               TEMP; =  45,00000      RELAXATION FACTOR RFI=   0,25000    TOLERANCE DEL= 0.100E-02
     FINAL TOLER, DEL= 0,100E-02               MCEL; OF DOWEL YMS= 0,300E 08               POISSON S RATIO OF DOWEL PRD=   0,20000

   FOR SLAB NO, 1 #  X=    0,        48,00000  78,00000 144,00000 180,00000 216,00000 240,00000 252,00000 264,00000 276,00000

 288,00000
                       Y=    0,        48,00000  78,00000 144,00000 180,00000 216,00000 252,00000 276,00000 288,00000

   FOR LAYER NO, 1          THICKNESS T=  12,00000      POISSON S RATIO PR=   0,20000      MODULUS YM= 0,400E 07

   NODAL NO, AT WHICH STRESSES ARE PRINTED
     60    61    62    63    69    70    71    72    78    79    80    81    87    88    89    90    96    97    98    99

   SLAB NO,, INITIAL NODAL NUMBER(INITNP), LAST NODAL NUMBER(LASTNP); AND LAST ELEMENT NUMBER(LASTEN) ARE
   1     1    99    80

   NODAL NUMBERS AND INITIAL GAPS ARE TABULATED AS FOLLOWS...
    0    0.
Entry 2.
   AMOUNT OF INITIAL CURLING AND GAP AT THE NODES IS
```

1	0.31104	2	0.22404	3	0.17280	4	0.15552	5	0.16524	6	0.19440	7	0.24300	8	0.28020
9	0.31104	10	0.22405	11	0.18024	12	0.08640	13	0.06912	14	0.07884	15	0.10000	16	0.15040
17	0.19980	18	0.22404	19	0.17280	20	0.08640	21	0.03456	22	0.01728	23	0.02700	24	0.05616
25	0.10476	26	0.14796	27	0.17280	28	0.15552	29	0.06912	30	0.01728	31	0.	32	0.00972
33	0.03888	34	0.08748	35	0.13068	36	0.15552	37	0.16524	38	0.07884	39	0.02700	40	0.00972
41	0.01944	42	0.04860	43	0.09720	44	0.14040	45	0.16524	46	0.19440	47	0.10000	48	0.05616
49	0.03888	50	0.04860	51	0.07776	52	0.12636	53	0.16956	54	0.19440	55	0.22464	56	0.13824
57	0.08640	58	0.06912	59	0.07084	60	0.10000	61	0.15660	62	0.19980	63	0.22468	64	0.24300
65	0.15660	66	0.10476	67	0.08748	68	0.09720	69	0.12636	70	0.17496	71	0.21816	72	0.24300
73	0.26352	74	0.17712	75	0.12528	76	0.10000	77	0.11772	78	0.14688	79	0.19548	80	0.23868
81	[illegible]	82	[illegible]	83	[illegible]	84	[illegible]	85	[illegible]	86	[illegible]	87	[illegible]	88	[illegible]
89	0.26136	90	0.28620	91	0.31104	92	0.22464	93	0.17280	94	0.15552	95	0.16524	96	0.19440

(Continued)

Table 11 (Continued)

97 0.24300 98 0.28620 99 0.31104

THE MULTIPLYING FACTOR FOR EFFICIENCY OF MOMENT TRANSFER, CM , IS 0.

NO. OF ITERATION CYCLE FOR CHECKING CONTACT,ICE = 1

CASE NO. FOR MOMENT TRASFER,MMT= 1 MULTIPLYING FACTOR FOR EFFICIENCY OF MOMENT TRANSFER,CM= 0.

Entry 3.

NODE	DEFLEC.	ROTAT,X	ROTAT,Y	NODE	DEFLEC.	ROTAT,X	ROTAT,Y	NODE	DEFLEC.	ROTAT,X	ROTAT,Y
1	0.2094E 00	0.7322E-03	-0.7295E-03	2	0.1753E 00	0.6645E-03	-0.7010E-03	3	0.1436E 00	0.4124E-03	-0.6710E-03
4	0.1381E 00	0.1020E-04	-0.6593E-03	5	0.1435E 00	-0.2999E-03	-0.6688E-03	6	0.1537E 00	-0.5297E-03	-0.6911E-03
7	0.1801E 00	-0.6367E-03	-0.7169E-03	8	0.1956E 00	-0.6476E-03	-0.7307E-03	9	0.2034E 00	-0.6463E-03	-0.7369E-03
10	0.1754E 00	0.7038E-03	-0.6620E-03	11	0.1423E 00	0.6476E-03	-0.6452E-03	12	0.1163E 00	0.4009E-03	-0.6383E-03
13	0.1061E 00	0.1101E-04	-0.6364E-03	14	0.1113E 00	-0.2878E-03	-0.6386E-03	15	0.1240E 00	-0.5114E-03	-0.6437E-03
16	0.1467E 00	-0.6170E-03	-0.6517E-03	17	0.1616E 00	-0.6262E-03	-0.6601E-03	18	0.1631E 00	-0.6204E-03	-0.6662E-03
19	0.1488E 00	0.6741E-03	-0.4110E-03	20	0.1164E 00	0.6408E-03	-0.3998E-03	21	0.9061E-01	0.3991E-03	-0.3981E-03
22	0.8044E-01	0.1174E-04	-0.3984E-03	23	0.8550E-01	-0.2856E-03	-0.3987E-03	24	0.1091E 00	-0.5069E-03	-0.3995E-03
25	0.1205E 00	-0.6064E-03	-0.4027E-03	26	0.1352E 00	-0.6044E-03	-0.4084E-03	27	0.1423E 00	-0.5891E-03	-0.4128E-03
28	0.1383E 00	0.6630E-03	-0.1222E-04	29	0.1062E 00	0.6391E-03	-0.1344E-04	30	0.8041E-01	0.3994E-03	-0.1422E-04
31	0.7023E-01	0.1193E-04	-0.1455E-04	32	0.7529E-01	-0.2856E-03	-0.1439E-04	33	0.8937E-01	-0.5064E-03	-0.1392E-04
34	0.1103E 00	-0.6030E-03	-0.1310E-04	35	0.1247E 00	-0.5964E-03	-0.1242E-04	36	0.1318E 00	-0.5776E-03	-0.1235E-04
37	0.1435E 00	0.6731E-03	0.2929E-03	38	0.1112E 00	0.6415E-03	0.2807E-03	39	0.8530E-01	0.3999E-03	0.2780E-03
40	0.7511E-01	0.1180E-04	0.2779E-03	41	0.8018E-01	-0.2861E-03	0.2783E-03	42	0.9479E-01	-0.5077E-03	0.2756E-03
43	0.1153E 00	-0.6058E-03	0.2834E-03	44	0.1299E 00	-0.6039E-03	0.2897E-03	45	0.1370E 00	-0.5880E-03	0.2945E-03
46	0.1584E 00	0.6957E-03	0.5192E-03	47	0.1255E 00	0.6468E-03	0.4969E-03	48	0.9949E-01	0.4008E-03	0.4917E-03
49	0.8929E-01	0.1142E-04	0.4911E-03	50	0.9438E-01	-0.2873E-03	0.4924E-03	51	0.1091E 00	-0.5107E-03	0.4953E-03
52	0.1297E 00	-0.6152E-03	0.5019E-03	53	0.1446E 00	-0.6207E-03	0.5114E-03	54	0.1520E 00	-0.6114E-03	0.5186E-03
55	0.1719E 00	0.7131E-03	0.5958E-03	56	0.1384E 00	0.6519E-03	0.5759E-03	57	0.1123E 00	0.4026E-03	0.5679E-03
58	0.1021E 00	0.1101E-04	0.5656E-03	59	0.1072E 00	-0.2892E-03	0.5681E-03	60	0.1220E 00	-0.5144E-03	0.5740E-03
61	0.1429E 00	-0.6225E-03	0.5831E-03	62	0.1580E 00	-0.6338E-03	0.5932E-03	63	0.1656E 00	-0.6295E-03	0.6007E-03
64	0.1792E 00	0.7217E-03	0.6149E-03	65	0.1455E 00	0.6550E-03	0.5952E-03	66	0.1192E 00	0.4042E-03	0.5843E-03
67	0.1090E 00	0.1077E-04	0.5805E-03	68	0.1142E 00	-0.2910E-03	0.5841E-03	69	0.1290E 00	-0.5173E-03	0.5924E-03
70	0.1500E 00	-0.6265E-03	0.6037E-03	71	0.1653E 00	-0.6401E-03	0.6136E-03	72	0.1729E 00	-0.6379E-03	0.6205E-03
73	0.1866E 00	0.7264E-03	0.6228E-03	74	0.1527E 00	0.6588E-03	0.6033E-03	75	0.1243E 00	0.4066E-03	0.5875E-03
76	0.1160E 00	0.1052E-04	0.5817E-03	77	0.1212E 00	-0.2935E-03	0.5868E-03	78	0.1362E 00	-0.5212E-03	0.5986E-03
79	0.1573E 00	-0.6311E-03	0.6131E-03	80	0.1727E 00	-0.6457E-03	0.6230E-03	81	0.1874E 00	-0.6451E-03	0.6287E-03
82	0.1941E 00	0.7347E-03	0.6230E-03	83	0.1599E 00	0.6635E-03	0.6020E-03	84	0.1333E 00	0.4101E-03	0.5798E-03
85	0.1229E 00	0.1031E-04	0.5712E-03	86	0.1282E 00	-0.2972E-03	0.5783E-03	87	0.1434E 00	-0.5266E-03	0.5950E-03
88	0.1647E 00	-0.6365E-03	0.6144E-03	89	0.1802E 00	-0.6505E-03	0.6249E-03	90	0.1830E 00	-0.6504E-03	0.6291E-03
91	0.2015E 00	0.7408E-03	0.6218E-03	92	0.1671E 00	0.6696E-03	0.5961E-03	93	0.1412E 00	0.4147E-03	0.5644E-03
94	0.1296E 00	0.1139E-04	0.5521E-03	95	0.1359E 00	-0.3019E-03	0.5623E-03	96	0.1534E 00	-0.5330E-03	0.5853E-03
97	0.1720E 00	-0.6432E-03	0.6120E-03	98	0.1877E 00	-0.6551E-03	0.6247E-03	99	0.1945E 00	-0.6536E-03	0.6280E-03

Entry 3.

THE GAP OR PRECOMPRESSION OF THE NODES IS=

1	0.10163	2	0.04932	3	0.02422	4	0.01742	5	0.02178	6	0.03566	7	0.06286	8	0.09059
9	0.10767	10	0.04920	11	-0.00408	12	-0.02994	13	-0.03702	14	-0.13242	15	-0.01798	16	0.00995
17	0.03815	18	0.05551	19	0.02399	20	-0.03323	21	-0.05605	22	-0.06316	23	-0.05850	24	-0.04393
25	-0.01578	26	0.01280	27	0.03048	28	0.01719	29	-0.03709	30	-0.06313	31	-0.07023	32	-0.06557
33	-0.05099	34	-0.02278	35	0.00593	36	0.02372	37	0.02171	38	-0.03232	39	-0.05830	40	-0.06539
41	-0.06074	42	-0.04619	43	-0.01806	44	0.01052	45	0.02820	46	0.03597	47	-0.01742	48	-0.04333
49	-0.05041	50	-0.04570	51	-0.03131	52	-0.00337	53	0.02492	54	0.14236	55	0.05278	56	-0.00021
57	-0.02592	58	-0.03297	59	-0.02839	60	-0.01401	61	0.01374	62	0.04179	63	0.05905	64	0.06384
65	0.01111	66	-0.01449	67	-0.02150	68	-0.01696	69	-0.00266	70	0.02497	71	0.09290	72	0.07007
73	0.07093	74	0.02443	75	-0.00101	76	-0.00797	77	-0.00347	78	0.01070	79	0.04810	80	0.06599
81	0.08309	82	0.09213	83	0.03987	84	0.01465	85	0.00779	86	0.01241	87	0.02621	88	0.05349
89	0.08118	90	0.09841	91	0.10950	92	0.05752	93	0.03262	94	0.02568	95	0.03020	96	0.04396
97	0.07097	98	0.09352	99	0.11551										

NO. OF ITERATION CYCLE FOR CHECKING CONTACT,ICE = 2

(Continued)

(Sheet 3 of 16)

Table 11 (Continued)

CASE NO. FOR MOMENT TRANSFER,NMT= 1 MULTIPLYING FACTOR FOR EFFICIENCY OF MOMENT TRANSFER,CM= 8.

NODE	DEFLEC.	ROTAT,X	ROTAT,Y	NODE	DEFLEC.	ROTAT,X	ROTAT,Y	NODE	DEFLEC.	ROTAT,X	ROTAT,Y
1	0.1398E 00	0.3186E-03	-0.2944E-03	2	0.1207E 00	0.3051E-03	-0.2946E-03	3	0.1076E 00	0.2226E-03	-0.3040E-03
4	0.1007E 00	0.5779E-04	-0.3007E-03	5	0.1010E 00	-0.7261E-04	-0.2857E-03	6	0.1054E 00	-0.1668E-03	-0.2650E-03
7	0.1124E 00	-0.2153E-03	-0.2498E-03	8	0.1178E 00	-0.8277E-03	-0.2427E-03	9	0.1235E 00	-0.2294E-03	-0.2396E-03
10	0.1216E 00	0.3187E-03	-0.2800E-03	11	0.1065E 00	0.3172E-03	-0.2927E-03	12	0.9271E-01	0.2329E-03	-0.3184E-03
13	0.8579E-01	0.4511E-04	-0.3182E-03	14	0.8693E-01	-0.1032E-03	-0.2924E-03	15	0.9262E-01	-0.2001E-03	-0.2630E-03
16	0.1004E 00	-0.2390E-03	-0.2333E-03	17	0.1069E 00	-0.8435E-03	-0.2200E-03	18	0.1024E 00	-0.2415E-03	-0.2155E-03
19	0.1101E 00	0.3299E-03	-0.1930E-03	20	0.9392E-01	0.3460E-03	-0.2059E-03	21	0.7943E-01	0.2410E-03	-0.2153E-03
22	0.7261E-01	0.3188E-04	-0.2113E-03	23	0.7459E-01	-0.1343E-03	-0.1868E-03	24	0.8160E-01	-0.2445E-03	-0.1726E-03
25	0.9122E-01	-0.2703E-03	-0.1443E-03	26	0.9776E-01	-0.2671E-03	-0.1304E-03	27	0.1079E 00	-0.2607E-03	-0.1257E-03
28	0.1048E 00	0.3301E-03	-0.1776E-04	29	0.8847E-01	0.3393E-03	-0.9801E-05	30	0.7345E-01	0.2386E-03	-0.4203E-06
31	0.8742E-01	0.2170E-04	0.7962E-05	32	0.6986E-01	-0.1513E-03	0.1319E-04	33	0.7763E-01	-0.2067E-03	0.1708E-04
34	0.8009E-01	-0.2975E-03	0.2233E-04	35	0.9504E-01	-0.8033E-03	0.2941E-04	36	0.9818E-01	-0.2741E-03	0.2703E-04
37	0.1067E 00	0.3187E-03	0.1228E-03	38	0.9107E-01	0.3253E-03	0.1486E-03	39	0.7716E-01	0.2277E-03	0.1734E-03
40	0.7100E-01	0.1767E-04	0.1854E-03	41	0.7348E-01	-0.1498E-03	0.1827E-03	42	0.8112E-01	-0.2616E-03	0.1711E-03
43	0.9134E-01	-0.2924E-03	0.1582E-03	44	0.9824E-01	-0.2807E-03	0.1484E-03	45	0.1016E 00	-0.2732E-03	0.1462E-03
46	0.1131E 00	0.3009E-03	0.2236E-03	47	0.9854E-01	0.3002E-03	0.2959E-03	48	0.8575E-01	0.2893E-03	0.2902E-03
49	0.8006E-01	0.1648E-04	0.3030E-03	50	0.8235E-01	-0.1371E-03	0.2867E-03	51	0.8934E-01	-0.2397E-03	0.2739E-03
52	0.9878E-01	-0.2729E-03	0.2462E-03	53	0.1053E 00	-0.8481E-03	0.2340E-03	54	0.1035E 00	-0.2644E-03	0.2308E-03
55	0.1190E 00	0.2901E-03	0.2611E-03	56	0.1051E 00	0.8822E-03	0.2854E-03	57	0.9318E-01	0.1944E-03	0.3220E-03
58	0.8787E-01	0.1654E-04	0.3348E-03	59	0.8991E-01	-0.1252E-03	0.3271E-03	60	0.7633E-01	-0.2204E-03	0.3026E-03
61	0.1051E 00	-0.2572E-03	0.2758E-03	62	0.1113E 00	-0.8597E-03	0.2851E-03	63	0.1114E 00	-0.2578E-03	0.2615E-03
64	0.1222E 00	0.2866E-03	0.2723E-03	65	0.1086E 00	0.8744E-03	0.2916E-03	66	0.9306E-01	0.1874E-03	0.3247E-03
67	0.9193E-01	0.1671E-04	0.3384E-03	68	0.9385E-01	-0.1192E-03	0.3291E-03	69	0.9999E-01	-0.2115E-03	0.3061E-03
70	0.1084E 00	-0.2508E-03	0.2840E-03	71	0.1145E 00	-0.8358E-03	0.2749E-03	72	0.1174E 00	-0.2549E-03	0.2713E-03
73	0.1255E 00	0.2839E-03	0.2791E-03	74	0.1121E 00	0.8678E-03	0.2945E-03	75	0.1059E 00	0.1811E-03	0.3210E-03
76	0.9596E-01	0.1686E-04	0.3332E-03	77	0.9778E-01	-0.1136E-03	0.3249E-03	78	0.1037E 00	-0.2039E-03	0.3057E-03
79	0.1119E 00	-0.2453E-03	0.2821E-03	80	0.1179E 00	-0.8325E-03	0.2804E-03	81	0.1209E 00	-0.2524E-03	0.2778E-03
82	0.1289E 00	0.2816E-03	0.2829E-03	83	0.1156E 00	0.8028E-03	0.2849E-03	84	0.1048E 00	0.1762E-03	0.3146E-03
85	0.9991E-01	0.1693E-04	0.3243E-03	86	0.1016E 00	-0.1091E-03	0.3176E-03	87	0.1073E 00	-0.1980E-03	0.3031E-03
88	0.1153E 00	-0.2410E-03	0.2893E-03	89	0.1213E 00	-0.8900E-03	0.2838E-03	90	0.1243E 00	-0.2505E-03	0.2818E-03
91	0.1323E 00	0.2794E-03	0.2842E-03	92	0.1192E 00	0.8293E-03	0.2933E-03	93	0.1049E 00	0.1728E-03	0.3080E-03
94	0.1037E 00	0.1681E-04	0.3149E-03	95	0.1054E 00	-0.1059E-03	0.3100E-03	96	0.1199E 00	-0.1938E-03	0.2991E-03
97	0.1188E 00	-0.2376E-03	0.2884E-03	98	0.1247E 00	-0.8481E-03	0.2839E-03	99	0.1274E 00	-0.2494E-03	0.2827E-03

THE GAP OR PRECOMPRESSION OF THE NODES IS=

1	0.17527	2	0.10398	3	0.06519	4	0.05485	5	0.06424	6	0.08876	7	0.14055	8	0.16841
9	0.19051	10	0.10288	11	0.03122	12	-0.00631	13	-0.01667	14	-0.00809	15	0.01538	16	0.05596
17	0.09334	18	0.11527	19	0.08272	20	-0.00752	21	-0.04487	22	-0.05533	23	-0.04755	24	-0.02544
25	0.01354	26	0.05028	27	0.07188	28	0.05874	29	-0.01935	30	-0.05007	31	-0.06742	32	-0.06014
33	-0.03875	34	-0.00057	35	0.03584	36	0.05714	37	0.05850	38	-0.01243	39	-0.05016	40	-0.06128
41	-0.05404	42	-0.08272	43	0.00986	44	0.04216	45	0.06368	46	0.08327	47	0.08944	48	-0.02959
49	-0.04120	50	-0.03375	51	-0.01158	52	0.02758	53	0.06429	54	0.08593	55	0.10565	56	0.03313
57	-0.00678	58	-0.01875	59	-0.01107	60	0.01167	61	0.05153	62	0.08870	63	0.11078	64	0.12081
65	0.04803	66	0.00778	67	-0.00445	68	0.00335	69	0.02637	70	0.06652	71	0.10362	72	0.12940
73	0.10801	74	0.06503	75	0.05454	76	0.01204	77	0.01994	78	0.04322	79	0.08361	80	0.12081
81	0.14242	82	0.15742	83	0.08417	84	0.04320	85	0.03077	86	0.03876	87	0.06225	88	0.10282
89	0.14010	90	0.16199	91	0.17825	92	0.10548	93	0.06431	94	0.05178	95	0.08983	96	0.08347
97	0.12819	98	0.16154	99	0.10339										

NO. OF ITERATION CYCLE FOR CHECKING CONTACT,ICC = 3

CASE NO. FOR MOMENT TRANSFER,NMT= 1 MULTIPLYING FACTOR FOR EFFICIENCY OF MOMENT TRANSFER,CM= 8.

NODE	DEFLEC.	ROTAT,X	ROTAT,Y	NODE	DEFLEC.	ROTAT,X	ROTAT,Y	NODE	DEFLEC.	ROTAT,X	ROTAT,Y
1	0.1197E 00	0.2474E-03	-0.2420E-03	2	0.1082E 00	0.8271E-03	-0.2928E-03	3	0.9832E-01	0.1518E-03	-0.2653E-03
4	0.9447E-01	0.2353E-04	-0.2726E-03	5	0.9549E-01	-0.7801E-04	-0.2663E-03	6	0.9978E-01	-0.1547E-03	-0.2540E-03

(Continued)

Table 11 (Continued)

7	0.1062E 00	-0.1960E-03	-0.2421E-03	8	0.1110E 00	-0.2064E-03	-0.2364E-03	9	0.1135E 00	-0.2078E-03	-0.2341E-03
10	0.1084E 00	0.2574E-03	-0.2216E-03	11	0.9617E-01	0.2457E-03	-0.2404E-03	12	0.8587E-01	0.1696E-03	-0.2691E-03
13	0.8103E-01	0.2236E-04	-0.2813E-03	14	0.8244E-01	-0.9046E-04	-0.2718E-03	15	0.8754E-01	-0.1789E-03	-0.2492E-03
16	0.9476E-01	-0.2151E-03	-0.2266E-03	17	0.9999E-01	-0.2187E-03	-0.2182E-03	18	0.1026E 00	-0.2170E-03	-0.2128E-03
19	0.9935E-01	0.2708E-03	-0.1458E-03	20	0.8613E-01	0.2746E-03	-0.1639E-03	21	0.7431E-01	0.1951E-03	-0.1894E-03
22	0.8892E-01	0.1963E-04	-0.1981E-03	23	0.7083E-01	-0.1209E-03	-0.1898E-03	24	0.7706E-01	-0.2141E-03	-0.1688E-03
25	0.8548E-01	-0.2431E-03	-0.1467E-03	26	0.9125E-01	-0.2366E-03	-0.1367E-03	27	0.9406E-01	-0.2310E-03	-0.1336E-03
28	0.9231E-01	0.2784E-03	-0.1680E-04	29	0.8159E-01	0.2869E-03	-0.1979E-04	30	0.6921E-01	0.2038E-03	-0.1318E-04
31	0.6366E-01	0.1689E-04	-0.1044E-04	32	0.6584E-01	-0.1328E-03	-0.8842E-05	33	0.7262E-01	-0.2317E-03	-0.7685E-05
34	0.8166E-01	-0.2576E-03	-0.6763E-05	35	0.8771E-01	-0.2458E-03	-0.6100E-05	36	0.9061E-01	-0.2383E-03	-0.5598E-05
37	0.9857E-01	0.2722E-03	0.8497E-04	38	0.8324E-01	0.2769E-03	0.1034E-03	39	0.7136E-01	0.1949E-03	0.1278E-03
40	0.6608E-01	0.1538E-04	0.1352E-03	41	0.6819E-01	-0.1281E-03	0.1345E-03	42	0.7472E-01	-0.2227E-03	0.1200E-03
43	0.8343E-01	-0.2501E-03	0.1024E-03	44	0.8935E-01	-0.2417E-03	0.9461E-04	45	0.9221E-01	-0.2355E-03	0.9227E-04
46	0.1011E 00	0.2599E-03	0.1610E-03	47	0.8858E-01	0.2549E-03	0.1850E-03	48	0.7783E-01	0.1752E-03	0.2197E-03
49	0.7305E-01	0.1453E-04	0.2357E-03	50	0.7492E-01	-0.1139E-03	0.2271E-03	51	0.8075E-01	-0.1998E-03	0.2046E-03
52	0.8865E-01	-0.2311E-03	0.1805E-03	53	0.9421E-01	-0.2302E-03	0.1695E-03	54	0.9695E-01	-0.2268E-03	0.1659E-03
55	0.1054E 00	0.2518E-03	0.1914E-03	56	0.9339E-01	0.2395E-03	0.2124E-03	57	0.8344E-01	0.1609E-03	0.2428E-03
58	0.7905E-01	0.1416E-04	0.2581E-03	59	0.8070E-01	-0.1024E-03	0.2499E-03	60	0.8599E-01	-0.1834E-03	0.2286E-03
61	0.9335E-01	-0.2184E-03	0.2081E-03	62	0.9864E-01	-0.2219E-03	0.1985E-03	63	0.1013E 00	-0.2204E-03	0.1951E-03
64	0.1077E 00	0.2484E-03	0.2089E-03	65	0.9598E-01	0.2330E-03	0.2189E-03	66	0.8637E-01	0.1547E-03	0.2442E-03
67	0.8215E-01	0.1397E-04	0.2578E-03	68	0.8371E-01	-0.9726E-04	0.2504E-03	69	0.8876E-01	-0.1765E-03	0.2327E-03
70	0.9590E-01	-0.2130E-03	0.2152E-03	71	0.1011E 00	-0.2183E-03	0.2070E-03	72	0.1037E 00	-0.2196E-03	0.2041E-03
73	0.1102E 00	0.2455E-03	0.2072E-03	74	0.9863E-01	0.2277E-03	0.2216E-03	75	0.8929E-01	0.1495E-03	0.2419E-03
76	0.8521E-01	0.1376E-04	0.2528E-03	77	0.8669E-01	-0.9305E-04	0.2471E-03	78	0.9156E-01	-0.1707E-03	0.2330E-03
79	0.9850E-01	-0.2089E-03	0.2188E-03	80	0.1036E 00	-0.2154E-03	0.2122E-03	81	0.1062E 00	-0.2153E-03	0.2100E-03
82	0.1127E 00	0.2432E-03	0.2107E-03	83	0.1013E 00	0.2236E-03	0.2215E-03	84	0.9216E-01	0.1455E-03	0.2372E-03
85	0.8821E-01	0.1351E-04	0.2456E-03	86	0.8965E-01	-0.8982E-04	0.2414E-03	87	0.9435E-01	-0.1662E-03	0.2307E-03
88	0.1011E 00	-0.2050E-03	0.2197E-03	89	0.1062E 00	-0.2132E-03	0.2148E-03	90	0.1087E 00	-0.2137E-03	0.2133E-03
91	0.1152E 00	0.2412E-03	0.2119E-03	92	0.1039E 00	0.2207E-03	0.2194E-03	93	0.9498E-01	0.1428E-03	0.2317E-03
94	0.9111E-01	0.1314E-04	0.2380E-03	95	0.9249E-01	-0.8761E-04	0.2352E-03	96	0.9709E-01	-0.1629E-03	0.2272E-03
97	0.1038E 00	-0.2023E-03	0.2189E-03	98	0.1088E 00	-0.2116E-03	0.2152E-03	99	0.1113E 00	-0.2128E-03	0.2143E-03

THE GAP OR PRECOMPRESSION OF THE NODES IS=

1	0.19132	2	0.11649	3	0.07398	4	0.06105	5	0.06975	6	0.09402	7	0.18681	8	0.17515
9	0.19751	10	0.11623	11	0.04207	12	0.00053	13	-0.01191	14	-0.00360	15	0.02048	16	0.06184
17	0.09981	18	0.12203	19	0.07345	20	0.00027	21	-0.03975	22	-0.05164	23	-0.04383	24	-0.02090
25	0.01928	26	0.05671	27	0.07874	28	0.06021	29	-0.01247	30	-0.05173	31	-0.06366	32	-0.05612
33	-0.03374	34	0.00582	35	0.04297	36	0.06491	37	0.06867	38	-0.06490	39	-0.04436	40	-0.05636
41	-0.06875	42	-0.02612	43	0.01377	44	0.05105	45	0.07303	46	0.09330	47	0.01942	48	-0.02167
49	-0.03417	50	-0.02632	51	-0.00299	52	0.03771	53	0.07535	54	0.09745	55	0.11928	56	0.04485
57	0.00296	58	-0.00993	59	-0.00186	60	0.02201	61	0.06325	62	0.10114	63	0.12333	64	0.13528
65	0.06062	66	0.01839	67	0.00533	68	0.01349	69	0.03760	70	0.07906	71	0.11707	72	0.13929
73	0.15335	74	0.07849	75	0.03599	76	0.02279	77	0.03203	78	0.05542	79	0.09698	80	0.13507
81	0.19732	82	0.17352	83	0.09851	84	0.05560	85	0.04247	86	0.05977	87	0.07523	88	0.11702
89	0.19518	90	0.17746	91	0.19582	92	0.12070	93	0.07782	94	0.06691	95	0.07275	96	0.09731
97	0.13923	98	0.17744	99	0.19973										

NO. OF ITERATION CYCLE FOR CHECKING CONTACT,ICE = 4

CASE NO. FOR MOMENT TRANSFER,KMT= 1 MULTIPLYING FACTOR FOR EFFICIENCY OF MOMENT TRANSFER,CM= 0.

NODE	DEFLEC.	ROTAT,X	ROTAT,Y	NODE	DEFLEC.	ROTAT,X	ROTAT,Y	NODE	DEFLEC.	ROTAT,X	ROTAT,Y
1	0.1207E 00	0.2524E-03	-0.2461E-03	2	0.1089E 00	0.2322E-03	-0.2561E-03	3	0.9930E-01	0.1572E-03	-0.2694E-03
4	0.9467E-01	0.3004E-04	-0.2767E-03	5	0.9543E-01	-0.7010E-04	-0.2709E-03	6	0.9940E-01	-0.1454E-03	-0.2586E-03
7	0.1055E 00	-0.1857E-03	-0.2471E-03	8	0.1101E 00	-0.1958E-03	-0.2410E-03	9	0.1124E 00	-0.1971E-03	-0.2393E-03
10	0.1092E 00	0.2624E-03	-0.2257E-03	11	0.9670E-01	0.2508E-03	-0.2443E-03	12	0.8615E-01	0.1749E-03	-0.2789E-03
13	0.8104E-01	0.2890E-04	-0.2850E-03	14	0.8218E-01	-0.8817E-04	-0.2792E-03	15	0.8695E-01	-0.1689E-03	-0.2536E-03
16	0.9379E-01	-0.2042E-03	-0.2316E-03	17	0.9876E-01	-0.2076E-03	-0.2215E-03	18	0.1012E 00	-0.2059E-03	-0.2183E-03
19	0.9993E-01	0.2757E-03	-0.1501E-03	20	0.8647E-01	0.2794E-03	-0.1679E-03	21	0.7442E-01	0.2081E-03	-0.1930E-03
22	0.8876E-01	0.2626E-04	-0.2016E-03	23	0.7039E-01	-0.1122E-03	-0.1927E-03	24	0.7627E-01	-0.2032E-03	-0.1731E-03

(Continued)

(Sheet 5 of 16)

Table 11 (Continued)

25	0.8427E-01	-0.2312E-03	-0.1518E-03	26	0.8976E-01	-0.8248E-03	-0.1421E-03	27	0.9243E-01	-0.2192E-03	-0.1390E-03
28	0.9567E-01	0.2831E-03	-0.2195E-04	29	0.8173E-01	0.8914E-03	-0.2039E-04	30	0.6913E-01	0.2086E-03	-0.1752E-04
31	0.6332E-01	0.2340E-04	-0.1455E-04	32	0.6522E-01	-0.1230E-03	-0.1271E-04	33	0.7163E-01	-0.2200E-03	-0.1137E-04
34	0.8022E-01	-0.2494E-03	-0.1031E-04	35	0.8599E-01	-0.8341E-03	-0.9590E-05	36	0.8876E-01	-0.2266E-03	-0.9072E-05
37	0.9675E-01	0.2709E-03	0.7944E-04	38	0.8320E-01	0.8814E-03	0.9800E-04	39	0.7111E-01	0.1995E-03	0.1223E-03
40	0.6557E-01	0.2151E-04	0.1341E-03	41	0.6743E-01	-0.1197E-03	0.1300E-03	42	0.7340E-01	-0.2110E-03	0.1166E-03
43	0.8190E-01	-0.2303E-03	0.1000E-03	44	0.8754E-01	-0.2302E-03	0.9254E-04	45	0.9026E-01	-0.2240E-03	0.9033E-04
46	0.1011E 00	0.2647E-03	0.1551E-03	47	0.8833E-01	0.8595E-03	0.1789E-03	48	0.7736E-01	0.1799E-03	0.2133E-03
49	0.7234E-01	0.2010E-04	0.2259E-03	50	0.7398E-01	-0.1064E-03	0.2210E-03	51	0.7950E-01	-0.1981E-03	0.2003E-03
52	0.8702E-01	-0.2203E-03	0.1775E-03	53	0.9232E-01	-0.2193E-03	0.1670E-03	54	0.9493E-01	-0.2159E-03	0.1637E-03
55	0.1052E 00	0.2547E-03	0.1893E-03	56	0.9300E-01	0.8443E-03	0.2081E-03	57	0.8291E-01	0.1656E-03	0.2363E-03
58	0.7818E-01	0.1937E-04	0.2517E-03	59	0.7963E-01	-0.9555E-04	0.2430E-03	60	0.8463E-01	-0.1745E-03	0.2240E-03
61	0.9165E-01	-0.2082E-03	0.2045E-03	62	0.9670E-01	-0.8115E-03	0.1955E-03	63	0.9923E-01	-0.2100E-03	0.1923E-03
64	0.1075E 00	0.2533E-03	0.1940E-03	65	0.9551E-01	0.8379E-03	0.2120E-03	66	0.8566E-01	0.1594E-03	0.2380E-03
67	0.8121E-01	0.1906E-04	0.2515E-03	68	0.8256E-01	-0.9072E-04	0.2447E-03	69	0.8735E-01	-0.1679E-03	0.2280E-03
70	0.9415E-01	-0.2032E-03	0.2115E-03	71	0.9910E-01	-0.8082E-03	0.2030E-03	72	0.1016E 00	-0.2079E-03	0.2011E-03
73	0.1099E 00	0.2504E-03	0.2010E-03	74	0.9808E-01	0.8326E-03	0.2158E-03	75	0.8851E-01	0.1543E-03	0.2357E-03
76	0.8420E-01	0.1876E-04	0.2468E-03	77	0.8548E-01	-0.8676E-04	0.2415E-03	78	0.9049E-01	-0.1625E-03	0.2283E-03
79	0.9671E-01	-0.1990E-03	0.2150E-03	80	0.1016E 00	-0.8055E-03	0.2088E-03	81	0.1040E 00	-0.2054E-03	0.2068E-03
82	0.1123E 00	0.2481E-03	0.2049E-03	83	0.1007E 00	0.8285E-03	0.2153E-03	84	0.9131E-01	0.1503E-03	0.2311E-03
85	0.8712E-01	0.1841E-04	0.2397E-03	86	0.8839E-01	-0.8374E-04	0.2360E-03	87	0.9242E-01	-0.1562E-03	0.2261E-03
88	0.9929E-01	-0.1950E-03	0.2159E-03	89	0.1041E 00	-0.8035E-03	0.2113E-03	90	0.1066E 00	-0.2039E-03	0.2099E-03
91	0.1148E 00	0.2461E-03	0.2057E-03	92	0.1032E 00	0.8255E-03	0.2135E-03	93	0.9405E-01	0.1475E-03	0.2255E-03
94	0.8995E-01	0.1793E-04	0.2322E-03	95	0.9115E-01	-0.8173E-04	0.2299E-03	96	0.9591E-01	-0.1553E-03	0.2227E-03
97	0.1019E 00	-0.1931E-03	0.2151E-03	98	0.1066E 00	-0.8020E-03	0.2117E-03	99	0.1091E 00	-0.2031E-03	0.2108E-03

THE GAP OR PRECOMPRESSION OF THE NODES IS=

1	0.19034	2	0.21576	3	0.07320	4	0.06085	5	0.06981	6	0.09500	7	0.14753	8	0.17613
9	0.19862	10	0.21545	11	0.04154	12	0.00025	13	-0.01192	14	-0.08344	15	0.02105	16	0.06281
17	0.10104	18	0.12340	19	0.07287	20	-0.00007	21	-0.03986	22	-0.05148	23	-0.04339	24	-0.02011
25	0.08049	26	0.05820	27	0.00037	28	0.05985	29	-0.01261	30	-0.05145	31	-0.06332	32	-0.05550
33	-0.08275	34	0.00720	35	0.04459	36	0.06676	37	0.06849	38	-0.10436	39	-0.04411	40	-0.05985
41	-0.04799	42	-0.02508	43	0.01530	44	0.05286	45	0.07498	46	0.09342	47	0.01967	48	-0.02120
49	-0.03346	50	-0.02538	51	-0.00174	52	0.03934	53	0.07724	54	0.09947	55	0.11948	56	0.04524
57	0.00359	58	-0.00900	59	-0.00079	60	0.02337	61	0.06495	62	0.10310	63	0.12541	64	0.13552
65	0.00109	66	0.01910	67	0.00627	68	0.01464	69	0.03901	70	0.08081	71	0.11906	72	0.14140
73	0.15366	74	0.07904	75	0.03627	76	0.02380	77	0.03224	78	0.05679	79	0.09877	80	0.13710
81	0.15947	82	0.17391	83	0.09913	84	0.05665	85	0.04356	86	0.05205	87	0.07675	88	0.11087
89	0.15725	90	0.17969	91	0.19628	92	0.12140	93	0.07875	94	0.06597	95	0.07409	96	0.09889
97	0.14112	98	0.17996	99	0.20196										

NO. OF ITERATION CYCLE FOR CHECKING CONTACT,ICE = 5

CASE NO. FOR MOMENT TRASFER,MMT= 2

MULTIPLYING FACTOR FOR EFFICIENCY OF MOMENT TRANSFER,CM= 0.

Entry 4.

NODE	DEFLEC.	ROTAT.X	ROTAT.Y	NODE	DEFLEC.	ROTAT.X	ROTAT.Y	NODE	DEFLEC.	ROTAT.X	ROTAT.Y
1	0.1206E 00	0.2522E-03	-0.2459E-03	2	0.1088E 00	0.8320E-03	-0.2559E-03	3	0.9927E-01	0.1570E-03	-0.2692E-03
4	0.9464E-01	0.2986E-04	-0.2765E-03	5	0.9541E-01	-0.7824E-04	-0.2704E-03	6	0.9939E-01	-0.1455E-03	-0.2585E-03
7	0.1055E 00	-0.1858E-03	-0.2470E-03	8	0.1101E 00	-0.1959E-03	-0.2415E-03	9	0.1124E 00	-0.1972E-03	-0.2392E-03
10	0.1091E 00	0.2622E-03	-0.2255E-03	11	0.9667E-01	0.8505E-03	-0.2441E-03	12	0.8613E-01	0.1747E-03	-0.2728E-03
13	0.8102E-01	0.2873E-04	-0.2848E-03	14	0.8217E-01	-0.8830E-04	-0.2750E-03	15	0.8694E-01	-0.1690E-03	-0.2534E-03
16	0.9379E-01	-0.2043E-03	-0.2314E-03	17	0.9876E-01	-0.8077E-03	-0.2214E-03	18	0.1012E 00	-0.2060E-03	-0.2181E-03
19	0.9989E-01	0.2758E-03	-0.1499E-03	20	0.8645E-01	0.2792E-03	-0.1677E-03	21	0.7440E-01	0.1999E-03	-0.1928E-03
22	0.6875E-01	0.2611E-04	-0.2015E-03	23	0.7039E-01	-0.1123E-03	-0.1926E-03	24	0.7627E-01	-0.2033E-03	-0.1729E-03
25	0.8427E-01	-0.2313E-03	-0.1517E-03	26	0.8977E-01	-0.8249E-03	-0.1419E-03	27	0.9243E-01	-0.2193E-03	-0.1390E-03
28	0.9564E-01	0.2829E-03	-0.2127E-04	29	0.8171E-01	0.8913E-03	-0.2013E-04	30	0.6913E-01	0.2084E-03	-0.1730E-04
31	0.6332E-01	0.2328E-04	-0.1437E-04	32	0.6523E-01	-0.1239E-03	-0.1294E-04	33	0.7143E-01	-0.2201E-03	-0.1119E-04
34	0.8023E-01	-0.2495E-03	-0.1013E-04	35	0.8601E-01	-0.8342E-03	-0.9422E-05	36	0.8877E-01	-0.2247E-03	-0.8896E-05
37	0.9674E-01	0.2767E-03	0.7992E-04	38	0.8320E-01	0.8812E-03	0.9826E-04	39	0.7111E-01	0.1994E-03	0.1226E-03
40	0.6558E-01	0.2141E-04	0.1343E-03	41	0.6744E-01	-0.1198E-03	0.1303E-03	42	0.7362E-01	-0.2119E-03	0.1160E-03

(Continued)

(Sheet 6 of 16)

Table 11 (Continued)

43	0.8191E-01	-0.2384E-03	0.1002E-03	44	0.8754E-01	-0.2303E-03	0.9276E-04	45	0.9028E-01	-0.2240E-03	0.9055E-04
46	0.1011E 00	0.2646E-03	0.1554E-03	47	0.8834E-01	0.2594E-03	0.1792E-03	48	0.7737E-01	0.1798E-03	0.2139E-03
49	0.7236E-01	0.1999E-04	0.2298E-03	50	0.7400E-01	-0.1065E-03	0.2229E-03	51	0.7952E-01	-0.1902E-03	0.2006E-03
52	0.8705E-01	-0.2204E-03	0.1777E-03	53	0.9235E-01	-0.2194E-03	0.1673E-03	54	0.9496E-01	-0.2160E-03	0.1640E-03
55	0.1052E 00	0.2565E-03	0.1896E-03	56	0.9301E-01	0.2442E-03	0.2064E-03	57	0.8283E-01	0.1655E-03	0.2366E-03
58	0.7821E-01	0.1926E-04	0.2520E-03	59	0.7965E-01	-0.9565E-04	0.2441E-03	60	0.8466E-01	-0.1746E-03	0.2243E-03
61	0.9168E-01	-0.2063E-03	0.2048E-03	62	0.9674E-01	-0.2116E-03	0.1958E-03	63	0.9927E-01	-0.2101E-03	0.1926E-03
64	0.1079E 00	0.2531E-03	0.1991E-03	65	0.9553E-01	0.2378E-03	0.2129E-03	66	0.8566E-01	0.1593E-03	0.2382E-03
67	0.8124E-01	0.1895E-04	0.2518E-03	68	0.8259E-01	-0.9083E-04	0.2450E-03	69	0.8738E-01	-0.1680E-03	0.2283E-03
70	0.9418E-01	-0.2032E-03	0.2117E-03	71	0.9914E-01	-0.2083E-03	0.2041E-03	72	0.1016E 00	-0.2075E-03	0.2014E-03
73	0.1099E 00	0.2503E-03	0.2013E-03	74	0.9810E-01	0.2325E-03	0.2156E-03	75	0.8853E-01	0.1541E-03	0.2360E-03
76	0.8423E-01	0.1864E-04	0.2471E-03	77	0.8552E-01	-0.8886E-04	0.2418E-03	78	0.9013E-01	-0.1626E-03	0.2280E-03
79	0.9675E-01	-0.1990E-03	0.2193E-03	80	0.1016E 00	-0.2056E-03	0.2091E-03	81	0.1041E 00	-0.2055E-03	0.2071E-03
82	0.1123E 00	0.2460E-03	0.2047E-03	83	0.1007E 00	0.2284E-03	0.2159E-03	84	0.9134E-01	0.1501E-03	0.2315E-03
85	0.8716E-01	0.1829E-04	0.2400E-03	86	0.8839E-01	-0.8385E-04	0.2363E-03	87	0.9286E-01	-0.1583E-03	0.2264E-03
88	0.9934E-01	-0.1957E-03	0.2162E-03	89	0.1042E 00	-0.2036E-03	0.2119E-03	90	0.1066E 00	-0.2040E-03	0.2102E-03
91	0.1148E 00	0.2460E-03	0.2059E-03	92	0.1033E 00	0.2254E-03	0.2138E-03	93	0.9408E-01	0.1473E-03	0.2258E-03
94	0.8999E-01	0.1781E-04	0.2325E-03	95	0.9119E-01	-0.8184E-04	0.2302E-03	96	0.9555E-01	-0.1553E-03	0.2230E-03
97	0.1019E 00	-0.1932E-03	0.2194E-03	98	0.1067E 00	-0.2021E-03	0.2120E-03	99	0.1091E 00	-0.2032E-03	0.2111E-03

Entry 4.

THE GAP OR PRECOMPRESSION OF THE NODES IS

1	0.19040	2	0.11500	3	0.07353	4	0.06088	5	0.06983	6	0.09501	7	0.13758	8	0.17614
9	0.19862	10	0.11550	11	0.04157	12	0.00027	13	-0.01190	14	-0.00333	15	0.02108	16	0.06281
17	0.10104	18	0.12340	19	0.07291	20	-0.00005	21	-0.03984	22	-0.05197	23	-0.04339	24	-0.02011
25	0.02049	26	0.05819	27	0.08037	28	0.05988	29	-0.01259	30	-0.05185	31	-0.06332	32	-0.05551
33	-0.03275	34	0.00725	35	0.04467	36	0.06675	37	0.06850	38	-0.00436	39	-0.04413	40	-0.05586
41	-0.04800	42	-0.02502	43	0.01529	44	0.05284	45	0.07496	46	0.09332	47	0.01968	48	-0.02121
49	-0.03348	50	-0.02540	51	-0.00176	52	0.03931	53	0.07721	54	0.09944	55	0.11948	56	0.04523
57	0.00357	58	-0.00909	59	-0.00081	60	0.02334	61	0.06492	62	0.10306	63	0.12537	64	0.13551
65	0.00107	66	0.01900	67	0.00624	68	0.01461	69	0.03898	70	0.08076	71	0.11902	72	0.14136
73	0.15365	74	0.07902	75	0.03675	76	0.02377	77	0.03220	78	0.05675	79	0.09875	80	0.13706
81	0.15943	82	0.17309	83	0.09931	84	0.05662	85	0.04352	86	0.05201	87	0.07670	88	0.11882
89	0.15721	90	0.17960	91	0.19627	92	0.12138	93	0.07872	94	0.06593	95	0.07405	96	0.09885
97	0.14107	98	0.17951	99	0.20191										

Entry 4.

AMOUNT OF FINAL CURLING AND GAP AT THE NODES IS

1	0.19040	2	0.11500	3	0.07353	4	0.06088	5	0.06983	6	0.09501	7	0.13758	8	0.17614
9	0.19862	10	0.11550	11	0.04157	12	0.00027	13	-0.01190	14	-0.00333	15	0.02108	16	0.06281
17	0.10104	18	0.12340	19	0.07291	20	-0.00005	21	-0.03984	22	-0.05197	23	-0.04339	24	-0.02011
25	0.02049	26	0.05819	27	0.08037	28	0.05988	29	-0.01259	30	-0.05185	31	-0.06332	32	-0.05551
33	-0.03275	34	0.00725	35	0.04467	36	0.06675	37	0.06850	38	-0.00436	39	-0.04413	40	-0.05586
41	-0.04800	42	-0.02502	43	0.01529	44	0.05284	45	0.07496	46	0.09332	47	0.01968	48	-0.02121
49	-0.03348	50	-0.02540	51	-0.00176	52	0.03931	53	0.07721	54	0.09944	55	0.11948	56	0.04523
57	0.00357	58	-0.00909	59	-0.00081	60	0.02334	61	0.06492	62	0.10306	63	0.12537	64	0.13551
65	0.00107	66	0.01900	67	0.00624	68	0.01461	69	0.03898	70	0.08076	71	0.11902	72	0.14136
73	0.15365	74	0.07902	75	0.03675	76	0.02377	77	0.03220	78	0.05675	79	0.09875	80	0.13706
81	0.15943	82	0.17309	83	0.09931	84	0.05662	85	0.04352	86	0.05201	87	0.07670	88	0.11882
89	0.15721	90	0.17960	91	0.19627	92	0.12138	93	0.07872	94	0.06593	95	0.07405	96	0.09885
97	0.14107	98	0.17951	99	0.20191										

Entry 5.

NODE	LAYER	STRESS X	STRESS Y	STRESS XY	MAJOR	MINOR	SHEAR	REACTION
60	1	-0.386426E 02	-0.761938E 02	-0.223988E 02	-0.866454E 02	-0.281910E 02	0.292272E 02	0.846611E 01
61	1	-0.377733E 02	-0.236911E 02	-0.171050E 02	-0.492297E 02	-0.122347E 02	0.184975E 02	0.916785E 01
62	1	-0.384379E 02	-0.405569E 01	-0.111644E 02	-0.417447E 02	-0.748222E 00	0.204981E 02	0.967388E 01
63	1	-0.393776E 02	0.	0.	-0.393776E 02	0.	0.196888E 02	0.992703E 01
69	1	-0.216750E 02	-0.734642E 02	-0.188918E 02	-0.796231E 02	-0.155161E 02	0.320535E 02	0.873807E 01
70	1	-0.237019E 02	-0.241718E 02	-0.145204E 02	-0.384592E 02	-0.941451E 01	0.145223E 02	0.941817E 01
71	1	-0.253923E 02	-0.464127E 01	-0.945355E 01	-0.290532E 02	-0.980378E 00	0.140364E 02	0.991415E 01
72	1	-0.264940E 02	0.	0.	-0.264940E 02	0.	0.132470E 02	0.101638E 02
78	1	-0.957755E 01	-0.713766E 02	-0.150877E 02	-0.748634E 02	-0.609077E 01	0.343863E 02	0.901250E 01
79	1	-0.124056E 02	-0.247143E 02	-0.117233E 02	-0.318005E 02	-0.531938E 01	0.132406E 02	0.967467E 01

(Continued)

(Sheet 7 of 16)

Table 11 (Continued)

60	1	-0.164491E 02	-0.512060E 01	-0.740956E 01	-0.185562E 02	-0.100153E 01	0.873732E 01	0.101424E 02
61	1	-0.157982E 02	0.	0.	-0.157982E 02	0.	0.709912E 01	0.104892E 02
67	1	-0.284394E 01	-0.700484E 02	-0.111990E 02	-0.710423E 02	-0.541957E 00	0.256503E 02	0.928568E 01
68	1	-0.941799E 01	-0.254171E 02	-0.960734E 01	-0.207822E 02	-0.200722E 02	0.138352E 02	0.993373E 01
69	1	-0.582384E 01	-0.585363E 01	-0.538819E 01	-0.112249E 02	-0.498710E 00	0.530821E 01	0.104190E 02
70	1	-0.796355E 01	0.	0.	-0.796355E 01	0.	0.478178E 01	0.106597E 02
76	1	0.	-0.497044E 02	0.	-0.497044E 02	0.	0.448522E 02	0.995539E 01
77	1	0.	-0.266396E 02	0.	-0.266396E 02	0.	0.133578E 02	0.101920E 02
78	1	0.	-0.767728E 01	0.	-0.767770E 01	0.	0.883809E 01	0.106693E 02
79	1	0.	0.	0.	0.	0.	0.	0.107127E 02

(Continued)

(Sheet 8 of 16)

Table 11 (Continued)

```
          INPUT DATA
  LOAD,TEMP,SLAB WT,
   1    0 9801  500  900  200  130
  11    9    0    0    0    0
BLANK HERE,NO. OF JOINT NJOINT=0,SC NO JOINT ELE, NEEDED
   1    1    0    0   20    2    0    1   20
   1    1    1    1    0    1    0    0    0
   0    0    0    0   49  199    0   15    100000
   0    0    0    0    0    0
100,00000  45,00000   0,25000 0,100E-01 0,100E-02 0,300E 06   0,20000
BLANK CARD  NO ADDIT, SUBG, MODU, TO BE READ IN
  0,        48,00000  96,00000 144,00000 180,00000 216,00000 240,00000 252,00000
264,00000 276,00000 288,00000
  0,        48,00000  96,00000 144,00000 180,00000 216,00000 252,00000 276,00000
288,00000
 15,00000   0,20000 0,600E 07
BLANK CARD NO ADDI.THICKNESS TO BE READ IN
BLANK CARD  NO, OF JOINT NJOINT=0
   14400,00
  90  -1,00000   1,00000  -1,00000   1,00000 100,00000
BLANK CARD NO. OF NO SUBGRADE CONTACT,NOTCON=0
  60   61   62   63   69   70   71   72   78   79   80   81   87   88   89   90
  96   97   98   99
BLANK CARD NO SYMMETRY ON X-AXIS
BLANK CARD NO SYMMETRY ON Y-AXIS
BLANK CARD NSTORE NOT EQUAL ONE
BLANK CARD NO GAP TO BE READ IN
BLANK CARD NO CONC. FORCE OR MOMENT APPLIED AT NODES
BLANK CARD NREAD=0
  0,
  0.
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(Continued)

(Sheet 9 of 16)

Table 11 (Continued)

```
LOAD,TEMP,SLAB WT,
                  FINITE ELEMENT ANALYSIS OF CONCRETE PAVEMENTS

 NSLAB=   1    NJOINT=   0    LNOBD= 9801    LCUD=  500    LCLD=  500    NHRU=  200    NELDA  130

FOR SLAB NO. 1 #  NX=   11    NY=   9    JCBS=       0        0        0        0

JOINT NO, INITIAL STARTING NODAL NO, (ISNN) AND LAST FINAL NODAL NO, (LFAN) ON BOTH SIDES OF JOINT ARE
 1     0     0     0     0

JOINT NO, AND VALUES OF IST ARE
 1     0     0

JOINT NO, AND VALUES OF NJT ARE
 1     0     0

JOINT NO, AND VALUES OF NKT ARE
 1     0     0

COMPUTED DIMEN. OF STIFFNESS MATRICES C AND G, LNCB=    9801                COMP. DIMEN. OF MATRIX CU,LCUD=     1
COMP.DIMEN. OF MATRIX CL,LCLZ=      1        TOTAL NO OF EQUATIONS,LNO=  297      TOTAL NO. OF NODAL PTS.,LNP=   99
Entry 6.
NLAYER=   1     NBOND=   1    NOTCON=   0     NGAP=   0    NCYLE=   20    NSTORE=   2    NREAD=   0
  INDP=   1    NPRINT=  20    NTEMP=    1      ICX=   1      ICY=    1    NLOAD=    1     NNCF=   0
  NNT=    1      NMT=    1      NSX=    0      NSY=   0     JNCK=    0     NOCK=    0     NECK=   0
 NNCK=    0      ICL=   45     ICLF=  199    IGNOR=   0    NNRFR=   19      NAS=    0   NARFAJ=  100000
 NAT1=    0     NAT2=    0     IFDR=    0     ILPR=   0   NPUNCH=    0    NCOMP=   0

SUBG. MODULUS SUBMOD= 100,00000        TEMP. =  45.00000     RELAXATION FACTOR RFI=  0.25000    TOLERANCE DEL= 0.100E-02
  FINAL TOLER. DEL= 0.100E-02         MCDU. OF DOWEL YMD= 0.300E 08             POISSON S RATIO OF DOWEL PRD=   0.20000

FOR SLAB NO. 1 #  X=   0,      48.00000  96.00000 144.00000 180.00000 216.00000 240.00000 252.00000 264.00000 276.00000
288.00000
               Y=   0,      48.00000  96.00000 144.00000 180.00000 216.00000 252.00000 276.00000 288.00000

FOR LAYER NO. 1         THICKNESS T,  12.00000     POISSSON S RATIO RR=   0.20000    MODULUS YM= 0.400E 07

LOADS ARE APPLIED ON THE ELEMENT NO.(AL) WITH COORDINATES(XDA + YDA) AND INTENSITY(W) AS SHOWN#
       80       -1.00000       1.00000      -1.00000       1.00000       100.00000

NODAL NO, AT WHICH STRESSES ARE PRINTED
   60   61   62   63   69   70   71   72   78   79   80   81   87   88   89   90   96   97   98   99

SLAB NO,, INITIAL NODAL NUMBER(INITNP), LAST NODAL NUMBER(LASTNP); AND LAST ELEMENT NUMBER(LASTEN) ARE#
 1    1    99   80

NODAL NUMBERS AND INITIAL GAPS ARE TABULATED AS FOLLOWS...
  0    0,

AMOUNT OF INITIAL CURLING AND GAP AT THE NODES IS#
```

1	0.31104	2	0.22464	3	0.17280	4	0.15552	5	0.16524	6	0.19440	7	0.24300	8	0.28620
9	0.31104	10	0.22464	11	0.13824	12	0.08640	13	0.06912	14	0.07884	15	0.10800	16	0.15660
17	0.19980	18	0.22464	19	0.17280	20	0.08640	21	0.03456	22	0.01728	23	0.02700	24	0.05616
25	0.18476	26	0.14796	27	0.17280	28	0.15552	29	0.06912	30	0.01728	31	0.	32	0.00972
33	0.03888	34	0.08748	35	0.13068	36	0.15552	37	0.16524	38	0.07884	39	0.02700	40	0.00972
41	0.01944	42	0.04860	43	0.09720	44	0.14040	45	0.16524	46	0.19440	47	0.10800	48	0.05616
49	0.03888	50	0.04860	51	0.07776	52	0.12636	53	0.16956	54	0.19440	55	0.22464	56	0.13824
57	0.08640	58	0.06912	59	0.07884	60	0.10800	61	0.15660	62	0.19980	63	0.22464	64	0.24300
65	0.15660	66	0.10476	67	0.08748	68	0.09720	69	0.12636	70	0.17496	71	0.21816	72	0.24300

(Continued)

(Sheet 10 of 16)

Table 11 (Continued)

73	0.26352	74	0.17712	75	0.12528	76	0.10800	77	0.11772	78	0.14688	79	0.19548	80	0.23868
81	0.26352	82	0.28620	83	0.19980	84	0.14796	85	0.13068	86	0.14040	87	0.16956	88	0.21816
89	0.28136	90	0.28620	91	0.33184	92	0.22464	93	0.17280	94	0.15552	95	0.16528	96	0.19440
97	0.24300	98	0.28620	99	0.33184										

THE MULTIPLYING FACTOR FOR EFFICIENCY OF MOMENT TRANSFER, CM , IS C.

Entry 7.

TOTAL UNIFORMLY APPLIED LOAD INPUT= 14400.00 TOTAL LOAD CALCULATED= 14400.00

NO. OF ITERATION CYCLE FOR CHECKING CONTACT,ICE = 1

CASE NO. FOR MOMENT TRANSFER,KMT= 1 MULTIPLYING FACTOR FOR EFFICIENCY OF MOMENT TRANSFER,CM= C.

NODE	DEFLEC.	ROTAT.X	ROTAT.Y	NODE	DEFLEC.	ROTAT.X	ROTAT.Y	NODE	DEFLEC.	ROTAT.X	ROTAT.Y
1	0.2091E 00	0.7379E-03	-0.7353E-03	2	0.1747E 00	0.6708E-03	-0.7058E-03	3	0.1477E 00	0.4194E-03	-0.6728E-03
4	0.1309E 00	0.1551E-04	-0.6589E-03	5	0.1421E 00	-0.8979E-03	-0.6651E-03	6	0.1574E 00	-0.5326E-03	-0.6835E-03
7	0.1790E 00	-0.6445E-03	-0.7054E-03	8	0.1947E 00	-0.6976E-03	-0.7171E-03	9	0.2026E 00	-0.6566E-03	-0.7221E-03
10	0.1748E 00	0.7084E-03	-0.6684E-03	11	0.1415E 00	0.6925E-03	-0.6502E-03	12	0.1153E 00	0.4054E-03	-0.6414E-03
13	0.1049E 00	0.1241E-04	-0.6362E-03	14	0.1101E 00	-0.8911E-03	-0.6346E-03	15	0.1250E 00	-0.5204E-03	-0.6346E-03
16	0.1461E 00	-0.6309E-03	-0.6364E-03	17	0.1615E 00	-0.6413E-03	-0.6407E-03	18	0.1691E 00	-0.6352E-03	-0.6446E-03
19	0.1479E 00	0.6768E-03	-0.4181E-03	20	0.1154E 00	0.6438E-03	-0.4044E-03	21	0.8942E-01	0.4008E-03	-0.3959E-03
22	0.7929E-01	0.7721E-05	-0.3949E-03	23	0.8462E-01	-0.8970E-03	-0.3884E-03	24	0.9977E-01	-0.5269E-03	-0.3794E-03
25	0.1211E 00	-0.6331E-03	-0.3780E-03	26	0.1364E 00	-0.6322E-03	-0.3664E-03	27	0.1438E 00	-0.6157E-03	-0.3661E-03
28	0.1371E 00	0.6624E-03	-0.1750E-04	29	0.1050E 00	0.6387E-03	-0.1474E-04	30	0.7926E-01	0.3959E-03	-0.1014E-04
31	0.8947E-01	-0.2288E-05	-0.1414E-06	32	0.7526E-01	-0.8126E-03	0.1308E-04	33	0.9108E-01	-0.5479E-03	0.3241E-04
34	0.1132E 00	-0.6555E-03	0.5749E-04	35	0.1290E 00	-0.6504E-03	0.7597E-04	36	0.1367E 00	-0.6295E-03	0.8480E-04
37	0.1422E 00	0.6691E-03	0.2911E-03	38	0.1100E 00	0.6372E-03	0.2841E-03	39	0.8443E-01	0.3895E-03	0.2898E-03
40	0.7510E-01	-0.1552E-04	0.3055E-03	41	0.8149E-01	-0.8330E-03	0.3259E-03	42	0.9819E-01	-0.5765E-03	0.3560E-03
43	0.1215E 00	-0.6924E-03	0.3973E-03	44	0.1382E 00	-0.6924E-03	0.4317E-03	45	0.1464E 00	-0.6738E-03	0.4510E-03
46	0.1571E 00	0.6877E-03	0.5186E-03	47	0.1249E 00	0.6373E-03	0.5063E-03	48	0.9921E-01	0.3805E-03	0.5126E-03
49	0.9054E-01	-0.3493E-04	0.5337E-03	50	0.9781E-01	-0.8631E-03	0.5626E-03	51	0.1198E 00	-0.6200E-03	0.6062E-03
52	0.1409E 00	-0.7506E-03	0.6668E-03	53	0.1592E 00	-0.7619E-03	0.7172E-03	54	0.1683E 00	-0.7499E-03	0.7450E-03
55	0.1707E 00	0.7023E-03	0.6028E-03	56	0.1378E 00	0.6382E-03	0.5894E-03	57	0.1126E 00	0.3739E-03	0.5941E-03
58	0.1045E 00	-0.5129E-04	0.6170E-03	59	0.1129E 00	-0.8896E-03	0.6516E-03	60	0.1317E 00	-0.6586E-03	0.7052E-03
61	0.1584E 00	-0.8021E-03	0.7800E-03	62	0.1780E 00	-0.8222E-03	0.8411E-03	63	0.1879E 00	-0.8158E-03	0.8746E-03
64	0.1780E 00	0.7092E-03	0.6236E-03	65	0.1450E 00	0.6392E-03	0.6101E-03	66	0.1199E 00	0.3709E-03	0.6124E-03
67	0.1120E 00	-0.6021E-04	0.6350E-03	68	0.1205E 00	-0.8048E-03	0.6728E-03	69	0.1403E 00	-0.6811E-03	0.7313E-03
70	0.1680E 00	-0.8518E-03	0.8130E-03	71	0.1884E 00	-0.8559E-03	0.8788E-03	72	0.1986E 00	-0.8522E-03	0.9145E-03
73	0.1856E 00	0.7152E-03	0.6328E-03	74	0.1524E 00	0.6408E-03	0.6189E-03	75	0.1272E 00	0.3687E-03	0.6168E-03
76	0.1197E 00	-0.6949E-04	0.6380E-03	77	0.1286E 00	-0.8215E-03	0.6779E-03	78	0.1492E 00	-0.7057E-03	0.7424E-03
79	0.1779E 00	-0.8639E-03	0.8307E-03	80	0.1990E 00	-0.8908E-03	0.8099E-03	81	0.2097E 00	-0.8896E-03	0.9353E-03
82	0.1932E 00	0.7205E-03	0.6340E-03	83	0.1598E 00	0.6434E-03	0.6182E-03	84	0.1346E 00	0.3673E-03	0.6091E-03
85	0.1273E 00	-0.7882E-04	0.6274E-03	86	0.1367E 00	-0.8396E-03	0.6697E-03	87	0.1581E 00	-0.7325E-03	0.7403E-03
88	0.1879E 00	-0.8980E-03	0.8356E-03	89	0.2099E 00	-0.9244E-03	0.9046E-03	90	0.2210E 00	-0.9238E-03	0.9339E-03
91	0.2008E 00	0.7254E-03	0.6332E-03	92	0.1672E 00	0.6472E-03	0.6120E-03	93	0.1418E 00	0.3670E-03	0.5926E-03
94	0.1347E 00	-0.8770E-04	0.6063E-03	95	0.1446E 00	-0.6591E-03	0.6507E-03	96	0.1669E 00	-0.7614E-03	0.7260E-03
97	0.1979E 00	-0.9325E-03	0.8321E-03	98	0.2207E 00	-0.9544E-03	0.9837E-03	99	0.2321E 00	-0.9472E-03	0.9273E-03

THE GAP OR PRECOMPRESSION OF THE NODES IS=

1	0.10194	2	0.04991	3	0.02514	4	0.01864	5	0.02314	6	0.03791	7	0.06401	8	0.09152
9	0.10848	10	0.04979	11	-0.00326	12	-0.02888	13	-0.03581	14	-0.03123	15	-0.01699	16	0.01049
17	0.03835	18	0.05592	19	0.02492	20	-0.02896	21	-0.05486	22	-0.06201	23	-0.05762	24	-0.04361
25	-0.01631	26	0.01101	27	0.02895	28	0.01843	29	-0.03587	30	-0.06198	31	-0.06947	32	-0.06554
33	-0.05220	34	-0.02570	35	0.00172	36	0.01887	37	0.02308	38	-0.03113	39	-0.05743	40	-0.06538
41	-0.06205	42	-0.04959	43	-0.02427	44	0.00220	45	0.01883	46	0.03732	47	-0.01652	48	-0.04305
49	-0.05166	50	-0.04921	51	-0.03807	52	-0.01458	53	0.01036	54	0.02613	55	0.05398	56	0.00046
57	-0.02021	58	-0.03535	59	-0.03387	60	-0.02369	61	-0.00182	62	0.02178	63	0.03678	64	0.06497
65	0.01161	66	-0.01510	67	-0.02452	68	-0.02327	69	-0.01397	70	0.00696	71	0.02980	72	0.04439

(Continued)

Table 11 (Continued)

73	0.07794	74	0.02474	75	-0.00197	76	-0.01165	77	-0.01086	78	-0.00240	79	0.01761	80	0.03963
81	0.05379	82	0.09301	83	0.03999	84	0.01334	85	0.00342	86	0.00372	87	0.01147	88	0.03028
89	0.05147	90	0.06523	91	0.11025	92	0.05745	93	0.03097	94	0.02085	95	0.02063	96	0.02749
97	0.04511	98	0.06547	99	0.07892										

NO. OF ITERATION CYCLE FOR CHECKING CONTACT,ICC = 2

CASE NO. FOR MOMENT TRASFER,MMT= 1 MULTIPLYING FACTOR FOR EFFICIENCY OF MOMENT TRANSFER,CM= 0.

NODE	DEFLEC.	ROTAT,X	ROTAT,Y	NODE	DEFLEC.	ROTAT,X	ROTAT,Y	NODE	DEFLEC.	ROTAT,X	ROTAT,Y
1	0.1286E 00	0.2946E-03	-0.2947E-03	2	0.1145E 00	0.2080E-03	-0.2860E-03	3	0.1020E 00	0.2173E-03	-0.2839E-03
4	0.9522E-01	0.5290E-04	-0.2650E-03	5	0.9589E-01	-0.8011E-04	-0.2366E-03	6	0.1012E 00	-0.2001E-03	-0.2020E-03
7	0.1097E 00	-0.2665E-03	-0.1741E-03	8	0.1164E 00	-0.2867E-03	-0.1600E-03	9	0.1199E 00	-0.2898E-03	-0.1532E-03
10	0.1145E 00	0.2858E-03	-0.2879E-03	11	0.1007E 00	0.2894E-03	-0.2892E-03	12	0.8800E-01	0.2143E-03	-0.2944E-03
13	0.8198E-01	0.2360E-04	-0.2788E-03	14	0.8410E-01	-0.1377E-03	-0.2464E-03	15	0.9136E-01	-0.2537E-03	-0.1998E-03
16	0.1016E 00	-0.3095E-03	-0.1509E-03	17	0.1092E 00	-0.3189E-03	-0.1246E-03	18	0.1130E 00	-0.3163E-03	-0.1137E-03
19	0.1020E 00	0.2834E-03	-0.2166E-03	20	0.8802E-01	0.2944E-03	-0.2133E-03	21	0.7531E-01	0.2067E-03	-0.2056E-03
22	0.7025E-01	-0.1072E-04	-0.1795E-03	23	0.7404E-01	-0.1956E-03	-0.1426E-03	24	0.8374E-01	-0.3309E-03	-0.8968E-04
25	0.9688E-01	-0.3839E-03	-0.2658E-04	26	0.1061E 00	-0.3794E-03	0.1247E-04	27	0.1106E 00	-0.3709E-03	0.2959E-04
28	0.9529E-01	0.2642E-03	-0.5099E-04	29	0.8208E-01	0.2783E-03	-0.2118E-04	30	0.7035E-01	0.1804E-03	0.1382E-04
31	0.6695E-01	-0.5476E-04	0.5812E-04	32	0.7263E-01	-0.2569E-03	0.1004E-03	33	0.8484E-01	-0.4085E-03	0.1523E-03
34	0.1009E 00	-0.4609E-03	0.2131E-03	35	0.1122E 00	-0.4602E-03	0.2562E-03	36	0.1176E 00	-0.4471E-03	0.2772E-03
37	0.9605E-01	0.2354E-03	0.5147E-04	38	0.8432E-01	0.2454E-03	0.1415E-03	39	0.7428E-01	0.1430E-03	0.2005E-03
40	0.7278E-01	-0.9704E-04	0.2620E-03	41	0.8009E-01	-0.3052E-03	0.3103E-03	42	0.9417E-01	-0.4647E-03	0.3633E-03
43	0.1124E 00	-0.5330E-03	0.4240E-03	44	0.1252E 00	-0.5280E-03	0.4696E-03	45	0.1315E 00	-0.5158E-03	0.4940E-03
46	0.1015E 00	0.2006E-03	0.2051E-03	47	0.9174E-01	0.1981E-03	0.2594E-03	48	0.8418E-01	0.8972E-04	0.3368E-03
49	0.8519E-01	-0.1487E-03	0.4136E-03	50	0.9436E-01	-0.3582E-03	0.4695E-03	51	0.1104E 00	-0.5233E-03	0.5281E-03
52	0.1310E 00	-0.6012E-03	0.5950E-03	53	0.1455E 00	-0.6046E-03	0.6468E-03	54	0.1527E 00	-0.5967E-03	0.6750E-03
55	0.1071E 00	0.1906E-03	0.2557E-03	56	0.9854E-01	0.1647E-03	0.3035E-03	57	0.9289E-01	0.4829E-04	0.3822E-03
58	0.9982E-01	-0.1878E-03	0.4645E-03	59	0.1064E 00	-0.3976E-03	0.5257E-03	60	0.1240E 00	-0.5667E-03	0.5985E-03
61	0.1462E 00	-0.6531E-03	0.6097E-03	62	0.1621E 00	-0.6034E-03	0.7251E-03	63	0.1790E 00	-0.6592E-03	0.7570E-03
64	0.1103E 00	0.1720E-03	0.2734E-03	65	0.1023E 00	0.1492E-03	0.3167E-03	66	0.9754E-01	0.2760E-04	0.3903E-03
67	0.1015E 00	-0.2065E-03	0.4733E-03	68	0.1128E 00	-0.4188E-03	0.5368E-03	69	0.1311E 00	-0.5904E-03	0.6094E-03
70	0.1543E 00	-0.6819E-03	0.6860E-03	71	0.1709E 00	-0.6956E-03	0.7497E-03	72	0.1793E 00	-0.6931E-03	0.7834E-03
73	0.1136E 00	0.1645E-03	0.2862E-03	74	0.1061E 00	0.1553E-03	0.3240E-03	75	0.1022E 00	0.7811E-05	0.3905E-03
76	0.1071E 00	-0.2296E-03	0.4724E-03	77	0.1192E 00	-0.4410E-03	0.5379E-03	78	0.1384E 00	-0.6157E-03	0.6106E-03
79	0.1626E 00	-0.7130E-03	0.6970E-03	80	0.1800E 00	-0.7290E-03	0.7637E-03	81	0.1808E 00	-0.7281E-03	0.7973E-03
82	0.1171E 00	0.1579E-03	0.2943E-03	83	0.1100E 00	0.1231E-03	0.3259E-03	84	0.1049E 00	-0.1060E-04	0.3892E-03
85	0.1128E 00	-0.2507E-03	0.4640E-03	86	0.1257E 00	-0.4043E-03	0.5310E-03	87	0.1498E 00	-0.6429E-03	0.6082E-03
88	0.1710E 00	-0.7457E-03	0.7062E-03	89	0.1892E 00	-0.7611E-03	0.7661E-03	90	0.1983E 00	-0.7603E-03	0.7940E-03
91	0.1207E 00	0.1513E-03	0.2973E-03	92	0.1139E 00	0.1124E-03	0.3234E-03	93	0.1115E 00	-0.2732E-04	0.3769E-03
94	0.1183E 00	-0.2714E-03	0.4510E-03	95	0.1320E 00	-0.4887E-03	0.5188E-03	96	0.1530E 00	-0.6718E-03	0.6003E-03
97	0.1794E 00	-0.7784E-03	0.6980E-03	98	0.1984E 00	-0.7896E-03	0.7651E-03	99	0.2078E 00	-0.7825E-03	0.7874E-03

THE GAP OR PRECOMPRESSION OF THE NODES IS=

1	0.18246	2	0.11012	3	0.07081	4	0.06030	5	0.06935	6	0.09321	7	0.13327	8	0.16979
9	0.19117	10	0.11012	11	0.03752	12	-0.00160	13	-0.01286	14	-0.00526	15	0.01665	16	0.05496
17	0.09057	18	0.11160	19	0.07080	20	-0.00162	21	-0.04075	22	-0.05297	23	-0.04708	24	-0.02758
25	0.00788	26	0.04188	27	0.06222	28	0.06023	29	-0.01296	30	-0.05397	31	-0.06695	32	-0.06291
33	-0.04596	34	-0.01347	35	0.01853	36	0.03792	37	0.06919	38	-0.00598	39	-0.04728	40	-0.06306
41	-0.06064	42	-0.04557	43	-0.01525	44	0.01516	45	0.03373	46	0.09289	47	0.01628	48	-0.02802
49	-0.04631	50	-0.04576	51	-0.03269	52	-0.00463	53	0.02404	54	0.04107	55	0.11756	56	0.03970
57	-0.00649	58	-0.02670	59	-0.02755	60	-0.01596	61	0.01040	62	0.03774	63	0.05468	64	0.13274
65	0.05433	66	0.00722	67	-0.01398	68	-0.01558	69	-0.00478	70	0.02004	71	0.04728	72	0.06375
73	0.14989	74	0.07100	75	0.02305	76	0.00086	77	-0.00152	78	0.08843	79	0.03285	80	0.05867
81	0.07477	82	0.16909	83	0.08978	84	0.04108	85	0.01792	86	0.01474	87	0.02379	88	0.04714
89	0.07216	90	0.06788	91	0.19037	92	0.11072	93	0.06134	94	0.03726	95	0.03328	96	0.04138
97	0.06358	98	0.06702	99	0.10325										

(Continued)

(Sheet 12 of 16)

Table 11 (Continued)

NO. OF ITERATION CYCLE FOR CHECKING CONTACT,ICC = 3

CASE NO. FOR MOMENT TRANSFER,KMT= 1 MULTIPLYING FACTOR FOR EFFICIENCY OF MOMENT TRANSFER,CM= 0.

NODE	DEFLEC.	ROTAT,X	ROTAT,Y	NODE	DEFLEC.	ROTAT,X	ROTAT,Y	NODE	DEFLEC.	ROTAT,X	ROTAT,Y
1	0.1020E 00	0.1890E-03	-0.1861E-03	2	0.5314E-01	0.1736E-03	-0.1905E-03	3	0.8611E-01	0.1099E-03	-0.1932E-03
4	0.8361E-01	-0.1407E-04	-0.1876E-03	5	0.8614E-01	-0.1259E-03	-0.1688E-03	6	0.9248E-01	-0.2220E-03	-0.1424E-03
7	0.1017E 00	-0.2838E-03	-0.1166E-03	8	0.1088E 00	-0.3031E-03	-0.1031E-03	9	0.1124E 00	-0.3060E-03	-0.9657E-04
10	0.9328E-01	0.1932E-03	-0.1707E-03	11	0.8408E-01	0.1841E-03	-0.1813E-03	12	0.7695E-01	0.1172E-03	-0.2029E-03
13	0.7414E-01	-0.3019E-04	-0.2030E-03	14	0.7766E-01	-0.1630E-03	-0.1791E-03	15	0.8554E-01	-0.2681E-03	-0.1383E-03
16	0.9638E-01	-0.3246E-03	-0.5374E-04	17	0.1043E 00	-0.3338E-03	-0.6896E-04	18	0.1043E 00	-0.3313E-03	-0.5843E-04
19	0.8638E-01	0.1961E-03	-0.1071E-03	20	0.7668E-01	0.8053E-03	-0.1144E-03	21	0.7795E-01	0.1335E-03	-0.1308E-03
22	0.6566E-01	-0.5721E-04	-0.1215E-03	23	0.7054E-01	-0.2162E-03	-0.8923E-04	24	0.8076E-01	-0.3409E-03	-0.3655E-04
25	0.9423E-01	-0.3943E-03	0.2420E-04	26	0.1037E 00	-0.3924E-03	0.8214E-04	27	0.1084E 00	-0.3844E-03	0.7897E-04
28	0.8401E-01	0.1906E-03	0.1714E-04	29	0.7440E-01	0.8057E-03	0.3270E-04	30	0.8540E-01	0.1242E-03	0.5489E-04
31	0.6456E-01	-0.8857E-04	0.5129E-04	32	0.7118E-01	-0.2763E-03	0.1322E-03	33	0.8393E-01	-0.4199E-03	0.1859E-03
34	0.1004E 00	-0.4793E-03	0.2483E-03	35	0.1119E 00	-0.4725E-03	0.2921E-03	36	0.1175E 00	-0.4603E-03	0.3133E-03
37	0.8602E-01	0.1719E-03	0.1276E-03	38	0.7800E-01	0.1817E-03	0.1648E-03	39	0.7876E-01	0.9184E-04	0.2182E-03
40	0.7127E-01	-0.1294E-03	0.2783E-03	41	0.7950E-01	-0.1257E-03	0.3275E-03	42	0.9420E-01	-0.4785E-03	0.3828E-03
43	0.1129E 00	-0.5455E-03	0.4460E-03	44	0.1268E 00	-0.5417E-03	0.4930E-03	45	0.1325E 00	-0.5302E-03	0.5179E-03
46	0.9300E-01	0.1455E-03	0.2223E-03	47	0.8592E-01	0.1489E-03	0.2684E-03	48	0.8102E-01	0.3972E-04	0.3487E-03
49	0.8404E-01	-0.1824E-03	0.4190E-03	50	0.9422E-01	-0.3810E-03	0.4775E-03	51	0.1110E 00	-0.5397E-03	0.5387E-03
52	0.1321E 00	-0.6162E-03	0.6081E-03	53	0.1470E 00	-0.6202E-03	0.6614E-03	54	0.1544E 00	-0.6128E-03	0.6961E-03
55	0.9890E-01	0.1277E-03	0.2671E-03	56	0.9292E-01	0.1110E-03	0.3108E-03	57	0.8977E-01	-0.4856E-06	0.3826E-03
5A	0.9476E-01	-0.2735E-03	0.4669E-03	59	0.1064E 00	-0.4223E-03	0.5309E-03	60	0.1217E 00	-0.5847E-03	0.5989E-03
61	0.1476E 00	-0.6696E-03	0.6743E-03	62	0.1638E 00	-0.6803E-03	0.7368E-03	63	0.1720E 00	-0.6762E-03	0.7692E-03
64	0.1022E 00	0.1198E-03	0.2832E-03	65	0.9473E-01	0.9702E-04	0.3830E-03	66	0.9442E-01	-0.2051E-04	0.3908E-03
67	0.1004E 00	-0.2451E-03	0.4754E-03	68	0.1129E 00	-0.4444E-03	0.5417E-03	69	0.1320E 00	-0.6093E-03	0.6129E-03
70	0.1558E 00	-0.6991E-03	0.6962E-03	71	0.1728E 00	-0.7129E-03	0.7607E-03	72	0.1814E 00	-0.7105E-03	0.7948E-03
73	0.1057E 00	0.1128E-03	0.2950E-03	74	0.1007E 00	0.8432E-04	0.3298E-03	75	0.9913E-01	-0.3974E-04	0.3923E-03
76	0.1061E 00	-0.2670E-03	0.4749E-03	77	0.1194E 00	-0.4675E-03	0.5429E-03	78	0.1394E 00	-0.6359E-03	0.6182E-03
79	0.1642E 00	-0.7308E-03	0.7069E-03	80	0.1820E 00	-0.7466E-03	0.7743E-03	81	0.1910E 00	-0.7457E-03	0.8081E-03
82	0.1093E 00	0.1060E-03	0.3023E-03	83	0.1846E 00	0.7302E-04	0.3319E-03	84	0.1038E 00	-0.9773E-04	0.3884E-03
85	0.1118E 00	-0.2887E-03	0.4673E-03	86	0.1259E 00	-0.4916E-03	0.5364E-03	87	0.1468E 00	-0.6639E-03	0.6161E-03
88	0.1728E 00	-0.7640E-03	0.7098E-03	89	0.1914E 00	-0.7790E-03	0.7764E-03	90	0.2007E 00	-0.7781E-03	0.8049E-03
91	0.1129E 00	0.1006E-03	0.3050E-03	92	0.1086E 00	0.6208E-04	0.3291E-03	93	0.1084E 00	-0.7419E-04	0.3869E-03
94	0.1173E 00	-0.3097E-03	0.4551E-03	95	0.1322E 00	-0.5168E-03	0.5240E-03	96	0.1512E 00	-0.6931E-03	0.6084E-03
97	0.1813E 00	-0.7971E-03	0.7077E-03	98	0.2007E 00	-0.8076E-03	0.7754E-03	99	0.2103E 00	-0.8084E-03	0.7978E-03

THE GAP OR PRECOMPRESSION OF THE NODES IS=

1	0.20906	2	0.13150	3	0.08669	4	0.07191	5	0.07910	6	0.10192	7	0.14130	8	0.17742
9	0.19860	10	0.13136	11	0.05416	12	0.00985	13	-0.00502	14	0.00118	15	0.02248	16	0.06022
17	0.09548	18	0.11633	19	0.08642	20	0.00972	21	-0.03339	22	-0.04848	23	-0.04358	24	-0.02460
25	0.01053	26	0.04424	27	0.06442	28	0.07151	29	-0.00928	30	-0.04892	31	-0.06458	32	-0.06146
33	-0.04505	34	-0.01293	35	0.01880	36	0.03804	37	0.07862	38	0.00084	39	-0.04378	40	-0.06155
41	-0.06006	42	-0.04560	43	-0.01573	44	0.01436	45	0.03277	46	0.10140	47	0.02208	48	-0.02486
49	-0.04516	50	-0.04502	51	-0.03323	52	-0.00573	53	0.02258	54	0.04801	55	0.12574	56	0.04532
57	-0.00337	58	-0.02504	59	-0.02757	60	-0.01672	61	0.00902	62	0.03597	63	0.05268	64	0.14079
65	0.05987	66	0.01044	67	-0.01294	68	-0.01565	69	-0.00564	70	0.01914	71	0.04535	72	0.06163
73	0.15784	74	0.07647	75	0.02615	76	0.00187	77	-0.00165	78	0.00748	79	0.04125	80	0.05663
81	0.07252	82	0.17693	83	0.09518	84	0.04414	85	0.01889	86	0.01495	87	0.02275	88	0.04540
89	0.07000	90	0.08550	91	0.19812	92	0.11605	93	0.06437	94	0.03819	95	0.03302	96	0.04024
97	0.06174	98	0.08553	99	0.10074										

NO. OF ITERATION CYCLE FOR CHECKING CONTACT,ICC = 4

CASE NO. FOR MOMENT TRANSFER,KMT= 1 MULTIPLYING FACTOR FOR EFFICIENCY OF MOMENT TRANSFER,CM= 0.

NODE	DEFLEC.	ROTAT,X	ROTAT,Y	NODE	DEFLEC.	ROTAT,X	ROTAT,Y	NODE	DEFLEC.	ROTAT,X	ROTAT,Y
1	0.8516E-01	0.1322E-03	-0.1281E-03	2	0.7908E-01	0.1148E-03	-0.1348E-03	3	0.7497E-01	0.4667E-04	-0.1424E-0[illegible]

(Continued)

(Sheet 13 of 16)

Table 11 (Continued)

4	0.7548E-01	-0.7464E-04	-0.1402E-03	5	0.8003E-01	-0.1778E-03	-0.1270E-03	6	0.8810E-01	-0.2665E-03	-0.1054E-03
7	0.9803E-01	-0.3234E-03	-0.6293E-04	8	0.1068E 00	-0.3410E-03	-0.7089E-04	9	0.1109E 00	-0.3437E-03	-0.6498E-04
10	0.7927E-01	0.1390E-03	-0.1108E-03	11	0.7270E-01	0.1286E-03	-0.1246E-03	12	0.6770E-01	0.5761E-04	-0.1478E-03
13	0.6831E-01	-0.8406E-04	-0.1549E-03	14	0.7357E-01	-0.2071E-03	-0.1372E-03	15	0.8294E-01	-0.3066E-03	-0.1021E-03
16	0.9510E-01	-0.3601E-03	-0.6181E-04	17	0.1039E 00	-0.3689E-03	-0.3909E-04	18	0.1043E 00	-0.3666E-03	-0.2940E-04
19	0.7536E-01	0.1466E-03	-0.4282E-04	20	0.6809E-01	0.1518E-03	-0.5382E-04	21	0.6202E-01	0.7996E-04	-0.7615E-04
22	0.6206E-01	-0.9566E-04	-0.7829E-04	23	0.6836E-01	-0.2520E-03	-0.5321E-04	24	0.7978E-01	-0.3724E-03	-0.6618E-05
25	0.9436E-01	-0.4247E-03	0.5018E-04	26	0.1046E 00	-0.4232E-03	0.8983E-04	27	0.1096E 00	-0.4156E-03	0.1016E-03
28	0.7604E-01	0.1445E-03	0.7793E-04	29	0.6867E-01	0.1589E-03	0.8737E-04	30	0.6223E-01	0.8206E-04	0.9907E-04
31	0.6280E-01	-0.1217E-03	0.1252E-03	32	0.7051E-01	-0.3043E-03	0.1899E-03	33	0.8422E-01	-0.4456E-03	0.2088E-03
34	0.1016E 00	-0.5054E-03	0.2685E-03	35	0.1137E 00	-0.4993E-03	0.3104E-03	36	0.1197E 00	-0.4874E-03	0.3307E-03
37	0.8070E-01	0.1513E-03	0.1881E-03	38	0.7404E-01	0.1411E-03	0.2099E-03	39	0.6864E-01	0.5694E-04	0.2546E-03
40	0.7062E-01	-0.1564E-03	0.3067E-03	41	0.7976E-01	-0.3491E-03	0.3514E-03	42	0.9527E-01	-0.5010E-03	0.4035E-03
43	0.1148E 00	-0.5692E-03	0.4645E-03	44	0.1289E 00	-0.5660E-03	0.5101E-03	45	0.1352E 00	-0.5546E-03	0.5343E-03
46	0.8882E-01	0.1098E-03	0.2673E-03	47	0.8346E-01	0.1059E-03	0.3072E-03	48	0.8012E-01	0.1053E-04	0.3726E-03
49	0.8437E-01	-0.2050E-03	0.4450E-03	50	0.9531E-01	-0.4012E-03	0.5803E-03	51	0.1128E 00	-0.5601E-03	0.5595E-03
52	0.1347E 00	-0.6381E-03	0.6274E-03	53	0.1501E 00	-0.6426E-03	0.6796E-03	54	0.1578E 00	-0.6351E-03	0.7078E-03
55	0.9576E-01	0.9448E-04	0.3084E-03	56	0.9136E-01	0.7908E-04	0.3473E-03	57	0.8942E-01	-0.2665E-04	0.4135E-03
58	0.9571E-01	-0.2438E-03	0.4930E-03	59	0.1080E 00	-0.4409E-03	0.5544E-03	60	0.1270E 00	-0.6042E-03	0.6202E-03
61	0.1506E 00	-0.6905E-03	0.6967E-03	62	0.1674E 00	-0.7016E-03	0.7543E-03	63	0.1798E 00	-0.6975E-03	0.7881E-03
64	0.9955E-01	0.8749E-04	0.3231E-03	65	0.9561E-01	0.6638E-04	0.3589E-03	66	0.9464E-01	-0.4538E-04	0.4216E-03
67	0.1017E 00	-0.2644E-03	0.5019E-03	68	0.1148E 00	-0.4623E-03	0.5656E-03	69	0.1346E 00	-0.6283E-03	0.6351E-03
70	0.1291E 00	-0.7196E-03	0.7170E-03	71	0.1766E 00	-0.7338E-03	0.7807E-03	72	0.1834E 00	-0.7314E-03	0.8143E-03
73	0.1035E 00	0.8130E-04	0.3338E-03	74	0.9996E-01	0.5476E-04	0.3653E-03	75	0.9972E-01	-0.6342E-04	0.4233E-03
76	0.1077E 00	-0.2853E-03	0.5017E-03	77	0.1216E 00	-0.4847E-03	0.5672E-03	78	0.1423E 00	-0.6540E-03	0.6407E-03
79	0.1678E 00	-0.7509E-03	0.7279E-03	80	0.1861E 00	-0.7671E-03	0.7946E-03	81	0.1953E 00	-0.7662E-03	0.8282E-03
82	0.1075E 00	0.7587E-04	0.3404E-03	83	0.1044E 00	0.4441E-04	0.3669E-03	84	0.1048E 00	-0.8031E-04	0.4197E-03
85	0.1137E 00	-0.3061E-03	0.4944E-03	86	0.1284E 00	-0.5082E-03	0.5610E-03	87	0.1499E 00	-0.6815E-03	0.6387E-03
88	0.1766E 00	-0.7836E-03	0.7310E-03	89	0.1957E 00	-0.7993E-03	0.7970E-03	90	0.2052E 00	-0.7985E-03	0.8248E-03
91	0.1117E 00	0.7032E-04	0.3429E-03	92	0.1087E 00	0.3309E-04	0.3647E-03	93	0.1098E 00	-0.9573E-04	0.4121E-03
94	0.1196E 00	-0.3261E-03	0.4824E-03	95	0.1350E 00	-0.5325E-03	0.5494E-03	96	0.1576E 00	-0.7105E-03	0.6310E-03
97	0.1853E 00	-0.8164E-03	0.7288E-03	98	0.2052E 00	-0.8277E-03	0.7960E-03	99	0.2151E 00	-0.8206E-03	0.8183E-03

THE GAP OR PRECOMPRESSION OF THE NODES IS=

1	0.22588	2	0.14556	3	0.09783	4	0.08004	5	0.08521	6	0.10630	7	0.14417	8	0.17937
9	0.20010	10	0.14537	11	0.06554	12	0.01850	13	0.00081	14	0.00527	15	0.02506	16	0.06150
17	0.09292	18	0.11634	19	0.09744	20	0.01831	21	-0.02746	22	-0.04478	23	-0.04138	24	-0.02362
25	0.01040	26	0.04339	27	0.06319	28	0.07948	29	0.00045	30	-0.04495	31	-0.06288	32	-0.06079
33	-0.04534	34	-0.01414	35	0.01694	36	0.03586	37	0.08454	38	0.00480	39	-0.04164	40	-0.06098
41	-0.06032	42	-0.04667	43	-0.01783	44	0.01188	45	0.03000	46	0.10528	47	0.02454	48	-0.02396
49	-0.04549	50	-0.04671	51	-0.03505	52	-0.00831	53	0.01947	54	0.03603	55	0.12888	56	0.04668
57	-0.00422	58	-0.02629	59	-0.02921	60	-0.01905	61	0.00597	62	0.03240	63	0.04888	64	0.14345
65	0.06099	66	0.01012	67	-0.01421	68	-0.01758	69	-0.00823	70	0.01584	71	0.04153	72	0.05758
73	0.16002	74	0.07716	75	0.02556	76	0.00028	77	-0.00386	78	0.00403	79	0.02768	80	0.05259
81	0.06823	82	0.17865	83	0.09545	84	0.04318	85	0.01698	86	0.01204	87	0.01962	88	0.04168
89	0.06571	90	0.08097	91	0.19939	92	0.11589	93	0.06303	94	0.03596	95	0.03021	96	0.03684
97	0.05768	98	0.08100	99	0.09596										

NO. OF ITERATION CYCLE FOR CHECKING CONTACT,ICE = 5

CASE NO. FOR MOMENT TRASFER,KMT= 1 MULTIPLYING FACTOR FOR EFFICIENCY OF MOMENT TRANSFER,CM= 0.

NODE	DEFLEC.	ROTAT,X	ROTAT,Y	NODE	DEFLEC.	ROTAT,X	ROTAT,Y	NODE	DEFLEC.	ROTAT,X	ROTAT,Y
1	0.8429E-01	0.1307E-03	-0.1247E-03	2	0.7829E-01	0.1133E-03	-0.1314E-03	3	0.7425E-01	0.4525E-04	-0.1387E-03
4	0.7483E-01	-0.7627E-04	-0.1366E-03	5	0.7945E-01	-0.1796E-03	-0.1233E-03	6	0.8758E-01	-0.2683E-03	-0.1018E-03
7	0.9837E-01	-0.3251E-03	-0.7949E-04	8	0.1064E 00	-0.3426E-03	-0.6748E-04	9	0.1145E 00	-0.3453E-03	-0.6163E-04
10	0.7857E-01	0.1373E-03	-0.1074E-03	11	0.7208E-01	0.1270E-03	-0.1211E-03	12	0.6736E-01	0.5612E-04	-0.1440E-03
13	0.6784E-01	-0.8566E-04	-0.1511E-03	14	0.7317E-01	-0.2089E-03	-0.1339E-03	15	0.8259E-01	-0.3082E-03	-0.9855E-04
16	0.9480E-01	-0.3616E-03	-0.5846E-04	17	0.1036E 00	-0.3703E-03	-0.3584E-04	18	0.1081E 00	-0.3681E-03	-0.2619E-04
19	0.7481E-01	0.1448E-03	-0.3976E-04	20	0.6763E-01	0.1499E-03	-0.5067E-04	21	0.8165E-01	0.7817E-04	-0.7274E-04

(Continued)

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Table 11 (Continued)

22	0.6177E-01	-0.9718E-04	-0.7476E-04	23	0.6812E-01	-0.2535E-03	-0.4987E-04	24	0.7939E-01	-0.3737E-03	-0.3511E-05
25	0.9421E-01	-0.4260E-03	0.5389E-04	26	0.1045E 00	-0.4245E-03	0.8864E-04	27	0.1095E 00	-0.4170E-03	0.1044E-03
28	0.7564E-01	0.1427E-03	0.8080E-04	29	0.6836E-01	0.1569E-03	0.9020E-04	30	0.9201E-01	0.8018E-04	0.1018E-03
31	0.6266E-01	-0.1231E-03	0.1278E-03	32	0.7042E-01	-0.3055E-03	0.1624E-03	33	0.8416E-01	-0.4467E-03	0.2112E-03
34	0.1016E 00	-0.5065E-03	0.2788E-03	35	0.1137E 00	-0.5004E-03	0.3127E-03	36	0.1197E 00	-0.4885E-03	0.3329E-03
37	0.8039E-01	0.1295E-03	0.1829E-03	38	0.7382E-01	0.1393E-03	0.2122E-03	39	0.8851E-01	0.5524E-04	0.2570E-03
40	0.7057E-01	-0.1577E-03	0.3088E-03	41	0.7974E-01	-0.3502E-03	0.3934E-03	42	0.9529E-01	-0.5021E-03	0.4055E-03
43	0.1149E 00	-0.5702E-03	0.4664E-03	44	0.1286E 00	-0.5671E-03	0.5120E-03	45	0.1353E 00	-0.5557E-03	0.5362E-03
46	0.8862E-01	0.1081E-03	0.2659E-03	47	0.8334E-01	0.1043E-03	0.3097E-03	48	0.8007E-01	0.9051E-05	0.3748E-03
49	0.8438E-01	-0.2082E-03	0.4478E-03	50	0.9536E-01	-0.4022E-03	0.5022E-03	51	0.1129E 00	-0.5611E-03	0.5613E-03
52	0.1348E 00	-0.6391E-03	0.6292E-03	53	0.1502E 00	-0.6437E-03	0.6814E-03	54	0.1579E 00	-0.6361E-03	0.7098E-03
55	0.9562E-01	0.9285E-04	0.3109E-03	56	0.9130E-01	0.7750E-04	0.3497E-03	57	0.8963E-01	-0.2800E-04	0.4157E-03
58	0.9577E-01	-0.2448E-03	0.4958E-03	59	0.1081E 00	-0.4419E-03	0.5563E-03	60	0.1272E 00	-0.6052E-03	0.6220E-03
61	0.1508E 00	-0.6915E-03	0.6985E-03	62	0.1676E 00	-0.7027E-03	0.7581E-03	63	0.1760E 00	-0.6986E-03	0.7899E-03
64	0.9944E-01	0.8589E-04	0.3256E-03	65	0.9557E-01	0.6484E-04	0.3613E-03	66	0.9467E-01	-0.4667E-04	0.4238E-03
67	0.1018E 00	-0.2654E-03	0.5039E-03	68	0.1149E 00	-0.4633E-03	0.5675E-03	69	0.1347E 00	-0.6293E-03	0.6370E-03
70	0.1593E 00	-0.7207E-03	0.7188E-03	71	0.1768E 00	-0.7348E-03	0.7825E-03	72	0.1837E 00	-0.7324E-03	0.8161E-03
73	0.1034E 00	0.7973E-04	0.3363E-03	74	0.9995E-01	0.5326E-04	0.3676E-03	75	0.9977E-01	-0.6467E-04	0.4255E-03
76	0.1078E 00	-0.2863E-03	0.5037E-03	77	0.1217E 00	-0.4857E-03	0.5691E-03	78	0.1424E 00	-0.6550E-03	0.6426E-03
79	0.1680E 00	-0.7519E-03	0.7298E-03	80	0.1863E 00	-0.7682E-03	0.7964E-03	81	0.1955E 00	-0.7673E-03	0.8300E-03
82	0.1075E 00	0.7432E-04	0.3429E-03	83	0.1044E 00	0.4295E-04	0.3693E-03	84	0.1049E 00	-0.8151E-04	0.4219E-03
85	0.1138E 00	-0.3070E-03	0.4964E-03	86	0.1285E 00	-0.5091E-03	0.5629E-03	87	0.1501E 00	-0.6824E-03	0.6405E-03
88	0.1768E 00	-0.7846E-03	0.7328E-03	89	0.1959E 00	-0.8003E-03	0.7988E-03	90	0.2045E 00	-0.7995E-03	0.8267E-03
91	0.1116E 00	0.6879E-04	0.3454E-03	92	0.1088E 00	0.3366E-04	0.3671E-03	93	0.1099E 00	-0.9688E-04	0.4143E-03
94	0.1197E 00	-0.3270E-03	0.4844E-03	95	0.1352E 00	-0.5334E-03	0.5513E-03	96	0.1578E 00	-0.7114E-03	0.6328E-03
97	0.1856E 00	-0.8174E-03	0.7387E-03	98	0.2055E 00	-0.8287E-03	0.7978E-03	99	0.2154E 00	-0.8217E-03	0.8261E-03

THE GAP OR PRECOMPRESSION OF THE NODES IS#

1	0.22675	2	0.14635	3	0.09855	4	0.08069	5	0.08579	6	0.10682	7	0.14463	8	0.17979
9	0.20049	10	0.14607	11	0.06616	12	0.01904	13	0.00128	14	0.00507	15	0.02541	16	0.06180
17	0.09617	18	0.11658	19	0.09799	20	0.01877	21	-0.02709	22	-0.04449	23	-0.04112	24	-0.02343
25	0.01055	26	0.04350	27	0.06329	28	0.07988	29	0.00076	30	-0.04473	31	-0.06268	32	-0.06070
33	-0.04528	34	-0.01413	35	0.01693	36	0.03584	37	0.08485	38	0.00502	39	-0.04151	40	-0.06085
41	-0.08030	42	-0.04669	43	-0.01789	44	0.01180	45	0.02990	46	0.10578	47	0.02468	48	-0.02391
49	-0.04550	50	-0.04676	51	-0.03514	52	-0.00843	53	0.01931	54	0.03647	55	0.12902	56	0.04694
57	-0.00323	58	-0.02605	59	-0.02931	60	-0.01918	61	0.00580	62	0.03221	63	0.04864	64	0.14356
65	0.06103	66	0.01009	67	-0.01429	68	-0.01770	69	-0.00839	70	0.01565	71	0.04132	72	0.05735
73	0.16010	74	0.07717	75	0.02551	76	0.00017	77	-0.00401	78	0.00445	79	0.02748	80	0.05235
81	0.06798	82	0.17870	83	0.09543	84	0.04310	85	0.01685	86	0.01187	87	0.01942	88	0.04136
89	0.08545	90	0.08069	91	0.19941	92	0.11585	93	0.06292	94	0.03580	95	0.03002	96	0.03662
97	0.05742	98	0.08071	99	0.09567										

AMOUNT OF FINAL CURLING AND GAP AT THE NODES IS#

1	0.22675	2	0.14635	3	0.09855	4	0.08069	5	0.08579	6	0.10682	7	0.14465	8	0.17979
9	0.20049	10	0.14607	11	0.06616	12	0.01904	13	0.00128	14	0.00507	15	0.02541	16	0.06160
17	0.09617	18	0.11658	19	0.09799	20	0.01877	21	-0.02709	22	-0.04449	23	-0.04112	24	-0.02343
25	0.01055	26	0.04350	27	0.06329	28	0.07988	29	0.00076	30	-0.04473	31	-0.06268	32	-0.06070
33	-0.04528	34	-0.01413	35	0.01693	36	0.03584	37	0.08485	38	0.00502	39	-0.04151	40	-0.06065
41	-0.08030	42	-0.04669	43	-0.01789	44	0.01180	45	0.02990	46	0.10578	47	0.02465	48	-0.02391
49	-0.04550	50	-0.04676	51	-0.03514	52	-0.00843	53	0.01931	54	0.03647	55	0.12902	56	0.04694
57	-0.00323	58	-0.02605	59	-0.02931	60	-0.01918	61	0.00580	62	0.03221	63	0.04868	64	0.14356
65	0.06103	66	0.01009	67	-0.01429	68	-0.01770	69	-0.00839	70	0.01565	71	0.04132	72	0.05735
73	0.16010	74	0.07717	75	0.02551	76	0.00017	77	-0.00401	78	0.00445	79	0.02746	80	0.05235
81	0.06798	82	0.17870	83	0.09543	84	0.04310	85	0.01685	86	0.01187	87	0.01942	88	0.04136
89	0.08545	90	0.08069	91	0.19941	92	0.11585	93	0.06292	94	0.03580	95	0.03002	96	0.03662
97	0.05742	98	0.08071	99	0.09567										

	NODE	LAYER	STRESS X	STRESS Y	STRESS XY	MAJOR	MINOR	SHEAR	REACTION
Entry 8.	60	1	-0.112571E 03	-0.187940E 03	0.730199E 02	-0.232372E 03	-0.679392E 02	0.822166E 02	0.127182E 02
			-0.737289E 02	-0.111746E 03	0.954187E 02	-0.145727E 03	-0.397482E 02	0.529894E 02	
	61	1	-0.100081E 03	-0.714246E 02	0.876717E 02	-0.179682E 03	-0.424066E 00	0.896289E 02	0.150801E 02

(Continued)

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Table 11 (Concluded)

		-0.709081E 02	-0.477335E 02	0.104777E 03	-0.130452E 03	0.110106E 02	0.711314E 02	
62	1	-0.113174E 03	-0.152727E 02	0.973956E 02	-0.173228E 03	0.447418E 02	0.109805E 03	0.167592E 02
		-0.747367E 02	-0.112170E 02	0.108560E 03	-0.131404E 03	0.459381E 02	0.885069E 02	
63	1	-0.117127E 03	0.	0.	-0.117127E 03	0.	0.585636E 02	0.176004E 02
		-0.777495E 02	0.	0.	-0.777495E 02	0.	0.388748E 02	
69	1	-0.742179E 02	-0.185068E 03	0.777590E 02	-0.225134E 03	-0.341927E 02	0.954904E 02	0.134746E 02
		-0.525428E 02	-0.111604E 03	0.966508E 02	-0.145510E 03	-0.180366E 02	0.634369E 02	
70	1	-0.724984E 02	-0.715723E 02	0.944273E 02	-0.166663E 03	0.221923E 02	0.944276E 02	0.159314E 02
		-0.487985E 02	-0.478005E 02	0.108948E 03	-0.128284E 03	0.310008E 02	0.799053E 02	
71	1	-0.792457E 02	-0.115641E 02	0.102889E 03	-0.151249E 03	0.040390E 02	0.107844E 03	0.176845E 02
		-0.498533E 02	-0.732286E 01	0.112342E 03	-0.122196E 03	0.650194E 02	0.938075E 02	
72	1	-0.770619E 02	0.	0.	-0.770619E 02	0.	0.385309E 02	0.185652E 02
		-0.505679E 02	0.	0.	-0.505679E 02	0.	0.252840E 02	
78	1	-0.416340E 02	-0.183990E 03	0.829471E 02	-0.222112E 03	-0.451179E 01	0.109300E 03	0.142432E 02
		-0.320565E 02	-0.112013E 03	0.900348E 02	-0.147249E 03	0.257898E 01	0.749138E 02	
79	1	-0.387426E 02	-0.738030E 02	0.100512E 03	-0.158302E 03	0.457961E 02	0.102829E 03	0.160015E 02
		-0.263370E 02	-0.450887E 02	0.112235E 03	-0.120591E 03	0.510795E 02	0.887883E 02	
80	1	-0.317942E 02	-0.352985E 01	0.103886E 03	-0.122505E 03	0.871811E 02	0.104843E 03	0.186329E 02
		-0.173451E 02	0.165875E 01	0.111296E 03	-0.103949E 03	0.882627E 02	0.961050E 02	
81	1	-0.291026E 02	0.	0.	-0.291026E 02	0.	0.145513E 02	0.195543E 02
		-0.133043E 02	0.	0.	-0.133043E 02	0.	0.665217E 01	
87	1	-0.170433E 02	-0.185187E 03	0.880984E 02	-0.222891E 03	0.206910E 02	0.121776E 03	0.150137E 02
		-0.146997E 02	-0.115146E 03	0.992890E 02	-0.151049E 03	0.212026E 02	0.861256E 02	
88	1	-0.147444E 02	-0.774693E 02	0.102115E 03	-0.152931E 03	0.907130E 02	0.106822E 03	0.176797E 02
		-0.123307E 02	-0.520522E 02	0.111124E 03	-0.124178E 03	0.617932E 02	0.929867E 02	
89	1	0.158566E 02	0.160585E 02	0.942939E 02	-0.783364E 02	0.110258E 03	0.942940E 02	0.195912E 02
		0.216005E 02	0.219121E 02	0.996821E 02	-0.871095E 02	0.110782E 03	0.889057E 02	
90	1	0.587749E 02	0.	0.	0.	0.587749E 02	0.293878E 02	0.205584E 02
		0.653370E 02	0.	0.	0.756355E 01	0.587740E 02	0.256052E 02	
96	1	0.	-0.190551E 03	0.	-0.190551E 03	0.	0.952757E 02	0.157782E 02
		0.	-0.120847E 03	0.	-0.120847E 03	0.	0.604234E 02	
97	1	0.	-0.829529E 02	0.	-0.829529E 02	0.	0.414765E 02	0.185582E 02
		0.	-0.563173E 02	0.	-0.563173E 02	0.	0.281586E 02	
98	1	0.	0.567793E 02	0.	0.	0.567793E 02	0.283896E 02	0.205486E 02
		0.	0.644570E 02	0.	0.767778E 01	0.567793E 02	0.245507E 02	
99	1	0.	0.	0.	0.	0.	0.	0.215370E 02
		0.	0.	0.	0.	0.	0.	

← Stresses due to load alone (first line of each node)

← Stresses due to load, temp and slab wt. (second line of each node)

Entry 9.

DEFLECTION DUE TO LOAD ALONE,NO TEMP, AND SLAB WEIGHT EFFECTS

1	-0.363E-02	2	-0.306E-01	3	-0.250E-01	4	-0.198E-01	5	-0.160E-01	6	-0.118E-01	7	-0.709E-02	8	-0.364E-02
9	-0.187E-02	10	-0.306E-01	11	-0.246E-01	12	-0.188E-01	13	-0.132E-01	14	-0.980E-02	15	-0.435E-02	16	0.101E-02
17	0.487E-02	18	0.002E-02	19	-0.251E-01	20	-0.188E-01	21	-0.128E-01	22	-0.698E-02	23	-0.226E-02	24	0.332E-02
25	0.994E-02	26	0.147E-01	27	0.171E-01	28	-0.200E-01	29	-0.134E-01	30	-0.711E-02	31	-0.661E-03	32	0.519E-02
33	0.129E-01	34	0.214E-01	35	0.277E-01	36	0.309E-01	37	-0.103E-01	38	-0.937E-02	39	-0.260E-02	40	0.499E-02
41	0.128E-01	42	0.217E-01	43	0.330E-01	44	0.419E-01	45	0.451E-01	46	-0.125E-01	47	-0.500E-02	48	0.271E-02
49	0.120E-01	50	0.214E-01	51	0.334E-01	52	0.477E-01	53	0.579E-01	54	0.630E-01	55	-0.958E-02	56	-0.171E-02
57	0.088E-02	58	0.176E-01	59	0.285E-01	60	0.425E-01	61	0.591E-01	62	0.789E-01	63	0.767E-01	64	-0.805E-02
65	0.439E-04	66	0.899E-02	67	0.205E-01	68	0.323E-01	69	0.474E-01	70	0.651E-01	71	0.777E-01	72	0.840E-01
73	-0.049E-02	74	0.105E-02	75	0.112E-01	76	0.236E-01	77	0.362E-01	78	0.523E-01	79	0.713E-01	80	0.847E-01
81	0.919E-01	82	-0.481E-02	83	0.369E-02	84	0.135E-01	85	0.267E-01	86	0.401E-01	87	0.573E-01	88	0.775E-01
89	0.918E-01	90	0.989E-01	91	-0.316E-02	92	0.553E-02	93	0.158E-01	94	0.297E-01	95	0.440E-01	96	0.622E-01
97	0.837E-01	98	0.988E-01	99	0.106E 00										

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and NTEMP are both equal to 1 because both the temperature and weight of the concrete slab are considered. The total temperature differential between the top and the bottom of the slab is 45°F. NSTORE = 0 because it is the first run, and NLOAD = 0 because the load is not considered in the first run.

Entry 2

100. The meaning and sign convention of the initial curling and gap can be found in Entry 3 of Computer Output 2.

Entry 3

101. The expressions in Entry 3 are the same as those shown in Entries 5, 6, and 7 of Computer Output 2.

Entry 4

102. The expressions in Entry 4 are the same as those in Entries 11 and 12 of Computer Output 2.

Entry 5

103. The computed stresses and deflections are stored to be used in the next run.

Entry 6

104. NSTORE = 2 indicates that the stresses and deflections computed in this run will be subtracted from those computed in the preceding run.

Entry 7

105. The applied load is considered in the second run.

Entry 8

106. Two sets of stresses are computed and printed. The stresses due to the applied load, temperature, and slab weight are printed in the line where the number of the nodal point is printed. The stresses due to the applied load alone are printed in the line immediately below the printed stresses due to the load, temperature, and slab weight and are printed one space to the right. For instance, at nodal point 71, stress σ_x due to the load, temperature, and slab weight is -75.2457 psi and that due to the load alone is only -49.8533 psi.

Entry 9

107. The deflections are those due to the applied load alone,

which are the differences of the computed deflections due to the applied load, slab weight, temperature, and gaps and those due to the slab weight, temperature, and gaps. In this example problem, gaps are not assumed. If they are assumed, the magnitude of the gaps should be those without temperature influence.

PART VI: CONCLUSIONS AND RECOMMENDATION

108. The computer program WESLIQID has the capacity of obtaining solutions for rigid pavements with discontinuities. The program is versatile because of its various options dealing with problems of different natures. The program is economical to operate and requires only a reasonable amount of core space. It is recommended that the program be used for routine pavement design, analysis, and research purposes.

APPENDIX A: ANALYSIS OF TWO-LAYER SLABS

1. The program can be applied to two-layer slabs, either bonded or unbonded. Layer 1 has a thickness t_1, a modulus of elasticity E_1, and a Poisson's ratio ν_1. Layer 2 has a thickness t_2, a modulus of elasticity E_2, and a Poisson's ratio ν_2.

2. In the case of unbonded layers, the displacements of both layers are assumed the same, the modulus of rigidity R of the two-layer slab is simply the summation of that of each layer, or

$$R = \frac{E_1 t_1^3}{12(1 - \nu_1^2)} + \frac{E_2 t_2^3}{12(1 - \nu_2^2)} \tag{A1}$$

After the displacements are determined, the stresses in each layer are computed, based on the stress matrix of each.

3. In the case of bonded layers, a composite thickness is used. The composite thickness t can be determined by

$$t = t_1 + t_2 E_2/E_1 \tag{A2}$$

Taking the moment at the surface, the distance of neutral axis from the surface d_n can be determined by

$$d_n = \frac{0.5t_1^2 + t_2(t_1 + 0.5t_2)E_2/E_1}{t_1 + t_2 E_2/E_1} \tag{A3}$$

The composite moment of inertia I_{comp} is

$$I_{comp} = \frac{1}{12} t_1^3 + t_1\left(d_n - \frac{t_1}{2}\right)^2 + \frac{1}{12}\left(t_2\right)^3 \cdot \frac{E_2}{E_1} + t_2 \cdot \frac{E_2}{E_1}\left(t_1 + \frac{t_2}{2} - d_n\right)^2 \tag{A4}$$

The composite Poisson's ratio ν_{comp} is

$$\nu_{comp} = \frac{\nu_1 t_1 + \nu_2 t_2 E_2/E_1}{t_1 + t_2 E_2/E_1} \tag{A5}$$

The modulus of rigidity of the composite slab is

$$R = \frac{E_1 I_{comp}}{1 - \nu_{comp}^2} \tag{A6}$$

After the displacements and moments are determined, the maximum stress in layer 1 σ_1 can be obtained by

$$\sigma_1 = \frac{Md_n}{I_{comp}} \tag{A7}$$

in which M is the moment in the direction corresponding to the component of stress. The maximum stress in layer 2 σ_2 is

$$\sigma_2 = \frac{M(t_1 + t_2 - d_n)E_2/E_1}{I_{comp}} \tag{A8}$$

In accordance with letter from DAEN-RDC, DAEN-ASI dated 22 July 1977, Subject: Facsimile Catalog Cards for Laboratory Technical Publications, a facsimile catalog card in Library of Congress MARC format is reproduced below.

Chou, Yu T.
  Structural analysis computer programs for rigid multicomponent pavement structures with discontinuities--WESLIQID and WESLAYER : Report 2 : Manual for the WESLIQID Finite Element Program / by Yu T. Chou (Geotechnical Laboratory, U.S. Army Engineer Waterways Experiment Station). -- Vicksburg, Miss. : The Station ; Springfield, Va. : available from NTIS, [1981].
  137, 2 p. : ill. ; 27 cm. -- (Technical report / U.S. Army Engineer Waterways Experiment Station ; GL-81-6, Report 2)
  Cover title.
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  "Prepared for Office, Chief of Engineers, U.S. Army under Project No. 4A762719AT40, Work Units 001 and 003."

  1. Computer programs. 2. Finite element method. 3. Materials--Dynamic testing. 4. Pavements. 5. WESLIQID (Computer programs). I. United States. Army. Corps of Engineers. Office of the Chief of Engineers. II. U.S. Army Engineer Waterways

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TA7.W34 no.GL-81-6 Report 2