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PROGRAM ROCMAS: INTRODUCTION AND USER'S GUIDE

J. Noorishad and M. S. Ayatollahi

Earth Sciences Division Lawrence Berkeley Laboratory University of California Berkeley, California 94720



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INTRODUCTION

ROCMAS (ROCK MASS) is a finite-element program for counled flow and stress in deformable, saturated, fractured rock medium. The two-dimensional code combines the capability of isothermal transient pressure analysis and stress-strain analysis in formations with discrete fractures and porous blocks. Coupling of the pressure field and the mechanical deformation is founded on the extension of Biot's consolidation theory for porous elastic medium to nonlinear fracture behavior. The current version of the model is described by Noorishad [18]. Summary of early developments and related information are in Ayatollahi [1]. The early version of this code is known as PORFRC.

I. GOVERNING EQUATIONS

In this model, the fluid movement and the solid deformation are coupled. Each point in space, either inside a discrete fracture or within a rock block, has a pressure variable P and a solid displacement vector \bar{u} . The pressure field determines the fluid flow. The coupling between P and \bar{u} can be described in the following loop. As the pressure changes, the effective stress acting on the rock solid changes accordingly and affects the displacement or strain of the solid. The displacement of solid changes the flow path of fluid and results in changes in the pressure field. The last coupling step is especially important for fractures. The fracture flow is very sensitive to the aperture 2b. The fracture-specific permeability $k^{f} = (2b)^{2}/12$ for parallel-plate laminar flow is used in this model.

Pressure-Strain Equation

The mathematical form of the coupling between the fluid flow and solid displacement can be written down as a set of three equations for the pressurestrain, strain-stress, and stress-load balance relations. The first fluid flow equation is

$$\frac{1}{M^{i}}\frac{\partial P}{\partial t} - \alpha^{i}\frac{\partial \varepsilon}{\partial t} = \nabla \cdot \frac{k^{i}}{\mu}\nabla P$$

where α^{i} and M^{i} (i = fractures or rock medium blocks) are material properties (Biot constants) representing the responses of fluid mass content to changes in pressure and changes in volumetric strain ε . Depending on the boundary conditions, the derivative $\partial\varepsilon/\partial t$ in some cases can be approximated in terms of the pressure derivative $\partial P/\partial t$. The fluid flow equation will be reduced to a simple transient pressure equation with the storage coefficient in front of $\partial P/\partial t$ determined by the porosity and compressibilities of fluid and void structures.

Stress-Strain Relation

In more general cases, the volumetric strain $\varepsilon = \varepsilon_{xx} + \varepsilon_{zz}$ depends on the effective stress field. The pressure counteracts normal to the fluid-solid interfaces. The effective stress-strain relation can be formally written in the form of Hook's Law [2-5]:

For isotropic elastic porous rock medium, the components of the tensor $\overset{{\bf x}_i}{C}$ can

be expressed in terms of two elastic constants, e.g., Young's modulus and Poisson's ratio. For anisotropic, inelastic deformable fractures, the stress-strain-strain relation is very nonlinear. In this model, a nonlinear normal stress-normal displacement relation and a nonlinear shear stress-shear displacement relation are used [12]. The normal and shear stiffness (change of stress per unit change of displacement) as functions of stresses characterize the fracture behavior. The displacement \bar{u} is simply related to the strain $\bar{\bar{e}}$ by the component definition:

$$\epsilon_{i,j} = 0.5 \left(\frac{\partial u_i}{\partial x_j} + \frac{\partial u_j}{\partial x_i} \right)$$

Load Balance

The third equation for the unknowns P, $\overline{\overline{\tau}}$ and $\overline{\overline{\epsilon}}$ is Newton's first law of static equilibrium applied to an infinitesimal volume element of the fluid-filled medium

$$\nabla \cdot \vec{\tau} + \rho_s \vec{f} = 0$$

where $\rho_{\rm S}$ is the bulk mass density and $\bar{\rm f}$ is the body force. One body force or volumetric force is the gravity. Both the gravity effects on the fluid and rock can be taken into account. Gravitational drainage of fluid can be modeled.

11. NUMERICAL METHOD

Having established the governing and constitutive relations for fractures and solids from structural and fluid flow analysis points of view, the media under consideration could be thought to be composed of two materials with known behaviors. Analysis of such media for coupled stress and fluid flow behavior is made feasible by application of a numerical method. The method starts with adoption of a variational principle [8,9]. The variational form, written for general initial and boundary conditions, includes all the terms of the static-structural analysis variational and those of the transient fluid flow analysis in porous media. A coupling term links the two functions [1,18]. A finite-element discretization is used to discretize the space domain. The two-dimensional space is decomposed into finite element quadrilateral domains with four-corner nodes[22]. Each node has the values of three variables: the pressure P and the two components of solid displacement u. Isoparametric bilinear polynomial basis functions are used to interpolate from the nodal values to the space within an element representing the porous rock medium. For a fracture, it is assumed that the aperture is small and fluid flow is along the fracture surfaces. The pressure difference between adjacent nodes across the aperture is negligible and a one-dimensional element can be used for interpolating between two end point pressures [21]. For the fracture displacements, it is convenient to take the same spatial (glohal) coordinates for each pair of points across the small aperture for the fourcorner element. However, the relative movements of the surfaces in the direction vertical to the fracture plane and along the fracture are important for

the structure analysis. The fracture element in terms of these relative displacements is used [12].

Taking variation of the discretized variational principle with respect to u and p results in the following matrix equations:

 $[K] \{\overline{u}\} + [C] \{P\} = \{P\}$

$$(C)^{T}{\overline{u}} + ({E}) + 1 + ({H}){P} = 1 + (Q)$$

where the matrix [X] contains the coefficients of the stiffness of stress displacement of both inelastic fractures and elastic medium, [C] the Biot coupling coefficients, [E] fluid storage coefficients, [4] fluid hydraulic conductivities, and {Q} the fluid boundary fluxes. The column vector $\{\overline{u}\}$ contains the 2N nodal values of \overline{u} for the m porous nodes and n = m fracture nodes, {P} the N values of P, and {F} the body force and boundary loads.

Time Discretion: The notation 1* in the matrix equation represents the time integration from 0 to t. To step from t to t+A+, this model uses a predictor-corrector scheme. The solution is first predicted at t+AAt with 2 2 2 3 1

$$1 * P_{5} = A(t+5\Delta t) = \int_{0}^{t+5\Delta t} P(\tau) d\tau = A(t) + \frac{1}{2} \Im(t) (P_{t} + P_{t+1\Delta t})$$

and then it is corrected by linear interpolation

$$1 * p_t = A(t + \Delta t) = A(t) + \frac{1}{2} \Delta t (P_t + P_{t+1\Delta t})$$

the unknown at t+At is given by

$$P_{t+\Delta t} = P_t + \frac{1}{0} (P_{t+0\Delta t} + P_t)$$

It is noted that 0 = 1 is the central differencing Crank-Nicholson scheme. The coefficient $\theta > 1$ is used to damp out the numerical oscillation while slightly slowing down the convergence rate [20].

Solution Scheme

The nonlinear behavior of fracture stress-displacement is dealt with by the stiffness perturbation technique [12] during each time step. The stiffness matrix depends on the displacement when the displacement are out of the linear range. Iterations proceed until the stiffness matrix stabilizes within convergent criteria.

Within one iteration the matrix equation of $\{\overline{u}\}$ and $\{P\}$ is solved by a direct procedure. The matrix is decomposed into lower and upper triangular matrices by the Gaussian LU decomposition method [2]. This reduces the matrix equation into two triangular systems which can be solved by backward and forward substitution procedures.

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III. COMPUTER CODE

Documentation and Availability

The code is written in FORTRAN IV and presently being used on the CDC 7600 at LBL. Set-up of the data follows the organization of other finiteelement programs at the University of California, Berkeley. Familiar options of two-dimensional finite-element (2-D FE) stress and strain analysis codes and two-dimensional finite-element (2-D FE) fluid flow codes are included in this code.

spatial Grid

The two-dimensional grid consists of four-corner quadrilateral elements for the porous rock medium and two-node elements for the discrete fractures. The fractures can extend from one boundary to another, intersect each other, or can be isolated in the porous rock medium. An axisymmetric grid is also used.

Material Properties

The constant permeability of the porous -k medium and the initial aperture of the fracture are input parameters. For coupled calculations, the pressure- and stress-induced changes in displacement will be used to undate the aperture and the fracture permeability.

The parameters \P^{i} in the fluid flow equation for the porous rock medium and fracture can be estimated in general from the porosity and the compressibility of fluid as $1/(\pi C_{e})$. The coupling constants a^{i} are dimensionless.

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 α^{i} = 0 decouples the pressure calculations from the stress-strain analysis. For material with highly incompressible solid grains, $\alpha \approx 1$.

The mechanical properties required are Young's modulus and Poisson's ratio for the elastic porous rock medium and the initial normal stiffness, tangential stiffness, cohesion, and angle of friction for the fracture.

Fluid Properties

The fluid density and viscosity are input parameters.

Initial Conditions

Distribution of stresses, pressure and displacement can be specified at initial or program restarting time.

Boundary Conditions

Pressure and flux boundary conditions can be specified for the fluid flow. Static load and displacement boundary conditions can be specified for the stress-strain analysis.

Time Stepping and Solution Control

The time step can be increased logarithmically. A convergent criterion is specified on the stiffness difference in the iteration-perturbation procedure to handle the nonlinear fracture behavior.

Output

At the end of each time step, the pressure, displacement and the flow flux and the stress components on the elements can be printed. Graphic output of the mesh with the plot of the principal components of stress, and displacement are generated in the program.

IV. VALIDATION

The code is developed from an early iterative finite element program with steady state flow and static force-displacement analysis in jointed formation with impermeable rock [17]. Most of the efforts to validate this code are on the transient fluid flow behavior in fractures embedded in porous rock medium. Validation of the capability to handle coupling between transient fluid flow and stress-strain analysis is limited due to absence of both the analytic solutions and other numerical results. The documented tests [1] on the transient fluid flow in porous media and in fractures will be listed below.

1. Continuous Finite-Radius Well Source: The early time transient pressure responses of an axisymmetric flow to a producing well are compared with the analytic solution of Mueller and Witherspoon [15].

2. Finite Axisymmetric Aquifer: The late time pressure responses with no flow as well as constant outer boundaries are compared with the analytic solutions of Muskat [16].

3. Vertical Fractures: The pressure responses for a single vertical fracture and two perpendicular vertical fractures intersecting a well at the center of a rectangular porous medium are compared with the analytic solutions of Raghavan [19]. Geometry, mesh, input data, and the results for the latter problem are given at the end.

4. Vertical Fracture Near a Well: The pressure responses for an observation well is a system with a fracture not intersecting, but aligned with a producing and an observation well, are compared with the analytic solution of Heber-Cinco et al. [13].

5. Horizontal Fracture: The pressure responses for a horizontal fracture located at the center of an aquifer and intersecting a well in an axisymmetric region are compared with the analytic solution of Gringarten and Ramey [11].

V. APPLICATION

The importance of the coupling between the fluid flow and the mechanical deformation in fractures has been analyzed by the iterative steady state version of this code. The flow through a jointed dam foundation has been simulated [17]. It is noted that a deformable fracture system has lower flow through the foundation and higher uplift pressure than a rigid network of fractures. The code has also been used in the analyses of laboratory experiments of large rock samples with tension fractures and of field tests in shallow fractured formations [7]. It is well known that high pressure at a wellbore can open up the fractures and will result in a high injection rate while low pressure at a wellbore during withdrawal can close the fracture and decrease the hydraulic conductivity of flow.

This recently developed transient code is well suited for a thorough study of the mentioned effects due to the fact that it can provide additional insight to the very important transient processes of the coupling phenomena.

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VI. SUMMARY

This model is for the study of coupled fluid flow and stress in deformable fractured rock masses. The effective masss theory of Biot is used to relate the pressure changes with the displacements of the rock matrix. The deformation of the fracture surfaces in turn affects the fracture flow through the sensitive dependence of permeability on aperture.

The code combines techniques of fluid flow modeling and stress-strain analysis. The two-dimensional finite-element code incorporates the flow element of Wilson and Witherspoon [21] for the fracture flow, the joint element of Goodman et al. [12] for the representation of mechanical behavior, and a predictor-corrector scheme to damp out numerical oscillation.

The model is based on general theory which is of fundamental interest and practical importance. The code has the capability of handling a range of complex problems in fluid flow, induced rock mass deformation and soil consolidation [8]. Further developments to couple the fluid flow with heat transfer, or to incorporate dynamic stress analysis, can increase the range of applicability. More extensive application of the code is called for.

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VIII. USER'S GUIDE

The program "ROCMAS" is written in FORTRAN IV and uses both large core and small core memory of the CDC 7600. The large core is used for storage of (i) nodal points, their coordinates in two directions, their proper code used to describe boundary conditions, initial loads or displacements, and (ii) elements, their material type properties, the correspondence between structural nodes and flow nodes, and between structural elements and flow elements, flow boundary codes, and any other properties that are unique for each node or each element.

The large core is also used to store large matrices and vectors needed for the solution of the final system of equations and the equation identifiers for the three degrees of freedom at each nodal point.

The small core memory furnishes storage of the COMMON blocks as well as DIMENSION statements.

Since "ROCMAS" is not written to use a dynamic storage option, it is necessary to keep in mind the maximum size of the arrays for which large core storage is provided. For the time being, the following limits should be kept in mind:

> Maximum number of nodal points = 300 Maximum number of structural elements (joints and solids) = 300 Maximum number of joint elements = 50 Maximum number of different materials = 12

The input data* should be prepared in the groups of cards described below:

Group	Column	Format	Word	Explanation
I-1	1- 5	A5	"TITLE"	Title card to start with computation
1-2	1-72	8A9	hed	Any desired titling, or blank cards
I-3	1-72	8A9	HED	two cards.
1-4	1-5	15	NUMNP	Total no. of nodal noints in the mesh
	6-10	15	NUMEL	Total no. of elements in the mesh
	11 - 15	15	NUMMAT	Total no. of different materials
	16-20	15	NSHELL	Highest no. of solid material
	21 - 25	15	NPC	No. of boundary pressure cards
	26-30	15	NJMP	No. of joints with modified aperture
	31 - 35	15	I RAND	Random aperture generator if = 1,
				otherwise equal to zero
	36-40	15	NIT	Total no. of time sten iterations
	41-45	15	IPLOT	Plot outpur requested, if equal to 1;
				otherwise equal to zero
	46-50	15	IPUNCH	Punch requested for final joint element
				properties if = 1, otherwise = 0
	51-55	F5.0	TTOTAL	Total estimated on time (decimal seconds)
	56-65	F10.0	CONLIM	Joint stiffness convergence constant
	66-70	15	NAXI	Axisvmmetric problem if 1,
				two-dimensional problem if 0

* An example of input data preparation is given at the end.

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Group	Column	Format	Word	Explanation
I - 5	1-10	F10.3	AAM	Mean aperture lognormal distribution
	11-20	F10.3	THETA	Time integration factor
	21-30	F10.3	AAS	Standard deviation lognormal
				distribution
	31-40	F10.3	ACELX	x-direction acceleration
	41-50	F10.3	ACELY	y-direction acceleration
I - 6	1-10	F10.3	XNHP	Maximum net head pressure (optional)
	11-20	F10.3	SPWT	Fluid specific gravity
	21-35	E15.5	VISC	Fluid viscosity
	36-40	15	IPRINT	No. of time step printouts required
	41-45	15	NDTN	Variable time sten counter if > 1
	46-55	E10.5	DT	Initial time increment
	56-65	E10.5	SYSDIM	System dimension, if P_D , t_D calculated*
	66-75	E10.5	TOTALQ	Total flow, if P_D , t_D calculated*
11-1	1-8	A10	"MATERIAL"	Title card for material specifications
11-2	1-5	A10	"INCOMPRESS"	For incompressible fluid **
			"COMPRESS"	for compressible fluid

*Note that P_D , t_D calculation uses properties of first solid, therefore, it is meaningful only for a special class of problems.

**Only used for uncoupled steady state fluid flow problems. Minor modification of the solution algorithm is required for steady state coupled problems, i.e. when $\alpha \neq 0$ and incompressible fluid assumption is used.

Group Column Format Word Explanation

II-3 Properties of solid materials

1-5	15	MTYPE	Material type, NSHELL > MTYPE > 1
6-14	E9.4	RO	Mass density
15 - 23	E9.4	E(1,MTYPE)	Permeability
24-32	E9.4	E(2,MTYPE)	Compression modulus
33-41	E9.4	E(3,MTYPE)	Poisson's ratio
42-50	E9.4	E(4,MTYPE)	Biot's constant α (pressure displacement
			coupling coefficient)
_			

51-59 E9.4 E(5,MTYPE) Biot's constant M (reciprocal of specific storage in case of flow analysis alone)

One card per material type should be punched. Maximum number of solid material cards is equal to NSHELL.

II-4 Fracture material properties

1-5	15	MTYPE	Material type
6-14	E9.4	BLANK	
15-23	E9.4	E(1,MTYPE)	Normal stiffness
24-32	E9.4	E(2,MTYPE)	Tangential stiffness
33-41	E9.4	E(3,MTYPE)	Cohesion
42-50	E9.4	E(4,MTYPE)	Friction angle
51-59	E9.4	E(5,MTYPE)	Maximum closure
60-68	E9.4	E(6,MTYPE)	Biot's constant, a
69-77	E9.4	E(7,MTYPE)	Biot's constant, M

Group	Column	Format	Word	Explanation		
111	Output	Informati	lon			
	1-6	A 10	"OUTPUT"	Title card for output specifications		
	1-80	4012	NPP(I)	Number of perturbabions in time step I		
	1-80	4012	IPAT(J)	Output scheme for each time step		
Out	put sches	les: (1)	IPAT=0	No prints, no plots requested		
		(2)	IPAT=1	Print requested		
		(3)	IPAT=2	Print and plot requested		
IV Plot Information						
If	If 1PLOT=0 skip this group.					

1-10	E10.4	XLENGTH	x-dimension of plot (inches)
11 - 20	E10.4	YLENGTE	y-dimension of plot (inches)
21-30	E10.4	PSCL	Factor for plotting stresses in the
			solids
31-40	E10.4	CONJT	Multiple for PSCL to plot stresses
			in joints

Group	Column	Format	Word	Explanation
v	Nodes			
V-1	1-5	A5	"NODES"	Title card for nodal points
V-2	15	15	N	Nodal point number
	6-10	15	NXP	Increment to reach next nodal point
	11-20	E10.3	R(N)	x-coordinate (R-if axisymmetric) of N
	21-30	E10.3	7(N)	y-coordinate (z-if axisymmetric) of N
	31-40	E10.3	CD	Displacement code of N
	41-50	E10.3	CDI	Displacement code to be used for
				preceding r le
	51-60	E10.3	DÜ	Load or displacement at N in x-direction
	61-70	E10.3	DV	Load or displacement at N in y-direction

Note: If CD or CDI are equal to:

- 0 DU and DV are specified loads
- 1 DU is specified displacement, DV is specified load
- 2 DU is specified load, DV is specified displacement
- 3 DU and DV are specified displacements (Sig. 7)



Sketch: Application of load or displacement boundary codes. Nodal point cards need not be in order, except when generating a set where the 'ast node in the row should come after the first. The last modal point of the system should appear on the last card.

Group	Column	Format	Word	Explanation
VI	Element	5		
VI-1	1-7	A7	"ELEMENT"	Title card for elements
VI- 2	1-5	15	м	Element number
	6-10	15	IX(M, 1)	Nodal points 1 to 4 defining the element
	11-15	15	IX(M,2)	must be counterclockwise for solids and
	16-20	15	IX(M,3)	lengthwise for joints (Fig. 8)
	21-25	15	$_{1X(M,4)})$	
	26-30	15	IX(M,5)	Material type
	31-35	15	IXD(1)	Increments used to change $IX(M,1)$ to
	36-40	15	IXD(2)	reach next generated element
	41-45	15	IXD(3)	
	46-50	15	$_{IXD(4)})$	
	51-55	15	JXD	Increment used to alternate material type
Elements are calculated in order. Use as many cards as necessary until 4				



Sketch: Element nodal point numbering.

Group Column Format Word Explanation

VII Boundary distribution load

If NPC = 0, skip this group.

VII-1	1~8	A8	"PRESSURE"	Title card for boundary pressures
VII-2	1~5	15	11	Nodal point number
	6~10	15	12	Nodal point number
	11~20	F10.3	PS1	Pressure at I1
	21~30	F10.3	PS2	Pressure at I2

VIII Flow conditions

This group must not appear before Group VII.

VIII-1	1-4	A4	"FLOW"	Title card for flow at the boundary
VIII-2	1-5	15	N	Nodal point number. If joint use
				smaller nodal point across the joint.
	6-10	15	ыг	<pre>IB(N) = nonzero, if constant PHIO(N)</pre>
	11-20	F10.3	РН	PHIU(N) ≍ pressure or …ead if SPWT = 0
	21-30	F10.3	QQ	Q(N) = flowrate at N

If IB(N) = 0 and Q(N) = 0.0, omit this card. Cards are needed only if $IB(N) \neq 0$ or if $Q(N) \neq 0.0$.

Group Column Format Word Explanation

IX Residual stresses

Skip this group if no initial stress is given.

IX-1	1-8	A8	"RESIDUAL"	Title card for initial stresses
IX-2	1-10	1:0	Ŋ	Element number
	11-20	E10.3	RESID(N,1)	Stress in x-direction
	21-30	E10.3	RESID(N,2)	Stress in y-direction
	31-40	E10.3	RESID(N,3)	Stress in z-direction
	41-50	E10.3	RESID(N,4)	Shear stress in xy plane

Note that compressive stresses are negative. Repeat as many cards as needed to define NUMEL. The program will calculate stresses for intermediate elements by assigning the preceding values.

A 1-4 A4 "DONE" Title card

This card marks the end of the data for generating the mesh physical information for this particular problem.

Group	Column	Format	Word	Explanation
XI	Joint prope	rties mod	ification	
	Use only if	NJMP > 0	•	
XI	1-5	15	I	Joint element to be modified
	6-15	F10.3	COEG	Coefficient to modify the aperture
	16-30	F15.5	COEM1	Coefficient to modify normal stiffness
	31-45	F15.5	COEM2	Coefficient to modify tangential stiffness
	46-60	F15.5	COEM3	Coefficient to modify cohesion
	61 - 75	F15.5	COEM4	Coefficient to modify friction angle
XII	1-5		"BLANK"	If the flow or pressure source is a step
				function (kept constant in time).
				Use another title card if the source is
				an initial pulse.
111x	1-10	I10	NSTEP	Number of time steps with a constant
				time increment DT
	11-30	⊵20, 5	DT	Constant time increment for NSTEP
XIV	Use as a	many card	s as needed	to reach NDTN in Group I. For steady
	state p	roblems*	use one card	, NSTEP = 1 and DT > zero.
¥7U	1=3	F13	"FND"	Final card in the data dock
∩ 1 ¥	1	, , , , , , , , , , , , , , , , , , ,	<u>1419</u>	FINAL CATA IN the usid usik.

^{*} Neminder: For steady state fluid flow problems, put E(6.MTYPE) equal to zero and use "INCOMPRESS" card.

APPENDIX I

SAMPLE PROBLEM

WITH SAMPLE INPUT OUTPUT

SAMPLE PROBLEM

As an example for data preparation, the problem of fluid flow to a well intercepting a vertical fracture is solved. Although the data is originally set up for coupled stress-flow analysis, the problem is first solved in uncoupled state for the purpose of comparison with the existing solution [Raghavan et al., (17)]. To achieve a conventional fluid flow analysis, one has to assign a zero value to the coupling coefficient 4 and a value equivalent to $1/S_s$ (inverse specific storage) to 4. Later, allowing for the deformability of the medium, a coupled analysis is performed. As it is shown in Table 1, in this case 4 \ddagger 0 (a value equal to 1.0 is assumed) and $M = 1/RC_f$. Figures 1 through 4 present the results of the modeling and following plates exhibit the setup of the data. PSF system equivalent units are used in the tabulation of the flata set.

Material type	Properties		Value
	Y _f , specific weight		9.8 x 10 ³ N/m ³
fluid	C _f ⁻¹ , incompressibility		1.95 GPa
	η, viscosity		2.8 x 10 ⁻⁴ N-sec/m ²
	E, Young's modulus		2.45 GPa
	v, Poisson's ratio		0.25
	Υ _r , snecific weight		2.45 x 10 ⁴ N/m ³
porous rock	n, porosity		2.15
	k, permeability		10 ⁻⁵ m/s
	M, Biot's storage constant	coupled uncoupled*	1.47 GPa 14.0 GPa
	α, Biot's coupling constant	coupled uncoupled	1.0 0.0
	K _N , initial normal stiffness	;	1.60 GPa/m
	K, initial tangential stiff	ness	0.50 GPa/m
	C, cohesion		1.0
fractures	ç, friction angle		30°.0
	2b, initial aperture		1×10^{-3} 1×10^{-14} m
	n, porosity		0.15
	<pre>Y, Birt's storage constant</pre>	coupled uncoupled*	1.47 GPa 14.0 GPa
	u, Biot's storage constant	coupled uncoupled	1.0 0.0

TABLE 1.	Material properties	used fo	or the	analysis o	of fluid	flow in	fractured
	rock mass.						

 $\ensuremath{^{\ast}}$ In this case M is the reciprocal of the specific coefficient of storage of the porous medium.



FIG. 1.--TWO-DIMENSIONAL FINITE ELEMENT MESH. (XBL 806-7222)



FIG. 2.--PD VERSUS t_d for a single fracture intersecting a well at the CENTER of a rectangular porous medium. Analytical solution after raghavan et al. (1976). (XBL 806-2703)



FIG. 3.--PRESSURE DROP ALONG SOFT FRACTURE OF 0.1 mm APERTURE IN FLUIDCLOW ANALYSIS AND STRESS-FLUID FLOW ANALYSIS. (XBL 806-2705)



FIG. 4. --THE VARIATION OF PRESSURE AND EFFECTIVE STRESS ALONG THE NEAR AND FAR ENDS OF THE FRACTURE. (XBL 806-2706)

SAMPLE INPUT DATA PREPARATION FOR COUPLED PROBLEM

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80 72 -50000		╶╏╶╢╸╿╒┥┕┽╌┞╴╽╷╌╎╌┞╼╫╴╀╴┼╶┫╌┽╴╋╶┽╴┠┽┽╸╽╌┽╸┽╶┥┥┥┥┥┥┥┥┥┥┥┥┥┥┥┥┥┥	╅┼┼┼┼┽┥┽
72 64 - 50000	-: : : : : : : : : : : : : : : : : : :	╶╢╶╆╌╿╶┽╵╞╾╿╴╢╹╫╌┽╵╫╾┿╌╄╾┽┼╍┼┲╇┅╇╍╄╼┽╍┿╼┽╼┽╼┽╍┽╼┿┥╼┿╌┥╼┿╴╋╼╋╋╋╋╋╋╋	++++++
64 56 - 50000		╶╏╶╎╹┼╌┥╶╄╾┿┅╎╌┩┅┾╍┾╍╽╎┟╍┼┅┼╸╂╌┥╼┥╌┥╶┨╼┥╸╋╌┥╾┽╼┨╌╎╴┥╍┼╍┫╍╋╍╄╍╋┲╋┲╋	++++++
56 48 -500000	-':'n'0'a'a'.	╴╏╴┧╴┧╸┥╴╎╶┥╴╎╶┥╶┧╴┥╌╎╌┥╌╎╌╎╌╎╌┝┿╸┥╌┿╌┿╌┝╵╎╌╎╼┽╶┥╼┥╼┥╾┥╾┥╾┥╼┿ ╸┥╺┥╺┥╸┥╸┥╸┥╸	

SYMBOL CODING FORM

TITLE:__

SHEET _____ OF___

LABEL	COMMAND	ARGUMENT	COMMENTS	
1 2 3 4 5 6 7 8 8	1011 12 13 14 15 18 17 18	9 20 21 22 23 24 25 28 27 28 29 30 31 32 33 34 35 38	37 38 39 40 41 42 43 44 45 48 47 46 45 50 51 52 53 54 55 58 57 56 58 60 81 82 83 84 85 88 87 88 88 78 78 71 72	73 74 75 78 77 78 78 88
48 4	0 - 50000	-50000		
40 3			┟ ┊┊╞┊╞┊╞╞╞╔╗╧╞╞┊╪┊╪╪╡╝┊┊╞╞╞╶╡╝┢╛╡ ╋╋╋	
32 2	4 - 5 00 0 0	- 50000		┼┼┼┼┼┼┽┥╸
34 1	6 - 5 00 00.			
FLOW				
		4.3 5-5		
88				
RESIDUAL				
	1 -5.	E4 -5 E4		
8	8	E44 - E. E4		
DONE				
BLANK				
	5	E-3		
		1 E - 2		
F1-1-1-1-1	5		┨╶┧╾ <u>╊╶╄┉┞</u> ╸┡╶┥╾┝╼╌┟┈┥┽╤╕╶┿╴╽╶╫╶╉╶┫╴┨╴┫╴┫╴┫╴┫╴┫╴┫╴┫╸╋ ╸╸╸	
		E + O	┨ _┪ ┇ ╕┥ ┥╎┤ ╷╷╞╞┊┝╝┊┤╎╎┥╺┊╎┨╏┥╹╎╵╽╹┝╹╹╵╹╹╹	
╞╾╋╌╋╼╋╍┝╌┆╴╆╌			·∦╶┽┚┽╌╢┽╴╢╫╍┨╺┽╶┧╌╸┽╌┼╶┥╼┼╾┼╌┼╌┼╌╋╍╋╍┽┥┼╶┤╼┝╼╊┹┾╋┥╋╋┱	┤╎╵╵╵╵
	5		┫╴┝╍╅╾╫╍┝╼╡╼┦╴╢╍╪╸┠╴╬╍╏╌╜┝┅┽┙╃╸╄╸╉┝╋╍╢═╋╍╏╸╇╶┨╶╄╼┨╍╫┱┫╼╄╋╋╋┥╸╋╍╢╹ <mark>╣</mark> ╼╄	
			<u>╢╫╫╫╫╫╫╫╫╫╫╫╫╫</u>	╏╎╎╎╎┝┝ ┝┼
			╵╢╵ [╣] ╴┋╾┝╼┝╌┨╴╢╌┨╶╀╶╫╌╄╌╃╼┼ ╼╊╌╕╌╞╴┧╌┤╌┥╶╃╶╢╌╊╍╠╌╫╌┼╶╂╌╄╼╢──┼╴╉	
			╶╢╴╅╾┧╌┼╼┤╴┤╶╎╺╢╌╽╴┼╌┼╌┾╌┾╾┾┅┝╾┠╌┥╼╁╌┿╌┼╍┼╼╉╼╫╸╉╶╄╼┾ ╸╞╸╞╸┥╸ ╋═╊	┧┼┽┽┼┼┼
			┤╴╎╴╿╶┼╶╽╶┼╶╁╸ ┝╶┝╶┝╶┝╶┥╶┥╶┥╸ ┣╾╃╌┨╌┾╍┝╌┼╶┼╶┽╼┡╼┽╞┽┨╞╍╁┲╈╋┱╋╸	┨┿╂╋╋╋
ENE			╴┨╎╎╴╢╎╴╎╴╎╴╢╺ ╎╴╿╴╢╶╢┥╸┝╶┥╶╊╵╢╸╢╸╽╸╋╍╣┥┥┝╎┥╶┥╍┫╸╋╺┨╸┥╸┫╸╋╸╋╸╋╸╋	╂╅┾╋┿╇╃╋
	┨╌┠╍╋╼╄╍┾╌┞╴┠╼╄╍┊	┨╺╍┿╾┾╍┿╍┿╸┟╌╂╴┠╴╉╺ ┥╸╋╶┨┉╬╸ ┩╶╃╌┾	╹╴┞╴╢╴╿╶┼╍┝╍┥┈┼╾╊╌┿╸┝╍ <mark>┥╍┤╌╌╌</mark> ╌╢╸╂╼╊╍┿╾┾╌┼╌ ╋┥╋┥┥┥┥	·╊╋╋┫╬╪ ╋╋
┝┾┼┾┺┼┶┼┼	┨╌╞╸╞╌┽╶┿╌┿╌┾╌┾╴┼╴┍╶╸	1	╶╢╎┍╢╵╄┄┾╌┼╌┦╷╾┊╞ ╶╎╴┾╌╎╌╎╴╞╶╋╶╋╍╋╸ ╋╺╋╼ ┍╶┨╶╌╹╸ ┝╍┥╍╋╼╋╍╋╍╋╍╋╍╋╍╋╍╋	╶╂┶┼┾┼┼┼┼┽╅╸

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I. General parameters and material properties
OF ANG STOATA-FLIGE ANALYSIS CF JUINTED STRUCTURE
SIMULATION PLAPING OF CONFINED AQUIFER WITH SINGLE VERTICAL FRACTURE
INTERSECTING THE WELLPLAIN STRAIN PROBLEM
NUNNP-NUMBER OF ACCAL PUINTS 80
NUMEL-NUMBER OF ELEVENTS 7C
NUMMAT-MUMBER OF DIFFERENT NATERIALS
NSHELL-NUMBER CF SOLIC MATERIALS
NPC-WUNBER OF BEUNE/RY PRESSURE CARDS 16
NJHP-NUMBER CF JEINIS WITH MODIFIED APERTURES0
TRAND-RANCON APERTURE GENERATOR IF 1
NIT-NUMBER OF T. WE STEFS
IPLOT-PLOT INFORMATION REQUIRED IF 1
IPUNCH-FUNCH 1F 1 1
TTOTAL-ESTIMATED TOTAL CP TIMELDEC INAL SECONDSI- 50
AAN-MEAN-APERTURE LOCHORMAL DISTRIBUTION
AAS-STANDARD DEVIATION-LOGNDRMAL DISTRIBUTION 0.
ACELX-X ACCELFRATION (FEET/SECOND) C.
ACELY-Y ACCELERATION (FEET/SECOND)
XNHP-MAXINUN NET HEAC PRESSURE (PSF)
SPWT-FLUID SPECIFIC NEIGHT
NOTN-VARIABLE TIME-STEP COUNTER, IF G.T. 1 10
IPRT.ND. OF CYCLES FOR DISPL. PRINT-0
DT-INITIAL 11HE INCREMENT 1.000000E-03
CONLIN JCINT STIFF.CCNVERG.CONSTANT6250
NAXI-AXISYN, PROBLEM IF= 1
INETA- TIME INTEGRATICA CONSTANT
VI SC-FLUID VI SCOSITY (PSF) 5.85000E-06
SYSDIM-SYSTEM GIMENSICN RECUIRED (F PD, TO WANTED 3.14160E+00
TOTALO-TOTAL FLCW RECUIRED IF PO,TO WANTED 4.3000DE-05
SIMULATICK FUMPING OF CONFINED AQUINEX WITH SINGLE VENTICAL FRACTURE Intersecting the WellPlain Strain Producm
HATEKIAL +P. = 1
PERMEAPILITY 3.100CE-13
ELASTIC MUDICUS 5.1400 +07 PCISSENS ARTID 2.5000E-01
BIDTS CONSTANTIALPPAT C. BIDTS CONSTANTIAT— 3.07COF+C7
MATERIAL NO. = 2
K1 1.COCCE+08
PHI 3.0J00E+01
HAR, LLUSCH
BIDIS CONSTANTS I A+1100E+01
MALERIAL AL. * J KN 7.500E+11
PHI 5.0000E+CI MAX. CLCSURE3.2800E-C9
BIOTS CUNSTANTIALPEATG. BIOTS CENSTANTI H 1 4-1100E+07

II. Displacement and Pressure Results

DISPL. AND PRESSURES AT FIME 5.5555E+01

1 -7.7667(r-3) -4.61257-16 2.492415-50 0. 4.1111400 3 -1.724457(r-3) -4.62257-16 2.492037-60 2.392447-00 2.45247-00 4 -1.620147-13 -4.62257-16 2.492037-60 2.392447-00 2.45247-00 4 -2.612571-13 -2.40317-15 2.493116-00 1.393117-00 1.203227-11 4 -2.612571-13 -2.40317-15 2.493116-00 1.393117-00 1.203227-11 4 -2.612571-13 -4.612584-15 2.493116-00 1.203227-11 1.203227-11 4 -2.413711-16 -2.403176-15 2.493116-00 1.41110-000 1.41110-000 12 -2.413711-16 -2.493716-00 2.413118-00 1.41111-000 1.41110-000 13 -2.413711-16 -4.693727-15 2.493716-00 2.71112-00 1.41111-000 14 -4.613727-13 -4.943727-16 2.973716-00 2.71112-00 1.41111-000 14 -4.613727-13 -4.943727-16 2.973716-00 2.71112-00 1.41111-000 1.41111-000	NODAL PT DESPL IN X-DIREC	DISPL IN Y-DIREC	PRESSURE	DIMENSICHLESS	TIPE.TC CIPENSICALESS PRESSURE.P
2 Mailor		=4-10125E=16	2-893416+64	0.	4-1111 +CC
j -1.2010/C -2.2020/C -2.2020/C -2.2020/C -2.2020/C -2.2020/C 4 -2.2020/C -2.2020/C -2.2020/C -2.2020/C -2.2020/C 4 -2.2020/C -2.2020/C -2.2020/C -2.2020/C -2.2020/C -2.2020/C 4 -2.2020/C	2 -7.861726-10	-8.202538-16	2.91475E+C4	3-35826E+01	3.306456+66
4 -1.401017-15 -4.20200-16 2.437216-50 2.737216-50 2.737216-50 9 -2.4010721-15 -7.40206-10 2.4010721-15 2.401026-10 2.2010721-15 9 -2.4010721-15 -7.40206-10 2.301076-00 1.202076-01 2.200776-01 9 -1.40106-11 -7.40206-17 -7.40206-17 -7.40206-17 -7.40206-17 10 -1.40106-10 -1.200776-10 -2.301076-00 -7.40706-10 -2.301076-00 11 -1.40106-10 -1.200776-10 -2.301076-00 -2.3010776-00 -2.3010776-00 12 -1.40106-10 -1.004016-15 2.49776-00 -2.3010776-00 -2.3010776-00 13 -2.401070-10 -2.400070-15 2.49776-00 -2.3010776-00 -2.3010776-00 14 -4.401070-10 -2.400070-15 2.49776-00 -2.3077776-00 -2.307776-00 14 -4.401070-10 -2.400070-15 2.49776-00 -3.701077-00 -2.2077776-00 14 -4.301070-16 -4.402070-15 -4.901070-15 -4.901070-10 -2.2077776-00<	3 -1.245446-15	- 8.2025CE-16	2.92903E+04	8.39566E+00	2.14155E+CC
1 -24/4021-13 -24/4021-13 -24/4021-14 -24/4021-15 -24/4021-16 -24/4021-15 -24/4021-16 -24	4 -1.65013E-15	-8.20250E-16	2.939716+04	3.7314CE+CC	2.334136+00
n	-2.172136-15	-8-202502-10	2.953615+04	1.163315+00	1-003505+00
e -1.612561-10 -2.996465-00 1.49256-01 1.49256-01 1.49256-01 1 -1.642561-01 -1.69216-01 2.993065-02	7 -2.018216-15	-4.101256-15	2.9916#E+04	3.35024E-01	3.22025E-C1
• -1.44220-11 -7.48421-16 2.493415-65 1.49226-01 4.110700 12 -1.44420-15 -4.0006-16 2.493715-66 3.71145-67 13 -2.122115-16 -4.0006-16 2.493715-66 3.71145-67 13 -2.122115-17 -1.00042-16 2.493715-66 1.00042-16 2.493715-66 14 -2.122115-17 -2.101237-15 2.497016-50 1.00042-16 2.497016-51 2.497016-51 16 -1.12315-17 -2.101237-15 2.497016-52 1.492264-01 1.692254-01 16 -1.137152-15 -4.000771-15 2.497016-52 1.497264-01 2.2711676-00 23 -2.00116-01 -1.09921-16 2.497016-54 1.497264-01 2.2711676-00 24 -4.01577-01 -1.09921-15 2.490016-54 1.497264-01 2.2711676-00 25 -4.01577-01 -1.09921-15 2.490016-54 1.497264-01 2.49716-01 24 -4.01577-01 -1.09921-15 2.490016-54 1.497264-01 2.49716-01 24 -4.015776-1	8 -2.51565F-28	-2.05062E-15	2.99486E+04	1-49255E-01	1.58822E-01
It -1.417261-16 -2.429921-16 2.418716-16 2.418716-16 2.418716-16 2.418716-16 It -2.121261-15 -1.000412-13 2.447716-16 2.001826-00 2.231116-00 It -2.121261-15 -1.000412-13 2.447716-06 2.001826-01 1.52226-01 2.31116-00 It -2.121261-15 -1.000412-13 2.447716-06 1.442266-01 1.52226-01 1.52226-01 It -1.011261-17 -7.100062-16 2.449065-26 1.442266-01 1.52226-01 1.52226-01 It -1.011261-17 -7.100062-16 2.449065-26 1.442266-01 2.227166-02 It -1.03316-16 -1.04020-15 2.4497865-26 1.442266-01 2.227166-02 It -1.03316-16 -1.04020-15 2.4497865-26 1.442266-01 1.227166-02 It -1.03316-16 -1.04020-15 2.4497866-20 1.3472660 2.227166-02 It -1.03316-16 -1.04020-15 2.4497678-40 1.447266-01 2.247176-02 It -1.040200-15 -1.047200	9 -1.£4C50E-17	-7.466ZIE-16	2.8938LE+C4	1.492568-01	4-11110E+0C
12 -1 4.02742 -2.027424 -2.027424 -2.027424<	IC -7.81726E-16	-8.52995E-16	2.914752+04	J+378262+01	3.360426+66
13 -2.12016-15 -1.000000 1.000000 1.000000 14 -2.14018-15 -2.000000 1.000000 1.000000 1.000000 15 -2.14018-15 -2.000000 1.000000 1.000000 1.0000000 1.0000000 16 -2.10000000 -2.0000000 1.00000000 1.00000000 1.00000000 1.00000000 1.00000000 1.00000000 1.00000000 1.00000000 1.000000000 1.0000000000 1.00000000000 1.000000000000 1.000000000000000000000000000000000000	12 -1.045825-15	-8.80766E-16	2.939716+04	3. 7314 (6+ 00	2.334136+00
16 -2.145316-15 -2.46746-15 2.465416-16 1.353216-00 1.272216-0 17 -4.101256-17 -2.407466-00 1.35326-00 1.272216-0 1.272216-0 18 -1.711656-0 -4.47076-16 2.475366-00 1.272216-0 1.272216-0 19 -1.2401671-15 -4.47076-16 2.475366-00 1.271166-0 2.727366-0 20 -1.2401671-15 -4.47076-15 2.475366-00 1.271166-0 2.71166-0 21 -2.001166-15 -4.47076-15 2.470766-0 1.243216-00 1.271166-0 22 -2.001126-15 -4.48706-0 1.243216-00 1.271166-0 1.243216-00 23 -4.12400-15 -4.48706-0 1.243216-00 1.243216-00 1.243216-00 24 -2.01126-15 -4.48706-0 1.233216-00 1.243216-00 1.243216-00 25 -4.124060-15 -4.48406-15 2.493026-00 1.233216-00 1.243216-0 26 -1.244060-15 -4.48406-15 2.493026-00 1.233216-0 1.2447666-00 27 <td>13 -2.122e1E-15</td> <td>-1.06843E-15</td> <td>2.94774E+04</td> <td>2.09892E+00</td> <td>2.C2221E+CC</td>	13 -2.122e1E-15	-1.06843E-15	2.94774E+04	2.09892E+00	2.C2221E+CC
13	14 -2.18933E-15	-2.46074E-15	2.95341E+C4	1.34331E+00	1.80358E+C0
17 4.10197-0 -7.27395-01 -4.27237-00 18 7.27257-00 -3.55626-00 -2.27277-00 19 -1.24707-15 -4.2707-16 2.427464-00 -2.27277-00 20 -1.24707-15 -4.27077-16 2.427464-00 -2.272777-00 21 -1.247077-15 -4.20177-15 2.437464-00 -2.272777-00 22 -2.01277-15 -4.00177-15 2.437464-00 1.337277-00 1.272777-00 23 -2.01127-15 -4.00177-15 2.437464-00 1.337277-00 1.272777-00 23 -4.011777-17 -2.071464-00 2.3300470-00 1.335264-00 2.2474764 24 -1.640407-15 -4.42047-16 2.4044716 1.335264-00 2.247476470 26 -1.2454671-15 -4.420471-16 2.4044764 1.335116400 2.247476470 27 -1.246407-15 -4.420471-16 2.4044764 1.335116400 2.247476470 27 -1.240407-15 -4.04446-18 2.4044764 1.335116400 2.247476470 28 -1.2412464-18 2.4044764 1.435116400 2.247476470 2.24746470<	15 -2.010200-15	-4.10123E-15	2.991061+04	3-328201-01	3.220258-01
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	16 -1+636146-20	-7.719546-16	2.89598E+04	L-49256F-01	4.027236+00
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	18 -7.73185E-16	-8.49702E-10	2.91527E+04	3.35826E+01	3.280588+00
$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	19 -1.24705E-15	-8.82404E-16	2.929468+64	8.39566E+00	2,731C8E+CC
2. 2.<	20 -1.65341(-15	-8.82912E-16	2.94000E+04	3.7314CE+C0	2+32275E+CC
73 -2201122-15 -4.000772-15 2.000772-05 2.000772-06 1.40226-01 1.40236-01 2.000772-06 75 -6.05070-17 -4.000112-16 2.000720-06 1.40226-01 2.07012-06 76 -7.007720-16 -4.010112-16 2.000720-06 1.40226-01 2.07012-06 76 -7.007720-16 -4.010112-15 2.000720-06 1.40226-01 2.070404-00 78 -7.007720-15 -4.01011-15 2.000420-00 2.070404-00 2.070404-00 78 -7.007720-15 -4.040071-15 2.000420-00 1.070400-00 2.070400-00 79 -7.0077720-16 -6.0724042-16 2.000400-00 1.402250-01 3.071400-01 79 -7.0077720-16 -6.0724042-16 2.001200-00 1.402250-01 3.071400-01 70 -7.0077720-16 -6.0724042-16 2.001200-00 1.402250-01 3.071400-01 70 -1.040770-15 -0.01530-16 2.001200-00 1.402250-01 3.071400-00 70 -1.040770-15 -0.01530-16 2.001200-00 1.402260-01 1.708146100 70 -1.040770-15 -0.0153	22 -2.16 826-15	-1.074202-15	2.95176F+04	1.343316+00	1.796176406
24 -c.13727F-17 -2.07090F-15 2.0900E004 1.49256F-01 1.46256F-01 25 -c.6.5220F-16 -8.4546F-16 2.0900E004 1.49256F-01 3.737356F00 26 -7.65155F-16 -8.45646F-16 2.0900E004 3.33526F00 2.203725F00 27 -7.2027171F-15 -8.4566F-16 2.4900E004 3.33526F00 2.033225F00 2.033225F00 30 -2.021171F-15 -2.4404F15 2.4904E004 3.33526F00 2.7775757777 31 -2.0014F-15 -2.4070F-15 2.0914576 1.33526F00 1.7775777777777777777777777777777777777	23 -2.011236-15	-4.08977E-15	2.991586+04	3.35826E-01	3.25ECEE-C1
25 -6.520(1-17) -8.10911E-16 2.49902E-04 1.49256-01 3.57401E00C 26 -1.40155C-15 -8.46402E-16 2.401811E-04 3.3381640 3.4718ECC 27 -1.40500E-15 -1.40402E-16 2.40403E+16 3.711401-00 2.72544E+CC 30 -2.1111E-15 -4.40402E-16 2.40432E+04 3.3331E+0C 1.7754C+CC 31 -2.0014E+15 -4.4040E+15 2.40432E+04 3.3331E+0C 1.77577E+CC 33 -1.2074E+16 -4.116464E+15 2.40142E+04 3.3331E+0C 1.77577E+CC 33 -1.24777E+16 -4.116464E+15 2.40142E+04 3.3356E+00 1.77577E+CC 34 -1.24777E+15 -4.40432E+16 2.4012E+04 3.3356E+00 2.43511E+CC 35 -1.24777E+15 -4.04132E+16 2.4012E+04 3.3358E+00 2.44511E+CC 36 -1.46777F+15 -4.0412E+04 3.3358E+00 2.44511E+CC 36 -1.4672E+16 -2.1532E+16 2.49511E+0C 1.37334E+0CC 37 -1.4672E+16 -2.1	24 -6.13567E-17	-2.07989E-15	2.99491E+04	1.49256E-01	1.96935E-01
col - 1.24000 2.270120 2.2002000 2.2002000 2.2002000 2.2002000 2.2002000 2.2002000 2.2002000 2.2002000 2.2002000 2.2002000 2.2002000 2.2002000 2.2002000 2.2002000 2.2002000 2.20020000 2.2002000 2.2002000 2.2002000 2.2002000 2.2002000 2.2002000 2.2002000 2.2002000 2.2002000 2.2002000 2.2002000 2.2002000 2.2002000 2.2002000 2.2002000 2.2002000 2.2002000 2.2002000 2.20020000 2.2002000 2.2002000 2.2002000 2.2002000 2.2002000 2.2002000 2.2002000 2.20020000 2.20020000 2.20020000 2.20020000 2.20020000 2.200200000 2.2002000000 2.20020000000 2.200200000000000000000000000000000000	25 -6.562C0E-17	-8.10911E-16	2.d9902E+04	1.49256E-01	3.509616+00
	20 - 1.091151-16	-0.972492-10 -8.86264F-16	2+710110+U4	3+37020C+U1 8-39566F+00	2.7066CF+CC
$\begin{array}{c} 2.9 & -2.23(17)(1-15) & -2.44246-15) & 2.9437(1-04) & 2.99492(1-02) & 1.65444(1+CC) \\ 3.1 & -2.03(14)(1-15) & -2.44246(1-15) & 2.99144(1+04) & 3.9542(1+0-1) & 3.911(1+-C1) \\ 3.2 & -1.633(1+1-2) & -1.1464(1+15) & 2.99144(1+04) & 3.9542(1+0-1) & 1.44259(1+-C1) \\ 3.2 & -1.633(1+1-2) & -1.64259(1+16) & -2.11764(1+0-2) & 3.9542(1+0-1) & 2.91147(1+0-2) \\ 3.3 & -1.24477(1+5) & -4.91453(1+0-1) & 2.99144(1+0-2) & 3.9542(1+0-0) & 2.91474(1+0-2) \\ 3.4 & -1.24477(1+5) & -4.91453(1+0-2) & 2.99114(1+0-2) & 3.955645+00 & 2.97144(1+0-2) \\ 3.4 & -1.644457(1+15) & -4.914524(1+15) & 2.99116(1+0-2) & 3.95565(1+00) & 2.97144(1+0-2) \\ 3.4 & -1.644457(1+15) & -4.911624(1+15) & 2.99116(1+0-2) & 3.95166(1+0-2) & 2.97144(1+0-2) \\ 3.4 & -1.644457(1+15) & -4.911624(1+15) & 2.99116(1+0-2) & 3.95166(1+0-2) & 2.97144(1+0-2) \\ 3.4 & -1.64457(1+15) & -4.911624(1+15) & 2.99116(1+0-2) & 3.95166(1+0-2) & 3.95166(1+0-2) & 3.95166(1+0-2) & 3.95166(1+0-2) & 3.95166(1+0-2) & 3.95166(1+0-2) & 3.95166(1+0-2) & 3.95166(1+0-2) & 3.95166(1+0-2) & 3.95166(1+0-2) & 3.95166(1+0-2) & 3.95166(1+0-2) & 3.95166(1+0-2) & 3.95166(1+0-2) & 3.95166(1+0-2) & 3.95166(1+0-2) & 3.95166(1+0-2) & 3.95166(1+0-2) & 3.95166(1+0-2) & 3.95566(1+0-2) & 3.95166(1+0-2) & 3.95166(1+0-2) & 3.95166(1+0-2) & 3.95166(1+0-2) & 3.95166(1+0-2) & 3.95166(1+0-2) & 3.95166(1+0-2) & 3.95166(1+0-2) & 3.95266(1+0-2) & 3.95766(1+0-2) & 3$	28 -1.65465E-15	-8.88605E-16	2.940456+04	3.73140E+00	2.205466+00
10 -2.1316TE-15 -2.44266E-15 2.9542TE-04 1.3433TE-00 1.7764TE-00 31 -1.60346E-16 -2.11866E-15 2.09148E-04 1.49256E-01 1.94259E-01 32 -1.60346E-16 -2.72445E-16 2.09448E-04 1.49256E-01 1.94259E-01 33 -1.64537E-16 -2.72445E-16 2.09114E-04 1.93566E-00 2.49511E-00 34 -1.64677E-15 -4.04757E-16 2.09114E-04 1.93516E-00 2.07914E-17 36 -1.64777E-15 -0.0105E-15 2.09510E-04 3.93164F-00 1.07357E+02 37 -1.64072E-15 -2.42466E-15 2.09510E+04 3.93164F-00 1.07357E+02 38 -1.26179E-15 -0.03778E-16 2.09512E+04 3.93726E-01 3.97427E+01 40 -2.03746E+05 -1.37746E-15 2.09372E+04 3.93746F+00 2.07472F+01 41 -2.03726E+15 -2.03774E+15 2.09372E+00 3.93746F+00 2.0472F+01 42 -1.62721E+15 -0.33774E+15 2.09374E+04 3.93746F+00 2.1872F+01	29 -2.C27C1E-15	-1.13101E-15	2.94837E+04	2.09892E+00	1.558846+00
21	30 -2.131616-15	-2.442648-15	2.95427E+04	1.34331E+CC	1.7704000
33 -1.442706-01 2.7228242-01 2.72222242-02 34 -1.4077677161 -0.4332251-16 2.003062-06 3.352265-01 2.187762170 35 -1.246777-15 -0.414331-16 2.003146-04 8.395265-00 2.27344747 36 -1.447777-15 -0.414331-16 2.0440226-04 2.0980276-00 1.733314-00 37 -1.447777-15 -2.0440226-04 2.0980276-00 1.733314-00 1.733314-00 40 -2.071461-15 -2.244066-15 2.0940276-04 1.442567-01 1.901166-04 41 -2.0113516-15 -2.093276-04 3.432567-01 1.201166-04 1.442567-01 1.201166-04 42 -2.20139216-15 -2.013567-15 2.093276-04 3.432567-01 1.201266-04 43 -1.2013976-15 -0.303376-16 2.093228-04 3.395267-01 1.3627267-01 44 -1.601267-15 -1.003376-16 2.093228-04 3.395267-01 1.4627267-01 45 -1.7627367-15 -3.37796-15 2.093176-04 3.359267-01 1.692767-01 46 -1.0627016-15 -1.063206-15 2.093126764 1.4427567-01	32 -1.503545-16	-4.074071-15	2.991435+04	1.492565-01	1-942596-01
34 -1.243717c-16 -0.43222C-16 2.91766E+01 2.35526E+01 2.1478CE+CC 36 -1.246777-15 -0.01438E-16 2.04112E+04 3.75167E+00 2.24611E+00 37 -1.44472C15 -1.18720E-15 2.04122E+04 3.75167E+00 1.73334E+00 38 -2.07745E+15 -2.042466E-15 2.09510E+04 1.4321E+00 1.73334E+00 39 -2.0668E+15 -2.07010E+15 2.07101E+15 2.0910E+04 1.43226E+01 1.43226E+01 41 -4.10115E+16 -1.01850E+15 2.01466E+04 1.43226E+01 1.26245E+02 42 -1.26750E+15 -2.0510E+16 2.05359E+16 2.05359E+01 1.24255E+02 43 -1.26750E+15 -2.0510E+16 2.05310E+04 3.35326+01 2.18254E+02 44 -1.46750E+15 -2.03178E+15 2.05107E+04 3.35326+01 2.04255E+02 45 -1.47502E+15 -1.03170E+15 2.04007E+04 3.35326+01 2.04255E+02 45 -1.475172E+15 -1.03172E+02 3.04007E+04 3.35326+01 2.0	33 -1.64C50E-16	-8.72584E-16	2.9036DE+04	1.49256E-01	3.722366+66
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	34 -7.63737E-16	-8.43422E-16	2.91766E+C4	3.35826E+01	2.1878CE+CC
35 -1.0847/ft-15 -2.04162610 2.04162610 2.04162610 2.04162610 36 -2.07164615 -2.04266615 2.04266615 2.04266610 1.343161600 39 -1.580786115 -4.051016115 2.0901286104 3.338266101 2.394228-01 40 -2.060486116 -1.03850415 2.09026810 1.402266101 2.0823817610 41 -4.101256116 -1.03850415 2.09026810 1.393266100 2.0823871760 42 -2.260048116 -0.032378616 2.093428100 1.090288010 2.083286100 43 -1.6670526115 -0.033786116 2.093021000 1.089428400 1.09428400 44 -1.027196115 -2.0970978115 2.09021000 1.094286100 1.094286100 45 -1.027196115 -2.0970978115 2.097021000 1.09728641 1.99728611 46 -1.027106115 -2.0970978115 2.097021600 1.09728641 1.99728641 47 -1.02710615 -2.097286101 1.497286101 1.997286101 1.997286100	<u>35</u> -1.24877f-15	-8.91453E-16	2.93114E+ C4	8.39566E+00	2.66611E+C0
18 -2.427402-15 -2.955102+06 1.343512+00 -7.736342+00 39 -1.565646-15 -0.01012-15 2.995028+04 1.492567-01 1.901862-01 40 -2.900548-16 -2.975062-15 2.995028+04 1.492567-01 1.901862-01 41 -4.10155-16 -1.93555-16 2.92208-04 3.35826+00 2.942567+00 43 -1.2517976-15 -9.073785-16 2.9932640 3.35826+00 2.842567+00 44 -1.6002572-15 -2.9170640 3.7318100 1.8472845+00 1.8472845+00 45 -1.78273872-15 -2.917046+00 1.7318100 1.8472845+00 1.8472845+00 46 -1.97762-13 -2.977845+15 2.917164+00 1.3472767-01 1.7872767-01 47 -0.025316-15 -1.311176-15 2.931028+00 1.497286-01 2.4721840 49 -1.025316-15 -1.931028+00 2.94721840-01 2.9421840 2.9421840 50 -1.69519215 -2.9473184-04 3.397261001 2.9421840 2.9421840 2.9421840	30 -1.549525-15	-1.187206-15	2.941225+04	7.09892F+00	1.973576+00
39 -1.6280586-10 2.99123E04 3.35826E-01 2.97423E-C1 40 -2.00546E-16 -2.17504E-15 2.991626E-04 1.49256E-01 2.90186E-C1 41 -4.10125E-16 -9.07378E-16 2.99208E-04 3.35826E-01 2.98255F-01 2.98255F-01 43 -1.26170E-15 -9.03578E-16 2.99208E-04 8.39566F-00 2.18724F+0C -45 -1.46755E-15 -1.37746E-15 2.93107E-04 2.09327600 1.8942F+0C 46 -1.031571F-15 2.93107E-04 2.090726F-00 1.49726E-01 1.60527E-01 47 -1.40173E-15 -2.37744E-15 2.93107E-04 3.35726E-01 1.60527E-01 48 -6.6023E-15 -3.1117E-15 2.93102E-04 3.95526F-01 1.60527E-01 49 -1.60106E-15 -9.06069E-16 2.99213E-04 3.95526F-01 1.60527E-01 50 -1.650106E-15 -9.06069E-16 2.99213E-04 3.95526F-01 1.67527E+02 51 -1.301078E-15 2.90508E+04 3.95526F-01 1.67527E+02 52 -1.631418E-15 2.90508E+04 3.95526F-01 1.67232F+1C	38 -2.077456-15	-2.42446E-15	2.95510E+04	1.34331E+00	1.73834E+CC
40 -2,2,17504E-15 2,0950EF06 1,49256E-01 1,40186E-C1 41 -4,10125E-16 -1,01854E-15 2,01246E-04 3,3526F001 2,24576F00 42 -E,276046E-16 -8,66925E-16 2,32240EF04 3,3526F001 2,34577F00E 43 -1,251770E-15 -0,01378E-16 2,037376E-16 2,037376E-16 2,037376E-16 45 -1,0370E-15 -2,037376E-15 2,05107E-04 3,35267E-01 1,6425E+CC 46 -1,03757E-15 -2,03736E-15 2,09574E+04 3,35267E-01 1,6422E+CC 47 -1,02551E-15 -2,03534E+16 1,49256E-01 1,6422E+CC 1,6422E+CC 49 -1,02251E-15 -1,31117E-15 2,09302E+04 3,35526F+01 2,62256E+01 3,5526E+01 2,6226E+01 51 -1,0206E-15 -9,40649E+16 2,0942E+00 1,0492E+16 2,0421E+04 8,39566E+00 2,2466E+CC 52 -1,601306E+15 -9,40649E+15 2,49602E+01 3,4532E+01 1,4795E+01	39 -1.5865BE-15	-4.05101E-15	2.99123E+04	3.35826E-01	3.39422E-C1
12 12 <td< td=""><td>40 - 2.90548E-16</td><td>-2.175045-15</td><td>2.995052404</td><td>1.492568-01</td><td>1.901866-01</td></td<>	40 - 2.90548E-16	-2.175045-15	2.995052404	1.492568-01	1.901866-01
43 -1.25179E-15 -9.07378E-16 2.09432E+04 8.93566E+00 2.44255E+1C 45 -1.78275E-15 -1.32779E-15 2.09107E+06 2.09092E+00 1.4042E+CC 46 -1.93776E-15 -2.93764E+01 2.95107E+06 2.09092E+00 1.4042E+CC 47 -1.9553E-15 -2.99072E+06 3.35826E-01 1.4042E+CC 48 -0.61652E+16 -2.99032E+06 1.40258E-01 1.60420E-CL 49 -1.02551E-15 -1.04206E+15 2.993316E+06 3.35826E+01 2.45258E+00 51 -1.02551E+15 -1.04206E+15 2.993516E+06 3.39566E+00 2.24621E+CC 52 -1.6030E+15 -1.99451E+0 3.99566E+00 2.24521E+CC 3.55266-01 53 -1.67114E+15 -2.94045E+CC 3.358266-01 3.45728F+CC 3.55826E-01 3.45728F+CC 55 -1.53146+15 -3.80306E+15 2.99568F+04 1.49258E+01 1.46718E+CC 56 -1.29154E+15 -1.99568E+04 1.49258E+01 1.46718E+CC 57 -1.53146+15	47 - 8-29C49E-16	-8.66925E-16	2.922906+04	3.35826[+0]	2.98517E+00
44 -1, 26 C S C = 15 -0, 585 S S = 16 2, 09 30 C = 06 3, 314 O F + 00 2, 18 32 46 + C C 46 -1, 78 25 = 15 -2, 37 78 4 = 15 2, 09 71 46 + 04 3, 35 42 6 + 01 1, 44 124 + 4 C C 47 -1, 65 5 (3 - 15) -2, 37 78 4 = 15 2, 09 72 4 + 04 3, 35 42 6 + 01 3, 56 22 6 + 01 3, 56 22 6 + 01 48 -6, 01 (5 3 - 16) -2, 30 30 9 5 + 15 2, 09 72 4 + 04 1, 49 25 5 + -01 1, 40 25 5 + -01 1, 40 25 5 + -01 50 -1, 62 (1 C = 15) -1, 04 20 6 + 16 2, 04 21 3 6 + 08 3, 38 22 6 + 01 2, 21 (1 0 + 00) 51 -1, 03 10 6 + 15 -1, 04 20 6 + 16 2, 04 21 3 6 + 08 8, 39 36 6 + 00 1, 46 23 5 + -00 52 -1, 03 10 6 + 15 -1, 04 20 6 + 16 2, 04 21 3 6 + 08 8, 39 36 6 + 00 1, 46 23 7 8 + 00 53 -1, 03 10 6 + 15 -1, 03 10 7 8 + 16 2, 04 20 8 + 04 1, 49 25 6 + 01 1, 46 21 7 8 + 01 54 -1, 30 12 6 + 15 -2, 06 20 8 + 04 1, 49 25 6 + 01 1, 46 21 7 17 + 01 1, 46 21 7 17 + 01 55 -1, 29 15 4 + 15 -1, 09 5 6 6 + 04 1, 49 25 6 + 01 1, 46 21 2 + 01 1, 46 21 2 + 01	43 -1.251796-15	-9.07378E-16	2.93432E+04	8.39566E+00	2.54255F+CC
	44 -1.6CCSCE-15	-9.585596-16	2.94360E+04	3.73140F+00	2.183546+00
$\begin{array}{c} +7 & -1, -95934 \pm -15 & -2, -99034 \pm -15 & 2, -99034 \pm -16 & 3, -55924 \pm -11 \\ +8 & -6, -6, -6, -5, -1, -2, -2, -2, -3, -2, -2, -2, -3, -2, -2, -2, -2, -2, -2, -2, -2, -2, -2$	45	-1.32//9E-15	2.951072+04	1.343315+00	1.647645466
48 -0.61 (\$\$2:1-16 -2:309396:15 2:09334:0:04 1.49236:0:01 1.80230:0:-(1 90 -1.02:1:1-15 -1.3111 (T=15 2:9320:2:00 1.49236:0:-01 2:21:1:4:10 90 -1.03:0:1:0:-15 -1.02:0:0:-15 2:9320:2:00 8.3956:0:00 2:24:0:1:4:00 51 -1.03:0:0:-15 -1.12:73:1:-15 2:942:3:0:04 8.3956:0:00 1.492:3:0:00 52 -1.50:0:0:0:-15 -1.12:73:1:-15 2:945:0:0:0 1.70:5:0:0:0 1.70:5:0:0:0 54 -1.73:1:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:0:	47 = 1.95553E-15	-3.94859E-15	2.99072E+04	3.35826E-01	3.592946-01
49 -1.022:12-13 -1.31117E-13 2.9202800 1.92350E-01 2.4221801 50 -1.02251E-13 -1.04206E-13 2.94238E-06 8.38526E+01 2.2412800 51 -1.0251EE-13 -4.94458E-06 8.38526E+01 2.24128E+02 52 -1.0210E-13 -1.12731E-15 2.94238E+06 8.39566E+01 2.24128E+02 53 -1.47114E-13 -1.48492E+15 2.946278E+04 1.3835826E+01 3.45127E+02 55 -1.753518E-15 -2.95028E+05 2.99002E+00 1.3835826E+01 3.65178E+02 56 -1.2714E+15 -2.46004E+15 2.99002E+06 1.49256E+01 1.64417E+02 57 -1.55141E+15 -1.49006E+15 2.99756F+04 1.49256E+01 1.642247E+02 58 -1.67218E+15 -1.99038E+05 3.95826F+01 1.64217E+02 1.99356E+00 1.47252E+02 59 -1.17532E+15 -1.94002E+15 2.96029E+02 3.95826F+01 3.9846E+02 1.49256C+01 1.49256C+01 1.49256C+01 1.49256C+01 3.9846E+02 3.9846E+02 3.9846E+02 3.9846E+02 3.9846E+02 3.9846E+02 3.9846E+02 3.9846	48 -6.61453E-16	-2.30999E-15	2.99534E+C4	1.492566-01	1.80420E-01
51 -1.205(kt-15 -9.90k+9t-16 2.94213k+04 8.3950kt+00 2.24221k+CC 53 -1.67114t-15 -1.12731t-15 2.94045k+C4 2.9982k+00 1.7C55k+CC 53 -1.7311kt-15 -1.94945k+C4 2.9982k+00 1.7C55k+CC 55 -1.7311kt-15 -2.9403k+2t-15 2.99000k+04 3.457k+00 1.7C55k+CC 56 -1.2311kt-15 -2.9403k+15 2.99000k+04 3.457k+00 1.4273k+CC 57 -1.5311kt-15 -1.8918k+15 2.9950k+04 1.4925k+01 1.64411k+CC 58 -1.7157k+15 -1.89086t+15 2.9975k+04 1.4925k+01 1.64411k+CC 59 -1.7157k+15 -1.39006t+15 2.9073k+04 8.3936k+01 1.622k+17CC 60 -1.7752k+15 -1.94800k+15 2.9073k+04 8.3936k+01 1.222k+15 61 -1.7703k+15 -1.89799k+15 2.9062g+16 3.935kk+01 1.925k+16 62 -1.7742k+15 -1.8999k+15 2.9073k+16 3.935kk+10 1.925k+16 63 -2.0371kt-15 -2.9073k+16 3.935kk+10 1.9272k+16 1.9773k+16	49 -1.025:1E-15	-1.3L11(t=15	2.932026+04	1.492361-01	2-510395+00
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	51 -1.305C6E-15	-9.96649E-16	2.94213E+04	8.395665+00	2.24C61E+CC
53 -1.7471146-15 -1.7469426-15 2.996024910 1.74039424400 1.74039424400 55 -1.731146-15 -2.307881715 2.996024610 1.343311400 1.7403744715 55 -1.731146-15 -2.307881715 2.990024610 1.492586-01 3.4827747-01 56 -1.271476-15 -2.30788704 1.492586-01 3.4827747-01 1.4627387-01 57 -1.2514715 -1.4804056-15 2.997586404 1.492586-01 1.462787400 59 -1.715527-15 -1.4940056-15 2.960738404 8.935686400 1.422582400 60 -1.77526415 -1.4940056-15 2.960738404 8.935686400 1.422572400 61 -1.740455-15 -1.840096-15 2.960246400 8.335266-01 3.954267-01 62 -1.7740456-15 -2.960324645 2.990482400 1.4925861-01 3.6726800 63 -2.053716-15 -2.9603246450 1.4927867-01 3.664207-01 3.664207-01 64 -2.053716-15 -2.997386404 1.4927867-01 1.6077284400 3.552667-01 3.664207-01 65 -2.672841-15 -2.997386404 <td>52 -1.50(30E-15</td> <td>-1.12731E-15</td> <td>2.94945E+C4</td> <td>3.73140E+00</td> <td>1.95695E+CC</td>	52 -1.50(30E-15	-1.12731E-15	2.94945E+C4	3.73140E+00	1.95695E+CC
39 -1.39732-13 -2.301080-15 2.400007000 1.497341-00 1.497341-01 56 -1.297144-15 -2.300061-15 2.095640-04 1.497361-01 1.61322-01 57 -1.551411-15 -1.090646-15 2.095640-04 1.492561-01 1.61322-01 58 -1.61411-15 -1.090646-15 2.097835404 1.492561-01 1.61322-01 50 -1.675724-15 -1.090646-15 2.097835404 1.492561-01 1.61241100 50 -1.7704411-15 -1.299041515 2.098025004 1.492561-01 1.61241100 60 -1.7704451-15 -1.299041515 2.090426004 3.391400 1.27277400 61 -1.770451-15 -2.9972516740 1.497561-01 1.664171400 1.27277400 63 -2.003716-15 -2.9973516740 1.497561-01 1.697726400 1.697726400 64 -2.005716-15 -2.99791640 3.958264701 1.607724400 1.697564701 65 -2.61767715-5 -2.99716404 3.958264701 1.697724400 1.697564701 66 -2.902784105 -1.977156404 3.958264701 1.6975647	53 -1.67114E-15	-1.54992E-15	2.936082+04	2.098926+00	1.700558+00
56 -1.29164E-15 -2.30201E-15 2.99568E+04 1.49256E-01 1.42182E-C1 57 -1.51417-15 -1.88149E-15 2.995154F04 1.49256E-01 1.644C1E+CC 58 -1.61641E-15 -1.995055E-15 2.995154F04 8.395656+00 1.5262E+CC 90 -1.77526E-15 -1.39506F-15 2.995154F04 8.395665+00 1.5262E+CC 90 -1.77626E-15 -1.88909E-15 2.90622E+CC 2.09392F+C0 1.22757F+CC 62 -1.7765E-15 -2.89622E+CC 3.35326F-01 3.06820E-01 0.06820E-01 63 -2.0571E-15 -2.90751F+C4 1.49256F-01 3.06820E-01 0.06820E-01 64 -2.0571E-15 -2.90731E-15 2.90731E+05 1.49256F-01 3.05826F+C1 5.72869E+01 65 -2.70655E-15 -1.93731E+15 2.97541E+04 8.39566F+00 9.51845F+C1 66 -2.70655E+15 -1.93731E+15 2.97541E+04 8.39566F+00 9.51845F+C1 67 -2.70625E+15 -1.91474E+15 2.97716E+04 8.39566F+00 9.51845F+C1 70 -2.272141E+15 -2.977124E+04 8.3	55 -1.53514F-15	-2.30/882-15	2.990095+04	3.358266-01	3.837785-03
57 -1.81417-15 -1.81447-15 2.975547404 1.42256C-01 1.644117+CC 58 -1.67547-15 -1.39406E-15 2.9673547404 3.352647+C1 1.6124174CC 59 -1.715472-15 -1.39406E-15 2.960354*04 8.355664*C1 1.272524*CC 60 -1.72526+15 -1.6494907E-15 2.966294*C4 3.731407*00 1.38446*CC 61 -1.74045E-15 -1.8494907E-15 2.966294*C4 3.731407*00 1.38446*CC 62 -1.774045E-15 -1.849026*C15 2.990424*C0 1.3935426*C0 1.72757*CC 63 -2.05371E-15 -2.990321*C4 1.34335426*C1 3.66420E*C1 3.66420E*C1 65 -2.87751E*C5 -2.997355*C4 3.39546*C1 1.49756*C1 1.607272*CC 66 -2.90231*E15 -2.907355*C4 3.39566*C10 9.51845*C1 3.5526*C1 67 -2.5425*E15 -1.91479*E15 2.97755*C4 3.39566*C10 9.51845*C1 68 -2.9023*E15 2.97755*C4 3.39566*C10 9.51845*C1 3.57826*C1 70 -2.5425*E15 -1.94771*E15 2.97755*C4 3.395826*C10	56 -1.24154E-L5	-2.56201E-15	2.99568E+04	1.49256F-01	1.67382E-C1
5f -1.676*1E-15 -2.97635F+C4 3.5826F+C1 1.61241*CC 59 -1.715*27+15 -1.39406F+15 2.996135F+C4 3.5826F+C1 1.62752E+CC 60 -1.7226E+15 -1.82532E+15 2.96622E+C4 3.3140F+C0 1.39464E+CC 61 -1.7405F+15 -1.64909E+15 2.96622E+C4 2.0982F+C0 1.2725F+CC 62 -1.7405F+15 -2.6633E+15 2.97251F+C4 1.39431F+00 1.66620E+C1 63 -2.0571E+15 -2.90231E+15 2.99738E+C4 1.49256F+01 1.66620E+C1 64 -2.0571E+15 -2.97351E+C4 1.49256F+01 1.675EE+C1 66 65 -2.871E+15 -2.97351E+C4 3.35726F+01 1.6752E+C0 66 -2.87657E+15 -1.93731E+15 2.9775E+C4 3.35726F+01 5.7695E+01 67 -2.8762E+15 -1.9775E+C4 3.35726F+01 5.7695E+01 5.7695E+01 5.7695E+01 68 -2.871E+15 -2.9775E+C4 3.35726E+01 5.7695E+01 5.7695E+01 7.4057E+01 70 -2.271E+15 -2.97791E+04 3.3572E+01 7.40575E+01 7.40575E+01 </td <td>57 -1.558476-15</td> <td>-1.881498-15</td> <td>2.957546+04</td> <td>1.49256E-01</td> <td>1.644016+00</td>	57 -1.558476-15	-1.881498-15	2.957546+04	1.49256E-01	1.644016+00
39 -1,71 -1,73 -1	56 -1.676516-15	-1.50965E-15	2.95835F+C4	3.35826F+C1	1-61247[+CC
$\begin{array}{cccccccccccccccccccccccccccccccccccc$		-1.594006-15	2.960/32+09	8.39566E+00 3.731405+00	1.576528+66
62 -1,774¢CE-15 -2,2603uE-15 2,09725[F1C4 1,33512600 1,0643)F1cC 63 -2,0571L-15 -3,49802E-15 2,0974E+04 1,357326-01 1,66220E-01 64 -2,0371L-15 -2,09231E-15 2,09738E+04 1,49256F-01 1,66220E-01 65 -2,E7C4FTE-15 -2,09731E-15 2,09738E+04 1,49256F-01 1,66220E-01 66 -2,0755EE-15 -1,39311E-15 2,077356E+04 3,35726F+01 5,57267E+01 67 -2,54725E-15 -1,43701E-15 2,07751E+04 8,39566F+00 9,31845E+01 68 -2,247428E+15 -1,91470E+15 2,07751E+04 8,39566F+00 9,31845E+01 69 -2,27148E+15 -2,099218E+04 1,33311E+00 7,20557E+01 2,09521E+01 70 -2,27148E+15 -2,09721E+04 1,33311E+00 7,20557E+01 2,09521E+01 71 -2,24748E+15 -2,09221E+04 1,342556+01 2,01718E+01 72 -2,21161E+15 -2,09221E+04 1,342556+01 2,013926+01 74 -3,0240E+015 </td <td>61 -1.74045E-15</td> <td>-1.849090-15</td> <td>2.96829E+C4</td> <td>2.098925+00</td> <td>1.727536+00</td>	61 -1.74045E-15	-1.849090-15	2.96829E+C4	2.098925+00	1.727536+00
63 -2.0371L-15 -3.49802E-15 2.99048E+C4 3.5926F-01 3.68620E-C1 64 -2.0557LE-15 -2.99231E-15 2.99738E+C4 1.49256F-01 1.4725EF-C1 65 -2.EFC67E-15 -2.99231E-15 2.99738E+C4 1.49256F-01 1.40256F-01 1.00722E+C0 66 -2.0527E+C5 -1.93731E-15 2.97736E+C4 3.5926F+C1 5.26865F-01 67 -2.24275E+15 -1.93771E+15 2.97751EF+C4 8.39566E+00 9.51845F+C1 68 -2.44275E+15 -1.93771E+15 2.97751EF+C4 8.39566E+00 9.51845F+C1 69 -2.4271E1F-15 -2.97751EF+C4 8.39566E+00 8.6857F+C1 70 -2.271E1F-15 -2.97951E+15 2.97751EF+C4 3.35826E+01 2.67057E+C1 71 -2.274791E+15 -3.97493E+15 2.99221E+C4 3.35826E+01 2.01845F+C1 72 -2.121E+15 -2.9921E+C4 3.35826E+01 2.01845F+C1 2.99221E+C4 3.35826E+01 2.01845F+C1 73 -4.101751-5 -2.9921E+C4 3.35826E+01 2.01845F+C1 2.9921E+C4 3.35826E+01 2.01846F+C1 <t< td=""><td>62 -1.774ECE-15</td><td>-2.26638E-15</td><td>2.97251E+C4</td><td>1.34331F+00</td><td>1.06417F+CC</td></t<>	62 -1.774ECE-15	-2.26638E-15	2.97251E+C4	1.34331F+00	1.06417F+CC
0.7 -2.03742-12. -2.07421E-12. 2.077358E+CL 1.27358E+CL 0.6 -2.0174E-12. -2.2871E-15. 2.07358E+CL 1.497357-01 1.0772E+CO 0.6 -2.01255E-15. -1.03731E-15. 2.074358E+CL 3.35826F+CL 5.57826F+CL 0.6 -2.5472E+15. -1.03731E+15. 2.077358E+CL 3.35826F+CL 5.57826F+CL 0.67 -2.5452E+15. -1.0371E+15. 2.07755EF4CA 3.378160E+00. 6.88857F+CL 0.67 -2.247427E+15. -1.04741E+15. 2.077010E+00. 4.07252E+00. 6.07225E+CL 70 -2.2211EE+15. -2.09022E+15. 2.09022E+00. 1.33311+00. 7.20557E+CL 71 -2.24701E+15. -3.22324E+15. 2.09022E+00. 1.462356E+01. 2.0119E+CL 72 -2.3105E+15. -2.0922E+15. 2.09022E+00. 1.442556E+01. 2.0119E+CL 73 -4.01756+15. -2.0922E+15. 2.09022E+00. 1.442556E+01. 2.0119E+CL 74 -3.024CEE+15. -2.09122E+00. 4.049256E+01. 2.01684E+CL 1.44256E+CL 76 -3.3114AE+15. -2.0319E+15. 2.09032E+00. <td></td> <td>-3.498020-15</td> <td>2.99048E+C4</td> <td>3.35426F-01</td> <td>3.68620E-01</td>		-3.498020-15	2.99048E+C4	3.35426F-01	3.68620E-01
66 -7.700150E-15 -1.03731E-15 -2.071315E-16 -1.03731E-15 -2.071315E-16 -1.03731E-15 -2.07131E-10 -1.03731E-15 -2.07131E-10 -1.03731E-15 -2.07131E-15 -2.07121E-15 -2.079101E-10 -2.079101E-10 -2.099221E-11 -2.099221	07 -2.03774E-13. 65 -2.F7CP7F-15	-2.287418-15	2.973586+ 64	1.492545-01	1.007225+00
$\begin{array}{cccccccccccccccccccccccccccccccccccc$	66 -2.70£55E-15	-1.93731E-15	2.97435E+04	3.358265+01	5.52869E-01
68 -2.491221E-15 -1.9147UE-15 2.977C5E+C4 3.31402e00 8.8857E-C1 70 -2.251E1F-15 -7.9990E+C4 3.297910E+C4 3.3931E0E00 7.20592E+C1 70 -2.221E1F-15 -7.9990E+C4 1.3331E0E00 7.20592E+C1 71 -2.24591E+15 -7.9902E+C4 1.34331E+C0 7.20597E+C1 72 -2.21C3E-15 -3.27932E+C4 1.49256E-01 2.6179E+C1 72 -2.31C3E-15 -2.92424E+C4 1.49256E-01 1.46199E+C1 74 -3.8246E+15 -2.9922E+C4 1.49256E+01 2.61648E+C1 74 -3.8246E+15 -2.9927E+C6 1.49256E+01 2.61648E+C1 75 -3.8256E+15 -2.9927E+C4 8.39566E+00 2.33031E+C1 76 -3.31147E+15 -2.03912E+15 2.9932E+04 3.73160E+00 2.43C32E+01 76 -3.31167E+15 -2.9932E+04 3.73160E+00 2.43C32E+01 2.2432E+01 78 -2.4523E+15 -2.99356E+04 3.3532E+00 2.43225E+01 2.24325E+01 76 -3.3239724E+15 2.99356E+04 1.492356E+01 3.24545E+02 2.2	67 -2.546251-15	-1.837616-15	2.97541E+04	8.39566E+00	9.51845E-C1
0.7 -2.021/81-15 -2.03706C-12 2.0771000000 8.007020000 8.007020000 70 -2.021/81-15 -3.04246(-15) 2.09130000 1.3453114:00 7.20557E-C1 71 -2.221/81-15 -3.04246(-15) 2.092216+00 1.3453114:00 7.20557E-C1 72 -2.210246-15 -3.042246(-15) 2.092216+00 1.40256E-01 2.40184E-01 73 -4.001251-15 -2.092216+00 1.40256+01 2.40184E-01 2.01184E-01 74 -3.022460-15 -2.092216+00 1.335860E-01 2.40184E-01 2.01080E-01 76 -3.02146E-15 -2.09325E-15 2.09326E-04 3.35866E-00 2.73021E-01 76 -3.5146E-15 -2.09356E-15 2.09356E-04 3.35866E-00 2.13021E-01 76 -2.5146E-15 -2.09356E-04 3.35866E-00 2.13021E-01 77 -2.0523E-15 -2.09356E-04 3.35826E-01 2.3265E-01 78 -2.0523E-15 -2.094626E-04 3.35826E-01 2.34605E-02 80 -2.040135E-15 -2.094626E-04 1.49256E-01 4.0561E-02 81 -2.02025E-15<	68 -2-434298-15	-1,91478E-15	2,917656+64	3. 73150E+00	8,88657E-()
71 -2,24601E-15 -3,27953E-15 2,09221E+26 3,55226E-01 3,62134E-01 72 -2,31024E-15 -3,24244E-15 2,09622E+06 1,49256E-01 2,61314E-01 73 -4,10125E-15 -2,48104E-15 2,09622E+06 1,49256E-01 2,01644E-01 74 -3,62246E-15 -2,0927E+06 1,49256E-01 2,01644E-01 74 -3,62246E-15 -2,07128E-04 3,33626E+01 2,01644E-01 75 -3,5154E-15 -2,0927E+06 4,393626E+01 2,79821E-01 76 -3,3114E+0 -2,07325E-15 2,09326E+04 3,33626E+00 2,33025E-01 76 -3,3117E+15 -2,073325E-15 2,09326E+04 2,008922600 2,43025E-01 77 -3,137E+15 -3,2307E+15 2,09356E+04 3,3331E+00 2,232655E-01 76 -2,260735E-15 -3,23097E+15 2,094626+04 3,3331E+00 2,243625E+01 78 -2,265723E+15 -2,847653E+15 2,094626+04 1,49256E+01 1,22452E+01 80 -2,240272E+15 -3,23977E+15 2,094626+04 1,49256E+01 1,221466+01 81	70 -2.221685-15	-2.34244E-15	2.981396+04	1.343311+60	7.20557F=C1
72 -2.31C34E-15 -3.24284E-15 2.99422E+04 1.49256E-01 2.46184E-01 73 -4.01256-15 -2.9912E+15 2.9927E+04 1.49256E-01 2.41684E-01 74 -3.0240E+15 -2.95120E+15 2.9927E+04 3.35226+01 2.91684E-01 75 -3.0240E+15 -2.03912E+15 2.9927E+04 3.35226+01 2.91684E-01 76 -3.3114AE+15 -2.03925E+15 2.99326E+04 3.73140E+00 2.43205E+01 76 -3.3114AE+15 -2.773325E+15 2.99336E+04 3.73140E+00 2.43205E+01 78 -2.455723E+15 -2.99356E+04 3.3931E+00 2.43205E+01 3.24305E+01 78 -2.455723E+15 -2.893276E+15 2.99356E+04 1.34331E+00 2.324955E+01 80 -2.400135E+15 -3.89276E+15 2.99462E+04 1.49250E+01 4.40250E+01 81 -2.05723E+15 -2.2935276E+15 2.99462E+04 1.49250E+01 1.22156E+02 82 -2.40135E+15 -2.99462E+04 1.49250E+01 1.22156E+01 1.22156E+01 84 -2.243252E+01 -2.99526E+15 2.99462E+04 3	71 -2.24591E-15	-3.279538-15	2.992216+C4	3.35826E-01	2.C1718E-C1
r3	72 -2.310368-15	-3.24284E-15	2.996228+04	1-49256E-01	1.46319E-C1
75 -5.25100 2.251100 1.252100 1.252100 1.252100 1.252100 1.252100 1.252100 1.252100 1.252100 1.252100 1.252100 1.252100 1.252100 1.252100 1.252100 1.252100 1.252100 1.252100 1.2521000 1.252100 1.252100 1.252100 1.252100 1.252100 1.252100 1.252100 1.252100 1.252100 1.252100 1.252100 1.252100 1.252100 1.252100 1.252100 1.252100 1.2521000 1.2521000 1.2521000 1.2521000 1.2521000 1.2521000 1.2521000 1.2521000 1.2521000 1.2521000 1.2521000 1.2521000 1.2521000 1.2521000 1.2521000 1.2521000 1.2521000 1.22110000 1.2521000 1.22110000 1.2521000 1.221100000 1.2211000000 1.22110000000 1.221100000000 1.221100000000000 1.221100000000000000 1.2211000000000000000000 1.2211000000000000000000000000000000000	76 -4.101756-15	-2.57124E-15	2.99278F+04	1.44/206E-01	2.81684E-C1
76 -2.03256-15 2.093216-04 3.731607-00 2.635026-01 77 -3.11307-15 -2.073326-15 2.09356F-01 2.09492000 2.635026-01 78 -2.057236-15 -2.073326-15 2.09356F-01 2.326956-01 2.326956-01 78 -2.057236-15 -2.0945076-04 3.393266-01 2.326956-01 2.326956-01 79 -2.060736-15 -3.299276E-15 2.0995076-04 3.393266-01 2.326956-01 80 -2.060736-15 -3.99276E-15 2.0997066 04 1.492505-01 4.005061E-02 81 -2.050736-15 -3.99276E-15 2.0997066 04 1.492506-01 1.231966-01 82 -2.040736E-15 -2.094642E+04 3.393264-01 1.2231966-01 1.2231966-01 84 -2.247953E-15 -2.995046E-15 2.994642E+04 3.731406*00 1.46252E-01 84 -2.247953E-15 -3.19462E+06 3.731406*00 1.46252E+01 1.223192E+01 84 -2.547264-15 -3.1997106+05 2.0997106+06 3.731406*00 1.4626346E+01	75 -3+55568E-15	-2.63919E-15	2.992946+04	8.39566E+00	2.73303E-C1
77 -2.113(27E-15 -2.77332E-15 2.99356E604 2.09822E000 2.49226E-C1 78 -2.65223E-15 -2.83441E-15 2.99359E604 -3.3332465E-01 -2.32455E-C1 76 -2.662C37E-15 -3.23597E-15 2.99359E604 -3.33326E01 1.25457E-C1 80 -2.60215E-15 -3.59276E-15 2.99770E604 1.49352EC01 4.0951E-02 81 -2.05762E-15 -2.29555E-15 2.99864E604 1.49256E-C1 1.23198E-C1 82 -2.243251-15 -2.49342E-15 2.99864E6404 3.33526400 1.223198E-C1 83 -2.243251-5 -2.49342E-15 2.99864E6404 3.33526400 1.223198E-C1 84 -2.43753E-15 -3.0332E-15 2.99864E640 3.33526400 1.22312E-C1 84 -2.434753E-15 -3.043972E400 3.33526400 1.22312E-C1 84 -2.547646-15 2.99910E400 3.33326400 1.22312E-C1 84 -2.54729E-15 -3.10351E-15 2.99710E400 1.34331E400 1.46284E-C1 84 -2.54729E-15	76 -3.31144E-15	-2.70325E-15	2.99321E+04	3.73140E+00	2.630636-01
rp 2.82525-15 -2.483441E-15 2.498378E10 3.3824E-01 2.32845E-C1 80 -2.460735E-15 -3.89276E-15 2.998706E0 1.49236E-01 2.54C7E-C1 80 -2.460735E-15 -3.89276E-15 2.998706E0 1.49236E-01 2.54C7E-C1 81 -2.05025E-15 -2.99862E0 1.49236E-01 1.2196E-C1 82 -2.24385E-15 -2.49840E-15 2.99864E0 3.38262001 1.22196E-C1 83 -2.28495E-15 -2.99864E0 3.38262001 1.22012E-C1 3.89262E-01 84 -2.243753E-15 -3.10312E-15 2.999016E00 3.731400000 1.4625EE-C1 84 -2.54279E-15 -3.1032E-15 2.99920E00 1.2331E-C0 3.8922E-01 84 -2.54279E-15 -3.1032E-15 2.99920E00 1.123316E-01 3.4852E-01 84 -2.54279E-15 -3.1032E-05 2.99920E00 1.23316E-01 3.6882E-01 84 -2.54279E-15 -3.49920E-15 2.99920E-01 1.23331E-01 1.64834E-01 84 -2.54	77	-2.77332E-15	2.99356E+04	2.09892E+00	2.492056-01
80 -2.60135E-15 -1.52274E-15 2.69776E-06 1.49235E-01 1.40235E-01 81 -2.055262E-15 -2.24955E-15 2.99842E-04 1.49235E-01 1.2019E-01 82 -2.24952E-15 -2.299842E-04 1.49235E-01 1.22198E-01 83 -2.299846F-15 -2.99846F-06 3.39566F00 1.22012E-01 84 -2.249753E-15 -2.99501E-05 2.99960FE-06 3.78140E+00 1.4825E-01 84 -2.547453E-15 -3.18551E-15 2.999710FE-06 3.07140E+00 1.4825E-01 84 -2.54229E-15 -3.1852E-15 2.999710FE-06 1.23192E-01 -2.04845E-01 84 -2.54229E-15 -3.499710FE-05 2.99970FE-00 1.23192E-01 -0.4683EE-01 84 -2.54529E-15 -3.99710FE-05 2.99970FE-00 1.23192E-01 -0.4683EE-01 84 -2.54529E-15 -3.99700FE-05 2.99700FE-04 3.3973EE-001 1.64838E-01 84 -2.54529E-015 -3.99807E+04 3.3973EE-010 1.64838E-01 -0.46845E-01	78 -2.557238-15	-2.834+10-15	2. 393592+C4 2. 99650F+04	1.34331E+00 3.35826E=01	2.324558-01
R1 -2.05C62E-15 -2.23955E-15 2.99682E+04 1.49256E-C1 1.23196E-C1 R2 -2.26262E-15 -2.47405E-15 2.99682E+04 3.352626+01 1.221245E-C1 B3 -2.28449E-15 -2.93571E-15 2.99682E+C4 6.39566E+00 1.20212E-C1 B4 -2.47453E-15 -3.10342E+15 2.99685E+C4 6.39566E+00 1.20212E-C1 B4 -2.2547C64-15 -3.10342E+15 2.99607E+004 3.37140E+00 1.4865E+CC1 B4 -2.55279E-15 -3.10352E-15 2.997264E+04 3.3331E+00 1.46634E+C1 B4 -2.556279E-15 -3.229453E-15 2.997264E+04 3.35331E+00 1.46634E+C1 B4 -2.546249E-15 -3.229453E-15 2.997264E+04 3.35331E+00 1.46634E+C1 B4 -2.546249E+15 -3.46551E-15 2.997264E+04 3.35331E+00 1.46634E+C1	80 -2.60775E-15	-3. 59276E-15	2.99770E+ C4	1.49256E-01	4.905618-02
#2 -2.26426512-13 -2.26426481E-13 2.2994645E+04 3.358262+01 1.22452E-01 #3 -2.2643645E-15 -2.93571E-15 2.994645E+04 3.358262+00 1.2012E-01 #4 -2.264753E-15 -3.10342E-15 2.994645E+04 3.73140E+00 1.46454E+02 #5 -2.254704E+15 -3.10352E+01 2.499404E+04 3.73140E+00 1.46454E+02 #6 -2.55279E+15 -3.12954E+15 2.99720E4+04 1.33531E+00 1.604934E+01 #6 -2.55279E+15 -3.49591E+15 2.99720E4+04 3.3532E+01 1.644934E+01 #7 -2.46426E+015 -3.49950E+05 2.99720E+04 3.3532E+01 1.644934E+01	812.05C62E-15	-2.23955E-15	2.99662E+04	1.49256E-CL	1-23196E-C1
Bit -2:47535-15 -3:103621-15 2:996986:06 3:731406:000 1:20312-01 B5 -2:547045-15 -3:103511-15 2:997266:06 3:731406:000 1:123316-01 B6 -2:547045-15 -3:045511-15 2:997266:06 1:333316:00 1:026326-01 B6 -2:562395-15 -3:269438-15 2:997266:04 3:35826-01 1:0648356-01 B7 -2:466666-15 -3:465516-15 2:99726640 3:35826-01 7:4648376-73	82 -2,243030-15 83	-2+8/888E-13 -2-94571F-15	2.994841+04 7.99485F+04	3+358265+01 8-395665+00	1.77452E-C1
85 -2.54(C4E-15 -3.18551E-15 2.99710E+C4 2.09892E+00 1.12331E-C1 86 -2.56239E-15 -3.22943E-15 2.99724E+C4 1.33331E+C0 1.42833EE-C1 87 -2.4454Ee-15 2.99807E+O4 3.3532E+C1 2.44435E-C1	14 -2.4753E-15	-3.103428-15	2.996988+04	3.73140F+00	1.148545+61
84 -2.56219E-15 -3.22943E-15 2.99724E+04 1.34331E+00 1.66434E-CL 87 -2.448E6E-15 -3.46551E-15 2.99807E+04 3.35826E-01 7.48487E-F7	85 -2.54CC4E-15	-3.18551E-15	2.99710E+C4	2.09892E+00	1.1233/6-01
#/ -2.448CC0E-13 ~3.490331C+13 2.47780/12+09 3.35826E-0[7.48485F-85	86 -2.56239E-15	-3.22943E-15	2.997246+04	1.34331E+00	1.060308-01
88 _3.39265515 -1.957485-15 2.998685476 1.492545-01 * ANARAS-A3	88 -2.982681-15	-3.957485-15	2.9780/2409 2.998685+26	1.49254E-01	7.98482E-C2

STRESSES AND FLORS AT TEME

LTERATEON NUMBER 25 FERTUREATION NUMBER 25

55.555

LIERATECN NUM	3EA _ 7	5 <u>FERI</u>	JREATEON N	UMBER 2	·					
ELEMENT ELLA	5167	\$101	SLORZ	STOPAN	SEGNEN	ANGLE	FLWR	F1.57	F1 5 8 8 8	ASGLE
TE IDINE SIGN	5165	NDISP	TOLSP	NSILF	TSTIF	STRNGTH	#1CT+	FRFLC	PE	
JT 1 -2.COE+04	0.	0.	0.	1.00E+08	1. COE+08	1.156+04	3. 28E-C4	6.42F-05	1.106+01	
JT 2 -2. COE+04	0.	0.	٥.	1.005+08	1.00E+08	1.15E+04	3.24E-C4	4.7EE-C5	7.466+00	
JT 32.COE+04	0.	0.	0.	1.0CE+08	1. COE+CA	1.15F+04	3.28E-04	3.276-05	5.556+00	
JT 4 -2.COE+04	C.	0.	0.	1.002+08	1.COE+08	1.15E+04	3.78E-C4	2.44E-C	4.718+00	
17 5 -2.COF+04	0.	0.	0.	1.006+08	1.00000	1.150+04	3.202-04	2 365-77	4 515-15	
JT 6 -2.00E+04	<u>.</u>	0.	0.	7.502+11	7.505+11	1.155+04	3.285-04	1.556-21	1.276-14	
JI 7 -7.002+04	-6 205404	-1 795-09	-3 675-05	-5-005+04	~5. COE+04	1.00F+07	-4-505-06	-1-085-05	-5.265-66	5.226+01
9 -5. (00+04	-5-002+04	-1-20L-00	8-95F-1C	~5-D0E+04	~5.00E+04	E-54E+01	-4-6CE-CE	- ?. 745-CE	-4.24E-C6	4.23E+01
10 -5.000+04	-5.CCE+04	-5.756-09	-6.36E-10	-5.COE+04	~5. COE+04	1.075+02	-3.43E-CE	-2.90E-Ce	-1.15E-Ce	4.26E+01
11 -5.00E+04	-5.00E+04	-1.00E-08	3.33E-09	-5.00E+04	~5.COE+04	5.55E+01	-2.54E-C#	-2.196-C6	-2.41E-C6	4.266+01
12 -5. COE+04	-5.CCE+04	-3.818-09	-7.17E-09	-5.00E+04	~5.COE+04	-3.77E+01	-1.85E-C¢	-7-41E-Ce	-2.17E-Ce	4. 88 E+01
13 -5.COE+0+	-5.COE+C4	3.376-09	6.68E-10	-5.002+04	~5. COE+04	E-27E+01	-2-46E-06	-1.001-06	-2-04E-C2	3.268+01
14 -5.CCE+04	-5.COE+04	2.19E-09	-3.43E-09	-5.00E+04	~5.COE+04	-1.1/6+01	-2.100-04	-1 046-06	-1./02-02	4.41E+01
<u>15 -5.COE+U4</u>	-5.CCE+04	-1.2/6-68	-2.921-09	-5+00004	~5.00F+04	1.005+02		-1.016-04	-4 366-64	5. 216+CZ
17 -6 005404	-5 COEAGA	-3.900-09	-1.055-10	-5.005+04	-5.005+04	1-005+02	-3.386-06	-2-915-06	-3-146-66	4.296+01
18 -5-006404	+*-CCE+C4	-9-66E-09	2.755-09	-5.00F+04	~5. CCF+04	5-21E+01	-2.57F-C6	-2.231-0e	-1.+1E-CE	4.30E+G1
19 -5.006+04	-5-COE+C4	-3-92E-09	-7.44E-05	-5.00E+04	~5. CCE+04	-1.93E+01	-1.898-CC	-2.40E-06	-2.168-06	4.45E+01
20 -5.COE+04	-5.CDE+04	3.11E-09	4.99E-10	-5.00L+04	~5. COE+04	8.4ZE +01	-2.42E-C6	-1.00E-CE	-3.016-06	3.276+01
21 -5.006+04	-5.CDE+04	2.33E-09	-3.30E-09	-5.00E+04	~5. COE+04	-1.21f+01	-2.22E-07	1.885-07	-3.36E-CB	4-262+01
22 -5. CCE+04	-5.00E+04	-1.19F-08	-5.80E-09	-5.00F+04	~5.COE+04	1.00€+02	-5.03E-C¢	-S.90E-CE	-1.24E-(6	5.45E+01
23 -5.000+04	-5.CCE+04	-6.2CE-09	-2.88E-1C	-5.CCE+04	~5.COE+04	1.000+02	-4.43E-C0	-4-201-02	-4.221-60	4-426+01
24 -5.000+04	-5.001+04	-6.191-09	2.08E-10	~5.002+04	-5.005.04	4 235401	-3.502-00	-7 306-04	-3-120-10	4.330401
25 -5.00000	-5.005+04	-3.945-09	-1 746-00	-5.000+04	~5. (05+04	-4.20E+01	-1.936-04	-2-355-06	+2.195-CA	4. #GE+CL
27 - 5.002+04	-5-005+04	2.86F-09	2.175-10	-5.00E+04	~5.00E+04	E.76E+01	-2.37E-Ce	-9-94E-07	-1.568-66	3.296+01
28 -5.COE+04	-5. CE+04	2.376-09	-3.10E-05	~ 5. COE + 04	-5. CCE+04	-1.25E+01	-2.39E-CT	1.746-07	-6.511-08	4.05E+01
29 -5.COE+04	-5.CCE+04	-1.03F-08	-5.25E-09	-5,00E+04	~5.COE+04	1.00E+02	-3.60E-0 <i>€</i>	-E.77E-CE	-1.276-C6	5.73E+01
30 -5.COE+04	-5.COE+04	-6.518-09	-1.996-09	-5.00E+04	~5.00E+04	1.00E+02	-4-05E-05	-4+53F-CE	-4.75E-CE	4.676.01
31 -5.00E+04	-5.0CE+04	-6.21E-09	5.36E-10	-5. COE+04	-5. COE+04	8.52E+01	-3.136-06	-3-008-06	-3.746-04	4-44E+01
32 -5.CCE+04	-5.00E+04	-7.198-09	2.54E-10	-5.00E+04	~5.00E+04	6.81E+00	-2.4/E-06	-2.39E-0E	-2.4 36-10	4.452+01
33 -5.0004	-5.005.004	-3.76-69	- 8.042-04	-5,102+04	-5. COEADA	1.000.002	-2.011-06	-C.A1F-00	-1.466-06	3.355+01
35 -5- 00000	-5-002+04	2.23(+09	-2.655-09	-5.COE+04	-5.006+04	-1.31E+01	-2.74F-C7	1.4CE-07	-1.745-67	3-56E+C1
36 -5. COE+04	-5.CCE+04	-7.081-09	-5-14E-09	-5.00E+04	-5. COE+04	-3.92E+01	-1.84E-06	-6.835-06	-5.78F-CE	6.26E+C1
37 -5. CCE+04	-5.COE+04	-6.35E-39	-2.87E-39	-5.00E+04	~5.00E+04	1.00€ +02	-2.97E-06	-4-6?E-06	-3.4 (8-6	5.138+01
38 -5.COE+04	-5.CCE+04	-5.738-09	-8.05E-1C	- 5. CCE+64	~5+COE+04	1.00f+02	-2.68E-CC	-3.158-66	-2.948-06	4.73E+C1
<u>39 -5+00E+04</u>	-5.COF+04	-5.39F-09	-2.62E-01	-5.00F+04	-5.COE+04	-2.910+01	-2.285-CE	-2-501-06	-2.4CE-C6	4.64E+01
40 -5.00000	-5.000.004	-3.04E-09	-B.06E-09	-5.00E+04	-5.002+04	1.000 +02	-2.075-01	-2+271-60	-2.101-LC	4.08C+UL
41 -7.(((+04	-5.001+04	1.696-09	-1.986-09	-5,0000404	-5.005+04	-1.41F+01	-1.306-01	6.84F-CF	-2.416-67	2.455+01
43 -5- COF+04	-5-000+04	-4- BCE-09	1.39F-10	-5-CCE+04	~5.COE+04	1.636+00	-6.39E-C1	-4.37E-C6	-1.85F-C6	6.91E+C1
44 -5. COE+04	-5.00E+04	-4-62E-09	-2.44E-03	-5.00F+04	-5.COE+04	- 2.91E+01	-1.51E-Ce	-3.75E-CE	-3.11E-C6	5.76E+01
45 -5. COE+04	-5.CCE+04	-4.0AE-09	-3.86F-09	-5.00E+04	~5.COE+04	- ?.50E+01	-1.75F-CE	-3.CCE-06	-2.148-06	5.26E+C1
46 -5. COE+04	-5.00E+C4	-3.200-09	-5.85E-09	-5.00E+04	~5. COE+04	-3.73E+01	-1.728-06	-2-428-06	-5-136-59	4.99E+01
47 -5.CCF+04	-5-002+04	-1.856-09	-7.406-09	-5.00E+04	~5. COE+04	1.000 + 02	-1.68E-CE	-7.016-06	-1.888-06	4.76E+01
48 -5.CUE+U4	-5-162+64	7.421-10	- 4. COE-04	-5.005+04	~5.00E+04	1.000002	-1.400-00	-5.786-08	-1.211-66	3-000-001
50 -5 CCE+04	-5-00000404	-2 326-00	-7. BUE-10	-5.00E+04	-5.005+04	-2.15[+01	-1.91F-C1	-7-126-06	-2.445-66	7.496+01
51 -5.005+04	-5.COE+C4	-2.00E-09	-4.47E-CS	-5.COE+04	-5.COE+04	-2.55E+01	-5.558-07	-7-481-CE	-2.13E-Ce	6.475+01
52 -5.00E+04	-5.00E+04	-1.80E-09	-6.00E-09	-5,00E+04	-5.00E+04	-7.0#+01	-8.31E-CT	-2.226-06	-1.848-08	5.85E+01
53 -5.COE+04	-5.CCE+04	-1.358-05	-7.02E-39	-5.00E+04	-5,00(+04	-3.50E+01	-9.86E-C1	-l.s1E-Ce	-1.55E-Ce	5.436+01
54 -5.COE+04	-5.CGF1C4	-8.00E-10	-7.26E-05	-5.CCE+04	~5. COF+04	-4.04E+01	-1.05E-06	-1-596-06	-1.378-06	5.09E+01
55 -5.COE+04	-5.001+04	6.176-11	-4.73E-09	->,COE+04	->.00F+04	1.00E+02	-4.308-07	54E-C7	-e.s.E.C7	4.382+01
56 -5.03(+64	-*.(21*.4	-1.541-10	-1.011-11	-9.101404	-5.(.L.****	1.071.02	~ 3. JOL - C /	-1.005-07		1-665+01
57 -5,071404	-5.000+004	1.74-29	-1-310-04	-5.005+04	-5.00[+04	-1.46f #01	-1-975-07	-1-14F-C4	-1.0:1-04	6. 76E C1
59 -5.001+04	-5-665+64	6.2df = 10	-1-298-05	-5.0Ct+04	~5. COF+04	-1.83E+01	-3.07E-C7	-1.09E-06	-5.141-07	6.20E+01
60 -5- CCF+04	-5.COE+04	1.161-10	-3.76E-09	-5.L01+04	-5.COE+04	-7.725+01	-3.896-67	-S.85E-C7	- 6.2(6-07 -	5.79E+01
61 -5.COE+04	-5.CCE+04	-1.48[-11	-3.856-09	-5. COF+04	~5.COF+94	-7.59F+01	-4.39F-C7	-8-746-07	-1,248-07	5.47E+D1
62 -5.COE+04	-5.COE+04	-1.821-10	-3.06E-09	-5.COL+04	~5.COE+04	- ?• 55F + 01	-4.30E-C7	-5.46F-C7	-4.958-07	4.846.01
63 ~5.COE+04	-5.CCE+04	-4.438-10	-1.4E-09	-5.00E+04	-5_COE+04	-1.71E+01	-1.685-07	-1-876-07	-1.786-67	**C5E*U1
64 -5.COE+04	-5.00F+C4	6.978-10	1.256-05	-5.002+04	~5. CUL+04	3.971+01	-1.101-08	-2.565-07	-2.778-67	*******
65 -5. CCF+04	-5_COE+04	2.948-10	L.40E-39	-5. COF+04	-5.00E+04	1.41E+01	-5.726-64	-2.501-07	-1.146-07-	6.44E+01
A7 -5.005+04	~5.00E+04	-1.546-10	8-07F-10	-5.002+04	-5. COE+04	1.176+01	-T.66E-CF	-2.366-07	-1.976-07	6.03E+01
68 ~5, COF+04	-5.COE+C4	-1.446-10	5.49E-10	-5.001+04	-5. COE+04	7.75++00	-9.268-08	-2.15E-C7	-1.818-07	5.70E+01
69 -5.00E+04	-5.006+04	-2.508-10	-1.20E-10	-5.CCf+04	-5. COE+04	-5.50£+00	-1.08E-07	-1.556-07	-1.368-07	>-02E+01
70 -5.000+04	-5.COE+04	-6.33(-10	-6.03E-10	-5.006+04	-5.COE+04	-2.30E+01	-5.20E-0F	-7.576-CE	-6.606-08	5.04E+01
DISPL.AND PRESS.AT	THE END OF	TIME STEP	NU. 26				-			

APPENDIX II

LISTING OF FORTRAN IV SOUPCE PROGRAM

	PROGRAM ROCHAS(INFUT=201,OUTPUT,PUNCH=201,PLOT,TAPEB,TAPE9.	STRFLC
	1 TAPE992PLCT.TAPE98.TAPE1)	STRELC
с		STRFLC
C++++	***************************************	STRFLC
c	PROGRAM ROCHAS	STRFLC
C****	* * * * * * * * * * * * * * * * * * *	STRFLC
С	PLANE-STRAIN AND AXISYMMETRIC QUASI-STATIC STRESS-FLUID FLOK	STRFLC
С	ANALYSIS OF FRACTURED ROCK MASS. A DIRECT EQUATION SOLVER IS USED	STRFLC
C	TO SOLVE THE COUFLED EQUATIONS.A STIFFNESS PERTUREATION SCHEME	STRFLC
С	FORCES STRESSES AND DEFORPATIONS TO FOLLOW THE PROPER NON-LINEAR	STRFLC
С	CONSTITUTIVE LAW OF THE FRACTURE MATERIALS.	STRFLC
C	THIS CODE WAS BASICALLY DEVELOPED BY N.S. AVATOLLAHI IN 1978.	STRFLC
C	LATER, IN 1979, IT WAS CORRECTED, REVISED AND EXTENDED, FOR GENERAL	STRFLC
C.	APPLICATION, BY J.NOORISHAD.	STRFLC
C++++		STRFLC
5	IN SPITE OF THE FOUNDING INTERVED FOUND SECOND HEALINGS, ANT CONSISTENT	STRFLL
L C	94899999999999999999999999999999999999	DIRTOCIC
0	CONSISTER STRUCTURAL NODAL BOTHE CODE THAT THOTOATES HEAT BOUNDARY	CTRELC
č	CONCEPTION FOR THE THE FORTH STATE FOR A PRIME TO THE AND THE AND THE AND THE ADDRESS AND THE	STRFIC
ř	FL. HTYPEI- MATERIAL HODILT (ROCK OR LOTNI)	STREIC
č	FPSK - AVERAGE DEFORMATION OF A JOINT	STRELC
č	TBIN - FLOW MESH NODAL POINT CODE, IF #8 ASSIGNED VALUE OF HEAD	STRELC
č	OR PRESSURE REMAINS CONSTANT AT POINT N	STRFLC
ċ	INDEX- PRINT PLCT CODE	STRFLC
С	IPAT- PRINT AND PLOT CODE-NO PRINT, NOPLOT IF 0, PRINT IF 1, PRINT.	STRFLC
С	PLOT IF 2	STRFLC
С	IPER- TOTAL PERTURBATION INDEX	STRFLC
ç	IX(H.I). I=1, 5- THE FIRST FOUR REPRESENT NODAL POINTS AROUND ELEME	STRFLC
C	N IN STRUCTURAL NESH AND THE LAST INDICATES HTYPE	STRFLC
Ç	KN(I)- NOFHAL STIFFRESS OF JOINT I CALCULATED INITIALLY FROM E(1,2	STRELC
ç	KS(I)- TANGENTIAL STIFFNESS OF JOINT I CALCULATED FROM E (1.3)	STRFLC
C .	NY TIRE STEP INCEX	STRFLC
5	HITLE MUTDER ASSIGNED IN ENDA ANIEKIAT (SINKIING MIN I)	STRFLU
č	NAL-WUNDER UT LINE SIEFS	STRELL
č		STREIC
č	HPP(J)- NUMMER OF PERTREATIONS IN TIME STEP NUMBER J	STRFLC
č	G(N) - FLOH RATE AT FLOH NODAL POINT N	STRFLL.
č	PHID (N) -PRESCRIBEC HEAD OF PRESSURE AT FLOH POINT N WHERE IS (N) =0	STRFLC
C	R (I) - X COORDINATE OF STRUCTURAL NODAL POINT 2	STRFLC
C	RESID(N.I), I=1.4 X. Y. Z. AND XY COMPONENTS OF FESIDUAL STRESS	STRFLC.
C	RO(HTYPE) - SPECIFIC MASS OF ROCK MATERIAL	STRFLC.
0	XLNGTH - X LENGTH OF NESH PLOT	STRFLC
C	TLNGTH - T LENGTH OF MESH PLOT	STRFLC
C	UISPL - SCALE FACTOR FOR DISPLACEMENT PLOTS	STRFLC
C A	PSF - SURLE FUR SINESS FLUF	SIRFLC
C	SPHT-FLUID SPECIFIC WEIGHT	STRELL
C	TFL- TIME NEEDED FOR FLOW CALCULATION	STRFLC
č	THE TIME STERN FOR DRE FERIORDRIADR	STRELCO
č	TST- TIPE REQUIRED FOR REAC AND PRINT OF INPUT DATA	STRELC
č	URITI-UZITI-R AND Z CONPONENTS OF DISPLACEMENT OR LOAD AT POINT ?	STRFLC.
č	V- RELATIVE DISPLACEMENT OF OPPOSING NODAL POINTS IN A JOINT	STRFLC.
č	VISC-FLUID VISCOSITY	STRFLC.
с	WINS - APERTURE OF FLOW ELEMENT N CALCULATED IN EACH ITERTION	STRFLC.
C	HT(I)- INITIAL APERTURE OF JOINT I IN STRUTURAL PESH	STRFLC.
0	Z(I) - Z OR Y COORDINATE OF STRUCTURAL NODAL POINT I	STRFLC.
C		STRFLC.
C	NOTE VECTORS OISP(N.3+,286 (2N) - IMP (50, 4) , IEL (50, 2) , SIGN (50) ,	STRFLC.
5	AND SIGT(58) ARE GOT USED IN THIS VERSION .	STRFLC.
C		STRFLC.

```
LARGE A (125000) , TO (988)
                                                                              STRFLF
      LARGE IX(341,5) RESID(341,4) R(340) Z(384) WR(348) UZ(344)
                                                                              LARGE.
       -.CODE (388) .IDE ST (388) .R.KK(58) .R.KS (58) .NT(58) .IOUT(381) .Q(388) . LAPGE.
     +QP(30),W(30), VEL(50),FR(50),RE(50),QN(9001,DISPI(300,2),TEMP(380),LARGE.
     * PHIO(300 ), ID (300), IDEQ(3, 388), CODE (3, 388), IEL (58, 2), IM (58, 4)
                                                                              LARGE .
     *,TLBAD(908),SIGN(58),SIGT(58),0884688)
                                                                              STRFLP
      CONNON/OLANK/SIS, 8), PILE), RSTRS(4), VOL, RRR (5), ZZZ(5), LEAD, RADN,
                                                                              BLANK.
                          AR(4),22(4),IFAT(50),ACELX,ACELY,MRES,RO(12),
                                                                              BLANK.
            HTYPE, XI, XCE +, YCEN, XTR(18), FAC, H(6), PD(4, 12), 88(2,4),
                                                                              BLANK.
         PRS. PZS. PRT. PZT.EG
     3
                                                                              BLENK.
      COMICA/GE // NSHELL . IPUNCH, E (7, 12) . INDEX . NP. ININ, NC DRE. NUMP. ICOMPR. GEN.2
            NUMEL+ND2+HED(16)+DISPL+NJELT+IPER+NUMAT+PSF+PSFJ+XSCL+SPHT+GEN+3
     3VISC. VSCL. DSCL. FSCL. PJCL. NP (4).CONLIN. NAXI. NB. MEAND. LNGTH . NE Q. NJ MPGE N. 4
            . HOF LON, NUMMP2, NUMPNP, LK(121, NF2
                                                                              GEN.5
      COMICN/APTR/IRANG.NJUMP.AAS.AAN
                                                                              APTR.2
      CONHON/CC POOL/XMIN,XMAX, YMIN, YMAX,CCXMIN,CCXMAX,CCYMIN,CCYMAX
                                                                              CC#00L
      CONNEN/CEFACT/FACTOR
                                                                              COFACT
С
                                                                              STRFLC
      DIMENSION NOP(Se),NUF(Se)
DIMENSION IXD(4), IXP(4), LST(8)
                                                                              STRFLC
                                                                              STRFLC
      LOGICAL FLAG
                                                                              STRFLC
                                                                              STRFLC
      DATA TITLE/SHTITLE/.ZMAT/8HMATERIAL/.ZOUT/6HOUTFUT/.FLOM/4HFLON/. STRFLC
            ZNODE/SHMODES/.ELENEN/7HELEHENT/, PRESS/SHPRESSURE/.
                                                                              STRFLC
            INCOM/18HINC CHPRESS/ RESIX/8HRE SIDUAL/, RESTAR/7HRESTART/.
     2
                                                                              STRFLC
     3
            DONE/4HDONE/, BLANK/5HBLANK/,IXD/441/, END/3WEND/
                                                                              STRFLC
C
                                                                              STRFLC
      FACTOR = 100.
                                                                              STRFLC
      L840 = 8
                                                                              STRFLC.
    1 FORMAT (1H18A9/1H 8A9)
                                                                              STRFLC.
                                                                              STRFLC.
    5 READ 6, HORD
                                                                              STRFLC.
    6 FORMAT (ZALE)
                                                                              STRFLC.
      IF (WORD .EQ. TITLE)
                             60 TO 1880
                                                                             STRFLC.
      IF (NORD .EQ. ZHAT) GO TO 2000
                                                                              STRFLC.
      IF (WORD .EQ. ZOUT) GO TO 3888
                                                                             STRFLC.
      IF (WORD .EQ. ZHODE)
                             60 10 4000
                                                                              STRFLC.
      IF (NORD .EQ. ELEMEN) GO TO 5880
                                                                             STRFLC.
      IF (WORD .EQ. PRESS) GO TO 6888
                                                                             STRFLC.
      IF (WORD .EQ. FLOW) GO TO 6540
                                                                              STRFLC.
      IF (WORD .EQ. RESIX)
                             GO TO 8088
                                                                             STRFLC.
                              60 TO 9830
      IF (HORD .EQ. RESTAR)
                                                                             STRFLC.
      IF (WORD .EQ. DONE) GO TO 9999
                                                                             STRFLC.
      IF (WORD .EQ. END) 60 TO 388
                                                                             STRFLC.
                                                                              STRFLC.
      UNIDENTIFIED CARC
C
                                                                             STRFLC.
      PRENT 18. WORD
                                                                             STRFLC.
   10 FORMAT (18HBUNIDENTIFIED CARD A18/48H PROGRAM HILL SEARCH FOR NEXTSTRFLC.
     1 TITLE CARDI
                                                                             STRFLC.
                                                                             STRFLC.
      SCAN DECK FOR NEXT CASE IF ANY
С
                                                                             STRFLC.
   15 READ 6, NORD
                                                                             STRFLC.
      IF INORD .EQ. TITLE: GO TO 1889
                                                                             STRFLC.
      IF (WORD .EQ. END) GO TO 300
                                                                             STRFLC.
      GO TO 15
                                                                             STRFLC.
                                                                             STRFLC.
 1888 READ 28, HED, NUPPP, NUPEL, NUMMAT, NSHELL, NPC, NJHP, IRANG,
                                                                             STRFLC.
                NIT. IPLCT. IPUNCH. TTOTAL. CONLIN. NAXI. AAM, THETA,
                                                                             STRFLC.
     1
              AAS, ACELX, ACELY, XNHP, SPWT, VISC, IPRT, HOTN, DT, SYSDIH, TOTALC
                                                                             STRFLC.
   28 FORMAT (045/049/1015-F5-0-F10-0-15/5F10-3/2F10-3-E15-5-
                                                                             STRFLC.
                                                                             STRFLC.
     1215, E18.5)
      RENIND .
                                                                             STRFLC.
```

```
С
                                                                       STREFC
      IF (WSHELL .EQ. 0) NSHELL = 13
                                                                       STRFLC
      IF (NAXI .GT. 8) 60 TO 22
                                                                       STRFLC
      PRINT 21
                                                                       STRFLC
   21 FORMAT (49H1 PLANE STRAIN-FLOW ANALYSIS OF JOINTED STRUCTURE)
                                                                       STRFLC
      60 TO 24
                                                                       STRFLC
   22 PRINT 23
                                                                       STRFLC
   23 FORMAT (35H1 AXIS YMMETRIC STRESS-FLOW ANALYSIS)
                                                                       STRELS
   24 CONTINUE
                                                                       STRFLC
      PRINT 25. HED. NUMER, NUMEL, NUMPAT, NSHELL, NPC, NJPP, JRAND, NIT,
                                                                       STRFLE
     1
                     IPLOT.IPUNCH.TTOTAL
                                                                       STRFLC
   25 FORHAT (/849//849/
                                                                       STRFLC
    STRFLC
     2 SONE NUMEL-NUMBER OF ELENENTS------ IS /
                                                                       STRFLC
     3 SONO MUMPAT-NUMBER OF DIFFERENT MATERIALS------ IS /
4 SONO MSHELL-NUMBER OF SOLID MATERIALS------- IS /
                                                                       STRFLC
                                                                       STRELC
     STRFLC
                                                                       STRELC
                                                                       STRFLC
                                                                       STRFLC
     3 SONS IPLOT-PLOT INFORMATION REQUIRED IF 1----- IS /
                                                                       STRELC
     4 51H8 IPUACH-PUNCH IF 1 ----- It /
                                                                       STRFLC
     7 SOME TTOTAL-ESTIMATED TOTAL OF TIME (DECIMAL SECONDS)- F5.0 )
PRINT 26, AAM, AAS, ACELX, ACELY, XAMP, SPNT, NDTH, IPAT,
                                                                       STRFLC
                                                                       STRFLO
     *DT.CONLIN.NAK I. THETA . VISC. SYSDIM. TOTALO
                                                                       STRFLC
   26 FORMATL
                                                                       STRFLC
     1 SOND AAN-HEAN-APERTURE LOGNORMAL DISTRIBUTION---- 215.5 /
                                                                       STRFLC
     2 SAND AAS-STANDARD DEVIATION-LOGNORMAL DISTRIBUTION--- E15.5 /
                                                                       STRFLC
      SOND ACELX-X ACCELERATION (FEET/SECOND) ------ E15-5 /
Sond Acely-y acceleration (FEET/Second) ----- E15-5 /
     π.
                                                                       STRFLC
                                                                       STRFLC
     5 SOMS XNHF-MAXIMUM NET HEAD PRESSURE (PSF)----- E15.5 /
                                                                       STRFLC
      SOND SPHT-FLUID SPECIFIC HEIGHT----- E15.5 /
                                                                       STRFLC
     7 SOHO NOT -- VARIABLE TIME-STEP COUNTER, IF G.T. 1----- 15/
                                                                       STRFLC
     STRFLC
    STRFLC
                                                                       STRFLC
    2 58H8 MAXI-AXISTH. PRCBLEH IF= 1----- 15/
                                                                      STRFLC
    3 50H0 THE TA- TIME INTEGRATION CONSTANT------ F10.3/
4 50H0 VISC-FLUID VISCOSIT \ (PSF)------ £15.5 /
                                                                      STREFC
                                                                      STRFLC
     5 58H8 SYSOIN-SYSTEM DIMENSION REQUIRED IF PD.TD WANTED E15.5 /
                                                                      STRFLC
     6 58H8 TOTALQ-TOTAL FLOW REQUIRED IF PO.TD WANTED ---- E15.5)
                                                                      STRFLC
C
                                                                      STRFLC.
                                                                      STRFLC
     NJELT = 8
                                                                      STRFLC
     HRES = 0
                                                                      STRFLC
     NUH N P2 = NU PN P+ NU HN P
                                                                      STRFLC
     D0 29 I=1,NUMNP2
                                                                      STRFLC
  29 ID(I)=8
                                                                      STRFLC
 4.....
         INITIAL SET OF SYSTEM EQUATIONS *****
                                                                      STRFLC
С
     KEQ= 8
                                                                      STRFLC
     00 36 N=1,NUHNP
                                                                      STRFLC.
     IDEST(N)=0
                                                                      STRELC.
     TEHP (N)=0.8
                                                                      STRFLC
     DO 36 I=1.3
                                                                      STRFLC
     KODE (I+N)=0
                                                                      STRFLC.
     KEQ= KE0 +1
                                                                      STRFLC
     QN(KEQ)=#.0
                                                                      STRFLC.
  36 IDEQ (I+N) =KEQ
                                                                      STRFLC.
     00 35 N=1.NUHEL
00 35 H=1.4
                                                                      STRFLC.
                                                                      STRFLC.
   35 RESID(N.N) = 0.0
                                                                      STRFLC.
```

STRFLC

	60 10 5	STRELC
~		
č		STRFLC
	NAIERIAL FRUTERIJES	STRFLC
208		STRFLC
	READ 24 ICONFR	STRFLC
	2 FORMAT(A1F)	STRFLC
	IF(ICOMPR.EQ.INCOF) PRINT 3	STRFLC
	3 FORMAT(" FLUID IS INCCIPRESSIBLE ")	STRFLC
	DO 2835 H=1+NUMMAT	STRFLC
	READ 2010+MTTPE;RG{HTTPE};(E(J;HTYPE};J=1;7)	STRFLC
201	8 F GRHAT (15,889,4)	STRFLC
	PRINT 2015, NYYPE	STRFLC
281	5 FORMAT (/15H NATERIAL NO. =I3)	STRFLC
	IF(NTYPE.LE.NSHELL) 60 TO 2019	STRFLC
	PRINT 2830. (E (.).MTYPE).J=1.7)	STRELC
	GO TO 2835	STRELC
281	9 PRINT 2020, RD (NTYPE), (E(J.NTYPE), Ja1.5)	STRFLC
283	S CONTINUE	STRELC
282	E FANIAT (22) HARS OFNETT VARAGES (2/2) DEDIFARTI TY VARAGES	STRFLC
	ACL - 4/2TH FILTTO MONING	STREIC
	ALL LAST ELAST CONTANTIAL MAN SAL LAST BIAT CANTANTIAL	STREEC
	ATT TT	STRELC
		STRFLG
203	UT CALL IN CHARTER 23.4/184 KITCHER COMPACT 23.4/184 COMPACT 23.4/	STRFLL
	118F FRIEZS. 6/28H RAX. EL USUREELS. 4/	STRFLC.
	- 23H BIOTS CONSTANT (ALPHA) E14.4/22H BIOTS CONSTANT (H) E14.6)	STRFLC
	50 TO 5	STRFLC.
C		STRFLC.
C	INFORMATION FOR GUTPUT	STRFLC.
380	8 READ 3818+ (NPP(I)+ I=1+NIT)	STRFLC.
381	0 FORMAT (4012)	STRFLC
	ITOT # B	STRFLC
	DO 3012 I=1,NIT	STRFLC.
301	2 ITOT = ITOT + NPP(I)	STRFLC.
	READ 3015, (IPAT(J), J=1,ITOT)	STRFLC
301	S FORMAT(4012)	STRFLC.
		STRFLC.
	PRINT 1. HED	STRFLC.
	K1 = 1	STRFLC.
	DO 3825 I=1,NIT	STRFLC.
	KZ = K1 + NPP(I) - 1	STRFLC.
	PRINT 3828, HPP(T), T. (TPAT(J), Jack1-K2)	STRELC.
382	0 FORMAT (//16,* PERTURBATIONS IN TIME STEP NUMBER 413,10%, 40UTPUT	STRFLC.
	*SCHENE *2413)	STRFLC.
382	5 K1 = K2 + 1	STRFLC.
	IF(IPLOT.EQ.8) 60 TO 3835	STRFLC.
	READ 3030. XLNGTH, YLNGTH, PSCL. CONJT	STRFLC.
3.831	6 FORMAT (4F18.4)	STRELC.
3839	5 60 TO 5	STRFLC.
с		STRELC.
ř	PATTAR TSN HATAI BUTHT PROPOSE THES	STRELC.
		STREIT.
		STRELC.
4671		STREFT
		STRELC
		STRFLC
4412	7 N7 - N 75 IN - CC - Minupi CA TA 4875	STREFT
	27 LT 595 - NUMETI 100 10 9837	CTOFIC
	RA - RAF Aran Art. M.Ave de at an ant di du	CTRELS
	REAL THE TREATER AND A LUSCUSSION OF	STRELA
4821	F F RMAILEI 31 WELL 63/	SIRTLL:
	17 LM 0FE 40 000 00 01 0 MUNARY 64 10 4833	SIRFLU:
	CODE INJ = CU	SIRFLUS
	R(N) = UR	STRFLC.

Z(N) = DZ STRFLC URINI = OU STRFLC UZ(N) = DV STRFLC IF (NX.EQ. 8) 50 TO 4015 STRFLC IF ((N-NPI+NX. GE. #1 GO TO 4825 STRFLC NX = - NX STRFLC PRINT 4821, NP,N STRFLC 4821 FORMAT (* INCREMENT FOR GENERATION BETWEEN NODES* 15* AND+15+ IS OSTRFLC 1F INCORRECT SIGN ** SIGN CHANGED*1 STRFLC STRFLC 4825 LX = (IABS(N-NP) + IABS(NX) - 11/IABS(NX) STRFLC DR = (R(N)-R(NP))/LX STRFLC STRFLC DZ = (Z(N)-Z(NP))/LX 4830 NP = NP + NX STRFLC IF (NX.GT.B.AND.NP.GE.N) GO TO 4815 STRFLC IF(NX.LT.S.ANO.NP.LE.N) GO TO 4015 STRFLC RENP) = RENP-NK) + DR STRFLC Z (NP) = Z (NP-NC) + 0Z STRFLC CODE (NP) = COI STRFLC UR(NP) = 8. STRFLC UZ(NP) = 0. STRFLC STRFLC GO TO 4030 STRFLC PRINT NODAL POINTS STRFLC 4835 PRINT 1. HED STRFLC. PRINT 4848 STRFLC 4840 FORMAT (118HENODAL POINT TYPE X-ORDINATE Y-ORDINATE X-LO STRFLC 14D or DISPLACEMENT Y LOAD OR DISPLACEMENT X-CODE T-CODE } STRFLC) STRFLC. STRFLC. DO 4855 N=1, NUMKP IF (R (N) .EG. BLANK) FRINT 4045 STRFLC. 4845 FCRHAT (* NO INPUT FOR THIS NODE * 1 STRFLC. IF (CODE (N).EQ.8.0) GO TO 4022 STRFLC. IF (CODE (N) .NE .3.8) GO TO 4823 STRFLC. ID(2*N)=1 STRFLC. ID(2*N-1)=1 STRFLC. GO TO 4822 STRFLC. 4023 IF (CODE (N).NE.2.8) GD TO 4024 STRFLC ID(2*N)=1 STRFLC. GO TO 4822 STRFLC. 4824 IF (CODE (N). EQ.1) ID(2*N-1)=1 STRFLC. 4822 CONTINUE STRFLC. IF (R (N) .NE. BLANK) PRINT 4858, N. CODE (N) .R (N) . Z(N) .UR (N) .UZ (N) . STRFLC ID(2*N-1), ID(2*N) STRFLC. 4058 FORMAT(112, F12, 3, 2E12, 3, 2E24, 7, 2110) IF (CODE(N) .LT. (.0) CODE(N) = CODE(N) / 57, 25577951 STRFLC, STRFLC. 4855 CONFINUE STRFLC. STRFLC. 60 TO 5 STRFLC. NODAL POINTS, BANE WIDTH, CHECK CORE CAPACITY, JOIATS AND FLOW STRFLC. С 5488 PRINT 1. HED PRINT 5010 STRFLC. STRFLC. 5810 FORMAT (69HBELEMENT NO. MATER TAL JOSTRFLC. I J ĸ L 1INT NO WITTH) STRFLC. STRFLC. STRFLC. N = 1 HEAND = B STRFLC. STRFLC. JX = 8 5015 00 5020 I=1.4 STRFLC. SHED IXP(I) = IXD(I) STRFLC. STRFLC. $\mathbf{J}\mathbf{X} = \mathbf{J}\mathbf{X}\mathbf{D}$ STRFLC. READ 5025, M, (IX H,I), I=1,5), IXD, JXD 5025 FORMAT (1115) STRFLC.

```
IF (# - N) 5050, 5049, 5035
                                                                             STRFLC
                                                                             STRELC
 5835 IX(N.1) = IX(N-1.1) + IXP(1)
                                                                             STRFLC
      IX(N_{2}) = IX(N-1_{2}) + IXP(2)
                                                                             STRFLC
      IX(N.3) = IX(N-1.3) + IXP(3)
                                                                             STRFLC
      IX(N.6) = IX(N-1.4) + IXP(4)
                                                                             STRFLC
                                                                             STRFLC
      IX(N,5) = IX(N-1,5) + JX
      XL = XL
                                                                             STRFLC
                                                                             STRFLC
                                                                             STRFLC
 5840 K = 0
      DO 5838 I=1.3
                                                                             STRFLC
      II = I + \bar{I}
                                                                             STRFLC
      DO 5630 L=I1.4
                                                                             STRFLC
      KK=IA85(IX(N, I)-IX(N+L))+1
                                                                             STRFLC
      IF (KK .GT. K) K = KK
                                                                             STRFLC
 5830 CONTINUE
                                                                             STRFLC
                                                                             STRFLC
      IF (K .GT. MBAND) MBAND = K
                                                                             STRFLC
£
C.... LOOK FOR A JOINT ELEMENT
                                                                             STRFLC
      IF (IX(N.5) .GT. NSHELL) GO TO 5041
                                                                             STRFLC
      PRINT 5842, N.(IX (N.I). I=1.5), K
                                                                             STRFLC
                                                                             STRFLC
 5042 FORMAT (113.416.19.12%,19)
                                                                             STRFLC
      GO TO 5843
 5841 NJELT = NJELT + 1
                                                                             STRFLC
      IOUT(NJELT) = N
Print 5045, N. (IX(N,I), I=1,5), NJELT, K
                                                                             STRFLC
                                                                             STRFLC
 5045 FORMAT (113,416,19,112,19)
                                                                             STRFLC
                                                                             STRFLC
                                                                             STRFLC
 5843 N = N + 1
      IF (N .GT. NUMEL) GO TO 5060
IF (M - N) 5015, 5040, 5035
                                                                             STPFLC
                                                                             STRFLC
                                                                             STRFLC.
 5050 PRINT 5055, H
      1840 = 1
                                                                             STRFLC
                                                                             STRFLC
 5055 FORMAT (* ELEMENT CARD ERROR, N=*I4)
                                                                             STRELC
      HB3= XBAND
                                                                             STRFLC
 5860 NBAND=#BAND+HBAND+NBAND
                                                                             STRFLC.
C
C
                                                                             STPFLC
                                                                             STRFLC
                                                                             STRFLC.
 5875 NUMENP=0
      00 5898 I=1.NJELT
                                                                             STRFLC.
      H (I) =8.8
                                                                             STRFLC.
                                                                             STRFLC.
      NT([)=0.0
      KN(I)=8.0
                                                                             STRFLC.
                                                                             STRFLC.
 5098 KS(1)=0.0
                                                                             STRFLC.
C.... ESTABLISH NUNBERING CONTRACTION FOR THE FLOW NODES
                                                                             STRFLC.
      IF (NJELT.EQ.0) 60 TO 5100
                                                                             STRFLC.
      DO 5100 h=1, NJELT
                                                                             STRFLC.
      H = IOUT(N)
                                                                             STRFLC.
      J=IX (H+4)
                                                                             STRFLC.
      I=IX (Ny1)
                                                                             STRFLC.
                                                                             STRFLC.
      K = HING(I,J)
                                                                             STRFLC.
      L=1
 5095 IF(IDEST(I).EQ.0) IDEST(I)=K
                                                                             STRFLC.
                                                                             STRFLC.
      IF(IDEST(I)+LT+K) K=IDEST(I)
      IF (IDEST(I) +LE+K) 60 TO 5182
                                                                             STRFLC.
                                                                             STRFLC.
      KK=IDEST(I)
                                                                             STRFLC.
      DO 5181 II=1,NUMNP
      IF(IDEST(II).EQ.KK) IDEST(II)=K
                                                                             STRFLC.
                                                                             STRFLC.
 5101 CONTINUE
```

STPFLC 5102 IF([DEST(J).EQ. 0) IDEST(J)=K STRFLC IF (IDEST(J) .LT. K) IDEST(I)=IDEST(J) STRFLC IF(IDEST(J).LE.K) G0 T0 5186 STRFLC KK=IDEST(J) STRFLC STPFLC DO 5184 II=1, NUMEP IF(IDEST(II).EQ.KK) IDEST(II)=K STRFLC 5104 CONTINUE STRFLC STRFLC 5106 IF(L.EQ.2) GD TO 5100 STRFLC I=IK (H.2) STRFLC J=IK (H+3) STRFLC K # MINO(1,J) STRFLC L=2 STRFLC GO TO 5895 STRFLC STRFLC 5188 CONTINUE STRFLC STRFLC-DO 5118 N=1,NUHEL STRFLC. HTYPE=1X(N,5) IF (NTYPE. ET. NSHELLIGO TO 5110 STRFLC STRELC PERH=E(1.HTYPE) STRFLC IF (AES(PERH).LT.E-12) GD TD 5110 00 5111 K≠1,4 STRFLC STRFLC I=IX(H₁K) 5111 IF(IDEST(I).EQ.0) IDEST(I)=I STRFLC. 5110 CONTINUE STRFLC. STRFLC 00 5165 N=1.NUMNP I=IDEST (N) STRFLC. STRFLC. IF(I.EQ.0) GO TO 5105 STRFLC. IDEST(N)= IDEST(I) 5103 IF(I.NE.N) GO TO 5105 STRFLC. NUHENP=NUPENP+1 STRFLC. STRELC. IDEST(N)=NUPFNP 5105 CONTINUE STRFLC. 5113 PRINT 5112, HBAND, AJELT, NUPFNP STRFLC. 5112 FORMAT 135HDST. STIFFNESS PATRIX BAND WIDTH =15/28H MUMBER OF JICHSTRELC. ST ELEMENTS = 15/2EH NUMBER OF FLOW HODES =15) STRFLC. STRFLC. GO TO 5 STRFLC. STRFLC. PRESSURE CARDS IF ANY STRFLC. C 6808 PRINT 1, HED STRFLC. PRINT 6818 STRFLC. 6810 FORMAT 1/2 SHOPRESSURE BOUNDARY CONDITIONS/ 42H I J PRESSSTRFLC. 1URE-I PRESSURE-J) STRFLC. STRFLC. STRFLC. 00 6848 L±1, NPC READ 6815, IL. I2, PS1, PS2 STRFLC. 6815 FORMAT (215, 2F18-3) STRFLC. STRFLC. PRINT 6020, I1, I2, PS1, PS2 6020 FORMAT(215,2F15.3) STRFLC. STRFLC. DR = R(12) = R(11) 02 = Z(11) - Z(12) CC = CODE(11) STRFLC STRFLC. IF (CC .EQ. 3) GO TO 6830 PI = (2.*PS1 + PS2)/6. STRFLC. STRFLC. IF (NAXI .NE. 0) STRFLC. PI = (R(I1)*(3.0*PS1*FS2) + R(I2)*(PS1+PS2)) / 12.8 1 SINA = 0. STRFLC. STRFLC. COSA = 1. STRELC. IF (CC .GE. 8.8) GO TD 6825 SINA = SIN(CC) STRFLC.

```
COSA = COS(CC)
                                                                                 STRFLC
 6025 IF (CC .EG. 1.0 .OR. CC .EG. 1.8) UZ(I1) = UZ(I1) + DR*PI
IF (CC .WE. 1.8) UR(I1) = UR(I1) + DZ*PI*CDSA + DR*PI*SINA
                                                                                 STRFLC
                                                                                 STRFLC
                                                                                STRFLC
 6830 CC = CODE (12)
                                                                                 STRFLC
      IF (CC .EQ. 3.8) GO TO 6840
PI = (2.*PS2 + PS1)/6.
                                                                                 STRFLC
                                                                                 STRFLC
      IF (MAXI .NE. B)
                                                                                 STRFLC
            PI = {R(12)*(3.0*PS2+PS1) + R(11)*(PS1+PS2)) / 12.0
     1
                                                                                 STRFLC
      SINA = 4.
                                                                                 STRELC
      COSA = 1.0
                                                                                 STRFLC
      IF (CC .GE. 1.0) GO TO 6035
                                                                                 STRFLC
      SINA = SIA(CC)
                                                                                 STRFLC
      COSA = COS(CC)
                                                                                 STRFLC
 6835 IF (CC +ME, 1.0) UR(12) = UR(12) + DZ**PI*COSA + DR*PI*SINA
IF (CC +EC, 1.0 + OR+ CC +EQ, 0.0) UZ(12) = UZ(12) + DR*PI
                                                                                 STRFLC
                                                                                STRFLC
 6848 CONTINUE
                                                                                STRFLC.
      60 TO 5
                                                                                 STRFLC.
C
                                                                                 STRFLC.
C***** FLOW NOCE PROPERTIES ***
                                                                                STRFLC
6500 CONTINUE
                                                                                STRFLC.
      DO 6501 I=1.NUMFNP
                                                                                STRFLC.
      IB(I)=0
                                                                                STRFLC.
      PHIC(I)=0.0
                                                                                STRFLC.
6581 Q(1)=8.0
                                                                                STRFLC.
                                                                                STRFLC.
      IF (MUMENP .GT. 0) GO TO 7110
                                                                                STRFLC.
      PRINT 7105
                                                                                STRFLC.
 7105 FORMAT (37H FLOW CARDS MUST FOLLOW ELEMENT CARDS)
                                                                                STRFLC.
                                                                                STRFLC.
      L880 = 1
                                                                                STRFLC.
7110 MBFLCH = 0
                                                                                STRFLC.
                                                                                STRFLC.
      00 7120 H=1,NUNEL
                                                                                STRFLC.
      HTYPE=IX(H.5)
                                                                                STRFLC.
      IF(MTYPE.LE.NSHELL) GD TO 7121
                                                                                STRFLC.
      1=1X (H,1)
                                                                                STRFLC.
      J=IX (N.2)
                                                                                STRFLC.
      K=IABS(IDEST(I)-IDEST(J))
                                                                                STRFLC.
      IF(K.GT.NBFLDW) MBFLOW=K
                                                                                STRFLC.
      GO TO 7120
                                                                                STRFLC.
                                                                                STRFLC.
7121 DO 7122 I=1,3
                                                                                STRFLC.
      II=IX(H,I)
                                                                                STRFLC.
      I1=I+1
                                                                                STRFLC.
      00 7122 L=11.4
                                                                                STRFLC.
      LL=IX(H.L)
                                                                                STRFLC.
      K=IA 85(IDEST(LL)=IDEST(II))
                                                                                STRFLC.
      IF (K.GT.HBFLOW) HBFLOW=K
                                                                                STRFLC.
7122 CONTINUE
7128 CONTINUE
                                                                                STRFLC.
                                                                                STRFLC.
      HEFLON=HEFLON+1
                                                                                STPFLC.
                                                                                STRFLC.
     PRINT 7125
                                                                                STRFLC.
7125 FORMATCI18HOFLOW MODAL PCINTS CODE X-ORDINATE Y-ORDINATE
                                                                              NST PELC.
    1ET HEAD (PSF)
                         FLOW RATE (CFS) CORRESPONDING NODAL POINTS1
                                                                               STRFLC
                                                                                STRFLC.
     NX = 1
                                                                                STRFLC.
7138 READ 7135, N. HL. PH. QF
                                                                                STRFLC.
7135 FORMAT (215,2F10.3)
                                                                                STRFLC.
     IF IN .GT. NUMP .OR. N .LE. 0) GO TO 7178
                                                                                STRFLC.
     IF (N .GT. NK) GO TO 7145
                                                                                STRFLC.
```

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7148 L = IDEST (N)
                                                                              STRFLC
      [8(L) = NL
                                                                              STRFLC
      PHIO(L) = PH
                                                                              STPFLC
      Q (L) #QF
                                                                              STRFLC
      60 TO 7150
                                                                              STRFLC
                                                                              STRFLC
 7145 L1 = IDEST(NK)
                                                                              STRFLC
      IF (L1 .LE. L) GO TO 7165
                                                                              STRFLC
      L = L1
                                                                              STRELC
                                                                              STRFLC
 7158 00 7151 J=1.8
                                                                              STRFLC
 7151 LST(J) = 0
                                                                              STRELC
      J1 = 6
                                                                              STRFLC
      00 7155
                                                                              STRFLC
               J=NK NUFNP
      IF (IDEST(J) .NE. L) GO TO 7155
                                                                              STRFLC
      J1 = J1 + 1
                                                                              STRFLC
 LST(J1) = J
7155 CONTINUE
                                                                              STRFLC
                                                                              STRFLC
      PRINT 7160, L, IB 'L), R(NX), Z(HX), PHIO(L), Q(L), (LST(J), J=1, J1)
                                                                              STRFLC
 7168 FORHAT (2112, 2F12.2.2019.6,4X,814)
                                                                              STRFLC
      IF(J1.LE.1) GO TO 7162
                                                                              STRFLC
      JHIN=LST(1)
                                                                              STRFLC.
      00 7161 J=2,J1
                                                                              STRFLC
 7161 JHIN=HIND (JMIN, LST (J))
                                                                              STRFLC
      KEQ=KEQ-J1+1
                                                                              STRFLC
      JNUH=IDEQ (3, JMIN)
                                                                              STRFLC.
      00 100 J=1, J1
                                                                              STRFLC
      K=LST(J)
                                                                              STRFLC.
                                                                              STPFLC.
  100 IDEQ (3.K) = JNUM
      JHIN=JHIN+1
                                                                             STRFLC.
                                                                             STRFLC.
      J1=0
      DO 181 KEJMIN, NUMNP
                                                                              STRFLC.
      00 181 J=1,3
                                                                              STRFLC.
      IF(IDEQ(J.K).EQ.JNUM) J1=J1+1
                                                                              STRFLC.
  101 IF([DEQ(J.K).GT.JNUH) IDEQ(J.K)=IDEQ(J.K)-J1
                                                                             STRFLC.
 7162 IF(L.EQ.NUMFNP) GC TO 7170
                                                                             STRFLC
 7165 NX = NX + 1
                                                                             STRFLC.
 IF (NX - N) 7145. 7140. 7130
7170 PRINT 7175, HBFLCH
                                                                             STRFLC
                                                                             STRELC.
 7175 FORMAT(/ * F. CONDUCTIVITY MATRIX BAND WIDTH = * 15)
                                                                             STRFLC
                                                                             STRFLC.
                                                                             STRFLC
                                                                             STRFLO.
      D0 41 I=1.NUMM
                                                                             STRFLC.
      K=IDEST(I)
      KODE (1.I) = ID(2*I-1)
                                                                             STRFLC
      KODE (2, I)=IO(2*I)
                                                                             STRFLC
                                                                             STRFLC
   41 KODE (3,1)=18(K)
                                                                             STRFLC
C *******
            CONFUTE BANEWIDTH OF THE STRUCTURE .....
                                                                             STRFLC
                                                                             STRFLC
      HBAND=1
                                                                             STRFLC
      00 111 N=1, NUHEL
                                                                             STRFLC
      DO 111 I=1,4
                                                                             STRFLC.
      IN=IX(N,I)
                                                                             STRFLC.
                                                                             STRFLC
      DO 111 II=1.3
                                                                             STRFLC.
      IA=IDEQ(II, IN)
      80 111 J=1,4
                                                                             STRFLC
      JN=IX(N+J)
                                                                             STRFLC.
                                                                             STRFLC
      00 111 JJ=1,3
  111 NBAND-MAXB(MBAND, IABS(IA-IDEQ(JJ, JN)))
                                                                             STRFLC.
                                                                             STRFLC.
      NBAN D= NBA ND +1
      PRINT 182.HBAND.KEQ
                                                                             STRFLC.
```

```
102 FORMAT 125H GLOBAL SYSTEM BANGHIDTH, 15/24H TOTAL SYSTEM EQUATIONSSTRFLC
     1, 15)
                                                                        STRFLC
      PRINT 51
                                                                        STRFLC
   * ID(1.N) ,10H ID(2.N) .10H ID(3.N) )
                                                                        STRELC
      00 53 N=1.NUNNP
                                                                        STRFLC
   53 PRINT 52 .N,(IDEQ(I,N),I=1,3),(KODE(J,N),J=1,3)
                                                                        STRELC
   52 FORMAT(15,8110)
                                                                        STRFLC
      60 10 5
                                                                        STRFLC
С
                                                                        STRFLC
     INITIAL STRESSES IF ANY
С
                                                                        STRFLC
 8888 PRINT 1, HED
                                                                        STRFLC
     PRINT 8010
                                                                       STRELC
 8810 FORMAT (37H0
    FORMAT (37HO INI'IAL STRESSE S/56HBELEMENT
1STRESS Y-STRESS Z-STRESS XY-STRESS)
                                                                     X-STRFLC
                                                                       STRFLC
                                                                        STRFLC
     NRES = 1
                                                                        STRFLC
     L = 1
                                                                       STRFLC.
 8815 READ 8828+ N. (NESID (N+1), I#1+4)
                                                                       STRFLC
 8020 FORMAT (118,4E10.3)
                                                                       STRFL/C
      IF (N - L) 8840, 6035, 6825
                                                                       STRFLC
 8825 DO 8830 I=1,4
                                                                       STRFLC
 8030 RESID(L,I)=RESID(L-1,I)
                                                                       STRFLC.
 8835 PRINT 8037, L. (RESID(L.I), I=1.4)
                                                                       STRFLC
 8837 FORMAT ( 15,3X,4F12.3)
                                                                       STRELC.
      IF (L .EQ. NUMEL) GO TO 8850
                                                                       STRFLC
      1 = 1 + 1
                                                                       STRFLC.
     IF (N - L) 8015. 8035. 8025
                                                                       STRFLC.
8840 PRINT 8845, N
                                                                       STRFLC.
8045 FCRMAT(* RESIDUAL STRESS INPUT ERROR, N=+14)
                                                                       STRFLC.
     LBAD = 1
                                                                       STRFLC.
GO TO 8015
8058 GD TO 5
                                                                       STRFLC.
                                                                       STRFLC.
C
                                                                       STRFLC.
     RESTART PARAMETERS IF NEEDED
С
                                                                       STRFLC.
9000 IF (NJELT .GT. 8) GO TO 9815
                                                                       STRFLC.
     PRINT 9010
                                                                       STRFLC.
 9818 FORMAT (40H RESTART CARDS HUST FOLLOW ELEMENT CARES)
                                                                       STRFLC.
     60 70 15
                                                                       STRFLC.
                                                                       STRFLC.
9815 READ 9885. (KN(I).KS(I).WT(I).W(I). I=1.NJELT)
                                                                       STRFLC
 9485 FORMATE 4628.6 )
                                                                       STRFLC
     60 10 5
                                                                       STRFLC.
С
                                                                       STRFLC.
     ALL INPUT NOW IN -- IF COPRECT PROCEED WITH SOLUTION
С
                                                                       STRFLC.
9999 IF (LBAD .HE. 8) GO TO 15
                                                                       STRFLC
                                                                       STRFLC.
      PLOT HESH
С
                                                                       STRFLC.
     IF (IPLOT .EQ. 0) 60 TO 124
                                                                       STRFLC.
C
                                                                       STRFLC.
     PREPARE CONSTANTS FOR PLOTTING
C
                                                                       STRFLC.
     CYNIN = (18.5- YLNGTH) / 2.8
                                                                       STRFLC.
     CCYMAX = CCYMIH + YLNGTH
                                                                       STRFLC.
     CCXMIN . ...
                                                                       STRFLC.
     CCXNAX = XLNGTH
                                                                       STRFLC.
     XHIN=R(1)
                                                                       STRFLC.
     YHIN=Z(1)
                                                                       STRFLC.
     XHAX=XMIN
                                                                       STRFLC.
     YHAX=YH2H
                                                                       STRFLC
     00 112 I=2, NUMNP
                                                                       STRFLC.
     IF (R(I) .GT. XMAX) XMAX = R(I)
                                                                       STRFLC.
     IF (R(I) .LT. XHIN) XHIN = R(I)
                                                                       STRFLC.
```

IF (2(I) .GT. YMAX) YMAX = 2(I) IF (2(I) .LT. YPIN) YMIN = 2(I) STRFLC STRFLC 112 CONTINUE XCON = XLNGTH / (XMAX-XMIN) STRFLC STRFLC YCON = YLNGTH / (YMAX-YMIN) DISPL = 8.02 * (XMAX - XMIN) STRFLC STRFLC STRFLC XSCL = (XPAX - XMIN) / XLNGTH YSCL = (YMAX - YHIN) / YLNGTH STRFLC STRFLC DSCL = DISPL / FUNGTH STRFLC PSF=XSCL/PSCL+0.5 STRFLC PSFJ = PSF / CONJT STRFLC. PJCL=PSCL+CONJT STRFLC STRFLC CALL COBGN STRFLC WRITE (98, 115) HED STRFLC 115 FORMAT (849/849) STRFLC CALL CCLTF (-1.2.8.5. 1. 2) STRFLC. CALL COLBL (1.1) STRFLC. DO 119 N=1.NUHEL STRFLC. NI=IX(N,1) STRFLC. NJ=IX(N,2) STRFLC. NK=IX(N:3) STRFLC. NL=IX(N+4) STRFLC. XTR(1) = R(NI) STRFLC. XTR(2) = R(NJ) STRFLC XTR(3) = R(NC)STRFLC. XTR(4) = R(NL)STRFLC. XTR(5) = XTR(1) STRFLC. XTR(6) = 7(NI) STRELC. XTR(7) = Z(NJ)STRFLC. XTR(8) = 2(NK) STRFLC. XTR(9) = Z(NL) STRFLC. IF (IX (N. 5) .GT. NSHELL) GO TO 117 STRFLC. XTR(10) = XTR(6) STRFLC. CALL COPLOT (XTF 1), XTR(6), 5, 4HJOIN) STRFLC. 117 CONTINUE STRFLC. COR = 3. STRFLC. XCEN = XTR(1) + XTR(2) + XTR(3) YCEN = XTR(6) + XTR(7) + XTR(8) • STRFLC. STRFLC. IF (NK .EQ. NL) GO TO 118 STRFLC. COR = 4. XCEN = XCEN + XTR (4) STRFLC. STRFLC. YCEN = YCEN + XTR(9) STRFLC. 118 XCEN=XCEN/COR*XCO++.05 STRFLC. YCEN=YCEN/COR#YCON+1.1 STRFLC. 119 CONTINUE STRFLC. WRITE (90,121) XSCL, VSCL 121 FORMAT (15H 1 IN CN X AXIS/4H ==E12,4,3H FT/15h 1 IN ON Y AXIS/ STRFLC. STRFLC. =E12.4.3H FT) STRFLC. 14H STRFLC. DO 123 I=1.NUMMAT WRITE (98, 2015) I STRFLC. 1F (I .LE. NSHELL) GO TO 122 WRITE (98,2030) (E(J,I),J=1,7) STRFLC. STRFLC. 60 TC 123 STRFLC. 122 WRITE(98,2828) RO(I),(E(J,I),J=1,0) STRFLC. STRFLC. **123 CONTINUE** XP = CCXMAX + 8.5 STRFLC. CALL COLTE (XP. 16.5, 0, 2) STRFLC. CALL CONE XT STRFLC. Conners INITIALIZE ******** STRFLC. DO 4 I=1.HJELT STRFLC.

```
SIGN (1)=0.0
    4 SIGT(I)=0.8
       NF2= NUMENP+ NUMENP
  124 READ 5.WORD
      NF2= NUHFNP+ NUHFNP
      IF (WORD.EG. BLANK) NF2=NUMFNP
      MEQ= KEQ
      HN=NBAND= NE Q
      HH9=HBFLOH+HFZ
      N2±1
      H2=HH+1
      H3=#2+#N9
      N4=H3+NEQ
      115=14+HEQ
      N6=H5+NEQ
      H7=H6+NF2
      #8=#7+NF2
      M9=M8+NUMFNP
      11=1
      12=2#NF2+11
      I 3=NEQ+12
      DO 135 I=H3,H9
      A(1)=0.0
  135 CONTINUE
  ****
         INITIAL NODAL LOADS ****
C
      00 7501 1=1.NUMNP
      <1=I0EQ(1,I)
      K2=IDEQ(2.I)
      K3=IDEQ(3,I)
      J=IDEST(1)
      A (H5+K3-1)=PH ID (J)
      TEMP(I)=PHIO(J)
      A (H6 +K1-1)=A(H4 +K1-1)+UR(I)
      A {H4+K2-1}=A(H4+K2-1)+U2(I)
      D80(K1)=8.0
      080(K2)=0.0
 7501 CONTINUE
      DD 585 K=1.NEQ
      TLOAD(K)=0.0
  505 CONTINUE
      CONT INUE
C
C
      CALCULATION OF APERTURES
      IF(NJELT.GT.0) CALL APERTUR
ε
  125 TIT=0.0
      T#L=0.0
      T1=0.0
      P=0
      TIME=0.0
      IPER=0
      NSTEP=0
      DRT=1.=1./THE TA
      DTH=DT/2.
      TOTH=THETA#CTH
      HTOT =OTH- 10TH
      CALL SECOND (TST)
      SOLVE NON-LINEAR STRUCTURE BY SUCCESSIVE APPRCXINATIONS
C
Ċ
```

STRFLC STRFLC. STRFLC. STRFLC. STRFLC STRFLC STRFLC. STRFLE. STRFLC. STRFLC. STRFLC. STRFLC.

STRFLC.

```
STRFLC
C
  176 MP = MP + 1
                                                                               STRFLC
                                                                              STRFLC
      NCC= 0
      IP=NFP(PP)
                                                                              STRFLC
                                                                              STRFLC
      READ 1005, NSTEP, DT
C
                                                                               STRFLC
  174 CONTINUE
                                                                               STRFLC
                                                                               STRFLC
      TIPE=TINE +DT
                                                                              STRFLC
  175 DO 195 NNN=1. IP
      FLAG = .FALSE.
                                                                               STRFLC
      IPER=IPER+1
                                                                              STRFLC
      INDEX = IPAT(IPER)
                                                                               STRFLC
                                                                              STRFLC
С
                                                                              STRFLC
  185 CONTINUE
                                                                              STRFLC
      PO.TO CALCULATED, IF SYSDIP AND TOTALQ IS SUPPLIED
                                                                              STRFLC
C
                                                                              STRFLC
      QQ=TOTALQ
                                                                              STRFLC
      IF(QQ.NE.8.) GO TO 185
                                                                              STRELC
      R0=1.0
                                                                              STRELC
      TOT=1.8
                                                                              STRELC
                                                                              STRFLC
      GO TO 187
  186 CONTINUE
                                                                              STRFLC
      RD= SYSDIM*E(1,1)/(VISC*QQ)
                                                                              STRFLC
      TOT=E(1,1)*TIME *E (5,1)/VISC
                                                                              STRFLC
  187 CONTINUE
                                                                              STRFLC
                                                                              STRFLC
С
                                                                              STRFLC
      IF(FLAG) 60 TO 190
      CALL STIFF( THETA* CT/2., 4 (H2), 4 (H2), 4 (H3), 4 (H4), 4 (H5), NEQ, NUPFNP,
                                                                              STRELC
     . HN. MN9. MBAND. HBFLOW.TIHE)
                                                                              STRELO
C
                                                                               STRFLC
С
      SOLVE FOR DISPLACEMENTS
                                                                              STRELC.
c
                                                                              STRFLC
                                                                              STRFLC
      CALL SCLVES(THE TA, DT. TIME, A (N2), A (H2), A (H3), A (H4), A (H5), A (H6),
     *KODE, ID(1), ID(12), NUMNP, NEQ, NUMEL, NSHELL, MSAND, MBFLOW,
                                                                              STRFLC
     *NUMPNP, IC CMPR, IDE ST, INDEX, IPER, NNN, IDEQ, PHID, Q, IP, QN, A (M7), PN9,
                                                                              STRELE
                                                                              STRFLC
     $ TLOAD)
  321 CONT INUE
                                                                              STRFLC
      IF(THETA.EQ.1.0) GO TO 323
                                                                              STRFLC
                                                                              STRFLC
      1=0
      DC 325 K=1.NE0
                                                                              STRFLC
      A (H3 +1)=A (H3+1) /THETA+DRT*A (H5+1)
                                                                              STRFLC
  325 I=I+1
                                                                              STRFLC.
  323 CONT INUE
                                                                              STRFLC.
      IF(INDEX. NE.#) PRINT 324. HP
                                                                              STRFLC
  324 FORMAT (*0ISPL.AND PRESS.AT THE END OF TIME STEP NG. *. 15)
                                                                              STRFLC
      IF(INDEX.EQ.8) GO TD 192
                                                                              STRFLC
                                                                              STRFLC
      PRINT 2008.TIME
 2006 FORMAT (1H1. JOH DISPL. AND PRESSURES AT TIME , £15.4// 6X.
                                                                              STRFLC
     . 10H NODAL PT -ZEHDISPL IN X-DIREC
                                               .ZOHDISPL IN Y-DIREC
                                                                              STRFLC.
               PRESSURE ZZH DIMENSIONLESS TIME, TO, ZEH DIMENSIONLESS PRSTRFLC
         141
                                                                              STRFLC.
     *ESSURE, PD//)
      CALL PRINT(NUMMP, 10EQ, NAX1,R,RC, TOT, A(M3),TEMP)
                                                                              STRFLC.
  326 FORMAT(110, 5220.5)
                                                                              STRFLC.
  192 CONTINUE
                                                                              STRFLC.
  190 CALL STRFLD (A (H3) ,A(H4) ,A (H5) ,TIHE, IP, FLAG.NCC.DT)
                                                                              STRFLC.
      IF(FLAG) GO TO 191
                                                                              STRFLC.
      IFIINDEX.NE.8) GO TO 193
                                                                              STRFLC.
C..... NOT MEECEE IF UNCCUPLED FLOW PROBLEM IS SOLVED .....
                                                                              STRFLC.
      IF( E(4.1).EQ.0.0 ) GO TO 193
                                                                              STRFLC.
      PRINT 324.HP
                                                                              STRFLC.
                                                                              STRFLC.
      PRINT 2008.TINE
```

```
CALL PRINT (NUMNP, IDEQ, NA) I.R.RD. TOT.A (N3).TEMP)
                                                                                 STPFLC
  193 CONTINUE
                                                                                 STRFLC
       IPER=IPER+IP-NNN
                                                                                 STRFLC
       GO TO 195
                                                                                 STRFLC
  191 CALL SECOND (T)
                                                                                 STRFLC
       IFIIPER.EQ.1) TIT=T-TST
                                                                                 STRFLC
       TL=TTOTAL-T
                                                                                 STRFLC
       IF (TL.LE.TIT. AND. NW.LT. IP) GO TO 285
                                                                                 STRFLC
  195 CONTINUE
                                                                                 STRFLC
  195 CONTINUE
                                                                                 STRFLC
                                                                                 STRFLC
      I=0
DU 501 K=1,NEU
      A (H5+I) =A (H3+I)
                                                                                 STRFLC
                                                                                 STRFLC
      A (H3+I)=0.0
      TLOAD(K)=0.0
                                                                                 STRFLC
  581 I=I+1
                                                                                 STRFLC
С
                                                                                 STRFLC
                                                                                 STRFLC.
      NCC=NCC+1
                                                                                 STRFLC.
 IF(NCC.GE.NSTEP) GO TO 600
1005 FCRMAT(110.E20.5)
                                                                                STRFLC.
      HP=HP+1
                                                                                STRFLC.
                                                                                STRFLC
      IP=NPP(#P)
GD TO 174
  600 CONTINUE
                                                                                STRFLC
      NDTN=NDTN-1
                                                                                STRFLC.
  500 CALL SECOND(T)
                                                                                STRFLC.
      TL=TTOTAL-T
                                                                                STRFLC.
      IF(TL.LE.TIT.AND. PP.LT.NIT) PRINT 210
                                                                                STRFLC.
      IF(MP.LT.NIT.AND. NOTN.GT.0) GC TO 170
                                                                                STRFLC.
  210 FORMAT("NCT ENDUGH TIPE FOR ANOTHER PERTURBATION")
                                                                                STRFLC.
                                                                                STRFLC.
      IF(IPUNCH.EQ.1.OR.IPUNCH.EQ.3) GO TO 225
                                                                                STRFLC.
      GO TO 235
                                                                                STRFLC.
  205 PRINT 210
                                                                                STRFLC.
                                                                                STRFLC.
  225 PUNCH 230, (CN(I),KS(I),WT(I),W(I), I=1,NJELT)
                                                                                STRFLC.
  238 FCRMAT( 4E28.6 )
                                                                                STRFLC.
  235 PRINT 240, TIT
                                                                                STRELC.
  240 FORMAT (18H PERTURBATION TINEE10.3.8H SECONDS)
                                                                                STRELC.
      GO TO S
                                                                                STRFLC.
                                                                                STRFLC.
  300 IF (IPLOT .EQ. 1) CALL CCEND
                                                                                STRFLC.
                                                                                STRFLC.
      CALL EXIT
Ċ
                                                                                STRFLC.
      END
                                                                                STRFLC.
      SUBROUTINE APERTUR
                                                                                STRFLC.
                                                                                STRFLC.
С
      LARGE & (125080) .10(908)
                                                                                STRFLP.
      LARGE IX(301, 5) ,RESID(381,4),R(388),Z(388),UR(388),UZ(388)
                                                                                LARGE .
     + .CODE(300), IDEST(300), R.KN(50), R.KS(50), HT(50), ICUT(301), Q(300), LARGE.L
     +QP (58) .W(58) .VEL (58) .FR (58) .RE (58) .QN (988) .DISPI (380.2) .TENP (308) .LARGE ."
     PHIO(300), IB(388), IDEQ(3, 308), KODE (3, 308), IEL (58, 2), INP(50, 4)
                                                                                LARGE .!
     +, TLOAD (980) +51GN(58) +51GT (58) +090(680)
                                                                                STRFLF.
      CONHON/GEN/NSHELL.IPUNCH.E (7,12).INDEX.MP.INN.NCORE.NUMP.ICOMFR. GEN.2
            IVHEL.NO2, HED(16), DISPL.NJELT, IPER, NUMMAT, PSF, PSFJ, KSCL, SPHT, GEN. 3
     1
     3VISC.VSCL.DSCL.PSCL.PJCL.AP(4).COMLIN.NAXI.NS.NBAND.LNGTH.NEO.NJHPGEN.4
* .NBFLOW.NJHNF2.NJHFP.LN(12).NF2 GEN.5
                                                                                APTP.2
      CONHON/APTR/IRAND, NJUMP, AAS, AAH
      IF( IRAND .NE. B) GO TO 18
                                                                                STRFLC.
                                                                                STRELC.
      00 15 J=1,NJELT
      I = IOUT(J)
                                                                                STRFLC.
```

```
NAT= IABS(IX ([.5))
                                                                                   STRFLC
       WT (J )=E (5 .HAT )
                                                                                   STRFLC
   15 CONTINUE
                                                                                   STRFLC
       GO TO 35
                                                                                   STPFLC
C
                                                                                   STRFLC
   10 PRINT 16
   16 FORMAT (* APERTURES ARE RANDOMLY GENERATED*)
                                                                                   STRELC
       00 28 K#1.NJELT
                                                                                   STRFLC
       J = TOUT(K)
                                                                                   STRFLC
      MATEIABSE IX(J,5) )
                                                                                   STRFLC
       A PR= 6.8
                                                                                   STRFLC
      00 25 I=1+12
                                                                                   STRFLC
      YFL=RANF(D)
                                                                                   STR'LC
   25 APR=APR+YFL
                                                                                   STRFLC
       VTH= (APR-E.0) *AAS+AAH
                                                                                   STRFLC
      WT(K) = -EXP(VTH)
                                                                                   STRFLC
   20 CONTINUE
                                                                                   STRFLC
   35 IF( NUMP.EQ.8 ) GO TO 48
                                                                                   STRFLC
C
                                                                                   STRFLC
      00 58 JI=1.NJM
                                                                                   STRFLC
      READ 180. I. COEG. COEH1. COEH2. COEH3.COEH4
                                                                                   STRFLC
  100 FORMAT (15, F10.3, 4F15.5)
                                                                                   STRFLC
      PRINT 288 .I.COEG.COEM1.COEM2.COEM3.COEM4
                                                                                   STRFLC
  200 FORMAT 1/14.7%. 6HCOE G= . F 10. 3, 10%.7H COEH1= .F10. 3. 10%.7HCOEH2= .F1STRFLC
     18.3, 7HCOE H3= .F10.3, 5X, 7HCOE H4= .F10.3 )
                                                                                   STRFLC.
                                                                                   STRFLC
      DO 220 J = 1. NJELT
                                                                                   STRFLC
      IF (IOUT(J) .EQ. I) GO TO 230
                                                                                   STRFLC
  228 CONTINUE
                                                                                   STRFLC.
  230 WT (J) = COEG * WT (J)
                                                                                   STRFLC.
      HAT= TABS( IX(1,5) )
                                                                                   STRFLC.
      E (1, HAT)=COEH1+E(1,HAT)
                                                                                   STRFLC.
      E (2, MAT )= COEH 2+E (2, HAT )
                                                                                   STRFLC.
      E (3, HAT)=COEN 3*E (3, HAT)
                                                                                   STREFC
      E (4, NAT)=COEM4*E (4, MAT)
                                                                                   STRFLC.
   50 CONT INUE
                                                                                   STRFLC
C
                                                                                   STRELC
   48 CONT INUE
                                                                                   STRFLC
      RETURN
                                                                                   STRFLC.
      END
                                                                                   STREFC.
      SUBROUTINE STIFF(DT.A1,A2.8.00.PO.NO.NP.MN.MN.9.MT.MF.TIME)
                                                                                   STRFLC.
С
                                                                                   STRFLC.
      LARGE A (125400) .10(904)
                                                                                   STRFLF.
      LARGE IX(301, 5) .RESID(301,4),R(300),Z(300),JR(300),UZ(300)
                                                                                   LARGE .
     + _CODE(300) .IDEST(300) .R.KN(50) .R.KS(50) .HT(50) .ICUT(301) .0(300) . LARGE ...
     +QP(50),W(50), VEL (50),FR(50),RE(50),QN(900),DISPI(300,2),FEMP(300),LARGE.
     * PHIO(380), IB(300), IOEQ(3, 380), KODE (3, 380), IEL (50, 2), INP(50, 4)
                                                                                   LARGE ..
     *.TLOAD (988) .SIGN (58) .SIGT (58) .DBO (600)
                                                                                   STRELP.
      COMMON/ EL ANK/S(8,8).P(10).RSTRS(4).VCL.RRR(5).ZZZ(5).LBAD.RADN.
                                                                                   BLANK.
            RR(4), ZZ(4), IPAT(50), ACELX, ACELY, NRES, R0(12),
MTYPE, XI, XCE, YCEN, XTR(10), FAC, H(6), PD(4, 12), QQ(2,4),
                                                                                   BLANK.
     1
                                                                                   BLANK ...
          PRS. FZS. PRT. FZT.EG
     3
                                                                                   BLANK ..
      COMMEN/GEN/NSHELL.IPUNCH.E (7.12).INDEX.MP.NNN.NCDRE.NUMMP.ICCMPR. GEN.2
NUMEL.ND2.HED(16).DISFL.NJELT.IPER.NUMMAT.FSF.PSFJ.KSCL.SFWT.GEN.3
     1
     3VISC.VSCL.DSCL.FSCL.PJCL.NP(4),CONLIM.NAXI.NB.MEAND.LNGTH.NEQ.NJ#PGEN.4
            .HBFLOW, NUPNF2, NUMFNP+LH(12),NF2
                                                                                   GEN.5
     ٠
      CONNEN/EF/ST (4, 8) , SO (2.4) .AJ (8.2) .DD (2.2) . QJ (4) . HR (6) . HZ (6)
                                                                                  E#.2
                                                                                  EN.3
     ۰
       •EJ (2•5)
      LARGE A1(NQ.1), A2(NNP.1),8(1),80(1),90(1)
                                                                                   STRFLC.
      DIMENSION PP(2), RP(2), TL(8)
                                                                                  STRFLC,
      CONNCN/ST F/SF 18 .8).SC (8.4).SH(4.4).SE(4.4)
                                                                                   STRFLC.
                                                                                  STRFLC.
```

```
С
                                                                              STRFLC
                                                                              STRFLC
      REHIND 8
                                                                              STRFLC
      REWIND 9
      ISH=4
                                                                              STRFLC
                                                                              STRFLC
      JSH=2
                                                                              STPFLF
      LBAD= 0
С
                                                                              STRFLC
      00 702 K=1.HEQ
                                                                              STRFLC
                                                                              STRFLC
      00 782 L=1, MBAND
  702 A1(K.L)=8.8
                                                                              STRFLC
      00 781 KK=1.NNP
                                                                              STRFLC
      00 781 LL=1.HDFLCH
                                                                              STRFLC
      IF (NF2.GT.NUNFNPI A2 (KK.HBFLON+LL)=0.0
                                                                              STRFLC
  701 A21KK.LL)=0.0
                                                                              STRFLC
С
                                                                              STRFLC
                                                                              STRFLC
С
      HJ = 8
                                                                              STRFLC.
С
                                                                              STRFLC.
      00 386 N=1, NU HEL
                                                                              STRFLC
      00 200 I=1.4
                                                                              STRFLC.
      NP(I)=IX(N,I)
                                                                              STRELC.
  200 CONTINUE
                                                                              STRFLC.
      MTYPE=IX(N,5)
                                                                              STRFLC.
                                                                              STRFLC
      IF (MTYPE.LE.NSHELL) GO TO 92
                                                                              STRFLC
      1+LH=LH
                                                                              STRFLC.
C
                                                                              STRFLC.
C
¢
  JOINT MATERIAL PROPERTY ASSIGNMENT
                                                                              STRFLC.
                                                                              STRFLC.
c
¢
      KN AND KS ARE MODIFIED AFTER EACH PERTRBATION, THEREFORE.
                                                                              STRFLC.
      AFTER FIRST PERTUBATION OF FIRST TIME STEP CALCULATED STIFFNESSES STRFLC.
С
С
      ARE USED
                                                                              STRFLC.
                                                                              STRFLC.
      WHEN RESTARTED STIFFNESS VALUES THAT AVE RESULTS OF PRECEEDING
                                                                              STRELC.
C
C
      RUNS ARE READ IN DIRECTLY
                                                                              STRFLC.
                                                                              STRELC.
c
      IF (MP.GT. 1) GO TO 61
                                                                              STRFLC.
                                                                              STRFLC.
      IF(NNN.GT.1) GO TO 51
      IF (IPUNCH .GE. 2) GO TO 61
                                                                              STRFLC.
      KN(HJ) = E(1.HTYPE)
                                                                              STRFLC.
                                                                              STRFLC.
      KS(NJ) = E(2, MTYPE)
   61 CONT INUE
                                                                              STRFLC.
C
                                                                             STRELC.
C*******
                  JOINT ELEMENTS
                                   ..........
                                                                             STRFLC.
      CALL JTSTIF (8.80.PO.HJ.N)
                                                                             STRFLC.
      IF (VOL.LT.8.8) IX (N. 5) =- IX (N. 5)
                                                                             STRFLC.
      CALL ASHBLE (DT+A1+A2+N+S+AJ+DD+EJ+IDE0+NE0+NE2+IDEST+JSH)
                                                                             STRFLC.
      GO TO 380
                                                                             STRFLC.
C
                                                                             STRFLC.
C*******
                  SOLID ELEMENTS .....
                                                                             STRFLC.
C
                                                                             STRFLC.
   92 CONT INUE
                                                                             STRFLC.
                                                                             STRFLC.
      IF( IPER. GT.1. AND. SPHT.EQ. 0.0) GO TO 94
      IF(NNN.GT.1) GD TG 94
                                                                             STRFLC.
      CALL ELSTIF (8,80, PO.NI
                                                                             STPFLC.
                                                                             STRFLC
      CALL ASHBLE (DT. A1 .A2 .M. SF. SC. SH. SE. IDEQ. NO. HF2. IDEST. ISH)
      GD TO 380
                                                                             STRFLC.
   94 READ (8) SF.SC. SH. SE. NP
                                                                             STRFLC.
   93 CALL ASMELE (DT.A1.A2.H.SF.SC.SH. SE. IDEO. NO.NF2. IDEST.ISH)
                                                                             STRFLC.
  300 CONTINUE
                                                                             STPFLC.
      IFENNN, GT.13 GO TO 500
                                                                             STRELC.
```

STRFLC

```
DO 301 I=1, NUMNP
                                                                                 STRFLC
       J=IDEST(1)
                                                                                  STRFLS
       K=IDE0(3,1)
                                                                                 STRFLC
       IF( KODE(3.1).LE.0 ) 60 TO 350
                                                                                  STRFLF
       TLDAD(K)=PO(K)+1.0E+20
                                                                                  STRFLF
       QN (J)=TLOAD (K)
                                                                                 STRFLF
       GO TO 381
                                                                                 STRFLF
  350 QN(NUMENP+J)=TLOAD(K)+Q(J)
                                                                                 STRFLF
  391 CONTINUE
                                                                                 STRFLF
  540 RETURN
                                                                                  STRFLC
                                                                                  STRFLC
       END
       SUBROUTINE JTSTIF(8,80,P0.M,N)
                                                                                  STRFLC
С
                                                                                 STRFLC
       LARGE A (125 88 0) .10(908)
                                                                                  STRFLF
      LARGE IX(381, 5) .RESID(3(1,4),R(300),Z(380),UR(300),UZ(380)
                                                                                 LARGE.
      + .CDDE(308).IDEST(300).R.KN(50).R.KS(50).WT(50).ICUT(301).Q(300). LARGE.
     *QP(50),H(50),VEL(50),FR(50),RE(50),QN(900),DISPI(300,2),TEMP(300),LARGE.
     + PHIO(388), IB (388), IDEQ(3, 388), COLE (3, 388), IEL (58,2), INP (50,4)
                                                                                 LARGE .
     *, TLOAD (908) .SIGN(50) .SIGT (58) .DBO (688)
                                                                                 STRELE
       COMMON/BLANK/S(8,8),P(18),RSTRS (4), VOL.RRR(5),ZZZ(5),LBAD.RADN.
                                                                                 BLANK.
                           RR(4), ZZ(4), IPAT(50), ACELX, ACELY, NRES, RO(12),
                                                                                 BLANK.
     1
            MTYPE.XI.XCE .. YCEN, XTR(18). FAC. H(6). PD(4, 12). QQ(2,4).
                                                                                 BLANK .
     3
          PRS. PZS. PRT. PZT.EG
                                                                                 BLANK.
       COMMON/GEN/NSHELL.IPUNCH.E (7.12).INDEX.MP.NNN.NCORE.MUNNF.ICOMPR. GEN.2
     ۲
            NUMEL+N22, HED(16), DISPL, NJELT, IMER, NUMMAT, FSF, PSFJ, KSCL, SFWT, GEN, 3
     3VISC.VSCL.DSCL.FSCL.PJCL.NP(4).CONLIM, HAXI.NB.NEAND.LNGTH.NEQ.NJMPGEN.4
            +HOFLON, NUMAPZ, NUMPAP, LH(12) NF2
                                                                                 GE N. 5
      COMMON/EH/ST(4,8),SQ(2,4),AJ(8,2),DD(2,2),QJ(4),HR(6),HZ(6)
                                                                                 E#+2
     + ,EJ (2,2)
                                                                                 EH.3
                                                                                 STPFLC
С
                                                                                 STRFLC
      LARGE 8(1),80(1),F0(1)
       DIMENSION AS(4,4), TR(2,2), PPP(8), SS(4,4), TTF(6), SSS(6), V(4)
                                                                                 STRFLC
       DIMENSION AT(8,2),CJ(8,2),DUH(24),PP(8)
                                                                                 STRFLC
       DIMENSION EPRO(8) , CPRO(8)
                                                                                 STRFLC
       DATA AT/1 ++=1++1++=1++=1++1+++1+++1++
                                                                                 STRFLC
      DATA A5/2., 1., -1., -2., 1., 2., -2., -1., -1., -2., 2., 1., -2., +1., 1., 2./
                                                                                 STRFLC
      DATA SS/-0.5.0., C..D.5. 0..0.5. -0.5.0.. 0..-0.5.0.5.0..
                                                                                 STRFLC.
     1
                  0.5.0..0..-0.5/
                                                                                 STRFLC
C
                                                                                 STRFLC
      DATA INCOM/10HINC (PORESS/
                                                                                 STRFLF.
       II=IX(N+1)
                                                                                 STRFLC.
                                                                                 STRFLC.
       JJ= IX (N. 2)
      RM = -1.0
                                                                                 STRFLC
       IF (NAXI +NE+ 0) RM = -(R(JJ) + R(II)) / 2.0
                                                                                 STRFLC.
      DR=R (JJ)-R(II)
                                                                                 STRFLC.
      DZ=Z(JJ)-Z(II)
                                                                                 STRFLC.
      VOL = SORT(DR+DR + DZ+DZ)
                                                                                 STRFLC.
      IF (VOL .EQ. 0.0) GD TO 470
                                                                                 STRFLC.
                                                                                 STPFLC.
C** MATERIAL PROPERTIES
                                                                                 STRFLC.
   58 COHS+KS(H)+VOL/6.0
                                                                                 STRFLC.
      COMN=KH(H)= VOL/6.0
                                                                                 STPFLC.
C
                                                                                 STRFLC.
                                                                                 STRFLC.
c
           INITIAL IZE
                                                                                  06 106 II=1.8
                                                                                 ֥....
      P(II)=0.0
                                                                                 ·--.
      EPR0([])=0.0
                                                                                 iter en la compañía de la compañía d
      CFF0(II)=0.0
      00 100 JJ=1+8
                                                                                 372827.
                                                                                 .......
  100 S(II.JJ) = G.G
                                                                                 rttti.
      30 99 I=1.4
                                                                                 -----
       EJ(I)=0.0
```

```
99 DD(1)=0.0
                                                                               CTRFLI
      DO 98 I=1.16
                                                                               STPFLC
   98 AJ(I)=0.0
                                                                               STRFLC
                                                                               STRFLC
С
       DEVELOP RESIDUAL STRESS CONTRIBUTIONS TO THE LOAD VECTOR
                                                                               STRFLC
С
                                                                               STRFLE
STRFLC
C THE FOLLOWING SIGN CONVENTION IS ADOPTED. THE NORMAL STRESS IS POSITIVESTRALC
C WHEN DIRECTED OUTWARD THE ELEMENT ON THE FACE (II.JJ). THE SHEAF STRESSTRFLC
C IS FOSITIVE WHEN DIRECTED FFCH II TO JJ AND KK TO LL INSIDE THE ELEMEMSTRFLC
С
                                                                               STRFLC.
      TR(1,1)=0R/VOL
                                                                               STRFLC
      TR (1+2)=DZ/ VOL
                                                                               STPFLC
      IF(IPER.GT.1) GO TO 171
                                                                               STRFLC
      SC = TR(1+1) + TR(1+2)
                                                                               STPFLC
      S2 = TR(1.2) ** 2
                                                                               STRFLC
      C2 = TR(1,1) ** 2
                                                                               STRFLC.
  111 RSTRS(1)=RESID(N+1)*S2+RESID(N+2)*C2+2+*RESID(N+4)*SC
                                                                              STRFLC.
      RSTRS(2)= (RESID (N,2)-RESID (N,1)) *SC+RESID (N,4)*(S2-C2)
                                                                              STRFLC.
      TFORY=RSTRS (1 )+ VOL+RH
                                                                              STPFLC.
      TFORX=RSTRS (2)+ VOL+RM
                                                                              STRFLC.
      RATL C=0.0
                                                                               STRFLC.
      IF(NAXI.EQ.8) GO TO 112
                                                                              STRFLC.
      II=IX(N+1)
                                                                              STRFLC
      RATLO=(-1./RM)*(R(II)/2.+VOL/3.0)-0.5
                                                                              STRFLC.
  112 PPP(1)=TFCRY# (0.5-RATLO)
                                                                              STRFLC.
      PPP(2)=TFCRX+ (0.5-RATLD)
                                                                              STRFLC.
      PPP(3)=TFCR Y* (0.5+RATLO)
                                                                              STRFLC.
      PPP(4)=TFORX+ (0.5+RATLO)
                                                                              STRFLC.
      PPP(5)=-PPP(3)
                                                                              STRFLC.
      PPP(6)==PPP(4)
                                                                              STRFLC.
      P#P(7)=-P#P(1)
                                                                              STRFLC
      PPP(8)=-PPP(2)
                                                                              STRFLC.
  171 CONTINUE
                                                                              STRFLC.
                                                                              STRFLC
      00 200 II=1.4
                                                                              STRFLC.
      IN = II + II
                                                                              STPFLC.
                                                                              STOFLC.
      IS = IN - 1
      DO 200 JJ=1,4
                                                                              STPFLC.
      \dot{\mathbf{L}}\mathbf{L} + \mathbf{L}\mathbf{L} = \mathbf{M}\mathbf{L}
                                                                              STRFLC.
      JS = JN - 1
                                                                              STRFLC.
      TOUN=AS(II,JJ)
                                                                              STRFLC,
      IF (NAXI.NE. 1) TOUM=+TOUM+RH+SS(II.JJ)+OR
                                                                              STRFLC.
      S(IS,JS)=CONS*TDUH
                                                                              STRFLC.
  200 S(IN,JN)=COMN+TDUM
                                                                              STRFLC.
                                                                              STRFLC.
      ROTATE TO GLOBAL COORDINATES
                                                                              STRFLC
С
      TR(2.1) = -TR(1.2)
                                                                              STRFLC.
      TR(2,2) = TR(1,1)
                                                                              STRFLC.
                                                                              STRFLC
      IF (TR(1.1).EQ.1.) GO TD 450
                                                                              STRFLC.
      DO 480 NH=1.4
                                                                              STRFLC.
                                                                              STRFLC.
      JJ = NN + NN
      DO 410 II=1.8
                                                                              STRFLC.
      TDUM=S(II,JJ-1)*TR(1,1)+S(II,JJ)*TR(2,1)
                                                                              STRFLC.
      S(II,JJ) = S(II,JJ-1)*TR(1,2) + S(II,JJ) *TR(2,2)
                                                                              STRFLC.
 410 S(II.JJ-1)=TOUN
                                                                              STRFLC
      DQ 428 II=1.8
                                                                              STRFLC.
      TOUN =S (JJ-1.II) +TR (1.1) +S (JJ.II) +TR (2.1)
                                                                              STRFLC.
      S(JJ,II) = S(JJ-1,II)*TR(1,2) + SUJ,II)*TR(2,2)
                                                                              STRFLC.
                                                                              STRFLC
 420 S(JJ-1+II)=TDUR
 400 CONTINUE
                                                                              STRFLC.
```

C			STRFLC
	650	CONTINUE	STRFLC
		1F(1PER.NE.1) GO 70 665	STRELC
		88 468 T=1-4	STREET
		##XX (N. T)	STRELC
			STRELC
			STREEC
	461		STRAIC
	401		STEELC
		R_{1} r_{1} r_{2} r_{1} r_{2} r_{1} r_{2} r_{2	STREEC
		BO(1(2) - BO(1(2) - PPP(1) + TR(2, 2) + PPP(1T) + TR(1, 2))	STOFIC
	468		STREIC
	465		STRFIC
r	407		STRELE
ř			STREIC
ç		CON=1_8/112_8#WTSC1	STRELC
			STREEC
			STRFIC
			STRELC
			STRELC
	60	V(1)=PO((2)=TP(1,1)=PO((1)+TP(1,2)	STRELC
		FPSN = 54(v(4) + v(1) + v(3) + v(2))	STRELC
			STRFLC
		TELEPSN.GE. WDIGG TO 61	STRFLC
		PRINT 62-N	STRELC
	62	FORMAT (SO TSD ACEVENT OFFATER THAN ALLOWED TH FLENENT NO. + 15)	STRELC
	61		STRFLC
		IF (W (M) +L T + 1 + DE - B) W (W) = D + D	STRFLC
		E N=0 (M) ##3	STRFLC
		AP (N)= -EN CONTRM	STRFLC
			STRFLC
		DO 71 I=1.4	STRFLC
	71	DD(1)=QP(+)/VOL	STRFLC
	-	DD (1,2)=-DD (1,2)	STRFLC
		00(2.1)=00(1.2)	STRFLC
		K=IX (N, 5)	STRFLC
		IF(ICOMPR.EQ.INCCM) GO TO 73	STRFLC
		EE=VQL/(6.0%))	STRFLC
		EE=+EE+W(P)+RM	STRFLC.
		00 72 I=1,2	STRFLC
		D0 72 J=1,2	STRFLC.
	72	EJ([,J]= EE	STRFLC
		€J{1,1}=2.8°EJ{1,1}	STRFLG.
		EJ {2,2} = EJ { 1, 1 }	STRFLC.
	73	CONTINUE	STRFLC.
			STRFLC
		0L=~E(6,K)+V0L=RH/4.0	STRFLC
		TSIN=DL+TF(1,2)	STRFLC
		TCOS=DL*TF(2,1)	STRFLC.
		00 380 I=1.4	STRFLC
		II=I+I	STRFLC.
		AJ(II,1)=AT (II)=TCOS	STRFLC.
		AJ(II-1,1)=AT(II-1)*TSIN	STRFLC.
		AJ(II,Z)=AJ(II,1)	STRFLC.
		AJ(II-1+2)=AJ(II-1+1)	STRFLC.
	300	CONT INUE	STRFLC.
¢			STRFLC.
		IF (NNN.GT.1) GO TO 80	STRFLC.
		IF (SPWT-EQ. W.) GO TO BD	STRFLC.
		UT#* (K(1+2)	SIRFLE
		OPAGE(MI-SENT	STRELC
		u T=06=0T/2. ₩	SIRFLC

I1=IX(N+1) STRFLC I2=IX(N -2) K1=IDEQ(3.11) STRFLC <2=IDEQ(3,I2) STRFLC TLOAD(K1)=TLOAD(K1)+GY STRFLC TLOAD(K2)=TLOAD(K2)-GY STRFLC **80 CONTINUE** STRFLC С STRFLC IF(IPER.GT.1' GO TO 648 STRFLC 00 680 I=1.2 STRFLC 00 688 J=1,2 STRFLC K=IX (N.J) STRFLC. L=IDEST(K) STRFLC. EPRO(1)=EPRO(1)+EJ(1,J)+PHIO(L) STRFLC. 600 CONTINUE STRFLC. DO 610 I=1.8 STRFLC. 00 610 J=1.2 STRFLC K=IX(N,J) STRFLC. L=IDEST(K) STRFLC. CFR0(I)=CFR0(I)+#J(I,J)*PFI0(L) STRFLC. 610 CONTINUE STRFLC. 00 620 J=1.2 STRFLC. K=IX(N,J) STRFLC. K3=IDEQ(3,K) STRFLC. 80(K3)=80(K3)-EPRO(J) STRFLC. 620 CONTINUE STRFLC. 00 630 J=1,4 STRFLC. K#IX{N+J} STRFLC K1=[OEQ(1,K) STRFLC. K2=I DEQ (2 .K) STRFLC. BD(K1)=80(K1)+CPRC(J+J-1) STRFLC. 80 (K2)=80 (K2) +CPRC (J+J) STRFLC. 630 CONTINUE STRFLC. 640 CONTINUE STRFLC. RETURN STRFLC. 470 PRINT 471 .N STRFLC. 471 FORMAT(17H BAD JOINT •N=I3/) STRFLC. LBAD=LBAD+1 STRFLC. RETURN STRFLC. END STRFLC. SUBROUTINE FORMB(S1.T1,IP) STRFLC. COMMON/BLANK/S(4.8),P(10),RSTRS(4),VOL.RRR(5),ZZZ(5),LBAD,RADN, BLANK .: 1 R(4), ZZ(4), IPAT(50), ACELX, ACELY, NRES, RO(12), BLANK. HTYPE, XI .XCE . YCEN, XTR(18), FAC .H(6) .PD(4, 12),QQ(2.4) . 2 BLANK . 3 PRS, FZS, PRT, PZT, EG BLANKER CONMON/EN/ST(4,8),SQ(2,4),AJ(8,2),DD(2,2),QU(4),HR(6),HZ(6) EM.2 * *E1 (5*5) EM.3 DIMENSION HS(6),HT(6),II(6),JJ(6) STRFLC. DATA II/1.3.5.7.9.10/.JJ/2.4.6.8.11.12/ STRFLC C STRFLC. DO 58 I=1.48 STRFLC. 50 PO([)=8.8 STRFLC. SH=1.0-S1 STRFLC. SF=1.0+S1 STRFLC. TM=1.0-T1 STRELC. 7P=1-0+T1 STRFLD. C STRFLC. H(1)=SH#T#/4. STRFLC. STRFLC. H (2) =S#+T #/4. H(3)=SP+TP/4. STRFLC. H [4] =SH#T P/4. STRFLC. H(5)=(1.0-S1*S1) STRFLC.

```
H(6)=(1.0-T1=T1)
                                                                               STRFLC
С
                                                                               STRFLC
      HS(1)=-TH/4.
                                                                               STRFLC
      HS(2)=-HS(1)
                                                                               STRFLC
      HS(3)=TP/4.
                                                                               STRFLC
      HS(4)=-HS(3)
                                                                               STRFLC
      HS(5)=-2. #51
                                                                               STRFLC
      HS(6)=0.0
                                                                               STRFLC
С
                                                                               STRFLC
      HT(1)=-SH/4.
                                                                               STRFLC
      HT (2)=-SP/4.
                                                                               STRFLC
       HT (3 )=+HT (2)
                                                                               STRFLC
      HT (6)=-HT (1)
                                                                               STRFLC
      HT(5)=0.0
HT(6)=-2.*T1
                                                                               STRFLC
C
                                                                               STRFLC
                                                                               STRFLC
       PZT=HT(1)*ZZ(1)+HT(2)*ZZ(2)+HT(3)*ZZ(3)+HT(4)*ZZ(4)
       PZS=HS(1)*ZZ(1)+HS(2)+ZZ(2)+HS(3)+ZZ(3)+HS(4)+ZZ(4)
                                                                               STRFLC
       PRS=HS(1)*RR(1)+HS(2)*RR(2)+HS(3)*RR(3)+HS(4)*RE(4)
                                                                               STRFLC
       PRT=HT (1) *RR(1) +HT (2) *RR (2) +HT (3) *RR (3) +HT (4) *RE (4)
                                                                               STRFLC
      XJ#PRS#PZT-PRT#PZS
                                                                               STRFLC
С
                                                                               STRFLC.
      PSR=PZT/XJ
                                                                               STRFLC.
      PTR=-PZS/XJ
                                                                               STRFLC.
      PSZ=-PRT/XJ
                                                                               STRFLO
      PTZ=PRS/XJ
                                                                               STRFLC.
                                                                               STRFLC.
C
      00 100 I=1,6
                                                                               STRFLC.
      HR (I =PSR+HS(I) +PTR+HT (I)
                                                                               STRFLC.
  100 HZ([]=PSZ*HS(])+PTZ*HT(])
                                                                               STRFLC.
      IF (IP.NE.0) GO TO 150
                                                                               STRFLC.
      R=1
                                                                               STRFLC.
      GO TO 170
                                                                               STRFLC.
  150 R=H(1)*RR (1)+H(2)*RR(2) +H (3)*RR(3)+H (4)*RP(4)
                                                                               STRFLC.
                                                                               STRFLC.
¢
c
      FORM STRAIN DISPLACEMENT PATRIX
                                                                               STRFLC.
Ċ
                                                                               STRFLC.
  170 00 200 K=1.6
                                                                               STRFLC.
      I=II(K)
                                                                               STRFLC.
                                                                               STRFLC.
       J≠JJ{K}
      PD(1,1)=HR(K)
                                                                               STRFLC.
      P0(2,J)=HZ(K)
                                                                               STRFLC.
      IF (IP) 188,198,180
                                                                               STRFLC.
  188 PD(3,1)=H(K)/R
                                                                               STRFLC.
  190 PD(4.1)=HZ(K)
                                                                               STRFLC.
  200 PO(4.J)=HR(K)
                                                                               STRFLC.
                                                                               STRFLC.
      DO 380 K=1.4
                                                                               STRFLC.
      QQ(1,K)=HR(K)
  300 QQ(2,K)=HZ(K)
                                                                               STRFLC.
                                                                               STRFLC.
C
                                                                               STRFLC.
      FAC=XJ#R
      RETURN
                                                                               STRFLC.
                                                                               STRFLC.
      END
      SUBROUTINE ELSTIF (8,80,P0,N)
                                                                               STRFLC.
                                                                               STRFLC.
      LARGE A (125000) ,ID (908)
                                                                               STRFLF.
                                                                              LARGE .
      LARGE IX(301, 5) ,RESID(301, 4) ,R(300) .Z(310),UR(300).UZ(300)
     • .CODE (300) .IDEST (300) .R.KN (50) .R.KS (50) .HT(50) .ICUT (301) .D (300). LARGE .L
     +QP (58) .H(50) . VEL (58) .FR (58) .RE (50).QN (988) .DISPI (388.2). FENP (300) .LARGE .S
     * PHIC(308), IB (388), IDEQ(3,388), KODE (3, 380), IEL (58,2), THP (50,4)
                                                                              LAPGE .F
     TLOAD(988),SIGN(58),SIGT(58),DB0(680)
                                                                              STRFLF.
      COMMCN/BLANK/S(8.8),P(18),RSTRS(4),VGL,RRR(5),ZZZ(5),LBAD,RADN,
                                                                              BLANK .2
```

	:	1 RR(4),ZZ(4),IPAT(50),ACELX,ACELY,NRES,RC(12),	BLANK.
		2 HTYPE,XI,XCE};YCEN,XTR(10),FAC,H(6),PD(4,12),QQ(2,4).	BLANK.
	1	3 PRS, PZS, PRT, PZT, EG	BLANK.
		COMMEN/GEN/NSHELL, IPUNCH, E (7, 12), INDEX, MP, NNN, NCORE, NUMP, ICOMPR,	GEN.2
	4	1 MUHE L; HD 2; HE D (16); D IS PL; NJE LT; I PER; NUH4AT; PSF; PSFJ; X SCL; SPKT	GEN.3
		3 VISC, VSCL +DSCL+ FSCL+ PJCL+ NP(4)+CONLIM+ NAXI+NB+ MBAND+LNGTH+ NEQ+NJH	PGEN.4
		* * MBF LON, NUMA F2, NUMFAP, LH (12) ANF 2	GEN.5
		CONHON/EM/ST(4,8),SQ(2,4),AJ(8,2),DD(2,2),QU(4),HR(6),HZ(6)	EH.2
		• ,EJ (2,2)	EH.3
С			STRFLC
		LARGE B(1),BU(1),FU(1) DIMENSION DV(6) FE(4) FN((1) FN(4) FN(4) D((2))	STRFLC
		BING NSION DAWAY, EE (1/SENGLI) SENGLISE HAIY, OUN (24),	STRFLC
		5 FR (187,1); ((07,133)(07,140)(47,40)(4,14) AAMMAN (255 (25,14 - 6), (27,14 - 6), (37,14) (25,14 - 6)	STRFLC
		CUMPUN/3/17/37 (050/50/50/50/50/50/50/50/50/50/50/50/50/	STRELC
		DATA THEOREVISHTNE CHORE SS/+SSS/+S7735827.557735027.0.0.+.7745967.	STRFLC
		8 - 8 - 7765 - 777 / 1 - 7 - 7 - 7 - 7 - 7 - 7 - 7 - 7 - 7 -	STRELC
С			STRFLC
-		D0 6 I=1.10	STRFLC
		EPRO(I)=0.0	STRFLC
		CFRD (I)=0.0	STRFLO
		PR(I)=0.0	STRFLC.
	6	₱ (]}=0.8	STRFLC.
		DD 2 J=1.16	STRFLC
	_	SE(J)=0=0	STRFLC
	2	SH(J)=0.0	STRFLC
		00 3 JJ=1,32	STRFLC.
			STRFLC.
	3		STRFLU.
	1		STRFLL.
	5		STREEC
			STRELC.
		M=1X (M, 1)	STRFLC.
		RR([]=R(H)	STRFLC.
		ZZ (I)=Z (H)	STRFLC.
	70	CONT INUE	STRFLC
		K=IX (N=5)	STRFLC
		FACT=E(2,K)/((12.*E(3,K))*(1.+E(3,K)))	STRFLC
		C1=(1E(3.K))*FACT	STRFLC
			STRFLC.
		G31103-E(3)KIJ*FAUI #FM_E/L_VI	STRFLG.
			STRFLL.
		TERNI-LIATRICIAL TERNI-LIATRICIAL DI	STRFLU
		TE (ICONPE, FD. INC(N) EEN=1.0	STRFLC.
			STRFLC.
	55	SF([)=0.8	STRFLC.
			STRFLC.
C		FORM STRAIN AND FLOW MATRICES AT THE CENTER OF THE ELEMENT	STRFLC.
C			STRFLC.
		DO 520 I=1+3	STRFLC.
		D(I,4)=0.0	STRFLC.
		D (4, I)=0.0	STRFLC.
		UU 71V J=1+J D/T U=02	SIRFLE.
	210	U 149 JI 766 N 47 - T) - C1	SIRFLL.
	368		STRFLC
		CALL FORMALE. B. B. MAXII	STREIC
		ho Sas Inis	STRELC.
	540	50(I)=PERP*00(I)	STRFLC.
		00 533 I=1,4	STRFLC.

```
DO 533 J=1,8
                                                                            STRFLC
      DO 533 K=1+4
                                                                            STRFLC
  533 ST (1, J) =ST(1, J) +D(1, K) +PD(K, J)
                                                                            STRFLC
                                                                            STRFLC
      K=IX (N,5)
                                                                            STRFLC
                                                                            STRFLC
      NTS=2
                                                                            STRFLC
      IF(NAXI.NE.D) NTS=3
                                                                            STRFLC
      NN={*TS-2}=3
                                                                            STRFLC
                                                                            STRFLC
      DO 588 LR=1.NTS
                                                                            STRFLC
      S1=SSS(LR+NN)
                                                                            STRFLC.
      DO SOS LZ=1.NTS
                                                                            STRFLC.
      T1=S$S(LZ+NN)
                                                                            STRFLC
      CALL FORME(S1,T1, NAKI)
                                                                            STRFLC
      FAC=FAC+TTT (LR+NN)+TTT (LZ+NN)
                                                                            STRFLC
С
                                                                            STRFLC
С
  ****** FORM NODAL LOAD VECTOR *****
                                                                            STRFLC.
C
                                                                            STRFLC.
      IF (ACELY.EQ.S.) GO TO 453
                                                                            STRFLC.
      FACF=FAC+FO (K)+ACELY
                                                                            STRFLC.
      00 451 I=1.4
                                                                            STRFLC.
      J=I+I
                                                                            STRFLC.
  451 P(J)=P(J)-H(I)+FACF
                                                                            STRFLC.
  453 CONTINUE
                                                                            STRFLC.
      IF(IPER.NE.1) GO TO 58
                                                                            STRFLC.
      DC 57 I=1.8
                                                                            STRFLC.
      DO 57 J=1.4
                                                                            STRFLC.
   57 PR(I)=PR(I) +RESID(N, J) *PD(J, I)*FAC
                                                                            STRFLC.
   58 CONTINUE
                                                                            STRFLC.
С
                                                                            STRFLC.
С
      K NATRIX
                                                                            STRFLC.
С
                                                                            STRFLC.
      00 98 I=1.8
                                                                            STRFLC.
      D1={C1+PB(1,E)+C2+PD(2,E)+C2+PB(3,E))+FAC
                                                                            STRFLC.
      D2=(C2*PD(1+I)+C1*PD(2+I)+C2*PD(3+I))*FAC
                                                                            STRFLC.
      D3=(C2*PD(1,1)+C2*PD(2,1)+C1*FD(3,1))*FAC
                                                                            STRFLC.
      D4=(C3+PD(4+1))*FAC
                                                                            STRFLC.
      DO 90 J=I.8
                                                                            STRFLC.
   90 SF(J,I)=SF(J,I)+D1*PD(1,J)+D2*PD(2,J)+D3*PD(3,J)+D4*PD(4,J)
                                                                            STRFLC.
С
                                                                            STRFLC.
C
      C AND E MATRICES
                                                                            STRFLC.
                                                                            STRFLC.
      FACN=FAC*EEN
                                                                            STRFLC.
      DO 100 I=1,8
                                                                            STRFLC.
      D8=P0(1,I)+P0(2,I)+P0(3,I)
                                                                            STRFLC.
      DO 108 J=1,4
                                                                            STRFLC.
  100 SC([,J)=H(J)*D8*FACN+SC(I,J)
                                                                            STRFLC.
      IF (ICOMPR.EQ.INCCH) GO TO 150
                                                                            STRFLC.
      FACH=FAC/E(5+K)
                                                                            STRFLC.
      DO 130 I=1,4
                                                                            STRFLC.
      DO 130 J=1.4
                                                                            STRFLC.
  130 SE([,J)=H(I)+H(J)+FACH+SE(I,J)
                                                                            STRFLC.
  150 CONTINUE
                                                                            STRFLC.
C
                                                                            STRFLC.
С
      H HATRIX
                                                                            STPFLC.
¢
                                                                            STRFLC.
      FACK=FAC* FERM
                                                                            STRFLC.
      00 170 I=1,4
                                                                            STRFLC.
      DX(I)=DX(I)+FACK+(QQ(1,I)+ACELX+QQ(2,I)+(-1.8))+SPWT
                                                                            STRFLC.
      DO 178 J=1.4
                                                                           STRFLC.
      HH=QQ(1,1)+QQ(1,J)+QQ(2,J)+QQ(2,J)
                                                                           STRFLC.
```

```
170 SH(I.J)=HF*FACK+SH(I.J)
                                                                               STRFLC
  500 CONTINUE
                                                                               STRELC
С
                                                                               STRFLC
C ******* FORH GLOBAL HODAL LCAD VECTOR *****
                                                                               STRELC
C
                                                                               STRFLC
       IF(NNN.GT.1) G0 T0 503
                                                                               STRFLC
       DO 501 J=1.4
                                                                               STRELC
      K=IX (N.J)
                                                                               STRFLC
      K1=I0EQ(1,K)
                                                                               STRELC
      K2=IDEQ(2+K)
                                                                               STRFLC
       TLOAD(K1)=TLOAD(K1)-P(J+J-1)
                                                                               STRFLC
       TLOAD(K2)=TLOAD(K2)-P(J+J)
                                                                               STRFLC
       IF(IPER.GT.1) GO TO 501
                                                                               STRFLC
      80(K1)=80(K1)-PR(J+J-1)
                                                                               STRFLC
       50(K2)=80(02)-PR[J+J)
                                                                               STRFLC
  501 CONTINUE
                                                                               STRFLC
      IF(SPHT.EC.0) GO TO 503
                                                                               STRFLC
      DO 542 I=1.4
                                                                               STRFLC
       J=IX (N.I)
                                                                               STRFLC
                                                                               STRFLC
       K#IDEQ(3,J)
      TLOAD(K)=TLOAD(K)-DX(I)
                                                                               STRFLC
  502 CONTINUE
                                                                               STRFLC
  503 CONTINUE
                                                                               STRFLC
      DO 505 I = 1.8
DO 505 J = 1.1
                                                                               STRFLC
                                                                               STRFLC
  585 SF(J,I) = SF(I,J)
                                                                               STRFLC
c
                                                                               STRFLC
      IF(IPER.GT.1) GO TO 830
                                                                               STRFLC
      DD 800 I=1.4
                                                                               STRFLC
      DO 800 J=1.4
                                                                               STRFLC.
      K = [X (H_{2}J)]
                                                                               STRFLC
      L=IDEST(K)
                                                                               STRFLC.
      EPRO(I)=EPRO(I)+SE(I,J)+PHIO(L)
                                                                               STRFLC
  800 CONTINUE
                                                                               STRFLC
      00 810 I=1.8
                                                                               STRFLC
      00 810 J=1.4
                                                                               STRFLC
      K=IX(N,J)
                                                                               STRFLC
      L=IGEST (K)
                                                                               STRFLC
      CFRO(I)=CPRO(I)+SC(I,J)+PHIO(L)
                                                                               STRFLC.
  810 CONTINUE
                                                                               STRFLC
      00 820 J=1,4
                                                                               STRFLC.
      K=IX (N, J)
                                                                              STRFLC.
      K1=IDEQ(1+K)
                                                                              STRFLC.
      K2=IDEQ(2.K)
                                                                              STRFLC.
      K3=I0EQ (3,K)
                                                                              STRFLC.
      BO(K1)=BO(K1)+CPRC(J+J-1)
                                                                              STRFLC.
      $0(K2)=80(K2)+CFR({J+J}
                                                                              STRFLC.
      80(K3)=80(K3)-EPR((J)
                                                                              STRFLO.
  820 CONTINUE
                                                                              STRFLC.
  838 CONFINUE
                                                                              STRFLC.
  615 CONTINUE
                                                                              STRFLC.
      WRITE (9) ST, SQ, NP
                                                                              STRFLC.
      WRITE (8) SF. SC. SH. SE. NP
                                                                              STPFLC.
С
                                                                               STRFLC.
  708 RETURN
                                                                              STRFLC.
¢
                                                                              STRFLC.
¢
                                                                              STRFLC.
                                                                              STRFLC.
      END
      SUBROUTINE AS MOLE (DT, A1, A2, N, SF, SC, SH, SE, IDEQ, NQ, NNP, IDEST, NH)
                                                                              STRFLC.
С
                                                                              STRFLC.
      CONMON/BLANK/S(4,8),P(10) .RSTRS(4), VCL .RRR(5) . ZZZ(5) .L840 .RADN.
                                                                              BLANK .2
     1
                          RR(4), ZZ (4), IPAT(50), ACELX, ACELY, NRES, RO(12),
                                                                              BLANK.2
```

```
HTYPE, XI, XCE +, YCEN, XTR(10), FAC, H(6), PD(4, 12), QQ(2,4).
    2
                                                                             BLANK.
         PRS. FZS. PRT. PZT.EG
                                                                             BLANK .
      COMMCN/GEN/NSHELL.IPUNCH.E (7.12) .INDEX.MP, NHN, NCOFE, NUMP.ICCMFR, GEN.2
           NUHEL, ND2, HED (16), DISPL, NJELT, IPER, NUHAAT, PSF, PSFJ, KSCL, SPHT, GEN.3
     1
     JVISC, VSCL, DSCL, FSCL, FJCL, NP(4), COLIM, NAXI, NB, HEAND, LNGTH, NEQ, NJHPGEN, 4
     ٠
           + MBF LOW, NUMNF2, NUMFNP .LM (12 ) .NF2
                                                                             GEN.5
      COMMON/EM/ST(4,8),SQ(2,4),AJ(0,2),DD(2,2),QJ(4),MR(6),HZ(6)
                                                                             EM.2
    + ,EJ (2,2)
                                                                             EN.3
С
                                                                             STRFLC
      LARGE A1(AQ,1), A2(NNP,1), IDEST(1), IDEQ(3,1)
                                                                             STRFLC
                                                                             STRFLC
С
      DIMENSION SF(8,1),SC(8,1),SH(NH, 1),SE(NH, 1)
                                                                             STRFLC
                                                                             STRFLC
                                                                             STRFLC
      L=1
      DD 703 I=1.4
                                                                             STRFLC
                                                                             STRFLC
      J=NP(I)
      DO 784 K=1,2
                                                                             STRFLC
      LH(L)=IDEC(K,J)
                                                                             STRFLC
 704 L=L+1
                                                                             STRFLC
 713 LM(I+8)=IDEQ(3,J)
                                                                             STRFLC
                                                                             STRFLC
      13=12
      IF (MTYPE.GT.NSHELL) IJ=10
                                                                             STRFLC
                                                                             STRFLC
      DO 701 I=1,8
      II=LH(I)
                                                                             STRFLC
      DO 702 J=1,8
                                                                             STRFLC
      JJ=LH(J)-II+1
                                                                             STRFLC
 702 IF(JJ+GT+0) A1(II+JJ)=A1(II+JJ)+SF(I+J)
                                                                             STRFLC
                                                                             STRFLC.
      DO 701 J=9+IJ
      JJ=LH(J)-II+1
                                                                             STRFLC.
 701 IF(JJ.GT.0) A1(II.JJ)=A1(II.JJ)+SC(I.J-8)
                                                                             STRFLC.
      00 785 I=9,IJ
                                                                             STRFLC
      II=LH(I)
                                                                             STRFLC.
      L=1
                                                                             STRFLC.
      D0 786 K=1.4
                                                                             STRFLC.
      K2=L+L
                                                                             STRFLC.
      K1=K2-1
                                                                             STRFLC.
      KK=LH(K1)-II+1
                                                                             STRFLC.
      LL=LH(K2)-II+1
                                                                             STRFLC.
      IF (KK.GT.D) A1(II,KK)=A1(II,KK)+SC(K1,I-8)
                                                                             STRFLC.
      IF(LL.GT.#) A1(II.LL)=A1(II.LL)+SC(K2,I-8)
                                                                             STRFLO.
                                                                             STRFLC.
 706 L=L+1
      00 785 J=9.IJ
                                                                             STRFLC.
      JJ=LH(J)-II+1
                                                                             STRFLC.
 785 IF(JJ.GT.8) A1(II.JJ)=A1(II.JJ)-SH(I-8.J-8)+DT-SE(I-8.J-8)
                                                                             STRFLC.
      ÍJ=4
                                                                             STRFLC.
      IF (MTYPE. CT. NSHELL) IJ=2
                                                                             STRFLC.
      00 720 I=1.IJ
                                                                             STRFLC.
      I1=NP(I)
                                                                             STRFLC.
      LL=IDEST(I1)
                                                                             STRFLC
     DD 700 J=I.IJ
                                                                             STRFLC.
      J1=NP(J)
                                                                             STRFLC.
      KK#IDEST(J1)
                                                                             STRFLC.
      LLF=MINB(LL+KK)
                                                                             STRFLC.
      HEF= IA8S( LL-KK) +1
                                                                             STRFLC.
      A2(LLF, MBF) =A2(LLF, MBF)+SH(I,J)
                                                                             STRFLC.
                                                                             STRFLC.
      IF(NNP.GT.NUNFNP) A2(LLF,NBFLOW+NBF)=A2(LLF,NBFLOW+98F)-SE(I.J)
 768 CONTINUE
                                                                             STRFLC.
1000 RETURN
                                                                            STRFLC.
      ENC
                                                                            STRFLC.
      SUDROUTINE SOLVES (THETA, DT.TIME.A1, 2.8.80, PO.HI.ID. NOH, HO. NUMAP, STRFLC.
    *NEQ.NEL.NSH.HBAND.HBFLOW, NUMFRP.ICOMPR.IDEST, INDEX, IPER, NNN, IDEO, STRFLP.
    . PHIC.Q.IP. A.QA. NF2.TL)
                                                                            STRFLC.
```

STRFLC LARGE A1(NEQ,1),A2(1),B(1),B0(1),P0(1),ID(3,1),HB(1),TL(1), STRFLC *HBH(1), HI (1), IDEST(1), IDEG(3,1), PHID(1),Q(1),Q0(1),QA(1) STRFLC DIMENSION Q2 (680) STRFLC DATA INCOM/10HINC CHPRESS/ STRFLF С STRFLC С STRFLC C*****SET-UP LOAD VECTOF AND SOLVE STRFLC Ċ STRFLC STRFLC DTH = DT/2. TOTH = THETAPOTH STRFLC HTOT = OTH - TOTH STRFLC T DTH 2=2 .8 *T 01 H STRFLC IF(ICOMPR.EQ.INC(%) TOTH2=TOTH STRFLF HTDT 2=2.0*HTDT STRFLC 00 230 I=1, NU HNP STRFLC DO 230 J=1.3 STRFLC K=IDEQ(J.I) STRFLC. IF(ID(J+I)+LE+0) GO TO 230 STRFLC. STRFLC CALL HODIFY (K+A1+NEQ) 230 CONTINUE STRFLC NH=NUMENP+MBELOW STRFLC IF(NF2.EQ.NM) GC TO 351 STRFLC STRFLC. L1=NH+1 L2=NUHFNP+1 STRFLC L3=NUMFNP+L2 STRFLC 351 IF(IPER.GT.1) GO TO 940 STRFLC CALL PROFIL (A2(1) +MBH(1) +NUMEND+ MBFLOW) STRFLC. IF (NF2.GT.NM) CALL PROFIL (A2(L1), MBH(L3), NU4FNP, MBFLON) STRFLC 900 CALL TRIA (NEQ, MBAND, A1, HB) STRFLC. IF(NNN.GT.1) GC TO 250 STRFLC. DC 340 I=1. NUMNP STRFLC. J=IDEQ(3,I) STRFLC. K=IDEST(I) STRFLC. Q2(K)=3(J) STRFLC. Q2(NUMENP+K)=Q2(K)STRFLC. 348 PHIO(K)=PC(J) STRFLC. 00 330 I=1, NUMENP STRFLC IF (IB(I) +LE+0) QQ(I)=QQ(I)+TOTH2+QQ(NUMFNP+I) STREFT 2. IF (NF2.LE.NM) GD TO 330 STRFLC. HI(NUMENP+I)=PHIC(I) STRFLC. 330 HI(I)=HI(I)+TOTH* FHIO(I) STRFLC. 331 CONTINUE STRFLO. IF(ICOMPR.NE.INC(H) GO TO 345 STRFLP. DO 260 I=1, NUMENP STRFLP. 260 QA(1)=0.0 STRFLF. GO TO 250 STRFLP. 345 CONTINUE STRFLF. CALL MLTPLY (A2(1), 02(1), HI(1), 0A(1), MBH(1), NUMNP, NUMFNP) STRFLC. IF(IPER.GT.1) GO TO 250 IF(NF2.GT.NH) CALL MLTPLY(A2(L1),Q2(L2).HI(L2),QA(L2),MBH(L3), STRFLC. STRFLC. X NUMMP.NUPFNP) STRFLC. 250 CONTINUE STRFLC. IF(NNN.NE.1) GD TO 240 STRFLC. D0 242 I=1, NUMENP 242 QA(I)=QA(I)+QQ(I) STRFLC. STRFLC. IF (NF2.LE.NM) GC TO 240 STRFLC. IF (IPER.GT.1) GO TO 240 STRFLC. STRFLC. 00 245 I=1. NUMFNP STRFLC. 245 QA(I)=QA(I)+QA(I+NUHFNP) STRFLC. 240 CONTINUE 00 241 I=1. NUMNP STRFLC.

```
STRFLC
      L=IDEST(I)
      <=IDEQ(3,1)
                                                                               STRELC
      TL(K)=0.0
                                                                               STRFLC
                                                                               STRFLC
  241 B (K)=QA (L)
  D0 255 I=1.NE0
255 B(I)=B(I)+B0(I)+TL(I)
                                                                               STEFLC
                                                                               STRFLC
      CALL BACKS (NEQ. MBAND, A1, 8, HB)
                                                                               STRFLC
  276 IF (NNN. NE . IPI RETURN
                                                                               STRFLC
      DO 270 I=1, NUMNP
                                                                               STPFLC
      K3=IDEQ(3.1)
                                                                               STRFLC
      L=IDEST(I)
                                                                               STRFLC
      Q2(NUMFNP+L)=8(K3)
                                                                               STRFLC
  270 CONTINUE
                                                                               STRFLC
      DO 280 J=1. NUMENP
                                                                               STRFLC
      IF( 18(J).LE.C ) QQ(J)=QQ(J)+HTOT2*QQ(NUNFNP+J)
                                                                               STRFLF
  280 HI(J)=HI(J)+HTDT+PHIO(J)+OTH+O2(NUHFNP+J)
                                                                               STRFLC
                                                                               STRFLC
  275 RETURK
 2009 FORMAT(118, 5220.5)
                                                                               STRFLC
                                                                               STRFLC.
      END
      SUBROUTINE MODIFY (N. A1 . NEQ)
                                                                               STRFLC
      LARGE ALINE Q. 1)
                                                                               STRFLC.
      A1 (N,1)=1.0E+20
                                                                               STRFLC.
                                                                               STRFLC
       RETURN
                                                                               STRFLC.
      END
      SUBROUTINE PROFIL (AZ .HB, NEQ, HBAND)
                                                                               STRFLC.
                                                                               STRFLC
      LARGE A2(NEQ, 1), MB(1)
                                                                               STRFLC.
С
                                                                               STRFLC.
      NN=NEQ# HBAND
      00 380 N=1.NEQ
                                                                               STRFLC.
      NI=Ö
                                                                               STRFLC.
      NJ=0
                                                                               STRFLC.
      L = 0
                                                                               STRFLC.
      IL=N+NEQ
                                                                               STRFLC.
      00 100 1= IL .NN. NEQ
                                                                               STRFLC.
      LsL+1
                                                                               STRFLC.
      IF (A2(1).NE.0.0) MI=1
                                                                               STRFLC.
      IF (N-L) 100,100.80
                                                                               STRFLC.
                                                                               STRFLC.
   80 IF (A2(I-L).NE.0.0) NJ=I-L
  100 CONFINUE
                                                                               STRFLC.
                                                                               STRFLC.
      HB(N)=NI
      MG (N +NEQ) =NJ
                                                                               STRFLC.
  300 CONFINUE
                                                                               STRFLC.
      RETURN
                                                                               STRFLC.
      FNO
                                                                               STRFLC.
      SUBROUTINE TRIA (NEQ, M.A1, MB)
                                                                               STRFLC.
C
                                                                               STRFLC.
      LARGE A1(1) MB(1)
                                                                               STRFLC.
                                                                               STRFLC.
C
                                                                               STRFLC.
      NE=NEQ-1
      HN=H-1
                                                                               STRFLC.
      MM=MN"NEQ
                                                                               STRFLC.
      MK=NEQ-HN
                                                                               STRFLC.
      DO 300 N = 1. NE
                                                                               STRFLC.
      NT=N-HK
                                                                               STRFLC.
                                                                               STRFLC.
      EF(NT.GT.Q) HMEHH-NEQ
      NB (N )=0
                                                                               STRFLC.
                                                                               STRFLC.
      IF (A1(N).EQ.0.0) GO TO 300
      L=N
                                                                               STRFLC.
      IL=N+NEO
                                                                              STRFLC
                                                                              STRFLC.
      IH=N+MM
      J8 = 0
                                                                              STRFLC.
      I8 = 8
                                                                               STRFLC.
```

```
DG 200 I=IL, IH, NEO
                                                                              STRFLC
      L=L+1
                                                                              STRFLC
      J=L
                                                                              STRFLC
      18=[8+1
                                                                              STRFLC
      C=A1 (I)/A1(N)
                                                                              STRELC
      IF (C.EQ. 8.8) GO TO 200
                                                                              STRFLC
      DO 180 K=I.IH.NEQ
                                                                              STRFLC
      A1(J)=A1(J)-C*A1(K)
                                                                              STRFLC
  100 J=J+NEQ
                                                                              STRFLC
      A1(I)=C
                                                                              STRFLC
      JBFIB
                                                                              STRFLC
  200 CONTINUE
                                                                              STRFLC
                                                                              STRFLC
      H8(N)=JB
  300 CONTINUE
                                                                              STRFLC
      NO (NEQ)=
                                                                              STRFLC
      RETURN
                                                                              STRFLC
      END
                                                                              STRFLC
      SUBROUTINE NLTPLY (A2.8.H1.QQ.M8.WEQ. MUNFNP)
                                                                              STRFLC.
С
                                                                              STRFLC.
      LARGE A2(NUPFNP,1),H8(1),H1(1),QQ(1)
                                                                              STRFLC.
      DIMENSION 8(1)
                                                                              STRFLC.
С
                                                                              STRFLC.
      MM=NUMFNP-1
                                                                              STRFLC.
      00 300 N1=1,NUNFNP
                                                                              STRFLC.
      BB=#2(N1)*H1(N1)
                                                                              STRFLC.
      L=N1
                                                                              STRFLC.
      IL=N1+NUMFNP
                                                                              STRFLC.
      IH=HB(H1)
                                                                              STRFLC
                                                                              STRFLC.
      IF (EH) 120 .120,50
   50 DC 180 I=IL, IH, NUMENP
                                                                              STRELC
                                                                              STRFLC.
      L=L+1
      BB=BE+A2(I) +H1(L)
                                                                              STRFLC.
  100 CONTINUE
                                                                              STRFLC
  120 L=N1
                                                                              STRFLC.
                                                                              STRFLC.
      IL=H1+HM
      IH=HE(N1+NUPFNP)
                                                                              STRFLC.
      IF (IH) 250,250,150
                                                                              STRFLC.
  150 00 200 I=IL, IH, MH
                                                                              STRFLC.
      L BL + 3
                                                                              STRFLC.
      88×82+42(1)*H1(L)
                                                                              STRFLC.
  200 CONTINUE
                                                                              STRFLC.
  250 $ (N1)=88+8(N1)
                                                                              STRFLC.
      QQ(N1)=8(N1)
                                                                              STRFLC.
  300 CONTINUE
                                                                              STRFLC.
      RETURN
                                                                              STRFLC.
                                                                              STRFLC.
      END
      SUBROUTINE BACKS(NN. MH.A1. E. MB)
                                                                              STRFLC.
С
                                                                              STRFLC.
      LARGE A1(1),8(1), M8(1)
                                                                              STRFLC.
C
                                                                              STRFLC.
      HHP= HH=1
                                                                              STRFLC.
      N=0
                                                                              STRFLC.
  270 N=N+1
                                                                              STRFLC.
      C=B(N)
                                                                              STRFLC.
      IF (A1(N).NE.8.0) B(N)=8(N)/A1(N)
                                                                              STRFLC.
                                                                              STRFLC.
      IF(N.EQ.NN) GO TO 300
                                                                              STRFLC.
      IL=N+1
                                                                              STRFLC.
      IH=N+MB(N)
                                                                              STRFLC.
      위도처
      DO 285 I=IL.IH
                                                                              STRFLC.
                                                                              STRFLC.
      H=H+Nh
  285 B(I)=8(I)-A1(M)*C
                                                                             STRFLC.
```

```
GO TO 270
                                                                                 STRFLC
С
                                                                                 STRELC
  300 IL=N
                                                                                STRFLC
      N=N-1
                                                                                 STRFLC
      IF (N.EQ.0) RETURN
                                                                                 STRFLC
      IN = N+MB(N)
                                                                                 STRFLC
      M=N
                                                                                 STRFLC
      C=B(N)
                                                                                 STRFLC
      00 400 I=IL,IH
                                                                                STRFLC
      N=H+NN
                                                                                 STRFLC
  400 C=C-A1(H) *8(I)
                                                                                STRFLC
       B (N) =C
                                                                                 STRELT
      GO TO 380
                                                                                STRFLC
с
                                                                                STRFLC
                                                                                 STRFLC
      ENL
      SUBROUTINE STRFL0(8.80.00.TIME.IP.FLAG.NCC.)T)
                                                                                STRFLC
                                                                                STPFLC
C
      LARGE A (125 088) ,ID (908)
                                                                                STRFLP
      LARGE 1x(301, 5) ,RESID(301, 4),R(300),Z(300),UR(300),UZ(300)
                                                                                LARGE .
     • .CODE (300) .IDE $T (300) .R.KN(50) .R.KS (50) .WT (50) . IGUT (301) .Q(300) . LARGE.
     * 9 P (5 #) . # (5#) . YEL (50) . FR (5#) . RE (5#) . QN (9#0) . J ISPI (308-2) . TEMP (300) . LARGE .
     PHIO(300), IB(300), IDEQ(3, 300), COE (3, 300), IEL (50, 2), INP (50, 4)
                                                                                LARGE .
     +, TLOAD (980) ,SIGN (50) ,SIGT (50) ,DBC (680)
                                                                                STRFLP
      COMMON/BLANK/S(8,8)+P(10) +RSTRS(4)+VOL+RRR(5)+ZZZ(5)+LBAD+RADN+
                                                                                BLANK.
                           RR(4), 22(4), 1FAT(50), ACELX, ACELY, NRES, RO(12),
                                                                                BLANK.
     1
            MTYPE, XI .XCEN.YCEN.XTR(10).FAC.H(6).PO(4.12).QQ(2.4).
     2
                                                                                BLANK .
          PRS, PZS, PRT, PZT, EG
     3
                                                                                BLANK.
      CONNENJERNINSHELL.IPUNCH.E (7.12) .INDEX.NP. NNN.NCORE.NUMNP.ICONPR. GEN.2
            NUMEL, ND2, HED (16), DIS PL, NJELT, IPER, NUMMAT, FSF, PSFJ, KSCL, SFWT, GEN. 3
     3VISC, VSCL, DSCL, FSCL, PJCL, AP(4), CONLIM, NAXI, NB, MEAND, LNGTH, NEQ, KJMPGEN.4
            . HBFLOW, NUMAP2, NUMENP, LH(12), HFZ
                                                                                GEN.5
      COMMON/CCFOOL/XHIN, XHAX, YMIN, YHAX, CCXMIN, CCKMAX, CCYMIN, CC YMAX
                                                                                CCPOCL.
      CONNEN/EH/ST(4, 8) .SQ(2,4) .AJ(8,2) .DD(2,2).QU(4).HR(6).HZ(6)
                                                                                EH.2
       +EJ (2+2)
                                                                                EM.3
      LARGE 8 (1), 80 (1), PD(1)
                                                                                STRELC.
      DIMENSION SIG (7) . TP(6) . Q8(4)
                                                                                STRFLC
                                                                                STRFLC
      LOGICAL FLAG
С
                                                                                STRFLC
С
      COMPUTE ELEMENT STRESSES
                                                                                STRFLC-
                                                                                STRFLC.
    1 MPRINT=0
REWIND 9
                                                                                STRFLC.
      QFODR=0.0
                                                                                STRFLC.
      HJ= 0
                                                                                STRFLC.
      PI=4.0*ATAN(1.0)
                                                                                STRFLC.
      RADN=180.0/PI
                                                                                STRFLC.
      RADZ=0.5+RADN
                                                                                STRFLC.
      P12=2.8*ATAN(1.0)
                                                                                STRFLC.
      IF (INDEX. ME.0) PRINT 2001, TIME, MP.IPER
                                                                                STRELC.
      IF (IPER .EQ. 1) XMI =-1.0E15
                                                                                STRFLC.
С
                                                                                STRFLC.
      IF (INDEX .LT. 2) GO TO 10
                                                                                STRFLC.
      IF (XMIN .LT. XMI) GO TO 7
                                                                                STRFLC.
      RCON = (XHAX-XHIN) * 8.125 /(CCXHAX-CCXHIN)
                                                                                STRFLC.
      YCON = (YHAX-YHIN) * 0.125 / (CCYMAX-CCYHIN)
                                                                                STRFLC
      XPC = 0.05
                                                                                STRFLC.
      YPC = 8.85
                                                                                STRFLC.
      XHI = XHIN
                                                                                STRFLC.
      XMA = XMA3
                                                                                STRFLC.
      YMI = YMIN
                                                                                STRFLC.
      YMA = YMAX
                                                                                STRFLC.
      DEL = XPC = (XMAX - XMIN)
                                                                                STRFLC.
```

```
XMIN = XMIN - DEL
                                                                                     STRFLC
       XMAX = XMAX + DEL
                                                                                     STRFLC
       DEL = YPC * (YMA) - YMIN)
                                                                                     STRFLC
       YMIN = YMIN - DEL
                                                                                     STRFLC
       YMAX = YHAX + DEL
                                                                                     STRFLC
       DEL = XPC * (CCXMAX - CCXMIN)
                                                                                     STRFLC
       CCXMIN = CCXMIN - DEL
                                                                                     STRFLC
       CCXHAX = CCXHAX + DEL
                                                                                     STRFLC
       DEL = YPC * (CCYPAX - CCYMIN)
                                                                                     STEFLC
       CCTHIN = CCTHIN - DEL
                                                                                     STRFLC
       CCYMAX = CCYMAX + DEL
                                                                                     STRFLC
                                                                                     STRFLC
    7 WRITE (98, 5) HED, HP, IPER
                                                                                     STRFLC
     5 FORMAT (8A9/8A9/17H ITERATION RUNGERI4,20H PERTUREATION NUMBERI4) STRFLC
       CALL COLTS (-1.8. 0.5. 1. 2)
                                                                                     STRFLC
       CALL COLGL (1,1)
                                                                                     STRFLC
       CALL CCPLCT ( XMI, YMI, 1, GHNOJOIN, 8, 1)
CALL CCPLCT ( XMIN, YMIN, 1, GHNOJOIN, 8, 1)
CALL CCPLCT (XMA, YMIN, 1, GHNOJOIN, 1, 1)
CALL CCFLOT (XMAX, YMIN, 1, GHNOJOIN, 1, 1)
                                                                                     STRFLC
                                                                                     STRFLC
                                                                                     STRFLC
                                                                                     STRFLC
       CALL COPLOT (XMI, YMA, 1. 6HNOJOIN, 9, 1)
                                                                                     STRFLC
       CALL CCPLOT (XMIN, YMAX, 1, 6HNOJOIN, 1, 1)
Call CCPLCT (XMA, YMA, 1, 6HNOJOIN, 1, 1)
Call CCPLCT (XMAX, YMAX, 1, 6HNOJOIN, 1, 1)
                                                                                     STRFLC
                                                                                     STRFLC
                                                                                     STRFLC
С
                                                                                     STRFLC
   10 DO 300 N=1. NUMEL
                                                                                     STRFLC
                                                                                     STRFLC
       IF (INDEX .EQ. 0) GO TO 15
                                                                                     STRFLC
       MPRINT = PPRINT - 1
                                                                                     STRFLC
                                                                                     STRFLC
       IF (PPRINT .GT. 0) GO TO 15
       MPRINT = 50
                                                                                     STRFLC
¢
                                                                                     STRFLC
   15 IX(N,5)=IABS(IX(N,5))
                                                                                     STRFLC
       NTYPE = IX(N,5)
                                                                                     STRFLC
с
                                                                                     STRFLC.
       IF(INDEX. NE .2) GO TO 110
                                                                                     STRFLC
       DO 16 I=1.4
                                                                                     STRFLC
       J=IX (N. I)
                                                                                     STRFLC
       K1=I DEQ (1 .J)
                                                                                     STRFLC.
       K2=IDEQ(2.J)
                                                                                     STREFC
       XTR(I)=R(J)+8(K1)=DISPL
                                                                                     STRFLC
       II=I+5
                                                                                     STRFLC
   16 XTR(II)=Z(J)+E(K2)+DISPL
                                                                                     STRFLC.
       XTR(5)=XTR(1)
                                                                                     STRFLC.
       XTR(10}=XTR(6)
                                                                                     STRFLC.
                                                                                     STRFLC
       COR = 3
                                                                                     STRFLC.
       XCEN = XTR(1) + XTR(2) + XTR(3)
                                                                                    STRFLC.
       YCEN = XTR(8) + XTR(6) + XTR(7)
                                                                                    STRFLC.
       IF (N3 .EG. N4) GO FO 20
                                                                                    STRELC
       COR = 4
                                                                                     STRFLC.
       XCEN = XCEN + XTR (4)
                                                                                    STRFLC.
       YCEN = YCEN + XTR (9)
                                                                                    STRFLC.
   20 XCEN = XCEN / COR
                                                                                     STRFLC.
       YCEN = YCEN / COR
                                                                                    STRFLC.
       IF (HTYPE .GT. NSHELL) GO TO 290
                                                                                    STRFLC.
                                                                                    STRFLC.
с
       PLOT GRID INCLUDING DISPLACEMENTS
                                                                                    STRFLC.
      CALL COPLOT (XTR(1), XTR(E), 5, 4HJOIN)
                                                                                    STRFLC.
                                                                                    STRFLC.
      COR = COR
                                                                                    STRFLC.
      00 50 NC = 1.KOR
                                                                                    STRFLC.
```
	W1=IX(N=NC)	STRFLC
	NI=IDEQ(1.N1)	STRFLC
	EF (B(NI) .EQ. 0.0) 60 TO 30	STRFLC
	XC = XCON	STRFLC
	IF (XTR(NC) .GT. XCEN) XC = -XCON	STRFLC
	YC = YCON	STRFLC
	IF (XTR(NC+5) .GT. YCEN) YC = -YCON	STRFLC
	XC = XTRENCI + XC	STRFLC
	YC = XTR(NC+5) + YC	STRFLC
	NS=0	STRELL
	IF(B(NI),G(.0.0) NS=0	STRFLE
**	CALL COPLUTTRUE TOU 10 DEMOUJULES RD. 17	STRELL
30	CONI THOE	518760
~		STRELC
Č	TEINTYPE, 61, NSHELLL 60 TO 200	STRFLC
***	PEAD (9) ST_SO_NP	STREEC
	NO 31 Tet.4	STRELC
	SIG(I)=RESID(N.I)	STRFLC
31	QU(1)=0.0	STRFLC
	POAVE=0.0	STRFLC
	PAVE=0.0	STRFLC
	00 50 I=1,4	STRFLC
	NI=NP(I)	STRFLC
	L=IDEQ(1,NI)-1	STRFLC
	M=2* I-1	STPFLC
	NH=N+1	STRFLC
	DD 40 K=H+HH	STRFLC.
		STRELL
	UU 40 J#144 OTC/ 11-CTC/ 11-CT/ 1 / 180/1 1	SIRFLL
40	STRIDIESTRIDIESTRIDIESTRICI	514766
	L=1UEW(3) F1 7	514766.
	PAVE + PAVE + R (1 1/4_0	STRELL
	NG 45 K=1.2	STRELC
45	OU(K)=OU(K)+SO(K.J)*B(L)	STRFLC
50	CONT INUE	STRFLC
	PDIFF=E(4.HTYPE)*(PAVE-PDAVE)	STRFLC
	D0 55 I=1+3	STRFLC.
55	SIG(I)=SIG(I)+PDIFF	STRFLC
	GEFF=SPWT*E(1,MTYPE)/VISC	STRFLC.
	QU11]=-QU(1)	STRFLC.
	QU(2)=-(QU(2)+GEFF)	STRFLC.
	CC= (SIG(1)+SIG(2))/2.8	STRELC
	68=(516(1)=516(2))/2.0	SIRFLL.
	CRESCRI 135**2 *314 (4)**21	518760
	SIC(S)=CC-CP	STREET
	TE (STE(6).ST.18E-15.08.88.6T.10E-15) 60 TO 80	STRFLC.
	FPS=1.74539816	STRELC
	SIG(7)=100.0	STRELC
	GO TO 90	STRFLC
80	SIG(7)=RAD2=ATAN2(SIG(4),88)	STRFLC.
	EPS=ATAN2 (SIG (4), BB) /2.0	STRFLC.
98	AA=ABS(QU(1))	STRFLC.
	IF (AA.GT.102-30) 60 TO 100	STRFLC.
	ANGEFIZ	STRFLC
		STRFLC.
100	ANC-SONT(8)	SIRFLU
	ANG-STAK(ANC)	SIMPLL.
	AND - ALCONAUT AND - ALCONAUT	SIRFUL.
284	##101-#4111.(CA91400)E14A4(CL.(9tuleum)C)	318766

```
QU(4)=ANG*PADN
                                                                           STRFLC
      IF(INDEX.E0.8) GO TO 271
                                                                           STRFLC
      PRINT 270, N. (SIG(I), I=1,7), (QU(J), J=1,4)
                                                                           STRFLC
  270 FORMAT(18,1210.2)
                                                                           STPFLC
 2001 FCRHAT(1H1/*
                          STRESSES AND FLOWS AT TIME
                                                           *.F10.3//*
                                                                           STRFLC
     1ITERATION NUMBER
                           *+14+*
                                      PERTURBATION NUMBER .. 14. //
                                                                           STRFLC
     2* ELEMENT*.4X.*SIGR*.6X.*SIGZ*.5X.*SIGT*.6X.*SIGR2*.5X.*SIGHAX*.
                                                                           STRFLC
     35X.*SIGFIN*,4X. *ANGLE*,5X,*FLWR *.6X, *FLWZ *.5X,*FLWMAX*,4X. *ANGLESTRFL
     4*/*IF JOINT*,4X,*SIGN*,6X,*SIGS*,5X,*NDISP*,6X,*TDISP*,5X,*NSTIF*,STRFLC
     55%, * 15TIF*, 4%, * STRNGTH*, 5%, *WIOTH*, 5%, *FRFLO*, 3%, * RE*)
                                                                           STRFLC
C
                                                                           STRFLC
  271 CONTINUE
                                                                           STRFLC
      PLOT STRESSES
                                                                           STRFLC.
      IF (INDEX .LT. 2) 60 TO 220
                                                                           STRFLC.
      CC # COS(EPS)
                                                                           STRFLC.
      SS = SIN(EPS)
                                                                           STRFLC.
      XL = SIG(5) * CC * PSF
                                                                           STRFLC.
      XTR(1) = XCEH - XL
                                                                           STRFLC.
      XTR(2) = XCEN + XL
                                                                           STRFLC.
      XL = SIG(5) + SS + PSF
                                                                           STRFLC.
      XTR(5) = YCEN - XL
                                                                           STRFLC.
      XTR(6) = YCEN + XL
                                                                           STRFLC.
      CALL COPLCT (XTR(1), XTR(5), 2, 4HJDIN)
                                                                           STRFLC.
                                                                           STRFLC.
      IF(SIG(5).GE.0.0) GO TO 210
                                                                           STRFLC.
      XTR(1) = XTR(1) - 0.02 * SS
                                                                           STRFLC.
      XTR(2) = XTR(2) - 0.02 * SS
                                                                           STRFLC.
      XTR(5) = XTR(5) + 0.02 * CC
                                                                           STRFLC.
      XTR(6) = XTR(6) + 0.02 * CC
                                                                           STRFLC.
      CALL COFLOT (XTR(1), XTR(5), 2, 4HJOIN)
                                                                           STRFLC.
                                                                           STRFLC.
  210 XL = SIG(6) * SS * PSF
                                                                           STRFLC.
      XTR(1) = XCEN + XL
                                                                           STRFLC.
      XTR(2) = XCEH + XL
                                                                           STRFLC.
      XL = SIG(6) + CC + PSF
XTR(5) = YCEN + XL
                                                                           STRFLC.
                                                                           STRFLC.
      XTR(6) = YCEN + XL
                                                                           STRFLC.
      CALL COPLOT (XTR(1), XTR(5), 2, 4HUDIN)
                                                                           STRFLC.
      IF (SIG (6) .GE. 0.0) GO TO 220
                                                                           STRFLC.
      XTR(1) = XTR(1) - 0.02 * SS
                                                                           STRFLC.
      XTR(2) = XTR(2) - 0.02 * 55
                                                                           STRFLC.
      XTR(5) = XTR(5) - 0.02 * CC
                                                                           STRFLC.
      XTR(6) = XTR(6) - 0.02 * CC
CALL CCPLCT (XTR(1), XTR(5), 2, 4HJOIN)
                                                                           STRFLC
                                                                           STRFLC.
С
                                                                          STRFLC.
  220 GO TO 300
                                                                           STRFLC.
                                                                           STRFLC.
  STRFLC.
  300 CONTINUE
                                                                          STRFLC.
С
                                                                          STRFLC.
      IF(FLAG.OR. NNN.EQ.IP) GO TO 302
                                                                          STRFLC.
      PRINT 304, IPER
                                                                          STRFLC.
  304 FORMAT (SPHOPPOBLEM CONVERGED IN THIS ITERATION AT PERTURBATIONIA)STRFLC.
                                                                          STRFLC.
  302 IF (INDEX .NE. 2) GO TC 330
                                                                          STRELC.
      WRITE (98.305) XSCL. VSCL. OSCL. PSCL. FJCL
                                                                          STRFLC.
  305 FORMAT (15H 1 IN CN X-AXIS/4H == E12.4.3H FT/15H 1 IN ON Y-AXIS/ STRFLC.
           #E12.4.3H FT/18H 1 IN DISPLACEMENT/4H #E12.4.3H FT/5H 1 IN/STRFLC.
    14H
           #E12.4.11H PSF STRESS/5H 1 IN/4H =E12.4.14H FSF JT STRESS) STRFLC.
     24H
                                                                          STRFLC.
     DO 320 I=1,NURHAT
                                                                          STRFLC.
      IF(I.GT.KSHELL) WRITE(98,315) I.(E(J.I),J=1,5)
                                                                          STRFLC.
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IF(I_LE_NSHELL) WRITE(94,308) I,RO(I), (E(K,I),K=1,6)
                                                                              STRFLC
  388 FORMAT (/9H WATERIALI3/28H WASS DENSITY
                                                     =F4.3/16H PERHEADILITSTRFLC
                                       =E14.3/21H PCISSON RATIO
                                                                         =F9.STRFLC
     .Y =E14.3/21H ELASTIC MODULUS
     .3/23 HOLOTS CONSTANT ALPHA =F18.3/19HOLOTS CONSTANT H =E14.3/22H STRFLC
     .THERMAL EXPAN.COEF. =E14.3)
                                                                              STRFLC
                                                                             STRFLC
                                                     =E12.3/20H KS
  315 FORMATC/9H HATERIALI3/20H KN
                                                                             STRFLC
             =E12.3/20H C
                                             #E12.3/28H PHI
                                                                            =STRFLC
     2E12. 3/28H MAX CLOSURE
                                    =E12.3)
                                                                             STRFLC
  320 CONTINUE
                                                                              STRFLC
                                                                              STRFLC
      XP = CCXMAX + 0.5
                                                                             STRFLC
      CALL COLTE (XP. 10.5, 0, 2)
                                                                             STRELC
      CALL CONEXT
                                                                             STRFLC
  338 RETURN
                                                                             STRFLC
С
                                                                             STRFLC
      END
                                                                             STRFLC
      SUBROUTINE JTSTR(8,80,PG, H, N, FLAG, IP)
                                                                             STRFLC
С
                                                                             STRFLC.
      LARGE A (125480) ,10(980)
                                                                             STRELP
      LARGE IX(301, 5), RESID(301, 4), R(300), Z(300), UR(300), UZ(300)
                                                                             LARGE .
     + .CODE (308) ,IDEST (300) ,R.KN(58) ,R.KS (50) ,WT (50), IGUT (301) ,Q (300) , LARGE.
     +QP(50),WE50),VEL(50),FR(50),RE(50),QN(980),DISPI(380,2),TENP(380),LARGE.
     PHIO(380), IB (308), IDEQ(3,308), KODE (3,380), IEL (50,2), INP (50.4)
                                                                             LARGE ...
     *. TLDAD (988) .SIGN(58) .SIGT (58) .050(608)
                                                                             STRFLF.
      COMMON/BLANK/S(8.8).P(10).RSTRS(4).VGL.RPR(5).ZZZ(5).LBAD.PADN.
                                                                             BLANK .
                         RR (4), ZZ (4), IFAT(50) .ACELX. ACELY. NRES. RC(12).
     1
                                                                             BLANK.
           MTYPE, XI .XCE F.YCEN, XTR(10), FAC.H(6), PD(4,12), QQ(2,4).
                                                                             BLANK ...
     3
         PRS.FZS.PRT.FZT.EG
                                                                             BLANK .!
      COMM CN/GEN/NSHELL, IPURCHE (7.12) . INDEX.MP. NNN. NCORE. NUMNP. IC CMFR. GEN. 2
           NUPEL.ND2, HED (16).DISPL.NJELT, IPER, NUMMA1.FSF.PSFJ.KSCL.SPWT.GEN.3
     3VISC.VSCL.DSCL.FSCL.PJCL.NP(4).CONLIH.NAXI.HB.HBAND.LNGTH.NEQ.NJHDGEN.4
           . HOFLOW, NUMHF2, NUMFAP, LH112), NF2
                                                                             GEN.5
      CONHON/CCFOCL/XFIN,XMAX,YHIN, YMAX,CCXHIN,CCXMAX,CCYHIN,CCYMAX
                                                                             CCPOOL
                                                                             EH.2
      CONHON/EM/ST(4, 8), SQ(2, 4), AJ(8,2), DD (2,2), DU (4), HR(6), HZ(6)
       .EJ (2.2)
                                                                             EK.3
      CONHON/CCFACT/FACTOR
                                                                             CCFACT.
С
                                                                             STREUC
      LARGE 8(1).80(1).PO(1)
                                                                             STRFLC.
      OINENSION PPP(8), V(4), U(4)
                                                                             STRFLC.
      LOGICAL FLAG
                                                                             STRFLC.
      REAL
                                                                             STRFLC.
                                                                             STRFLC.
   *******ESTABLISH DISFLACEMENTS ALONG AND NORMAL TO JOINT
C
                                                                             STRFLC.
С
                                                                             STRFLC.
      N = N + 1
                                                                             STRFLC.
      CAYN = KN(M)
                                                                             STRFLC.
      CAYS = KS(M)
                                                                             STRFLC.
      EN1 = E(1.MTYPE)
                                                                             STRFLC.
      EH2 = E12.HTYPE)
                                                                             STRFLC.
      EH3 = E(3.HTYPE)
                                                                             STRFLC.
      EN4 = E(4.MTYPE)
                                                                             STRFLC.
      FT=0.0
                                                                             STRFLC.
      STREN=0.0
                                                                             STRFLC.
      PDAVE=8.8
                                                                             STRFLC.
                                                                             STRFLC.
                                                                             STRFLC.
      I=IX (N,1)
      J= IX(N,2)
                                                                             STRFLC.
      DR=R (J) -R (I)
                                                                             STRFLC.
                                                                             STRFLC.
      DZ=Z(J)-Z(I)
      RR1 = 8.5 * (R(J) + R(I))
                                                                             STRFLC.
      221 = 8.5 * (2(J) + 2(1))
                                                                             STRFLC.
```

```
L=SQRT(DR+DR+DZ+DZ)
                                                                            STRFLC
      DR=DR/L
                                                                            STRFLC
      02=02/L
                                                                            STRFLC
      DO 188 II=1+4
                                                                            STRFLC
      K=IX(N,II)
                                                                            STRFLC
      K1=IDEQ(1 .K)
                                                                            STRFLC
      K2=IDEQ(2+K)
                                                                            STRFLC
      POAVE=POAVE+TEMP(K)/4.8
                                                                            STRFLC
      ¥(II)==#(K1)+02+8(K2)+DR
                                                                            STRFLC
  108 U(II)=B(K1)*DR+8(K2)*DZ
                                                                            STRFLC
C
                                                                            STRFLC
C ********* COMPUTE EFFECTIVE STRAIN
                                                                            STRFLC
C EPSN POSITIVE MEANS JODAT IS CPEN
C EFST POSITIVE MEANS (KK,LL) MOVES ALONG U+ MORE THAN (II,JJ)
                                                                            STRFLC
                                                                            STRFLC
С
                                                                            STRFLC
      EPST=8.5*(U(4)-U(1)+U(3)-U(2))
                                                                            STRFLC
      EPST=-EPST
                                                                            STRFLC
      IF (ABS(EPST) .LE. 1.0E-15) EPST = 0.0
                                                                            STRFLC
      EPSN=8.5* (V(4)-V(1)+V(3)-V(2))
                                                                            STRFLC
      IF (A85(EPSN) .LE. 1.0E-15) EPSH = 0.0
                                                                            STRFLC
                                                                            STRFLC
  CUMPUTE NORHAL AND SHEAR FORCE PER UNIT LENGTH AND CALCULATE STRENGTHSTRFLC
С
C INITIAL STRESSES ARE ALWAYS COMPRESSIVE (NEGATIVE)
                                                                            STRFLC
С
                                                                            STRFLC
      C2=DR##2
                                                                            STRFLC
      $2=0Z++2
                                                                            STRFLC
      SC=OR*DZ
                                                                            STRFLC
      FNRES = RESID(N+1)*52 + RESID(N+2)*C2 + RESID(N+4)*2+*SC
                                                                           STRELC
      FNRES=FNRES+POAVE
                                                                            STRFLC
      FTRES = (RESID(N,2)-RESID(N,1))*SC + RESID(N,4)*(S2-C2)
                                                                            STRFLC
      ETHICK = WT (M)
                                                                            STRFLC
      FN = CAYN * EPSN + FNRES
                                                                           STRFLC
                                                                           STRFLC
      IF (INDEX .NE. 2) 50 TO 200
                                                                           STRFLC-
      IF (ABS(X TR (7)-XTR(6)) .LE. C.81 * (YHAX - YHIN))
                                                                           STRFLC
     1
                    XCEN = 0.4"XTR(1) + 0.6"XTR(2)
                                                                           STRFLC
      IF (ABS(XTR(2)-XTR(1)) .LE. 0.81*(XMAX-XHIN))
                                                                           STRFLC
                    YCEN = 8.4"XTR(6) + 0.6"XTR(7)
     1
                                                                           STRFLC.
      XL = FN + DZ + PSFJ
                                                                           STRFLC.
      XTR(1) = XCEN - XL
                                                                           STRFLC.
      XTR(2) = XCEN + XL
                                                                           STRFLC
      XL = FN + DR + PSFJ
                                                                           STRFLC.
      XTR(5) = YCEN + XL
                                                                           STRFLC
      XTR(6) = YCEN - XL
                                                                           STRFLC.
      CALL COPLOT (XTR(1), XTR(5), 2, 4HJOINE
                                                                           STRFLC.
      IF (FN.GE.0.0) GO TO 280
                                                                           STRFLC.
      XTR(1) = XTR(1) - 0-82 * OR
                                                                           STRFLC.
      XTR(2) = XTR(2) - 0.02 * 0R
                                                                           STRFLC.
      XTR(5) = XTR(5) + 8.02 + 02
                                                                           STRFLC.
      XTR(6) = XTR(6) + 8-82 * 02
                                                                           STRFLC.
      CALL COPLOT EXTRESS, 2. 4HUDIN)
                                                                           STRFLC.
  200 CONTINUE
                                                                           STRFLC.
С
                                                                           STRFLC.
      IF(FNRES.GT.8.) GC TO 228
                                                                           STRFLC.
                                                                           STRFLC.
C
      FNRES .LE. 0
                                                                           STRFLC.
      IF (ETHICK .EQ. 8.) GO TO 215
                                                                           STRFLC.
      IF (EPSH .LE. 0.0) GO TO 205
                                                                           STRFLC.
                                                                           STRFLC.
      ETHLCK .NE. & AND EPSH .GT. 0
С
                                                                           STRFLC.
      CAYN = -FHRES / EPSN
                                                                           STRFLC.
      IF (CAYN .EQ. 8.8) CAYN = 1.8E-8
                                                                           STRFLC.
```

IF (CAYN .GT. EM1) CAYN = EM1 STRFLC GO TO 230 STRFLC STRFLC FREES LE. 8 AND NT .NE. 8 AND EPSH .LE. 8 285 CAYN = (FN - FRRES) / ETHICK STRFLC С STRFLC STRFLC IF (CAYN .LT. EM1) CAYN = EM1 60 TO 230 STRFLC STRFLC ETHECK = 0. FARES .LE. 0 .OR. FARES .GT. 8 AND EPSN .LT. 0 STRFLC C 215 CAYN = CAYN = 1.8E10 STRFLC CAYS = CAYS + 1.0E10 STRFLC GO TO 268 STRELC STRFLC STRFLC FHRES .GT. 8 C 228 IF (EPSN .LT. 8.8 .AND. ETHICK .EG. 8.8) GD TO 215 IF (EPSN .EQ. 8.8) GD TO 230 STRFLC STRFLC CAYN = +FHRES / EPSN STRFLC IF (EPSN .LT. B.B) CAYN = CAYN + EM1 STRFLC STRFLC CALCULATION OF KS STRFLC 230 FT = CAYS * EPST + FTRES STRFLC AFN = ABS (FN) STRFLC EPSNLH = ABS(FNRES) / EH1 STRFLC IF (EPSN .GT. EPSNLH .OR. FN .GT. B.B) AFN = 0.8 STRFLC STREN = EH3 + AFN * TAN (EH4/57.29577951) STRFLC STRFLC IF (EPST .EQ. 8.0) GO TO 260 STRFLC IF (EH3 .EQ. 0.8 .AND. EH4 .EQ. 0.0) GO TO 260 IF (EPST .LT. 0.8) STREN = - STREN STRFLC STRFLC CAYS = (-FTRES + STREN) / EPST STRFLC. IF (CAYS .EQ. 0.0) CAYS = 9.0E-9 STRFLC STRFLC IF (CAYS.GT. EM2) CAYS=ENZ STRFLC C ABS(FTRES) .LE. ABS(STREN) STRFLC IF (ABS(FTRES) .GT. ABS(STREN)) GD TO 235 STRFLC GO TO 268 STRFLC STRFLC ABS(FTRES) .GT. ABS(STREN) STRFLC С 235 1F (FTRES * EPST .GE. 8.8) 60 TO 260 STRFLC STRFLC FTRES AND EPST HAVE OPPOSITE SIGNS C STRFLC EPSLIM = 2.8 + STREN / EM2 STRFLC, IF (ABS(EFST) .GT. EPSLIN) GO TO 260 STRFLC. STRFLC ACS(EPST) +LE+ EPSLIH CAYS = I-FTRES + STREN) / EPST + EM2 С STRFLC STRFLC STRFLC 268 IF (ABS(CAYN-KN(H)) .GT. CONLIM .OR. ABS(CAYS-KS(M)) .GT. CONLIM) STRFLC FLAG = .TRUE. STRFLC. 1 KN(H)=CAYN STRFLC. KS(H) = CAYS STRFLC. STRFLC. C ********* CALCULATE FLOW IN FRACTURES ********** С STRFLC. č STRFLC. STRFLC. IF (INDEX.EQ.8) GO TO 588 STRFLC. 115 WERNT(N) IF(EPSN.GE.WE) GD TO 158 STRFLC. PRINT 148.H STRFLC. 148 FORMAT ("DISPLACEMENT GREATER THAN ALLONED IN JOINT ELEMENT NO." 15) STRFLC. STRFLC. 158 W(H)=ABS(ABS(W)+EPSH) STRFLC. COM= 1. #/{12.#*VISC} STRFLC.

```
QP(H)=H(H)==2=COH/L
                                                                                STRFLC
       RAD=1.8
                                                                                STRELC
       I=IX (N,1)
                                                                                STRFLC
       J=IX (N,2)
                                                                                STRFLC
       II=IDEST(I)
                                                                                STRFLC
       JJ=IDEST(J)
                                                                                STRFLC
       IF (NAXI-NE.8) RAD= (R(I)+R(J))/2.0
                                                                                STRFLC
       I3=IDEQ(3.I)
                                                                                STRFLC
       J3=IDEQ(3,J)
                                                                                STRFLC
       VEL ( H) = QP (H )* (8 (J 3) -8 (13))
                                                                                STRFLC
       IF( DZ.NE.B.D ) VEL(M)=VEL(M)+SFWT*QP(M)*L*DZ
                                                                                STRFLP
       FR (H J=VEL (H)+W(H)+RAD
                                                                                STRFLC
       RE(H)=FR(H)/VISC
                                                                                STRFLC
       PRINT 270.N.FN.FT.SPSN,EPST.CAYN.CAYS.STREN.W(W).FR(M).RE(M)
                                                                                STRFLC
  270 FCRHAT (* JT *, 14, 12E 10.2)
                                                                               STRFLC
  500 RETURN
                                                                                STRFLC
       END
                                                                               STRFLC
       SUBROUTINE FRINT(NUMMP, IDEQ, NAXI, R. RD. TDT.A. TEMP)
                                                                               STRFLC.
      LARGE IDEQ(3,1) ,R(1),A(1),TEMP(1)
                                                                               STRFLO.
                                                                               STRFLC.
      TD=0+0
                                                                               STRFLC.
      PDD= f. f
                                                                               STRFLC
      DO 100 I=1, NUMMP
                                                                               STRFLC.
       K1=IDEQ(1.I)
                                                                               STRFLC.
      K2=IDEQ(2,I)
                                                                               STRFLO.
       K3=IDEQ(3,I)
                                                                               STRFLC.
       IF (TDT.EQ.1.0.AND.RD.EQ.1.0) GO TO 188
                                                                               STRFLC.
       IF( R(I).EQ.0.0 ) GO TO 50
                                                                               STRFLC.
       TD=TDT/(R(I)=R(I))
                                                                               STRFLC.
   50 CONTINUE
                                                                               STRFLC.
       PDD=RD* (TEMP(I) -A (K3))
                                                                               STRFLC
  100 PRINT 200, I, A (K1), A(K2), A(K3), TD, PD0
                                                                               STRFLC.
  200 FORMAT(I18,6E18.5)
                                                                               STRFLC.
       RETURN
                                                                               STRFLC.
      END
                                                                               STRFLC.
      SUBROUTINE PRHAT(A.NR.NC. FAX.TITLE)
                                                                               STRFLC.
C
                                                                               STRFLC.
      DIMENSION A (8.1)
                                                                               STRFLC.
C
                                                                               STRFLC.
      PRINT 1002, TITLE
                                                                               STRFLC.
      DG 180 J=1.NC.8
                                                                               STRFLC.
      JH=J+7
                                                                               STRFLC.
      IF (JH-NC) 75,75,50
                                                                               STRFLC.
   58 JH=NC
                                                                               STRFLC.
   75 PRINT 1000. (N.N=J.JH)
                                                                               STRFLC.
      00 100 I=1.NR
                                                                               STRFLC.
  108 PRINT 1801.1. (A (I.K).K=J.JH)
                                                                               STRFLC.
c
                                                                               STRFLC.
      RETURN
                                                                               STRFLC.
                                                                               STRFLC
 1838 FORMAT (7778X.8114)
1881 FORMAT (14,4X.8114)
                                                                               STRFLC.
                                                                               STRFLC.
 1802 FORMAT (////BH MATRIX .A10)
                                                                               STRFLC.
                                                                               STRFLC.
      END
```