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COMPUTER PROGRAM (OPTCOMP) FOR OPTIMIZATION OF COMPOSITE STRUCTURES FOR MINIMUM WEIGHT DESIGN

ANALYSIS & OPTIMIZATION BRANCH
STRUCTURAL MECHANICS DIVISION

FEBRUARY 1977

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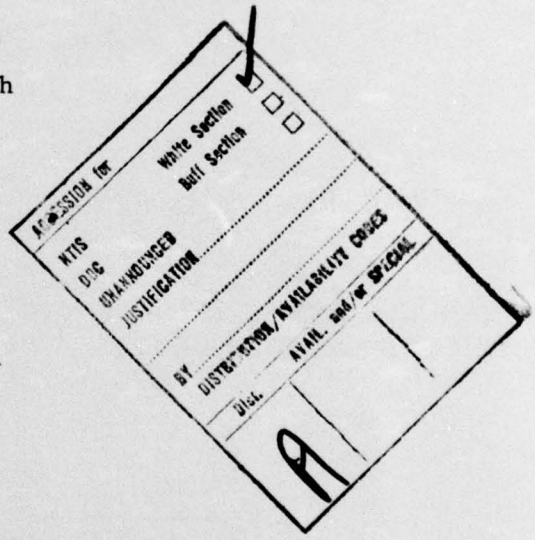
Richard D. Krobusek

RICHARD D. KROBUSEK, Maj, USAF
Chief, Analysis & Optimization Branch
Structural Mechanics Division
AF Flight Dynamics Laboratory

FOR THE COMMANDER:

Howard L. Farmer

HOWARD L. FARMER, Col, USAF
Chief, Structural Mechanics Division
AF Flight Dynamics Laboratory



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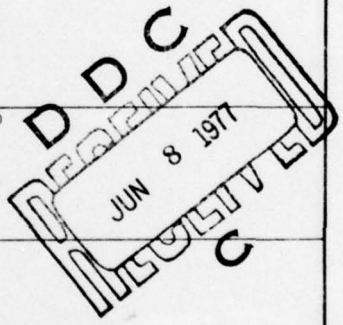
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The computer program OPTCOMP can be used to optimize or analyze a composite structure. The program uses an iterative procedure based on optimality criteria to design a minimum weight structure. The response of the structure to the applied loads is obtained by finite element analysis. The design variables are modified during each iteration by using a recurrence relation. The four strength criteria included in the program are maximum stress, maximum strain, Hill's criteria modified by Tsai and Norris criteria. The plate elements can be designed to prevent local buckling. The elements can be linked to have the same

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cont → sizes if desired. A mixture of composite and metal structure can be designed by suitable definition of material properties.

FOREWORD

This report is prepared as a part of in-house effort under Project 1467, "Structural Analysis Methods", Task No. 146702, "Structural Analysis Methods for Aerospace Vehicles", and Work Unit 14670246, "Automated Design of Advanced Aerospace Structures". The work was carried out in the Design and Analysis Methods Group of the Analysis and Optimization Branch (FBR), Structural Mechanics Division, Air Force Flight Dynamics Laboratory (AFFDL), Wright-Patterson AFB, Ohio. The time period of the effort was June 1973 - October 1976.

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SECTION I

INTRODUCTION

Advanced fiber reinforced composites such as boron-epoxy, graphite-epoxy, etc. are being used increasingly in flight vehicle structures. In order to make the most efficient use of these composites, it is necessary to have a reliable design procedure. In References 1 and 2, an optimization method was presented for the minimum weight design of composite structures with stress and displacement constraints. The concepts developed in these two references for the stress constraint design form the basis of a computer program to Optimize Composite (OPTCOMP) structures discussed in this report.

The OPTCOMP program can be used to design a minimum weight structure or to analyze a given structure which is idealized with finite elements. This is an experimental program and as such it includes different recurrence relations and strength criteria for experimentation. A metal structure or a combination of metal and composite structure can be designed by proper definition of the elastic properties of the elements.

The basic relations of the finite element method, the optimality criteria, the recurrence relations and the various strength criteria are discussed in Section II. The buckling equations and the transformations for the elastic constant matrix are also given in Section II. Section III contains a general description of the computer program. The input and output instructions are included in Sections IV and V. Section VI discusses the sample problem. The Fortran listing of the program and the output of the sample problem are presented in an Appendix.

SECTION II

ANALYTICAL FORMULATION

The optimization of a structure is an iterative procedure. The two main steps involved in the algorithm are 1) to analyze the structure to determine the response of the structure to the applied loads and 2) to modify the design variables by using a recurrence relation. These two steps are repeated for a specific number of iterations. The recurrence relations used to modify the design variables are based on the selected optimality criteria. The optimality criteria used to derive the recurrence relation may be theoretical or intuitive. In the OPTCOMP program, the response of the structure is obtained by a finite element analysis of the structure. The geometry of the structure is fixed. Hence, the design variables are the thicknesses of the homogeneous plate elements, the thicknesses of the layers in the composite elements, and the cross-sectional areas of the bars. As used throughout this report, the word "layer" identifies the total quantity of all the plies or laminae which are oriented in a specified direction within a composite laminate. Since out-of-plane bending effects are not considered in this program, the concept of layers may be applied. However, in actual laminates, these plies will be dispersed throughout the thickness. In the composite elements, the fiber directions to be used are specified.

1. Equations of Analysis

Since the finite element method of analysis is used in OPTCOMP, the basic equations are given here for ready reference. In this method the structure is discretized into a group of elements. Let the number

of elements in the structure be m and the number of layers in the composite elements be n. The force displacement relation for the whole structure is given by

$$[K]\ \{r\} = \{R\} \tag{1}$$

where [K] is the stiffness matrix of the structure, {r} is the displacement vector and {R} is the force vector. The force displacement relation for the jth layer of the ith element is given by

$$[k]_{ij}\ \{r\}_i = \{f\}_{ij} \tag{2}$$

where $[k]_{ij}$ is the stiffness matrix of the jth layer of the ith element, $\{r\}_i$ are the ith element nodal displacements and $\{f\}_{ij}$ are the nodal forces of the jth layer of the ith element. The strain energy e_{ij} of the jth layer of the ith element is given by

$$e_{ij} = \{r\}_i^t\ [k]_{ij}\ \{r\}_i \tag{3}$$

The element strains $\{\varepsilon\}_i$ in the ith element are given by

$$\{\varepsilon\}_i = [c]\ \{r\}_i \tag{4}$$

where [c] is the strain-displacement matrix. The stresses $\{\sigma\}_{ij}$ in the jth layer of the ith element are given by

$$\{\sigma\}_{ij} = [A]_{ij}\ \{\varepsilon\}_i \tag{5}$$

where $[A]_{ij}$ is the matrix of elastic constants of the jth layer of the ith element.

2. Strength Criteria

The state of stress in a layer of an element has to satisfy a certain specified strength criteria in order to avoid failure. There

are several strength criteria proposed by different authors (For a detailed discussion, see Reference 3.). Most of these are explicit or implicit functions of the stresses or strains and the corresponding maximum allowable stresses or strains.

For an orthotropic material, there are basically five allowables required for each layer of a plane stress problem. These are the tension and compression maximum allowables in the fiber direction and in the transverse direction, and the maximum shear allowable.

In the OPTCOMP computer program four strength criteria are included. The user of the program can select the one he prefers. The four criteria for the generalized plane stress condition are given below.

a. Maximum Stress Criteria

This criteria states that the failure of the material would occur if any one of the following conditions are not satisfied.

$$\begin{aligned} \sigma_1 &\leq \tilde{\sigma}_1 \\ \sigma_2 &\leq \tilde{\sigma}_2 \\ \sigma_{12} &\leq \tilde{\sigma}_{12} \end{aligned} \tag{6}$$

where σ_1 and σ_2 are the stresses in the fiber direction and the one normal to it and σ_{12} is the shear stress. $\tilde{\sigma}_1$ and $\tilde{\sigma}_2$ are the maximum allowable stresses in the fiber and transverse directions, and $\tilde{\sigma}_{12}$ is the maximum allowable shear stress.

b. Maximum Strain Criteria

In this criteria strains instead of stresses are checked. The criteria can be expressed as

$$\begin{aligned} \varepsilon_1 &\leq \tilde{\varepsilon}_1 \\ \varepsilon_2 &\leq \tilde{\varepsilon}_2 \\ \varepsilon_{12} &\leq \tilde{\varepsilon}_{12} \end{aligned} \tag{7}$$

where ε_1 and ε_2 are the strains in the fiber direction and the one normal to it and ε_{12} is the shear strain. $\tilde{\varepsilon}_1$ and $\tilde{\varepsilon}_2$ are the maximum allowable strains in the fiber and transverse directions, and $\tilde{\varepsilon}_{12}$ is the maximum allowable shear strain. The layer is considered to have failed if any one of the conditions specified in Eq. 7 is not satisfied.

In the maximum stress and strain criteria the individual failure modes are independent.

c. Hill's Criteria Modified by Tsai

According to this criteria the material is assumed not to have failed if

$$\left[\left(\frac{\sigma_1}{\tilde{\sigma}_1}\right)^2 + \left(\frac{\sigma_2}{\tilde{\sigma}_2}\right)^2 - \left(\frac{\sigma_1 \sigma_2}{\tilde{\sigma}_1^2}\right) - \left(\frac{\sigma_{12}}{\tilde{\sigma}_{12}}\right)^2\right] \leq 1 \tag{8}$$

The definitions of $\tilde{\sigma}_1$, $\tilde{\sigma}_2$, etc. are the same as in the maximum stress criteria above.

d. Norris Criteria

This criteria can be written as

$$\left[\left(\frac{\sigma_1}{\tilde{\sigma}_1}\right)^2 + \left(\frac{\sigma_2}{\tilde{\sigma}_2}\right)^2 - \left(\frac{\sigma_1 \sigma_2}{\tilde{\sigma}_1 \tilde{\sigma}_2}\right) - \left(\frac{\sigma_{12}}{\tilde{\sigma}_{12}}\right)^2\right] \leq 1 \tag{9}$$

This criteria is similar to Eq. 8 except for the third term.

It should be pointed out that different versions of the above four criteria can be used by a proper choice of the allowables. For example, if the transverse stress is not to be considered critical as in the case of a fiber controlled laminate, $\tilde{\sigma}_2$ can be assigned a high value so that σ_2 will not become critical. Any special type of criteria can be easily introduced into the program by writing a new subroutine.

3. Recurrence Relations

In this section the recurrence relations incorporated in the OPTCOMP program are given. For the stress constraint problem, when the maximum allowable stress is not the same in all the elements of a structure, there is no rigorous method based on optimality criteria for designing a minimum weight structure. This is particularly true when the structure has plate elements. If the structure consists of bar elements only, the problem can be correctly solved by replacing the stress constraints by equivalent displacement constraints and treating it as a multiple displacement constraint problem (Reference 2). However, this procedure of treating stress constraints by equivalent displacement constraints is not feasible in a structure where there are elements connecting more than two nodes. The recurrence relations proposed here for resizing the elements are based on optimality criteria which are not rigorous in the mathematical sense, but they are found to give near optimum weight designs for large structures in a very efficient way. The recurrence relations included in OPTCOMP are either based on the strain energy in an element or the state of stress in an element. Those depending on the state of stress correspond to the fully stressed iterative procedure. The user of the program may select any one of them depending on his preference.

The optimality criteria for the generalized stiffness requirement can be stated as, "the optimum structure is the one in which the ratio of the average strain energy density to the mass density is the same in all elements" (Reference 2). This criteria can be written as

$$1 = \lambda \frac{\bar{e}_{ij}}{\rho_{ij}} \tag{10}$$

$$i = 1, \text{ -- } m$$

$$j = 1, \text{ -- } n$$

where λ is the Lagrangian parameter, ρ_{ij} is the mass density of the jth layer of the ith element, and $\bar{e}_{ij}$ is the strain energy density given by

$$\bar{e}_{ij} = \frac{e_{ij}}{V_{ij}} \tag{11}$$

Here V_{ij} is the volume of the element defined as

$$V_{ij} = t_{ij}\, l_i \tag{12}$$

where t_{ij} is the thickness of the jth layer of the ith element and l_i is the surface area of the ith element. The design variable t_{ij} can be written as

$$t_{ij} = \Lambda\, \alpha_{ij} \tag{13}$$

where α_{ij} is the relative thickness (normalized to the maximum thickness) of the jth layer of the ith element and Λ is the scaling parameter. For homogeneous elements in the structure j = 1. Introducing the scaling parameter Λ in Eq. 1 gives

$$\Lambda\, [K']\, \{r\} = \{R\} \tag{14}$$

or

$$[K']\, \{r'\} = \{R\} \tag{15}$$

where

$$\{r\} = \frac{1}{\Lambda}\, \{r'\} \tag{16}$$

In Eq. 15 [K'] is the stiffness matrix for the whole structure obtained by using the relative design vector α_{ij}. Introducing the scaling parameter into Eqs. 2 through 5, the relations between the actual quantities and the relative quantities at element level can be expressed

as

$$[k]_{ij} = \Lambda[k']_{ij} \tag{17}$$

$$\{r\}_i = \frac{1}{\Lambda}\{r'\}_i \tag{18}$$

$$\{\varepsilon\}_i = \frac{1}{\Lambda}\{\varepsilon'\}_i \tag{19}$$

$$\{\sigma\}_{ij} = \frac{1}{\Lambda}\{\sigma'\}_{ij} \tag{20}$$

where the primed quantities are the relative values.

Introducing Eqs. 11, 17 and 18 in Eq. 10 gives

$$1 = \frac{\lambda}{\Lambda^2}\ \frac{\bar{e}'_{ij}}{\rho_{ij}} \tag{21}$$

where $$\bar{e}'_{ij} = \frac{\{r'\}_i^t\ [k']_{ij}\ \{r'\}_i}{\alpha_{ij}\ l_i} \tag{22}$$

Multiplying both sides of Eq. 21 by α_{ij}^2 and taking the square root gives

$$\alpha_{ij} = B\ \alpha_{ij}\left(\frac{\bar{e}'_{ij}}{\rho_{ij}}\right)^{\frac{1}{2}} \tag{23}$$

where B is a constant. Eq. 23 can be rewritten in an iterative form as

$$\left(\alpha_{ij}\right)_{\nu+1} = B\left(\alpha_{ij}\right)_{\nu}\left[\frac{\bar{e}'_{ij}}{\rho_{ij}}\right]_{\nu}^{\frac{1}{2}} \tag{24}$$

where $\nu+1$ and ν refer to the cycles of iteration. In Eq. 24, B is a constant and generally it is not essential to evaluate it, since only the normalized relative design vector α_{ij} is used to analyze the structure. In the case of multiple loading conditions, a sum of relative strain energy densities due to all the loading conditions is used in Eq. 24.

In order to take into consideration the effect of different allowable stresses, the optimality criteria defined by Eq. 10 may be modified as

$$1 = \lambda \frac{\tilde{e}_{ij}}{\rho_{ij}} \qquad (25)$$

$$i = 1, --, m$$

$$j = 1, --, n$$

where

$$\tilde{e}_{ij} = \frac{e_{ij}}{(\tilde{\sigma}_1 \; \tilde{\varepsilon}_1)_{ij}} \qquad (26)$$

where $\tilde{\sigma}_1$ is the maximum allowable stress and $\tilde{\varepsilon}_1$ is the maximum allowable strain in the fiber direction of the jth layer of the ith element. Following the procedure similar to the one used to derive Eq. 24, the recurrence relation corresponding to the optimality criteria defined by Eq. 25 can be written as

$$\left(\alpha_{ij}\right)_{\nu+1} = B\left(\alpha_{ij}\right)_{\nu} \left[\frac{\tilde{e}'_{ij}}{\rho_{ij}}\right]^{\frac{1}{2}}_{\nu} \qquad (27)$$

where

$$\tilde{e}'_{ij} = \frac{\bar{e}'_{ij}}{(\tilde{\sigma}_1 \; \tilde{\varepsilon}_1)_{ij}} \qquad (28)$$

In Eq. 28 the prime quantities are the relative values. In the case of multiple loading conditions $\tilde{e}'_{ij}$ is calculated for each loading condition and the sum is used in Eq. 27.

The fully stressed iterative procedure is based on the intuition that a structure will have minimum weight if the stress in each member is equal to the maximum allowable stress for that member, under at least one loading condition. In this procedure the resizing of an element is done by multiplying the design variable by the ratio of the maximum actual stress to the corresponding maximum allowable stress for that member. In the case of a plate element since there will be three stresses (two normal and one shear), the effective stress ratio can be used. Hence, in the case of Hill's criteria modified by Tsai (Eq. 8) the recurrence relation can be written as

$$\left(\alpha_{ij}\right)_{\nu+1} = \left(\alpha_{ij}\right)_{\nu} \left[\sigma'_{eff}(Ht)\right]^{\frac{1}{2}}_{\nu} \tag{29}$$

where

$$\sigma'_{eff}(Ht) = \left[\left(\frac{\sigma'_1}{\tilde{\sigma}_1}\right)^2 + \left(\frac{\sigma'_2}{\tilde{\sigma}_2}\right)^2 - \left(\frac{\sigma'_1\,\sigma'_2}{\tilde{\sigma}_1^2}\right) + \left(\frac{\sigma_{12}}{\tilde{\sigma}_{12}}\right)^2\right]_{max} \tag{30}$$

Similarly, to fully stress the design with Norris criteria (Eq. 9), the recurrence relation is

$$\left(\alpha_{ij}\right)_{\nu+1} = \left(\alpha_{ij}\right)_{\nu} \left[\sigma'_{eff}(N)\right]^{\frac{1}{2}}_{\nu} \tag{31}$$

where

$$\sigma'_{eff}(N) = \left[\left(\frac{\sigma'_1}{\tilde{\sigma}_1}\right)^2 + \left(\frac{\sigma'_2}{\tilde{\sigma}_2}\right)^2 - \left(\frac{\sigma'_1\,\sigma'_2}{\tilde{\sigma}_1\,\tilde{\sigma}_2}\right) + \left(\frac{\sigma_{12}}{\tilde{\sigma}_{12}}\right)^2\right]_{max} \tag{32}$$

In using the recurrence relation to resize a bar element or a shear panel, only the appropriate component of the stress vector is used.

4. Buckling Equations

The equations used to modify the layer thickness of a plate element to prevent local buckling are given in this section (Reference 4). For a simply supported orthotropic plate where the length to width ratio is large (>>1),

$$N_{xcr} = K_x \frac{\pi^2 D_{11}}{w^2} \tag{33}$$

and

$$N_{xycr} = K_{xy} \frac{\pi^2 D_{11}}{w^2} \tag{34}$$

where N_{xcr} and N_{xycr} are the critical compressive load (parallel to 0° fiber) and critical shear load respectively. In Eqs. 33 and 34,

$$K_x = 2\sqrt{\beta} + \alpha \tag{35}$$

and

$$K_{xy} = \left(3.293 + \frac{2.047}{\tilde{\theta}}\right) \beta^{3/4} \quad \text{for } \tilde{\theta} \geq 1 \tag{36}$$

$$K_{xy} = (4.742 + 0.216\ \tilde{\theta} + 0.380\ \tilde{\theta}^2) \left(\frac{\alpha\beta}{2}\right)^{1/2} \quad \text{for } \tilde{\theta} < 1 \tag{37}$$

where

$$\alpha = \frac{2(D_{12} + 2D_{66})}{D_{11}} \tag{38}$$

$$\beta = \frac{D_{22}}{D_{11}} \tag{39}$$

$$\tilde{\theta} = \frac{2\beta^{1/2}}{\alpha} \tag{40}$$

In Eqs. 33 and 34, w is the effective width of the plate and D_{11}, D_{12}, etc. are the elements of the bending stiffness matrix. When the plate is subjected to combined compressive and shear load, the stability criterion is

$$\frac{n_x}{N_{xcr}} + \left(\frac{n_{xy}}{N_{xycr}}\right)^2 \leq 1 \tag{41}$$

where n_x and n_{xy} are the actual compressive and shear force per unit length applied to the laminate. If the elastic properties are smeared one can assume that

$$D_{ij} = \frac{A_{ij}\, t^3}{12} \tag{42}$$

where t is the total thickness of the plate. Substituting Eq. 42 in Eqs. 33 and 34 gives

$$N_{xcr} = \bar{K}_x\, t^3 \tag{43}$$

and

$$N_{xycr} = \bar{K}_{xy}\, t^3 \tag{44}$$

where

$$\bar{K}_x = \frac{K_x\, \pi^2\, A_{11}}{12\, w^2} \tag{45}$$

and

$$\bar{K}_{xy} = \frac{K_{xy}\, \pi^2\, A_{11}}{12\, w^2} \tag{46}$$

Substituting Eqs. 43 and 44 in Eq. 41 gives

$$\frac{n_x}{\bar{K}_X t^3} + \left(\frac{n_{xy}}{\bar{K}_{XY} t^3}\right)^2 \leq 1 \qquad (47)$$

Hence, knowing n_x, n_{xy}, $\bar{K}_X$, and $\bar{K}_{XY}$, Eq. 47 can be solved for t to satisfy the stability criteria in the equality sense. In the OPTCOMP program during each iteration in the second stage, the required 't' is evaluated and the thickness of each layer is increased proportional to the specified fractions. The influence of boundary conditions can be taken into consideration by specifying the proper value of the width, w, of the plate.

5. Transformations

In this section the transformations used to define the fiber direction and the elastic constants in the local coordinate system are given. The fiber direction for 0° fibers can be defined in OPTCOMP either by giving the angle θ as shown in Figure 1(a) separately for each element or by specifying the projection of the 0° fibers on a defined plane (Figure 1(b)). If the latter is used, the projected direction will be the same for all 0° fibers in all the elements. In Figure 1(a) ($\bar{e}_1$, $\bar{e}_2$, $\bar{e}_n$) is the local coordinate system used to define the position of the quadrilateral ABCD. Let $\overline{AF}$ be the unit vector parallel to the 0° fibers in the element. On the plane PQRS in Figure 1(b), $\overline{A_1F_1}$ is the projection of $\overline{AF}$. The plane PQRS is defined by $\overline{A_1F_1}$ and $\overline{A_1G_1}$ which are perpendicular to each other. $\bar{n}$ is the normal vector of unit length to the plane PQRS.

Consider a plane passing through the vectors $\overline{A_1F_1}$, $\bar{n}$ and $\overline{AF}$. (See Figure 1(c)). Then

$$\overline{A_1F_1} + \overline{F_1F} = \overline{A_1F} = \overline{AF} \tag{48}$$

and

$$\overline{F_1F} = H\,\bar{n} \tag{49}$$

where H is a scalar quantity. The relation given in Eq. 49 is correct since the unit vector $\bar{n}$ is parallel to $\overline{F_1F}$. Taking the scalar product of Eq. 48 with $\overline{e_n}$ and using Eq. 49, one can write

$$H = - \frac{\overline{e_n} \cdot \overline{A_1F_1}}{\overline{e_n} \cdot \bar{n}} \tag{50}$$

Thus, knowing the direction of the projected vector $\overline{A_1F_1}$, Eqs. 48 through 50 can be used to define the vector $\overline{AF}$. In the input data of the OPTCOMP program the vectors $\overline{A_1F_1}$ and $\overline{A_1G_1}$ are defined by giving the coordinates of points A_1, F_1 and G_1.

In Figure 2, $(\overline{e_1}, \overline{e_2}, \overline{e_n})$ is the local coordinate system of the element. The unit vector parallel to the fiber direction is $\overline{e_f}$. $\overline{e_g}$ is perpendicular to $\overline{e_f}$ such that $\overline{e_n} = \overline{e_f} \times \overline{e_g}$. The two coordinate systems are related by

$$\begin{aligned} \overline{e_f} &= \ell_{11}\,\overline{e_1} + \ell_{12}\,\overline{e_2} \\ \overline{e_g} &= \ell_{21}\,\overline{e_1} + \ell_{22}\,\overline{e_2} \end{aligned} \tag{51}$$

where ℓ_{11}, ℓ_{12}, etc. are the direction cosines. Let $\{\sigma\}$ and $\{\varepsilon\}$ be the stresses and strains in the local coordinate system, and $\{\bar{\sigma}\}$ and $\{\bar{\varepsilon}\}$ be the same quantities in the fiber coordinate system ($\bar{e_f}$, $\bar{e_g}$, $\bar{e_n}$). The stresses and the strains in the two coordinate systems are related by

$$\{\bar{\sigma}\} = [L_1]\{\sigma\} \tag{52}$$

$$\{\bar{\varepsilon}\} = [L_2]\{\varepsilon\} \tag{53}$$

where

$$[L_1] = \begin{bmatrix} \ell_{11}^2 & \ell_{12}^2 & 2\ell_{11}\ell_{12} \\ \ell_{21}^2 & \ell_{22}^2 & 2\ell_{22}\ell_{21} \\ \ell_{11}\ell_{21} & \ell_{12}\ell_{22} & \ell_{12}\ell_{21} + \ell_{11}\ell_{22} \end{bmatrix} \tag{54}$$

and

$$[L_2] = \begin{bmatrix} \ell_{11}^2 & \ell_{12}^2 & \ell_{11}\ell_{12} \\ \ell_{21}^2 & \ell_{22}^2 & \ell_{22}\ell_{21} \\ 2\ell_{11}\ell_{21} & 2\ell_{12}\ell_{22} & \ell_{12}\ell_{21} + \ell_{11}\ell_{22} \end{bmatrix} \tag{55}$$

It is of interest to note that

$$[L_1]^{-1} = [L_2]^t \tag{56}$$

and

$$[L_2]^{-1} = [L_1]^t \tag{57}$$

The stress-strain relations are given by

$$\{\sigma\} = [A]\{\varepsilon\} \tag{58}$$

and

$$\{\bar{\sigma}\} = [\bar{A}]\ \{\bar{\varepsilon}\} \tag{59}$$

where [A] and $[\bar{A}]$ are the elastic constant matrices in the two coordinate systems. Using Eqs. 52 and 53, Eq. 59 can be written as

$$[L_1]\ \{\sigma\} = [\bar{A}]\ [L_2]\ \{\varepsilon\} \tag{60}$$

Multiplying both sides of Eq. 60 by $[L_1]^{-1}$ gives

$$\{\sigma\} = [L_1]^{-1}\ [\bar{A}]\ [L_2]\ \{\varepsilon\} \tag{61}$$

or

$$\{\sigma\} = [L_2]^{t}\ [\bar{A}]\ [L_2]\ \{\varepsilon\} \tag{62}$$

Comparing Eqs. 58 and 62 we can write

$$[A] = [L_2]^{t}\ [\bar{A}]\ [L_2] \tag{63}$$

Eq. 63 can be used to transform the elastic constant matrix from one coordinate system to the other.

SECTION III

DESCRIPTION OF THE PROGRAM

The flow diagram showing the basic steps of the optimization procedure used in OPTCOMP is given in Figure 3. In the first stage, the structure is optimized to satisfy the stress constraints alone. The design at the end of this stage will have minimum weight, and it will satisfy the strength criteria in all the elements. In the second stage, the plate elements which are critical in buckling are increased in thickness to prevent local buckling. At the end of the second stage, all elements will satisfy the strength criteria and no plate elements will fail due to local buckling. The initial thicknesses of the elements for optimization can be included in the input data or the program will assign 0.1-inch thickness for plate elements with equal percentage of laminas in all fiber directions, and 1.0 square inch cross-sectional area for bar elements.

The four types of elements included in the program are: 1) a constant strain triangle, 2) a quadrilateral constructed from four constant strain triangles, 3) a shear panel, and 4) a bar. The sequence of node numbers used to define the elements is given in Figure 4. The triangle and the quadrilateral may be layered composite elements. In defining the material axis, either the direction of the 0° fiber orientation is specified by angle θ (Figure 1(a)) defined by the variable ZANGLE in the input Card Set 11 for each element, or the projection of the 0° fibers is given on a certain plane (See Figure 1(b)). This projection will be the same for all the elements. The projection and the plane is defined by the coordinates of the three points in the input Card Set 9. The fiber

directions in other layers are given in the input Card Set 10, with respect to the 0° direction. The material properties are given for all layers in an element as a set, which is designated by one material number. For example, an element with all layers of graphite epoxy may be assigned material number 1, an element with one layer of boron-epoxy and the remaining layers of graphite epoxy may be assigned material number 2, and an element with two layers of graphite-epoxy and the remaining layers of glass-epoxy may be assigned material number 3. If there are any metal elements with isotropic properties they can be assigned yet a different material number. The total number of materials to be used for quadrilaterals and triangles is defined by the variable NMAT2 in the input Card Set 3, and the elastic properties, thickness of lamina, minimum number of lamina in each layer are read in the input Card Set 7. In the case of shear panels and bar elements the number of materials used is defined by NMAT1 in Card Set 3 and the elastic properties and the maximum allowable stresses are read in Card Set 6. It should be pointed out here that the material numbers assigned for the quadrilaterals and the triangles may be the same as the one used for the shear panels and bars, but their meanings are different for the two cases.

The program has provision for four widely used strength criteria for composite structures. These are: 1) maximum allowable stress, 2) maximum allowable strain, 3) Hill's criteria modified by Tsai, and 4) Norris criteria. These criteria are given in Section II(2). The user can select any one of these criteria depending on his preference by specifying the proper number for NCRTIA in the input Card Set 3, and

for NEF in the input Card Set 4. All these criteria are functions of the maximum normal allowable stress or strain in the fiber direction and in the transverse direction, and the maximum shear allowable. The maximum normal allowable stresses may have different magnitudes depending on whether they are tensile or compressive stresses. As such the total number of maximum allowable stresses specified is five. In case the user wants to relax the restriction on any of these allowables, he can specify a very high value. Selection of these allowables is very important since the weight of the structure is directly proportional to the scaling parameter which is determined on the basis of satisfying the strength criteria for each element. This data is included in the input Card Set 8 for each layer of the material set.

There are four recurrence relations included in the program (See Section II(3)). Two relations are based on the strain energy density in an element and the remaining are based on the state of stress. The user may select any one of these by assigning the proper value to NENG in the input Card Set 3. If the user is not familiar with the implications of using the different recurrence relations, it is recommended that he use NENG = 1. This will produce good results for a general structure.

In the input Card Set 3, LSTCCL designates the total number of iterations for the stress constraint design. Out of this total, for LLSTCL iterations, the design variables are modified by using the recurrence relation. In the remaining iterations, the thickness of each element is modified to make the scaling parameter Λ (See Eqs. 13, 19, 20) nearly the same for all the elements. During this second phase of optimization, the percentage of laminas in the different fiber directions in the composite

elements remains unchanged. This process of equalizing the scaling parameter sometimes reduces the weight of the structure depending upon the type of structure, the variation in the magnitude of the different maximum allowables, and the selected strength criteria. At the end of LSTCCL iterations, the details of the minimum weight design are printed out. In the second stage for LNSB iterations, the thicknesses of the quadrilateral and triangular elements are modified to prevent local buckling of the panels (See Section II(4)). These equations are based on the approximation of smeared orthotropic properties. The effect of boundary conditions can be taken into consideration by specifying the proper value of the effective width of the plate (AWIDE(I), BWIDE(I) in the input Card Set 11). It should be noted that the effective width is not the width of the element, but the distance between the supports multiplied by the proper fraction to account for boundary conditions other than simply supported. The user has the option to indicate which layer thicknesses to increase and in what proportion to satisfy the stability criteria. This is achieved by giving proper values to PECT in the input Card Set 5. In the case of a 0°, 90°, $\pm$ 45° laminate, it has been found that it is more beneficial to increase the $\pm$ 45° layers than to increase the thickness of the whole laminate. The initial design for the second stage of optimization is the minimum weight design obtained in the first stage. In the second stage, since the thicknesses of the elements are increased, the weight of the structure goes up with each additional iteration. When all the plate elements satisfy the stability criteria, the weight of the structure stabilizes. It has been found that about five to six iterations are generally sufficient to reach the stable conditions.

The program has a provision for specifying the minimum and maximum thickness of each element by specifying the proper values of BMIN and BMAX in the input Card Sets 11 and 12. The minimum number of laminae in a layer is defined by THMIN in the input Card Set 7. The elements can be linked to have the same sizes by defining the number of sets and the element numbers in each set in the input Card Sets 13 and 14.

When the structure is to be analyzed only, set LSTCCL = 0 in the input Card Set 3. The elements which violate the specified criteria can be separated by assigning LCHEK = 1 in the input Card Set 4. This control will print out all the elements which violate the strength criteria and also the ratio of the actual stress to the maximum allowable stress for those elements. If the specified criteria is the maximum strain criteria, it will be the ratio of strains and for the Hill and Norris criteria, the effective stress ratio.

In the output the user has the option to print the stresses in the local element coordinate or the fiber coordinate system in a layer (See Figure 2), the strains in the fiber coordinate system, the effective stress ratios in each layer as defined by the Hill or Norris criteria, the average stresses in the 0° fiber coordinate system, and the nodal forces in the local or global coordinate system. The control parameters for this data are defined in the input Card Set 4. The reactions at the boundaries and the sum of the forces and moments about the three coordinate axes through the origin are printed at the end. This information is generally useful for an equilibrium check.

The program listed in the report is limited to solving problems with a maximum value of the different variables as given below

Number of members - MEMBS - 120

Number of quadrilaterals and triangles - NC - 50

Number of shear panels and posts - NI - 70

Number of nodes - JOINTS - 50

Number of boundaries - NB - 50

Number of loading conditions - LOADS - 2

Number of layers in the composite elements - NZ - 4

Number of sets of the materials for shear panels and bars - NMAT1 - 4

Number of different materials used for quadrilaterals and triangles - NMAT2 - 4

Number of elements in the stiffness matrix - NMAT - 5000

Number of sets of linked elements - LNK - 5

Number of elements in each linked sets - LMAX - 10

Core required on the Cyber-7400 - NOS/BE operating system - 114_8K

On the Cyber-7400 a much larger problem can be solved by increasing the dimensions of the different variables as indicated by the comments in the program.

A short description of the subroutines used in the program is given below.

Program MAIN

The MAIN program reads the input data, generates the stiffness matrix of the whole structure and determines the displacement vector. It then uses the information received from the MEMB subroutine to calculate the weight of the structure and to modify the design variables by using the recurrence relations. At the end it prints out the number of laminas in the layered elements, the cross-sectional areas of the bar elements and the thicknesses of the remaining elements.

SUBROUTINE MEMB

This subroutine is the longest subroutine and is called twice from the MAIN program. It calculates the stresses, strains, and strain energies in all the elements. The scaling parameter Λ used to satisfy the strength criteria in all the elements is determined in this subroutine. The membrane elements which are susceptible to local buckling are modified here. The stresses, strains, nodal forces, etc. are printed out by this subroutine after the last iteration.

The following subroutines are called by MAIN and MEMB to carry out various calculations.

SUBROUTINE SUGD

This subroutine calculates the scaling parameter for the membrane element to satisfy the maximum stress criteria or the maximum strain criteria.

SUBROUTINE AVECT

This subroutine defines the direction of the fibers in the layer of a membrane element by a set of components in the local coordinate system of the element.

SUBROUTINE SURFACE

This subroutine calculates the scaling parameter for a shear panel and a bar element to satisfy the maximum allowable stress.

SUBROUTINE COORD

This subroutine establishes the local coordinate system of the elements. It also determines the transformation matrices needed to transform the stiffness matrix and the displacement vector from one coordinate system to another.

SUBROUTINE ELAS

This subroutine determines the elastic matrix of the layer in the membrane element in the local coordinate system. It also calculates the transformation matrix to get the stresses and strains in the fiber coordinate system from the local coordinate system.

SUBROUTINE STRAIN

This subroutine evaluates the strains in a membrane element from the nodal displacements in the local coordinate system.

SUBROUTINE COMP

This subroutine calculates the stiffness matrix of a triangular membrane element in the local coordinate system.

SUBROUTINE ELSTIF

This subroutine determines the stiffness matrix of a bar element in the local and the global coordinate system.

SUBROUTINE ASEMBL

This subroutine assembles the stiffness matrix for the whole structure in the global coordinate system.

SUBROUTINE CONDNS

This subroutine eliminates the internal dummy node point of the quadrilateral and condenses the stiffness matrix from (10x10) to (8x8).

SUBROUTINE SUM

This subroutine assembles the stiffness matrix (10x10) of the quadrilateral from the stiffness matrices of the four triangles.

SUBROUTINE CHANGE

This subroutine which is called from the CONDNS subroutine rearranges the stiffness matrix of the quadrilateral and the shear panel.

SUBROUTINE TRNSF

This subroutine is used to transform the stiffness matrix from the local coordinate system to the global coordinate system.

SUBROUTINE POP

This subroutine determines the exact core required to store the stiffness matrix of the whole structure. It also defines the location of the elements on the main diagonal and the first nonzero element of each row.

SUBROUTINE GAUSS

This subroutine solves the linear algebraic equations and determines the displacement vector.

SUBROUTINE BOUND

This subroutine eliminates the rows and columns corresponding to the boundary conditions from the stiffness matrix of the whole structure.

SUBROUTINE PRNTDR

This subroutine is called to print out the node numbers, coordinates, forces, and the displacements.

SUBROUTINE REDUCE

This subroutine eliminates the rows from the force matrix corresponding to the boundary conditions.

SUBROUTINE RESTOR

This subroutine restores the boundary conditions in the force and the displacement matrices.

SUBROUTINE ELSTRS

This subroutine determines the stress and the strain energy in a bar element.

SUBROUTINE SCOMP

This subroutine computes the stiffness matrix of a shear panel.

SUBROUTINE SSRS

This subroutine determines the stress and the strain energy in a shear panel.

SUBROUTINE BFORCE

This subroutine calculates the average stress on the the membrane element.

SUBROUTINE SBUCKL

This subroutine determines the increase in thickness of the membrane element needed to prevent local buckling of the plate.

SUBROUTINE ANORM

This subroutine normalizes the relative design vector.

SUBROUTINE MULT

This subroutine is used to multiply the stiffness matrix and the displacement matrix to determine the applied forces and the reactions at the supports.

SUBROUTINE ENGS

This subroutine determines the strain energy in a layer of a membrane element.

SUBROUTINE STRESS

This subroutine determines the stresses in the local coordinate system and the material coordinate system and the strains in a membrane element.

SUBROUTINE SHILL

This subroutine determines the scaling parameter in a membrane element for the strength criteria of Hill or Norris.

SUBROUTINE AVG

This subroutine determines the average stresses for a quadrilateral from the stresses in the four triangles.

SUBROUTINE AEQ

The sum of all the external forces and the moments about the three axes passing through the origin are calculated in this subroutine to check the overall equilibrium.

SUBROUTINE ALINK

This subroutine calculates the average strain energy density for all the elements which are specified to have the same thickness for linking of variables.

SECTION IV

PROGRAM INPUT INSTRUCTIONS

This section describes the input data required for optimization of a structure.

Card Set 1		PROBLEMS (I5)	
Col	1-5	NSTAR	Number of problems

Note: Subsequent set of cards are repeated depending on the number of problems to be solved.

Card Set 2		HEADING (8A10)	
Col	1-80	HED	An alphanumeric description of the problem to be solved.

Card Set 3		GENERAL PROBLEM RELATED DATA (16I5)	
Col	1-5	MEMBS	Number of elements
	6-10	NC	Number of membrane elements (quadrilaterals and triangles)
	11-15	NI	Number of shear panels and posts (bar elements)
	16-20	JOINTS	Number of nodes
	21-25	NB	Number of restrained degrees of freedom
	26-30	LOADS	Number of loading conditions
	31-35	MM	Number of degrees of freedom per node

$$MM = \begin{cases} 2 - \text{two-dimensional problem} \\ 3 - \text{three-dimensional problem} \end{cases}$$

	36-40	NZ	Number of layers in the membrane elements. Each layer corresponds to a fiber orientation.

41-45	INCHES		Control for units of distance
		INCHES =	1 - for inches 0 - for feet
46-50	KIPS		Control for the units of the applied forces
		KIPS =	1 - for kips 0 - for pounds
51-55	NMAT1		Number of different sets of materials used for shear panels and bars (See Section III)
56-60	NMAT2		Number of different materials used for membrane elements (See Section III)
61-65	NFIBER		Control for the definition of 0° fibers
		NFIBER =	0 - Projection specified 1 - Angle θ is specified for each element
66-70	NCRTIA		Control for the strength criteria
		NCRTIA =	1 - Maximum stress (See Eq. 6) 2 - Maximum strain (See Eq. 7) 3 - Hill(See Eq. 8)(NEF in Card Set 4 must be 1) 4 - Norris(See Eq. 9)(NEF in Card Set 4 must be 2)

71-75	NENG		Control for the recurrence relation
		NENG =	1 - Strain energy density (See Eq. 24) 2 - Ratio of strain energy to maximum strain energy density (See Eq. 27) 3 - Effective stress ratio (See Eq. 29) NCRTIA must be 3 4 - Effective stress ratio (See Eq. 31) NCRTIA must be 4
76-80	LINK		Control for linkage of elements (See Section III)
		LINK =	0 - No linkage 1 - linkage
1-5	MCONST		Control for specified sizes for a set of elements
		MCONST =	0 - Small number of specified sizes (less than 20% of the total number of elements) 1 - Large number of specified sizes
6-10	NSTART		Control to read the element sizes for the initial design
		NSTART =	0 - Not specified 1 - Specified
11-15	LSTCCL		Number of iterations for the stress constraint design. If LSTCCL = 0 the given structure is to be analyzed only.

16-20	LLSTCL	Number of iterations to modify the design variables by using the recurrence relation (See Section III) LLSTCL < LSTCCL
21-25	LNSB	Number of iterations for modification of the membrane elements to avoid local buckling (See Section III).
26-30	NBLNCE	Control to equalize the thickness of $\pm\theta$ layers (last two layers).

NBLNCE = [0 - Not required; 1 - Required]

Card Set 4 OUTPUT CONTROL (16I5)

Note: This set controls the nature of the output desired. The program will write only that information which the user asks. Most of these controls are for the stresses in the quadrilaterals and triangles.

Col		
1-5	NAREA	The relative sizes of the elements for intermediate iterations

NAREA = [0 - Not required; 1 - Required]

6-10	NLO	The stresses in the layers of the membrane elements in the local element coordinates.

NLO = [0 - Not required; 1 - Required]

11-15	NZEO	The stresses in the layers of the membrane elements in the material coordinates of the 0° layer

NZEO = [0 - Not required; 1 - Required]

16-20	NSTRN		The strains in the layers of the membrane elements in fiber direction
		NSTRN =	0 - Not required 1 - Required
21-25	NAVG		The average stresses for the laminate in the 0° fiber direction
		NAVG =	0 - Not required 1 - Required
26-30	NFI		The stresses in the layers of the membrane elements in the individual layer material coordinates
		NFI =	0 - Not required 1 - Required
31-35	NEF		The effective stresses in the layers of membrane elements
		NEF =	0 - Not Required 1 - Required (See Eq. 8) 2 - Required (See Eq. 9)
36-40	NFOR		The nodal forces in the elements
		NFOR =	0 - Not required 1 - Required (local element coordinates) 2 - Required (global coordinates)

41-45	LCHEK	Identification of the elements which do not satisfy the strength criteria, when the structure is to be analyzed only (LSTCCL = 0).

$$LCHEK = \begin{cases} 0 - \text{Not required} \\ 1 - \text{Required} \end{cases}$$

Card Set 5 DATA TO PREVENT MEMBRANE ELEMENTS FROM LOCAL BUCKLING (8E10.4)

Note: Card set 5 is needed only if LNSB defined in card set 3 is not equal to zero.

PECT(I) I = 1,...NZ	Fractions to control the increase in thickness of each layer to prevent local buckling (See Section III)

$$\sum_{I=1}^{NZ} PECT(I) = 1.$$

Card Set 6 MATERIAL PROPERTY DATA FOR SHEAR PANELS AND BARS (4F20.4)

Note: Units of the allowable stresses in this set should be consistent with that of the loads. There will be two cards for each value of I. I is the material property number.

Col

1-20	E(I)	Elastic modulus in psi/10^6 for the Ith material
21-40	PMU(I)	Poisson's ratio for the Ith material
41-60	GSHE(I)	Shear modulus in psi/10^6 for shear panels for the Ith material. If this input is zero, then

$$GSHE(I) = \frac{E(I)}{2*(1+PMU(I))}$$

61-80	SSTRT(I)	Allowable stress in tension for bars for the Ith material
1-20	SSTRC(I)	Allowable stress in compression for bars for the Ith material
21-40	SSTRS(I)	Allowable stress in the shear panels for the Ith material
41-60	SPWTT(I)	Density in lbs/in^3 for the Ith material

I = 1,...,NMAT1

Card Set 7 — MATERIAL PROPERTY DATA FOR MEMBRANE ELEMENTS (8E10.4)

Note: The total number of data cards in this set is equal to NZ * NMAT2. There will be NMAT2 subset of cards. The Jth subset contains NZ cards giving the properties of each layer in sequence. J defines the material property number for the laminate.

Col

1-10	E11(I,J)	Elastic modulus parallel to the fiber direction for the Ith layer of the Jth material in $psi/10^6$.
11-20	E22(I,J)	Elastic modulus transverse to the fiber direction for the Ith layer of the Jth material in $psi/10^6$.
21-30	ANU1(I,J)	Poisson's ratio ν_{12} for the Ith layer of the Jth material.
31-40	ANU2(I,J)	Poisson's ratio ν_{21} for the Ith layer of the Jth material. If this input is zero, then $ANU2(I,J) = ANU1(I,J) \frac{E22(I,J)}{E11(I,J)}$
41-50	GSH(I,J)	Shear modulus for the Ith layer of the Jth material in $psi/10^6$. If this input is zero, then $GSH(I,J) = \frac{E11(I,J)}{(2(1+ANU1(I,J)))}$

51-60	SPWTC(I,J)	Density in lbs/in^3 for the Ith layer of the Jth material.
61-70	THEK(I,J)	Thickness of a lamina of the Ith layer of the Jth material. This value is used to calculate the number of laminas in a layer for the final design.
71-80	THMIN(I,J)	Minimum thickness of the Ith layer of the Jth material. This value is equal to the minimum number of laminas multiplied by THEK(I,J).

I = 1,...,NZ

J = 1,...,NMAT2

Card Set 8 ALLOWABLE STRENGTHS FOR THE MEMBRANE ELEMENTS (5F15.2)

Note: The number of cards in this set is equal to NZ * NMAT2 Thus there will be NMAT2 subset of cards. The Jth subset contains NZ cards giving the allowables of each layer in sequence. J is the material property number for the laminate. Units of the allowable stresses in this set should be consistent with that of the loads. If NCRTIA = 2 (i.e., Maximum strain criteria) this set will contain allowable strains instead of allowable stresses.

Col		
1-15	SSMAX(1,K,J)	Tension allowable parallel to the fiber direction in the Kth layer of the Jth material.
16-30	SSMAX(2,K,J)	Compression allowable parallel to the fiber direction in the Kth layer of the Jth material.
31-45	SSMAX(3,K,J)	Tension allowable transverse to the fiber direction in the Kth layer of the Jth material.

46-60	SSMAX(4,K,J)	Compression allowable transverse to the fiber direction in the Kth layer of the Jth material.
61-75	SSMAX(5,K,J)	Shear allowable transverse to the fiber direction in the Kth layer of the Jth material.

K = 1,...,NZ

J = 1,...,NMAT2

Card Set 9 — DATA FOR DEFINITION OF THE 0° FIBER (3E10.4)

Note: Coordinates of three points are given. This defines the plane of projection and the projection of the 0° fibers on the plane. (See Section II(5)). If MM=2, only XD(I) and YD(I) are input. If NIFBER=1 in card set 1, this card set is not read.

Col		
1-10	XD(I)	X coordinate of the Ith point.
11-20	YD(I)	Y coordinate of the Ith point.
21-30	ZD(I)	Z coordinate of the Ith point.

I = 1,...,3

Card Set 10 — FIBER DIRECTION ANGLES IN LAYERS (8E10.4)

ANGLE(I)	Angle in degrees for the NZ layers. The first angle is 0°.

I = 1,...,NZ

Card Set 11 DATA FOR MEMBRANE ELEMENTS
(QUADRILATERALS OR TRIANGLES)
(I5, I3, I2, 4I5, 5E10.4)

Note: There is one card for each membrane element (See Figure 4). The elements are numbered in sequence but can be arranged in any order within this card set. All membrane elements are first numbered, then shear panels and bars are numbered.

Col		
1-5	I	Element number
6-8	KTYPE(I)	Type of element KTYPE(I) = 3 - triangle 4 - quadrilateral
9-10	NMAT(I)	Material property number of the element
11-15	MA(I)	First node number of the element
16-20	MB(I)	Second node number of the element
21-25	MC(I)	Third node number of the element
26-30	MD(I)	Fourth node number of the element. For a triangle MD(I) = 0
31-40	BMAX(I)	Maximum thickness allowed for the element. If there is no limit on size input a large number say 100.
41-50	BMIN(I)	Minimum thickness allowed for the element. This should be consistent with THMIN(I,J) in card set 7.

Note: AWIDE and BWIDE should be consistent with the element supports for local buckling.

51-60	AWIDE(I)	Effective width of the Ith element transverse to the 0° fibers for local buckling N_x (compression) critical.
61-70	BWIDE(I)	Effective width of the Ith element parallel to the 0° fibers for local buckling. N_y (compression) critical.

Note: If NFIBER = 0 in card set 3, then ZANGLE(I) is zero.

71-80	ZANGLE(I)	Angle in degrees which the 0° fibers make with a line joining MA(I) and MB(I). See Fig. 1(a).

I = 1,...,NC

Card Set 12 DATA FOR SHEAR PANELS AND BARS
(I5, I3, I2, 4I5, 2E10.4)

Note: There is one card for each element. The element numbering is sequential but they can be arranged in any order within this card set. These elements are numbered after all the membrane elements are numbered.

Col		
1-5	I	Element number
6-8	KTYPE(I)	Type of element

$$KTYPE(I) = \begin{cases} 5 - \text{shear panel} \\ 2 - \text{bar} \end{cases}$$

9-10	NMAT(I)	Material property number of the element
11-15	MA(I)	First node number of the element
16-20	MB(I)	Second node number of the element
21-25	MC(I)	Third node number of the element. MC(I) = 0 for bar.

26-30	MD(I)	Fourth node number of the element. MD(I) = 0 for bar.
31-40	BMAX(I)	Maximum thickness allowed for the element. For a bar element BMAX(I) is the cross-sectional area. If there is no limit on size, input a large number, say 100.
41-50	BMIN(I)	Minimum thickness allowed for the element. For a bar element BMIN(I) is the cross-sectional area.

I = (NC + 1),...,MEMBS

Note: Card sets 13, 14, and 15 are read only if LINK = 1 in card set 3.

Card Set 13 DATA FOR LINKAGE (3I5)

Col

1-5	LNK	Total number of sets of linked elements.
6-10	NSKIN	Number of sets of linked elements amongst the membrane elements.
11-15	NINT	Number of sets of linked elements amongst the shear panels and bars.

Card Set 14 NUMBER OF ELEMENTS LINKED PER SET (16I5)

NLINK(I) — Number of elements in each linked set.

I = 1,...,LNK

Card Set 15 LINKED ELEMENTS (16I5)

NELEM(K,J) — Element numbers in each linked set. Each subset is started on a new card.

K = 1,...,LNK
J = 1,...,NLINK(K)

Note: Card sets 16 and 17 are read only if LSTCCL = 0 or NSTART = 1 in card set 3.

Card Set 16 THICKNESSES OF THE QUADRILATERALS AND TRIANGLES (8E10.4)

AL(I,L) I = 1,...,NC L = 1,...,NZ	Thickness of membrane elements. Each subset contains one thickness of the layer for all elements. The number of subsets is equal to the number of layers. Each subset is started on a new card.

Card Set 17 THICKNESSES OF SHEAR PANELS AND CROSS-SECTIONAL AREAS OF BARS (8E10.4)

A(I) I = (NC + 1),...,MEMBS	Thickness of shear panels and cross-sectional areas of bars.

Card Set 18 COORDINATES OF NODES (I5, 3E10.4)

Note: The node numbering must be sequential but may be arranged in any order within this card set.

Col

1-5	I	Node number
6-15	X(I)	X coordinate of the Ith node
16-25	Y(I)	Y coordinate of the Ith node
26-35	Z(I)	Z coordinate of the Ith node

I = 1,...,JOINTS

Card Set 19 BOUNDARY CONDITIONS (16I5)

IBND(I) I = 1,...,NB	Degree of freedom numbers of those nodes which are restrained. For node k the degree of freedom numbers are 3*K-2, 3*K-1, and 3*K (X, Y and Z respectively) for MM = 3 and 2*K-1 and 2*K (X and Y respectively) for MM = 2.

Card Set 20 NUMBER OF FORCES IN EACH LOADING CONDITION (16I5)

NJLODS(I) I = 1,...,LOADS	Number of load components in the Ith loading condition.

Card Set 21 LOCATION AND APPLIED LOADS
3(E10.4, 2I5)

Note: The number of subsets is equal to the number of loading conditions (LOADS). Each subset is started on a new card.

Col

1-10	TFR(J)	Value of the Jth load.
11-15	IM(J)	Direction of the load

$$IM(J) = \begin{cases} 1 - X \text{ direction} \\ 2 - Y \text{ direction} \\ 3 - Z \text{ direction} \end{cases}$$

16-20	JM(J)	Number of the node where the load is applied.

J = 1,...,NJLODS(I)

SECTION V

PROGRAM OUTPUT DETAILS

This section describes the output from the program. The items are discussed in the order they appear.

1) The input data is printed out in the same format as the READ statements in the program.

2) The output from the POP subroutine concerning the distribution of elements in the stiffness matrix is printed. This information is

a) GROSS POPULATION - total number of elements in the upper triangle of the matrix.

b) APPARENT POPULATION - actual number of elements considered as non-zero by a given solution scheme. The apparent population represents the number of storage locations required for the stiffness matrix. If the apparent population is greater than NMAX, the program will write the message INSUFFICIENT CORE TO STORE STIFFNESS MATRIX, DIMENSION OF SK SHOULD BE (APPARENT POPULATION NUMBER).

c) STARTING ROW NUMBER FOR EACH COLUMN - The number of the row where the first non-zero element occurs in each column. The variable defined in the program is IC(I), I=1, NN(total degrees of freedom).

d) NUMBERS OF DIAGONAL ELEMENTS IN SINGLE ARRAY STIFFNESS MATRIX - For each column I the actual number of elements, ID(I) in the upper triangular matrix up to and including that column, i.e.,

$$ID(I) = \frac{I(I + 3)}{2} - \sum_{j=1}^{I} b_j$$

where b_j is the row number given for Column I in (c). Thus for the last column ID(LAST) = APPARENT POPULATION.

3) TIME USED IN SECONDS - Time the program has spent in execution up to that point. This item is repeated after each iteration.

4) RELATIVE AREAS OF MEMBERS - These are printed only if NAREA in the Input Card Set 4 is 1.

a) The first set includes the relative total areas of all members. For composite elements this will be the relative total thickness of all layers; for shear panels, the total thickness, and for bars, cross-sectional areas. The variable defined in the program is A(I), I = 1,...,MEMBS.

b) The remaining sets include the relative thickness of each layer in the quadrilateral and triangular elements. The variable in the program is AL(I,J), I = 1,...,NC

J = 1,...,NZ

5) WEIGHT-SKIN - Weight of all quadrilateral and triangular elements

WEIGHT-S-PANELS - Weight of all shear panels

WEIGHT-POSTS - Weight of all bar elements

TOTAL-WEIGHT - Total weight of the structure. This is the sum of above three weights.

ELE SKIN - Element amongst the quadrilaterals and triangles requiring the largest value of the scaling parameter to satisfy the strength criteria.

ABASE - Scaling parameter for the element ELE SKIN.

ELE STRUCT - Element amongst shear panels and bars requiring largest value of the scaling parameter to satisfy the maximum allowable stress.

CBASE - Scaling parameter for the element ELE STRUCT.

STRUCTURE NO - Problem number

NO OF LOADS - Number of loading conditions

CYCLE NO - Iteration number

EQ CYCLE NO - Number of iterations used to equalize the scaling parameter in the elements. (See Section III)

NSTBLTY - Number of iterations used to modify the elements critical in local buckling.

The data in item 5 is repeated after each iteration.

6) The following information is given for the minimum weight design after completing the specified number of iterations.

L = element number

BASEA = scaling parameter

L-C = critical loading condition for the element

CRI = the critical stress in that element

1 - stress in fiber direction
2 - stress in transverse direction
3 - shear stress

In the case of the maximum strain criteria this number will correspond to the critical strain. For Hill and Norris criteria CRI = 1.

LAR = layer number where the stress is critical

PRCNT = percentage of laminae in the different fiber directions.

In the case of shear panels and bars only L, BASEA, L-C are printed.

7) The following information is given if the structure is to be analyzed only. The output is optional. It is printed only if LCHEK = 1 in the input Card Set 4.

L = element number not satisfying the strength criteria.

BASEA = ratio of actual state of stress to the maximum allowable stress. In the case of maximum strain criteria, BASEA is the ratio of strains and for the Hill and Norris criteria BASEA is the ratio of effective stress.

L-C = same as in Item 6

CRI = same as in Item 6

LAR = same as in Item 6

In the case of shear panels and bars only L, BASEA, L-C are printed.

8) MINIMUM WEIGHT CYCLE - the iteration number which gave the lowest weight design.

9) STRESSES - The following information is given under this heading for the minimum weight design

a) MEMB - element number

b) NODES - node numbers defining the element

c) AREA - area of the element (in.^{2})

d) THICK - total thickness of the element (in.)

e) LAYER(THICK) - individual layer thickness (in.)

f) The following output are optional. They are printed only if proper control numbers are input in Card Set 4.

1) STRESSES IN INDIVIDUAL LAYERS (LOCAL COORDINATES)

2) STRESSES IN INDIVIDUAL LAYERS (ZERO FIBER DIRECTION)

3) STRAINS IN INDIVIDUAL LAYERS (FIBER DIRECTION)

4) AVERAGE STRESSES (ZERO FIBER DIRECTION)

5) STRESSES IN INDIVIDUAL LAYERS (FIBER DIRECTION)

6) EFFECTIVE STRESS

7) NODAL FORCES

For items 1 through 6 the stresses or strains are given for each loading condition on one line. The first number is the loading condition, then the layer numbers, and the stresses σ_1, σ_2, σ_{12} are printed out for each layer. The format can accommodate a maximum of four layers. In the case of average stresses only three stresses are given. The nodal forces are printed for each loading condition on one line. When NFOR = 2, Fx, Fy, Fz are given in the global coordinates and when NFOR = 1, Fx and Fy are given in the local coordinates. The sequence of nodal forces is the same as the sequence of numbers used to define the element.

In the case of shear panels MEMB, NODES, AREA, and THICK are given and for bar elements MEMB, NODES, LENGTH, and AREA are printed out. In these two cases since there is only one pertinent stress in the member, the loading conditions and stresses are printed on one line under the heading of stresses.

10) DISPLACEMENTS - The following information is given for each node under this heading for the minimum weight design

a) JOINT - Node number

b) X, Y, Z - x, y, z coordinates of the node

c) FORCE-X, FORCE-Y, FORCE-Z - Applied forces in the x, y, z directions.

d) DISPL-X, DISPL-Y, DISPL-Z - Displacement in the x, y, and z directions.

The quantities (c) and (d) are given for each loading condition.

11) NUMBER OF LAMINAE IN COMPOSITE ELEMENTS - The number of laminae in all composite elements are given. The element number is given in the parenthesis before the laminae numbers.

12) TOTAL THICKNESS OF ELEMENTS - The actual thicknesses of all the elements corresponding to the minimum weight design are listed.

13) If LNSB > 0 items 3 to 12 are repeated for the iterations used to modify the quadrilaterals and triangles to prevent local buckling.

14) REACTIONS - The format for this item is the same as Item 10, except that under the heading FORCE-X, FORCE-Y, FORCE-Z, the reactions are given corresponding to the fixed boundary conditions.

15) SUMMATION OF FORCES

a) Applied loads

LOAD - loading condition

MX - moment of applied forces about x axis through the origin

MY - moment of applied forces about y axis through the origin

MZ - moment of applied forces about z axis through the origin

b) REACTIONS - Same as (a) above except that the quantities are calculated for the reactions at the boundaries.

SECTION VI

ILLUSTRATIVE PROBLEM

A cantilever box-beam shown in Figure 5 is designed to illustrate the use of the computer program. The top and bottom skins consist of four layers with fibers in 0°, 90°, +45°, and -45°. The coordinates of the node numbers shown in Figure 5 are given in the computer output in the Appendix. There are 40 nodes and the nodes 37 through 40 are fixed. The total number of elements are 54. There are 18 quadrilaterals, 18 shear panels, and 18 posts. The 6 quadrilaterals at the tip of the box-beam consist of four layers of graphite epoxy. The 6 quadrilaterals in the middle consist of one layer of boron epoxy and three layers of graphite epoxy, and the remaining quadrilaterals consist of four layers of boron epoxy. The shear panels and posts have different elastic properties.

Number of elements - MEMBS = 54
Number of quadrilaterals - NC = 18
Number of shear panels and bars - NI = 36
Number of nodes - JOINTS = 40
Number of restrained degrees of freedom - NB = 12
Number of loading conditions - LOADS = 2
Number of degrees of freedom per node - MM = 3
Number of layers - NZ = 4
Coordinates of nodes given in feet - INCHES = 0
Applied loads given in kips - KIPS = 1
Number of materials used in shear panels and bars - NMAT1 = 2
Number of sets of materials used in quadrilaterals - NMAT2 = 3
Projection of 0° fibers is specified - NFIBER = 0
Maximum stress criteria - NCRTIA = 1
Recurrence relation used (Eq. 24) - NENG = 1
No linkage of elements - LINK = 0
No specified sizes of elements - MCONST = 0
Initial sizes of the elements not specified - NSTART = 0
Total number of iterations - LTSCCL - 15
Number of iterations to modify the design variables by using the recurrence relation - LLSTCL - 10
Number of iterations to modify the element sizes to prevent local buckling - LNSB - 8
Equal thickness of layers in +45° and -45° required - NBLNCE - 1

Relative sizes of elements required - NAREA = 1
Stresses in fiber direction needed - NFI = 1
Nodal forces in global coordinates required - NFOR = 2

Only the thickness of +45° and -45° layers are to be increased to prevent local buckling. Hence PECT(1) = 0.0; PECT(2) = 0.0; PECT(3) = 0.5; PECT(4) = 0.5.

In Card Set 12, material property number NMAT1 for all bars is 1 and for all shear panels is 2. The elastic properties for the two materials are as follows

	Material 1	Material 2
E	10.5×10^6 psi	30.0×10^6 psi
ν	0.3	0.3
G	-	-
Allowable Stress in Tension	25.0 kips/in^2	10.0 kips/in^2
Allowable Stress in Compression	20.0 kips/in^2	10.0 kips/in^2
Allowable Stress in Shear	15.0 kips/in^2	8.0 kips/in^2
Density	0.1 lbs/in^3	0.28 lbs/in^2

In Card Set 11 material property number NMAT2 for quadrilaterals 13 through 18 is 1; quadrilaterals 7 through 12 is 2 and quadrilaterals 1 through 6 is 3

	Material 1	Material 2	Material 1
0° layer	graphite-epoxy	boron-epoxy	boron-epoxy
90° layer	graphite-epoxy	graphite-epoxy	boron-epoxy
+45° layer	graphite-epoxy	graphite-epoxy	boron-epoxy
-45° layer	graphite-epoxy	graphite-epoxy	boron-epoxy

Elastic properties and allowable stresses for graphite epoxy and boron epoxy are as follows:

	graphite-epoxy	boron-epoxy
E_{11}	18.5×10^6 psi	32.0×10^6 psi
E_{22}	1.6×10^6 psi	3.5×10^6 psi
ν_{12}	0.208	0.25
ν_{21}	0.0203	-
G	0.65×10^6 psi	0.93×10^6 psi
density	.55 lbs/in^3	.0725 lbs/in^3
thickness of laminae	.0052	.0052
Minimum thickness of a layer	.0104	.0104
Allowable stress fiber direction (tension)	139.0 kips/in^2	166.0 kips/in^2
fiber direction (compression)	92.4 kips/in^2	86.0 kips/in^2
Allowable stress transverse fiber direction (tension)	4.95 kips/in^2	6.0 kips/in^2
fiber direction (compression)	29.7 kips/in^2	11.86 kips/in^2
Allowable stress shear	4.68 kips/in^2	3.95 kips/in^2

The projection of 0° fibers is defined by two points (0.0, 0.0, 0.0), (1.0, 0.0, 0.0). The third point defining the plane is (0.0, 1.0, 0.0). The line joining the first and second points is perpendicular to the line joining the first and the third points.

The four fiber orientations are 0°, 90°, +45°, and -45°.

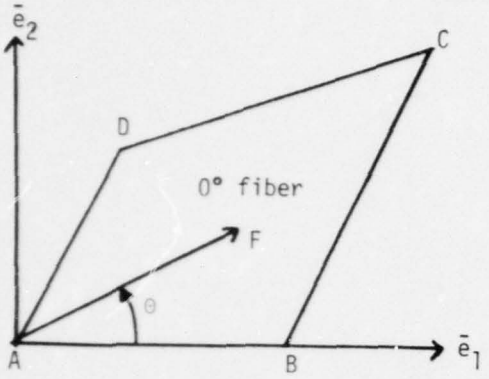
The element connections and coordinates of the nodes are given in the output of the program. The sequence of defining the elements is as shown in Figure 4.

The minimum thickness of all elements is .01 inch.

For all quadrilaterals AWIDE = 9.0 in
For all quadrilaterals BWIDE = 12.0 in

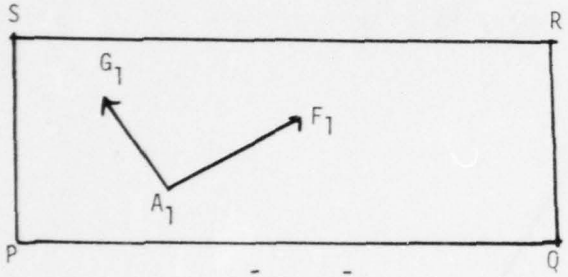
Nodes 37 through 40 are fixed. Hence, the restrained degrees of freedom are 109 through 120.

The first loading condition consists of a 1 kip load at nodes 1, 2, 3 and 4 acting in the negative z direction. The second loading condition consists of a 0.5 kip load at nodes 2 and 4 acting in the negative z direction.



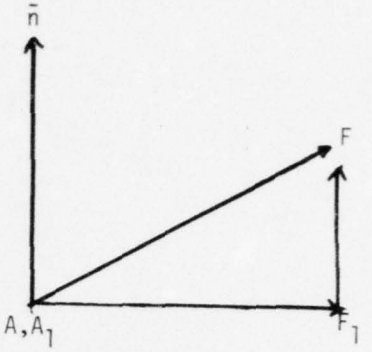
$$\bar{e}_n = \bar{e}_1 \times \bar{e}_2$$

(a) fiber direction



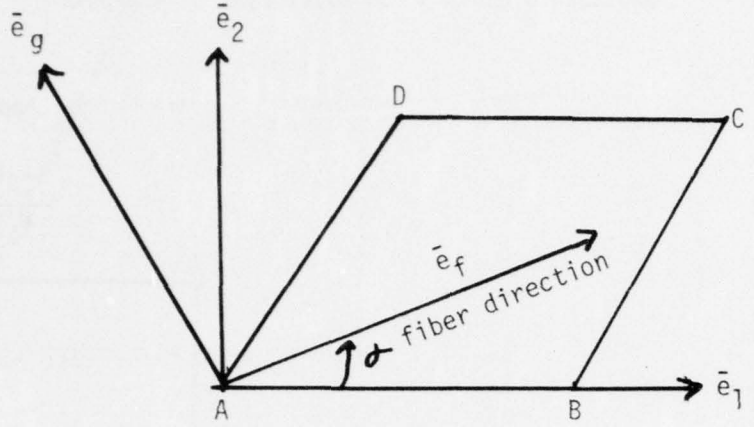
$$\bar{n} = \frac{\bar{A}_1F_1 \times \bar{A}_1G_1}{|\bar{A}_1F_1 \times \bar{A}_1G_1|}$$

(b) projection



(c) fiber direction and projection

FIGURE 1. DEFINITION OF 0° FIBER DIRECTIONS



$\bar{e}_n = \bar{e}_1 \times \bar{e}_2 = \bar{e}_f \times \bar{e}_g$

$(\bar{e}_1, \bar{e}_2, \bar{e}_n)$ local coordinate system of the element ABCD

$(\bar{e}_f, \bar{e}_g, \bar{e}_n)$ material coordinate system

FIGURE 2. LOCAL AND FIBER COORDINATE SYSTEMS

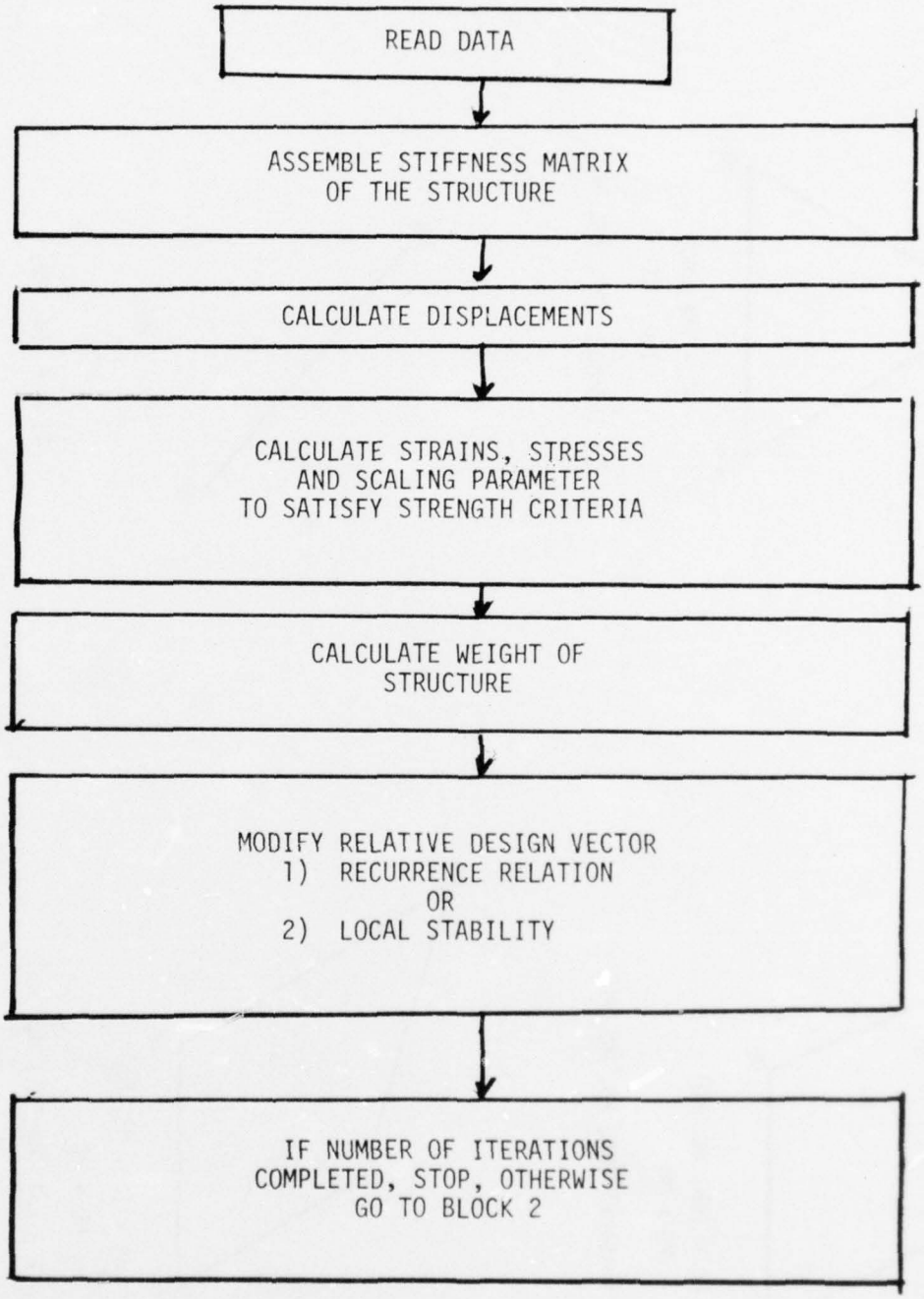
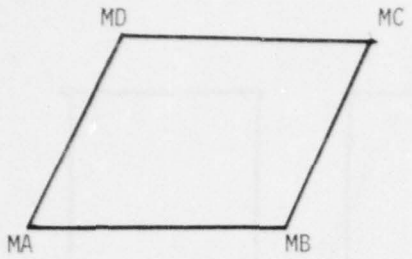


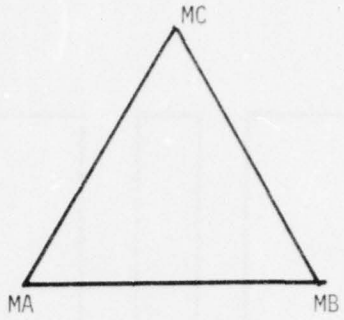
FIGURE 3. FLOW DIAGRAM



MA < (MB, MC, MD)

MD > MB

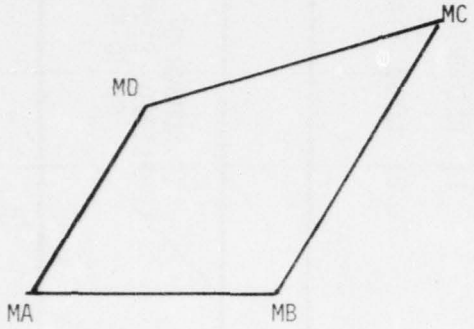
1) quadrilateral (MA, MB, MC, MD)



MA < (MB, MC)

MB < MC

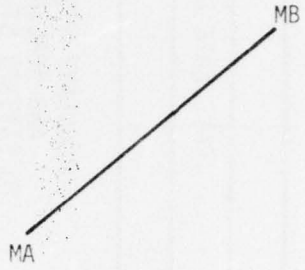
2) triangle (MA, MB, MC)



MA < (MB, MC, MD)

MD > MB

3) shear panel (MA, MB, MC, MD)



MA < MB

4) bar (MA, MB)

FIGURE 4. NODAL NUMBERING SYSTEM FOR ELEMENTS

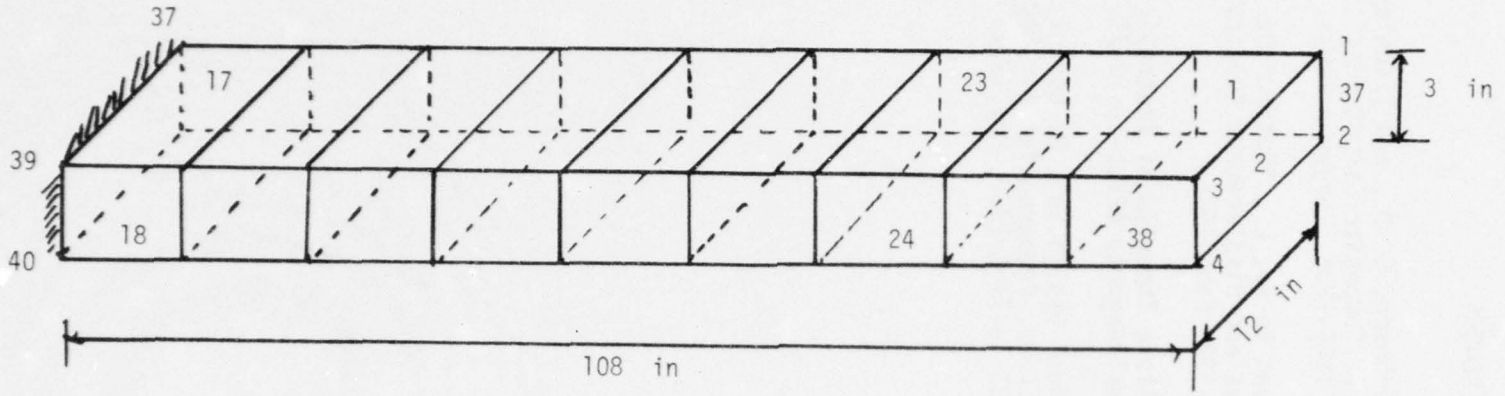


FIGURE 5. Cantilever Box-Beam

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1. Khot, N. S., Venkayya, V. B., Johnson, C. D., and Tischler, V. A., "Optimization of Fiber Reinforced Composite Structures," Int. J. Solids Structures, Vol. 9, pp. 1225-1236, Pergamon Press, Sept. 1973.

2. Khot, N. S., Venkayya, V. B., and Berke, L., "Optimum Design of Composite Structures with Stress and Displacement Constraints," AIAA Journal, Vol. 14, pp. 131-132, Feb. 1976.

3. Sandhu, R. S., "A Survey of Failure Theories of Isotropic and Anisotropic Materials," Technical Report, AFFDL-TR-72-71, Sept. 72.

4. "Advanced Composites Design Guide" Design Vol. 2, Book 2, Division of the North American Rockwell Corp. Prepared for Air Force Materials Lab. (AFML/LC), Contract No. F33615-71-C-1362, Nov.1971.

CORRECTION IDENTS ARE LISTED IN CHRONOLOGICAL ORDER OF INSERTION

MAIN	MEMB	SUGD	AVECT	SURF	COORD	ELAS	STRAIN
COMP	ESTIF	ASEMBL	CONDNS	SUM	CHANG	TRNSF	POP
GAUSS	BOUND	PRNTD	REDUCE	RESTOR	ELSTRS	SCOMP	SSRS
BFORCE	SBUCK	ANORM	MULT	ENGS	STRESS	SHILL	AVG
AEQ	ALINK						

DECKS ARE LISTED IN THE ORDER OF THEIR OCCURRENCE ON A NEW PROGRAM LIBRARY IF ONE IS CREATED BY THIS UPDATE

YANK$$$	MAIN	MEMB	SUGD	AVECT	SURF	COORD	ELAS
STRAIN	COMP	ESTIF	ASEMBL	CONDNS	SUM	CHANG	TRNSF
POP	GAUSS	BOUND	PRNTD	REDUCE	RESTOR	ELSTRS	SCOMP
SSRS	BFORCE	SBUCK	ANORM	MULT	ENGS	STRESS	SHILL
AVG	AEQ	ALINK					

65

DECKS WRITTEN TO COMPILE FILE

MAIN	MEMB	SUGD	AVECT	SURF	COORD	ELAS	STRAIN
COMP	ESTIF	ASEMBL	CONDNS	SUM	CHANG	TRNSF	POP
GAUSS	BOUND	PRNTD	REDUCE	RESTOR	ELSTRS	SCOMP	SSRS
BFORCE	SBUCK	ANORM	MULT	ENGS	STRESS	SHILL	AVG
AEQ	ALINK						

THIS UPDATE REQUIRED 34100B WORDS OF CORE.

FTN 4.5+414 10/29/76 12.20.38

PROGRAM OPTCOMP 74/74 OPT=1

```
      PROGRAM OPTCOMP(INPUT,TAPE5=INPUT,OUTPUT,TAPE6=OUTPUT)                    MAIN       2
C                                                                               MAIN       3
C     PROGRAM**********OPTCOMP**********                                        MAIN       4
C     THIS COMPUTER PROGRAM CAN BE USED TO ANALYZE OR OPTIMIZE                  MAIN       5
C     COMPOSITE STRUCTURES. THE PLATE ELEMENTS CAN BE DESIGNED TO               MAIN       6
C     PREVENT LOCAL BUCKLING                                                    MAIN       7
      COMMON /AA/ NEF,NAVG,NFULL,NCHK,NCRTIA,NSTBLTY,NLO,NFI,NZEO,NSTRN,        MAIN       8
     1NFOR,NENG,NBLNCE,LAST,LNSB,ABAS,CBAS,LSKIN,LINT,MEMBS,MM,E1,BASEAE       MAIN       9
     2,BASEA,NFIBER,LSTCOL,LCHEK                                               MAIN      10
      COMMON /BB/ MAA,MBB,MCC,EK,EKK,B,C,XI,ETA,ZI,XXI,YII,XO,YO,ZO,SSMA        MAIN      11
     1X,THE,THETA,EKL,E,AEE,CC,AA,AAA,AE,AB,DA,EE,EO                           MAIN      12
      COMMON /CC/ E11,E22,ANU1,ANU2,GSH                                         MAIN      13
C  ACTUAL DIMENSIONS MUST BE GREATER THAN OR EQUAL TO THE DIMENSIONS            MAIN      14
C  MENTIONED UNDER THE COMMENT CARDS. THE DIMENSIONS OF UNMENTIONED           MAIN      15
C  VARIABLES ARE INDEPENDENT OF THE SIZE OF THE PROBLEM                       MAIN      16
C  X,Y,Z,--(JOINTS)$$$IDIAG,ICOL,IDIAGS,ICOLS,--(MM*JOINTS)$$$               MAIN      17
C  SK,--(NMAX)$$$IBND,--(NB)$$$FR,DR,--(MM*JOINTS,LOADS)$$$                  MAIN      18
C  NJLODS,--(LOADS)$$$                                                       MAIN      19
C  MA,MB,MC,MD,A,KTYPE,ELENTH,BMAX,BMIN,NMAT,--(MEMBS)$$$                    MAIN      20
C  AL,STRENG,AAEL,NLYRS,SSTHK,--(NC,NZ)$$$AWIDE,BWIDE,ZANGLE,--(NC)$$$       MAIN      21
C  STNG,ENGL,AAEI,AENG,NANEG,--(NI)$$$AEE,CC,--(9,NMAT2,NZ)$$$               MAIN      22
C  E11,E22,ANU1,ANU2,SPWTC,THMIN,GSH,CNU,THEK,--(NZ,NMAT2)$$$                MAIN      23
C  S1,S2,S3,S4,S5,S6,S7,S8,ANGLE,PECT,AM,AN,--(NZ)$$$                        MAIN      24
C  E,PMU,GSHE,SSTRT,SSTRC,SSTRS,SPWTT,--(NMAT1)$$$SSMAX,--(5,NZ,NMAT2)$$     MAIN      25
C  THE,THETA,--(NZ,3)$$$NLINK,--(LNK)$$$NELEM(LNK,LMAX)$$$                   MAIN      26
C  LMAX=MAX NUMBER OF ELEMENTS MENTIONED IN NLINK                             MAIN      27
C  MEMBS=NC+NI                                                               MAIN      28
C  NCC=NC$$$NZK=MM*JOINTS$$$NMAX=DIMENSION OF SK                             MAIN      29
C  NCC,NZK NMAX ARE DEFINED AFTER THE DIMENSION CARDS                        MAIN      30
      DIMENSION X(50), Y(50), Z(50), IDIAG(150), ICOL(150), IDIAGS(150),     MAIN      31
     1 ICOLS(150)                                                           MAIN      32
      DIMENSION SK(5000), IBND(50)                                          MAIN      33
      DIMENSION FR(150,2), DR(150,2), NJLODS(2)                             MAIN      34
      DIMENSION MA(120), MB(120), MC(120), MD(120), A(120), KTYPE(120),     MAIN      35
     1ELENTH(120), BMAX(120), BMIN(120), NMAT(120)                          MAIN      36
      DIMENSION AL(50,4), STRENG(50,4), AAEL(50,4), NLYRS(50,4), SSTHK(5    MAIN      37
     10,4), AWIDE(50), BWIDE(50), ZANGLE(50)                                MAIN      38
      DIMENSION STNG(70), ENGL(70), AAEI(70), ANEG(70), NANEG(70)           MAIN      39
      DIMENSION AEE(9,4,4), CC(9,4,4), E11(4,4), E22(4,4), ANU1(4,4), AN    MAIN      40
     1U2(4,4), SPWTC(4,4), THMIN(4,4), GSH(4,4), CNU(4,4), THEK(4,4), S1   MAIN      41
     2(4), S2(4), S3(4), S4(4), S5(4), S6(4), S7(4), S8(4), ANGLE(4), PE   MAIN      42
     3CT(4), AM(4), AN(4), E(4), PMU(4), GSHE(4), SSTRT(4), SSTRC(4), SS   MAIN      43
     4TRS(4), SPWTT(4), SSMAX(5,4,4), THE(4,3), THETA(4,3)                  MAIN      44
      DIMENSION NLINK(5), NELEM(5,10)                                       MAIN      45
      DIMENSION AA(3,3), AB(3), EK(12,12), XI(5), ETA(5), C(12,12), B(12    MAIN      46
     1,12), II(3), JM(3), TFR(3), XXI(5), YII(5), ZI(5), EKK(12,12), AAA   MAIN      47
     2(3,3), MAA(4), MBB(4), MCC(4), AE(3,3), EE(3,3), EO(3), EKL(12,12)   MAIN      48
     3, DA(3,3), XO(3), YO(3), ZO(3), AC(3,3)                               MAIN      49
      DIMENSION HED(8)                                                      MAIN      50
      PRINT 107                                                             MAIN      51
      NMAX=5000                                                             MAIN      52
      NCC=50                                                                MAIN      53
      NZK=150                                                               MAIN      54
      NON=1                                                                 MAIN      55
      NTO=2                                                                 MAIN      56
      NTH=3                                                                 MAIN      57
      NTW=12                                                                MAIN      58
      NZERO=0
```

```
      WRITE (6,108)                                                     MAIN      59
      READ (5,125) NSTR                                                 MAIN      60
60    WRITE (6,125) NSTR                                                MAIN      61
      KSTR=1                                                            MAIN      62
    1 CONTINUE                                                          MAIN      63
      IF (KSTR.GT.1) WRITE (6,108)                                      MAIN      64
      READ (5,109) HED                                                  MAIN      65
65    WRITE (6,110) KSTR,HED                                            MAIN      66
      ATIME=SECOND(AAZ)                                                 MAIN      67
      WRITE (6,146) ATIME                                               MAIN      68
      READ (5,125) MEMBS,NC,NI,JOINTS,NB,LOADS,MM,NZ,INCHES,KIPS,NMAT1,N MAIN      69
     1MAT2,NFIBER,NORTIA,NENG,LINK,MCONST,NSTART,LSTCOL,LLSTCL,LNSB,NBLN MAIN      70
70   2CE                                                               MAIN      71
      WRITE (6,111) MEMBS,NC,NI,JOINTS,NB,LOADS,MM,NZ,INCHES,KIPS,NMAT1, MAIN      72
     1NMAT2,NFIBER,NORTIA,NENG,LINK,MCONST,NSTART,LSTCOL,LLSTCL,LNSB,NBL MAIN      73
     2NCE                                                               MAIN      74
      READ (5,125) NAREA,NLO,NZEO,NSTRN,NAVG,NFI,NEF,NFOR,LCHEK         MAIN      75
75    WRITE (6,111) NAREA,NLO,NZEO,NSTRN,NAVG,NFI,NEF,NFOR,LCHEK        MAIN      76
      NN=MM*JOINTS                                                      MAIN      77
      NM=NN-NB                                                          MAIN      78
      IF (LNSB.EQ.0) GO TO 2                                            MAIN      79
      READ (5,126) (PECT(I),I=1,NZ)                                     MAIN      80
80    WRITE (6,112) (PECT(I),I=1,NZ)                                    MAIN      81
    2 CONTINUE                                                          MAIN      82
      IF (NENG.EQ.4) LLSTCL=LSTCOL+1                                    MAIN      83
      LISS=LLSTCL-1                                                     MAIN      84
      DO 3 I=1,NMAT1                                                    MAIN      85
85    READ (5,113) E(I),PMU(I),GSHE(I),SSTRT(I),SSTRC(I),SSTRS(I),SPWTT( MAIN      86
     1I)                                                                MAIN      87
      WRITE (6,114) E(I),PMU(I),GSHE(I),SSTRT(I),SSTRC(I),SSTRS(I),SPWTT MAIN      88
     1(I)                                                               MAIN      89
    3 CONTINUE                                                          MAIN      90
90    IF (NC.EQ.0) GO TO 8                                              MAIN      91
      READ (5,115) ((E11(I,J),E22(I,J),ANU1(I,J),ANU2(I,J),GSH(I,J),SPWT MAIN      92
     1C(I,J),THEK(I,J),THMIN(I,J),I=1,NZ),J=1,NMAT2)                    MAIN      93
      WRITE (6,116) ((E11(I,J),E22(I,J),ANU1(I,J),ANU2(I,J),GSH(I,J),SPW MAIN      94
     1TC(I,J),THEK(I,J),THMIN(I,J),I=1,NZ),J=1,NMAT2)                   MAIN      95
95    DO 4 J=1,NMAT2                                                    MAIN      96
      DO 4 K=1,NZ                                                       MAIN      97
      READ (5,117) (SSMAX(I,K,J),I=1,5)                                 MAIN      98
      WRITE (6,118) (SSMAX(I,K,J),I=1,5)                                MAIN      99
    4 CONTINUE                                                          MAIN     100
100   IF (NFIBER.EQ.1) GO TO 6                                          MAIN     101
      DO 5 I=1,NTH                                                      MAIN     102
      READ (5,119) XD(I),YD(I),ZD(I)                                    MAIN     103
      WRITE (6,120) XD(I),YD(I),ZD(I)                                   MAIN     104
    5 CONTINUE                                                          MAIN     105
105 6 CONTINUE                                                          MAIN     106
      READ (5,126) (ANGLE(I),I=1,NZ)                                    MAIN     107
      WRITE (6,112) (ANGLE(I),I=1,NZ)                                   MAIN     108
      DO 7 J=1,NC                                                       MAIN     109
      READ (5,121) I,KTYPE(I),NMAT(I),MA(I),MB(I),MC(I),MD(I),BMAX(I),BM MAIN     110
110  1IN(I),AWIDE(I),BWIDE(I),ZANGLE(I)                                 MAIN     111
      WRITE (6,122) I,KTYPE(I),NMAT(I),MA(I),MB(I),MC(I),MD(I),BMAX(I),B MAIN     112
     1MIN(I),AWIDE(I),BWIDE(I),ZANGLE(I)                                MAIN     113
      ZANGLE(I)=ZANGLE(I)*3.1415926/180.                                MAIN     114
    7 CONTINUE                                                          MAIN     115
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```
      8     CONTINUE                                                          MAIN      116
            NK=NC+1                                                           MAIN      117
            DO 9 J=NK,MEMBS                                                   MAIN      118
            READ (5,121) I,KTYPE(I),NMAT(I),MA(I),MB(I),MC(I),MD(I),BMAX(I),BM MAIN      119
           1IN(I)                                                             MAIN      120
            WRITE (6,122) I,KTYPE(I),NMAT(I),MA(I),MB(I),MC(I),MD(I),BMAX(I),B MAIN      121
           1MIN(I)                                                            MAIN      122
      9     CONTINUE                                                          MAIN      123
            IF (LINK.EQ.0) GO TO 11                                           MAIN      124
            READ (5,125) LNK,NSKIN,NINT                                       MAIN      125
            WRITE (6,111) LNK,NSKIN,NINT                                      MAIN      126
            READ (5,125) (NLINK(I),I=1,LNK)                                   MAIN      127
            WRITE (6,111) (NLINK(I),I=1,LNK)                                  MAIN      128
            DO 10 K=1,LNK                                                     MAIN      129
            KX=NLINK(K)                                                       MAIN      130
            READ (5,125) (NELEM(K,J),J=1,KX)                                  MAIN      131
            WRITE (6,111) (NELEM(K,J),J=1,KX)                                 MAIN      132
     10     CONTINUE                                                          MAIN      133
     11     CONTINUE                                                          MAIN      134
            IF (NSTART.EQ.1) GO TO 12                                         MAIN      135
            IF (LSTCOL.GT.0) GO TO 15                                         MAIN      136
     12     CONTINUE                                                          MAIN      137
            IF (NC.EQ.0) GO TO 13                                             MAIN      138
            DO 14 L=1,NZ                                                      MAIN      139
            READ (5,126) (AL(I,L),I=1,NC)                                     MAIN      140
            WRITE (6,112) (AL(I,L),I=1,NC)                                    MAIN      141
     14     CONTINUE                                                          MAIN      142
     13     CONTINUE                                                          MAIN      143
            K1=NC+1                                                           MAIN      144
            READ (5,126) (A(I),I=K1,MEMBS)                                    MAIN      145
            WRITE (6,112) (A(I),I=K1,MEMBS)                                   MAIN      146
     15     CONTINUE                                                          MAIN      147
            DO 16 J=1,JOINTS                                                  MAIN      148
            READ (5,124) I,X(I),Y(I),Z(I)                                     MAIN      149
            WRITE (6,123) I,X(I),Y(I),Z(I)                                    MAIN      150
     16     CONTINUE                                                          MAIN      151
            READ (5,125) (IBND(I),I=1,NB)                                     MAIN      152
            WRITE (6,111) (IBND(I),I=1,NB)                                    MAIN      153
            DO 17 I=1,NN                                                      MAIN      154
            DO 17 J=1,LOADS                                                   MAIN      155
            DR(I,J)=0                                                         MAIN      156
     17     FR(I,J)=0                                                         MAIN      157
            READ (5,125) (NJLODS(I),I=1,LOADS)                                MAIN      158
            WRITE (6,111) (NJLODS(I),I=1,LOADS)                               MAIN      159
            DO 23 J=1,LOADS                                                   MAIN      160
            KH=NJLODS(J)                                                      MAIN      161
     18     IF (KH-3) 19,19,20                                                MAIN      162
     19     KX=KH                                                             MAIN      163
            GO TO 21                                                          MAIN      164
     20     KX=3                                                              MAIN      165
     21     READ (5,128) (TFR(I),IM(I),JM(I),I=1,KX)                          MAIN      166
            WRITE (6,127) (TFR(I),IM(I),JM(I),I=1,KX)                         MAIN      167
            DO 22 I=1,KX                                                      MAIN      168
            KY=MM*JM(I)-MM+IM(I)                                              MAIN      169
     22     FR(KY,J)=FR(KY,J)+TFR(I)                                          MAIN      170
            KH=KH-KX                                                          MAIN      171
            IF (KH) 23,23,18                                                  MAIN      172
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      23    CONTINUE                                                          MAIN      173
            DO 24 I=1,NMAT1                                                   MAIN      174
            IF (GSHE(I).EQ.0.) GSHE(I)=E(I)/(2.*(1+PMU(I)))                   MAIN      175
  175       E(I)=E(I)*10.0**6                                                 MAIN      176
            GSHE(I)=GSHE(I)*10.0**6                                           MAIN      177
      24    CONTINUE                                                          MAIN      178
            DO 25 I=1,NZ                                                      MAIN      179
            ANGLE(I)=3.1415926536*ANGLE(I)/180.                               MAIN      180
  180       THE(I,1)=COS(ANGLE(I))                                            MAIN      181
            THE(I,2)=SIN(ANGLE(I))                                            MAIN      182
      25    THE(I,3)=0.0                                                      MAIN      183
            E1=E(1)                                                           MAIN      184
            IF (NI.EQ.0) E1=E11(1,1)*10.**6                                   MAIN      185
  185       IF (NC.EQ.0) GO TO 27                                             MAIN      186
            DO 26 J=1,NMAT2                                                   MAIN      187
            DO 26 I=1,NZ                                                      MAIN      188
            E11(I,J)=E11(I,J)*10.**6                                          MAIN      189
            E22(I,J)=E22(I,J)*10.**6                                          MAIN      190
  190       GSH(I,J)=GSH(I,J)*10.**6                                          MAIN      191
            IF (GSH(I,J).EQ.0.) GSH(I,J)=E11(I,J)/(2.*(1.+ANU1(I,J)))         MAIN      192
            IF (ANU2(I,J).EQ.0.) ANU2(I,J)=ANU1(I,J)*E22(I,J)/E11(I,J)        MAIN      193
            CNU(I,J)=1.-ANU1(I,J)*ANU2(I,J)                                   MAIN      194
            C11=E11(I,J)/CNU(I,J)                                             MAIN      195
  195       C22=E22(I,J)/CNU(I,J)                                             MAIN      196
            C12=C22*ANU1(I,J)                                                 MAIN      197
            C66=GSH(I,J)                                                      MAIN      198
            C16=0.0                                                           MAIN      199
            C26=0.0                                                           MAIN      200
  200       AEE(1,I,J)=C11/E1                                                 MAIN      201
            AEE(5,I,J)=C22/E1                                                 MAIN      202
            AEE(2,I,J)=AEE(5,I,J)*ANU1(I,J)                                   MAIN      203
            AEE(9,I,J)=GSH(I,J)/E1                                            MAIN      204
            AEE(4,I,J)=AEE(2,I,J)                                             MAIN      205
  205       AEE(6,I,J)=0.0                                                    MAIN      206
            AEE(8,I,J)=0.0                                                    MAIN      207
            AEE(3,I,J)=0.0                                                    MAIN      208
            AEE(7,I,J)=0.0                                                    MAIN      209
            AM(I)=COS(ANGLE(I))                                               MAIN      210
  210       AN(I)=SIN(ANGLE(I))                                               MAIN      211
            S1(I)=AM(I)**4                                                    MAIN      212
            S2(I)=AM(I)**2*AN(I)**2                                           MAIN      213
            S3(I)=AM(I)**3*AN(I)                                              MAIN      214
            S4(I)=AN(I)**4                                                    MAIN      215
  215       S5(I)=AM(I)*AN(I)**3                                              MAIN      216
            S6(I)=AM(I)**2                                                    MAIN      217
            S7(I)=AN(I)**2                                                    MAIN      218
            S8(I)=AM(I)*AN(I)                                                 MAIN      219
            L=I                                                               MAIN      220
  220       CC(1,L,J)=S1(L)*C11+2.*S2(L)*C12+4.*S3(L)*C16+S4(L)*C22+4.*S5(L)*C MAIN      221
           126+4.*S2(L)*C66                                                   MAIN      222
            CC(2,L,J)=S2(L)*C11+(S1(L)+S4(L))*C12+2.*(S5(L)-S3(L))*C16+S2(L)*C MAIN      223
           122+2.*(S3(L)-S5(L))*C26-4.*S2(L)*C66                              MAIN      224
            CC(4,L,J)=CC(2,L,J)                                               MAIN      225
  225       CC(3,L,J)=-S3(L)*C11+(S3(L)-S5(L))*C12+(S1(L)-3.*S2(L))*C16+S5(L)* MAIN      226
           1C22+(3.*S2(L)-S4(L))*C26+2.*(S3(L)-S5(L))*C66                     MAIN      227
            CC(7,L,J)=CC(3,L,J)                                               MAIN      228
            CC(5,L,J)=S4(L)*C11+2.*S2(L)*C12+4.*S5(L)*C16+S1(L)*C22-4.*S3(L)*C MAIN      229
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                126+4.*S2(L)*C66                                                    MAIN      230
230              CC(6,L,J)=-S5(L)*C11+(S5(L)-S3(L))*C12+(3.*S2(L)-S4(L))*C16+S3(L)* MAIN      231
                1C22+(S1(L)-3.*S2(L))*C26+(S5(L)-S3(L))*2.*C66                      MAIN      232
                 CC(8,L,J)=CC(6,L,J)                                                MAIN      233
                 CC(3,L,J)=S2(L)*C11-2.*S2(L)*C12+2.*(S5(L)-S3(L))*C16+S2(L)*C22+2. MAIN      234
                1*(S3(L)-S5(L))*C26+(S6(L)-S7(L))**2*C66                            MAIN      235
235        26    CONTINUE                                                           MAIN      236
           27    CONTINUE                                                           MAIN      237
                 IF (NSTART.EQ.1) GO TO 28                                          MAIN      238
                 IF (LSTCOL.GT.0) GO TO 29                                          MAIN      239
           28    CONTINUE                                                           MAIN      240
240              CALL ANORM (A,AL,MEMBS,AMAX,NC,NZ,NCC)                             MAIN      241
                 BASEA=AMAX                                                         MAIN      242
                 BASEAE=BASEA*E1                                                    MAIN      243
           29    CONTINUE                                                           MAIN      244
                 IF (INCHES.EQ.1) GO TO 31                                          MAIN      245
245              DO 30 I=1,JOINTS                                                   MAIN      246
                 X(I)=X(I)*12.0                                                     MAIN      247
                 Z(I)=Z(I)*12.0                                                     MAIN      248
           30    Y(I)=Y(I)*12.0                                                     MAIN      249
           31    CONTINUE                                                           MAIN      250
250              IF (KIPS.NE.1) GO TO 35                                            MAIN      251
                 DO 32 I=1,NN                                                       MAIN      252
                 DO 32 J=1,LOADS                                                    MAIN      253
           32    FR(I,J)=1000.0*FR(I,J)                                             MAIN      254
                 DO 33 I=1,NMAT1                                                    MAIN      255
255              SSTRT(I)=SSTRT(I)*1000.                                            MAIN      256
                 SSTRC(I)=SSTRC(I)*1000.                                            MAIN      257
                 SSTRS(I)=SSTRS(I)*1000.                                            MAIN      258
           33    CONTINUE                                                           MAIN      259
                 IF (NCRTIA.EQ.2) GO TO 35                                          MAIN      260
260              DO 34 I=1,NMAT2                                                    MAIN      261
                 DO 34 K=1,NZ                                                       MAIN      262
                 DO 34 J=1,5                                                        MAIN      263
                 SSMAX(J,K,I)=SSMAX(J,K,I)*1000.                                    MAIN      264
           34    CONTINUE                                                           MAIN      265
265        35    CONTINUE                                                           MAIN      266
                 DO 36 I=1,MEMBS                                                    MAIN      267
                 BMAX(I)=BMAX(I)*E1                                                 MAIN      268
           36    BMIN(I)=BMIN(I)*E1                                                 MAIN      269
                 CALL POP (MEMBS,JOINTS,MM,MA,MB,MC,MD,KTYPE,ICOL,IDIAG,NONZRO)    MAIN      270
270              IF (NONZRO.LT.NMAX) GO TO 37                                       MAIN      271
                 WRITE (6,129) NONZRO                                               MAIN      272
                 GO TO 105                                                          MAIN      273
           37    CONTINUE                                                           MAIN      274
                 DO 38 I=1,NN                                                       MAIN      275
275              ICOLS(I)=ICOL(I)                                                   MAIN      276
           38    IDIAGS(I)=IDIAG(I)                                                 MAIN      277
                 IF (LSTCOL.EQ.0) GO TO 41                                          MAIN      278
                 ZN=FLOAT(NZ)                                                       MAIN      279
                 AZN=0.1/ZN                                                         MAIN      280
280              DO 39 I=1,NC                                                       MAIN      281
                 A(I)=0.1                                                           MAIN      282
                 DO 39 J=1,NZ                                                       MAIN      283
           39    AL(I,J)=AZN                                                        MAIN      284
                 K1=NC+1                                                            MAIN      285
285              DO 40 I=K1,MEMBS                                                   MAIN      286
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```
                A(I)=0.1                                                                MAIN      287
          40    IF (KTYPE(I).EQ.2) A(I)=1.0                                             MAIN      288
          41    CONTINUE                                                                MAIN      289
                DO 42 I=1,NN                                                            MAIN      290
      290       DO 42 J=1,LOADS                                                         MAIN      291
          42    DR(I,J)=0.0                                                             MAIN      292
                HTLAST=0.0                                                              MAIN      293
                LAST=0                                                                  MAIN      294
                KCOUNT=1                                                                MAIN      295
      295       NNEQ=0                                                                  MAIN      296
                NANLIS=1                                                                MAIN      297
                NSTBLTY=0                                                               MAIN      298
                MFORCE=0                                                                MAIN      299
                BAZSEA=0.0                                                              MAIN      300
      300       NPAGE=0                                                                 MAIN      301
                WMIN=10.**20                                                            MAIN      302
                DO 43 I=1,4                                                             MAIN      303
                ZI(I)=0.                                                                MAIN      304
                MAA(I)=I                                                                MAIN      305
      305       MBB(I)=I+1                                                              MAIN      306
          43    MCC(I)=5                                                                MAIN      307
                ZI(5)=0.                                                                MAIN      308
                MAA(4)=1                                                                MAIN      309
                MBB(4)=4                                                                MAIN      310
      310       NZERO=0                                                                 MAIN      311
          44    L=1                                                                     MAIN      312
                NDUM=0                                                                  MAIN      313
                DO 45 I=1,NN                                                            MAIN      314
                ICOL(I)=ICOLS(I)                                                        MAIN      315
      315       IDIAG(I)=IDIAGS(I)                                                      MAIN      316
                DO 46 I=1,NONZRO                                                        MAIN      317
          46    SK(I)=0                                                                 MAIN      318
                ATIME=SECOND(AAZ)                                                       MAIN      319
                WRITE (6,146) ATIME                                                     MAIN      320
      320       IF (NAREA.EQ.0) GO TO 48                                                MAIN      321
                WRITE (6,144)                                                           MAIN      322
                WRITE (6,143) (A(I),I=1,MEMBS)                                          MAIN      323
                WRITE (6,130)                                                           MAIN      324
                DO 47 J=1,NZ                                                            MAIN      325
      325       WRITE (6,143) (AL(I,J),I=1,NC)                                          MAIN      326
                WRITE (6,130)                                                           MAIN      327
          47    CONTINUE                                                                MAIN      328
          48    CONTINUE                                                                MAIN      329
                IF (NSTBLTY.GT.1) NRITE=1                                               MAIN      330
      330       NRITE=0                                                                 MAIN      331
                KM=NMAT(L)                                                              MAIN      332
                KNODE=4                                                                 MAIN      333
                IF (KTYPE(L).LE.4) KNODE=KTYPE(L)                                       MAIN      334
                CALL COORD (MA(L),MB(L),MC(L),MD(L),X,Y,Z,AA,XI,ETA,PL,KNODE,NZERO      MAIN      335
      335      1,AB)                                                                    MAIN      336
                IF (L.GT.NC) GO TO 49                                                   MAIN      337
                IF (NFIBER.EQ.1) PANGLE=ZANGLE(L)                                       MAIN      338
                CALL AMECT (XO,YO,ZO,THE,AA,THETA,NZ,PANGLE,NFIBER)
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      DO 51 I=1,12                                                      MAIN      344
      DO 51 J=1,12                                                      MAIN      345
345   C(I,J)=0.0                                                        MAIN      346
51    EK(I,J)=0.                                                        MAIN      347
      QUAD=0.                                                           MAIN      348
      DO 57 I=1,4                                                       MAIN      349
      CALL COORD (MAA(I),MBB(I),MCC(I),MD(I),XI,ETA,ZI,AAA,XXI,YII,PL,NT MAIN      350
350  1H,NZERO,AB)                                                       MAIN      351
      DO 52 JK=1,12                                                     MAIN      352
      DO 52 IK=1,12                                                     MAIN      353
52    EKK(IK,JK)=0.0                                                    MAIN      354
      DO 56 IL=1,NZ                                                     MAIN      355
355   THK=AL(L,IL)                                                      MAIN      356
      DO 53 KL=1,3                                                      MAIN      357
53    EO(KL)=THETA(IL,KL)                                               MAIN      358
      JK=0                                                              MAIN      359
      DO 54 J1=1,3                                                      MAIN      360
360   DO 54 K1=1,3                                                      MAIN      361
      JK=JK+1                                                           MAIN      362
54    AE(J1,K1)=AEE(JK,IL,KM)                                           MAIN      363
      CALL ELAS (AAA,AB,AE,EO,DA,EE)                                    MAIN      364
      CALL COMP (EKL,THK,TRIANG,XXI,YII,EE)                             MAIN      365
365   DO 55 IK=1,6                                                      MAIN      366
      DO 55 JK=1,6                                                      MAIN      367
55    EKK(IK,JK)=EKK(IK,JK)+EKL(IK,JK)                                  MAIN      368
56    CONTINUE                                                          MAIN      369
      QUAD=QUAD+TRIANG                                                  MAIN      370
370   CALL TRNSFM (EKK,AAA,B,C,NTO,NTH,NTH)                             MAIN      371
      CALL SUM (EK,C,MAA(I),MBB(I),MCC(I))                              MAIN      372
57    CONTINUE                                                          MAIN      373
      NZERO=0                                                           MAIN      374
      CALL COMONS (EK,EKK,MA(L),MB(L),MC(L),MD(L),NZERO)                MAIN      375
375   GO TO 66                                                          MAIN      376
58    CONTINUE                                                          MAIN      377
      DO 59 I=1,3                                                       MAIN      378
      DO 59 J=1,3                                                       MAIN      379
59    AC(I,J)=0.0                                                       MAIN      380
380   AC(1,1)=1.0                                                       MAIN      381
      AC(2,2)=1.0                                                       MAIN      382
      DO 60 I=1,6                                                       MAIN      383
      DO 60 J=1,6                                                       MAIN      384
60    EK(I,J)=0.0                                                       MAIN      385
385   DO 64 I=1,NZ                                                      MAIN      386
      THK=AL(L,I)                                                       MAIN      387
      DO 61 K=1,3                                                       MAIN      388
61    EO(K)=THETA(I,K)                                                  MAIN      389
      JK=0                                                              MAIN      390
390   DO 62 J1=1,3                                                      MAIN      391
      DO 62 K1=1,3                                                      MAIN      392
      JK=JK+1                                                           MAIN      393
62    AE(J1,K1)=AEE(JK,I,KM)                                            MAIN      394
      CALL ELAS (AC,AB,AE,EO,DA,EE)                                     MAIN      395
395   CALL COMP (EKL,THK,QUAD,XI,ETA,EE)                                MAIN      396
      DO 63 KI=1,6                                                      MAIN      397
      DO 63 KJ=1,6                                                      MAIN      398
63    EK(KI,KJ)=EK(KI,KJ)+EKL(KI,KJ)                                    MAIN      399
64    CONTINUE                                                          MAIN      400
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                      GO TO 66                                                  MAIN      401
                65    CONTINUE                                                  MAIN      402
                      CALL SCOMP (EK,A(L),QUAD,XI,ETA,GSHE(KM),E1)              MAIN      403
                      CALL CONDNS (EK,EKK,MA(L),MB(L),MC(L),MD(L),NTO)          MAIN      404
                66    CONTINUE                                                  MAIN      405
                      CALL TRNSFM (EK,AA,B,C,MM,KNODE,NTW)                      MAIN      406
                      GO TO 68                                                  MAIN      407
                67    CONTINUE                                                  MAIN      408
                      EBAR=E(KM)                                                MAIN      409
                      CALL ELSTIF (AA,B,C,A(L),MM,PL,EBAR,E1)                   MAIN      410
                      QUAD=PL                                                   MAIN      411
                68    CONTINUE                                                  MAIN      412
                      IF (NRITE.EQ.1) WRITE (6,131) ((C(I,J),J=1,8),I=1,8)      MAIN      413
                      CALL ASEMBL (SK,C,MA(L),MB(L),MC(L),MD(L),MM,IDIAG,KNODE,NTW)  MAIN  414
                      IF (L.GE.MEMBS) GO TO 69                                  MAIN      415
                      L=L+1                                                     MAIN      416
                      GO TO 43                                                  MAIN      417
                69    CONTINUE                                                  MAIN      418
                      IF (MFORCE.EQ.0) GO TO 71                                 MAIN      419
                      DO 70 I=1,NONZRO                                          MAIN      420
                70    SK(I)=SK(I)*BASEAE                                        MAIN      421
                      CALL MULT (SK,FR,DR,ICOL,IDIAG,NN,LOADS,NZK)              MAIN      422
                      CALL PRITDR (FR,DR,X,Y,Z,IBND,NN,MM,LOADS,JOINTS,NPAGE,NB,NON,NZK)  MAIN  423
                      CALL AEJ (X,Y,Z,FR,IBND,NZK,LOADS,JOINTS,NB,MM)           MAIN      424
                      GO TO 105                                                 MAIN      425
                71    CONTINUE                                                  MAIN      426
                      CALL BOUND (SK,IBND,NN,NB,IDIAG,ICOL)                     MAIN      427
                      CALL REDUCE (FR,IBND,NN,NB,LOADS,NZK)                     MAIN      428
                      CALL GAUSS (SK,FR,DR,ICOL,IDIAG,LOADS,NM,NZK,NZERO)       MAIN      429
                      ATIME=SECOND(AAZ)                                         MAIN      430
                      IF (LSTCOL.EQ.0) GO TO 72                                 MAIN      431
                      BASEAE=100.                                               MAIN      432
                      BASEA=BASEAE/E1                                           MAIN      433
                72    CONTINUE                                                  MAIN      434
                      CALL RESTOR (FR,IBND,NN,NB,LOADS,NZK)                     MAIN      435
                      CALL RESTOR (DR,IBND,NN,NB,LOADS,NZK)                     MAIN      436
                      NFULL=0                                                   MAIN      437
                      IF (KCOUNT.GE.LLSTCL.AND.NSTBLTY.EQ.0.AND.LAST.EQ.0) NFULL=1  MAIN  438
                      IF (NENG.EQ.4) NFULL=0                                    MAIN      439
                      IF (KCOUNT.GT.LLSTCL.AND.NFULL.EQ.1) NNEQ=NNEQ+1          MAIN      440
                      NCHK=0                                                    MAIN      441
                      NDLIS=0                                                   MAIN      442
                      CALL MEMB (X,Y,Z,MA,MB,MC,MD,KTYPE,A,DR,STRENG,AL,ELENTH,SSTHK,ZAN  MAIN  443
                     1GLE,STNG,ENGL,NMAT,SSTRT,SSTRC,SSTRS,GSHE,AWIDE,BWIDE,ANEG,NANEG,P  MAIN  444
                     2ECT,NC,NZ,LOADS,NCC,NZK,NON)                              MAIN      445
                      IF (MCONST.EQ.0) GO TO 73                                 MAIN      446
                      IF (LAST.EQ.1) GO TO 73                                   MAIN      447
                      WRITE (6,132) NANLIS                                      MAIN      448
                      PBASE=0.001*BASEA                                         MAIN      449
                      DBASE=ABS(BAZSEA-BASEA)                                   MAIN      450
                      WRITE (6,133) BASEA,DBASE                                 MAIN      451
                      IF (DBASE.LE.PBASE) GO TO 73                              MAIN      452
                      IF (NANLIS.GT.2) GO TO 73                                 MAIN      453
                      BAZSEA=BASEA                                              MAIN      454
```

```
      73    CONTINUE                                                    MAIN      458
            BAZSEA=0                                                    MAIN      459
            NANLIS=1                                                    MAIN      460
460         WSKIN=0.0                                                   MAIN      461
            IF (NC.EQ.0) GO TO 75                                       MAIN      462
            DO 74 L=1,NC                                                MAIN      463
            KM=NMAT(L)                                                  MAIN      464
            DO 74 J=1,NZ                                                MAIN      465
465         SPWT=SPWTC(J,KM)                                            MAIN      466
      74    WSKIN=WSKIN+AL(L,J)*BASEA*ELENTH(L)*SPWT                    MAIN      467
      75    CONTINUE                                                    MAIN      468
            WSHEAR=0.0                                                  MAIN      469
            WPOST=0.0                                                   MAIN      470
470         K1=NC+1                                                     MAIN      471
            DO 76 L=K1,MEMBS                                            MAIN      472
            KM=NMAT(L)                                                  MAIN      473
            SPWT=SPWTT(KM)                                              MAIN      474
            WELE=A(L)*BASEA*ELENTH(L)*SPWTT(KM)                         MAIN      475
475         IF (KTYPE(L).EQ.5) WSHEAR=WSHEAR+WELE                       MAIN      476
            IF (KTYPE(L).EQ.2) WPOST=WPOST+WELE                         MAIN      477
      76    CONTINUE                                                    MAIN      478
            WEIGHT=WSKIN+WSHEAR+WPOST                                   MAIN      479
            WRITE (6,145) WSKIN,WSHEAR,WPOST,WEIGHT                     MAIN      480
480         WRITE (6,134) LSKIN,ABAS,LINT,CBAS                          MAIN      481
            AABAS=ABAS                                                  MAIN      482
            WRITE (6,142) KSTR,LOADS,KCOUNT,NNEQ,NSTBLTY                MAIN      483
            IF (LAST.EQ.1) WRITE (6,135) NNCYCL                         MAIN      484
            DO 77 I=1,NN                                                MAIN      485
485         DO 77 J=1,LOADS                                             MAIN      486
      77    DR(I,J)=DR(I,J)/BASEAE                                      MAIN      487
            IF (KCOUNT.EQ.LISS) GO TO 78                                MAIN      488
            IF (NSTBLTY.GE.1) GO TO 95                                  MAIN      489
            IF (LSTCCL.EQ.0) GO TO 95                                   MAIN      490
490         IF (KCOUNT.EQ.1) GO TO 85                                   MAIN      491
            IF (LAST.GE.1) GO TO 95                                     MAIN      492
            IF (KCOUNT.GT.LSTCCL) GO TO 78                              MAIN      493
            GO TO 85                                                    MAIN      494
      78    CONTINUE                                                    MAIN      495
495         IF (WEIGHT.GT.WMIN) GO TO 81                                MAIN      496
            NNCYCL=KCOUNT                                               MAIN      497
            WMIN=WEIGHT                                                 MAIN      498
            BLAST=BASEAE                                                MAIN      499
            DO 79 I=1,NC                                                MAIN      500
500         DO 79 J=1,NZ                                                MAIN      501
      79    AAEL(I,J)=AL(I,J)                                           MAIN      502
            DO 80 L=1,NI                                                MAIN      503
            K1=L+NC                                                     MAIN      504
      80    AAEI(L)=A(K1)                                               MAIN      505
505         GO TO 84                                                    MAIN      506
```

```
                83    CONTINUE                                                  MAIN      515
5 5             84    CONTINUE                                                  MAIN      516
                      CALL ANORM (A,AL,MEMBS,AMAX,NC,NZ,NCC)                    MAIN      517
                      KCOUNT=KCOUNT+1                                           MAIN      518
                      IF (KCOUNT.EQ.LLSTCL) GO TO 44                            MAIN      519
                      LAST=LAST+1                                               MAIN      520
520                   BASEAE=BLAST                                              MAIN      521
                      BASEA=BLAST/E1                                            MAIN      522
                      GO TO 84                                                  MAIN      523
                85    CONTINUE                                                  MAIN      524
                      IF (WEIGHT.LT.WMIN) NNCYCL=KCOUNT                         MAIN      525
525                   IF (LINK.EQ.1) CALL ALINK (A,AL,STRENG,STNG,ELENTH,NELEM,NLINK,NZ,  MAIN  526
                     1NC,NSKIN,NINT,NSTBLTY,NCC)                                MAIN      527
                      IF (NC.EQ.0) GO TO 87                                     MAIN      528
                      DO 86 L=1,NC                                              MAIN      529
                      KM=NMAT(L)                                                MAIN      530
530                   DO 86 J=1,NZ                                              MAIN      531
                      SPWT=SPWTC(J,KM)                                          MAIN      532
                      IF (WEIGHT.LT.WMIN) AAEL(L,J)=AL(L,J)                     MAIN      533
                      IF (WEIGHT.LT.WMIN) BLAST=BASEAE                          MAIN      534
                      IF (NFULL.EQ.1) AL(L,J)=STRENG(L,J)                       MAIN      535
535                   IF (NFULL.EQ.1) GO TO 86                                  MAIN      536
                C     STRENG(L,J)=STRENG(L,J)/SPWT                              MAIN      537
                      AL(L,J)=AL(L,J)*SQRT(STRENG(L,J))                         MAIN      538
                86    CONTINUE                                                  MAIN      539
69              87    CONTINUE                                                  MAIN      540
540                   DO 88 L=1,NI                                              MAIN      541
                      K1=L+NC                                                   MAIN      542
                      IF (WEIGHT.LT.WMIN) AAEI(L)=A(K1)                         MAIN      543
                      KM=NMAT(K1)                                               MAIN      544
                      SPWT=SPWTT(KM)                                            MAIN      545
545                   IF (NFULL.EQ.1) A(K1)=STNG(L)                             MAIN      546
                      IF (NFULL.EQ.1) GO TO 88                                  MAIN      547
                C     STNG(L) =STNG(L)/SPWT                                     MAIN      548
                      A(K1)=A(K1)*SQRT(STNG(L))                                 MAIN      549
                88    CONTINUE                                                  MAIN      550
550                   IF (WEIGHT.LT.WMIN) WMIN=WEIGHT                           MAIN      551
                      NDUM=0                                                    MAIN      552
                89    CONTINUE                                                  MAIN      553
                      DO 94 K=1,2                                               MAIN      554
                      CALL ANORM (A,AL,MEMBS,AMAX,NC,NZ,NCC)                    MAIN      555
555                   IF (NC.EQ.0) GO TO 91                                     MAIN      556
                      DO 90 I=1,NC                                              MAIN      557
                      AMIN=A(I)                                                 MAIN      558
                      KM=NMAT(I)                                                MAIN      559
                      IF (AMIN*BASEAE.GT.BMAX(I)) A(I)=BMAX(I)/BASEAE           MAIN      560
560                   IF (AMIN*BASEAE.LT.BMIN(I)) A(I)=BMIN(I)/BASEAE           MAIN      561
                      DO 90 J=1,NZ                                              MAIN      562
                      AL(I,J)=AL(I,J)*A(I)/AMIN                                 MAIN      563
                      THK1=THMIN(J,KM)                                          MAIN      564
                      IF (AL(I,J)*BASEA.LT.THK1) AL(I,J)=THK1/BASEA             MAIN      565
565             90    CONTINUE                                                  MAIN      566
                91    CONTINUE                                                  MAIN      567
                      K1=NC+1                                                   MAIN      568
                      DO 93 I=K1,MEMBS                                          MAIN      569
```

```
                IF (LAST.GE.1) GO TO 92                                          MAIN      572
                IF (NANEG(KK).GT.0) A(I)=ANEG(KK)/(AABAS*E1)                     MAIN      573
             92 CONTINUE                                                         MAIN      574
                IF (A(I)*BASEAE.LT.BMIN(I)) A(I)=BMIN(I)/BASEAE                  MAIN      575
575             IF (A(I)*BASEAE.GT.BMAX(I)) A(I)=BMAX(I)/BASEAE                  MAIN      576
             93 CONTINUE                                                         MAIN      577
                CALL ANORM (A,AL,MEMBS,AMAX,NC,NZ,NCC)                           MAIN      578
             94 CONTINUE                                                         MAIN      579
                IF (LAST.GE.1) GO TO 44                                          MAIN      580
580             IF (NOLIS.EQ.1) GO TO 44                                         MAIN      581
                IF (NOU1.EQ.1) GO TO 97                                          MAIN      582
                WTLAST=WEIGHT                                                    MAIN      583
                KCOUNT=KCOUNT+1                                                  MAIN      584
                GO TO 44                                                         MAIN      585
585          95 CONTINUE                                                         MAIN      586
                LAST=0                                                           MAIN      587
                IF (NSTBLTY.NE.0.AND.NSTBLTY.NE.LNSB) NZERO=1                    MAIN      588
                NCHK=1                                                           MAIN      589
                NFULL=0                                                          MAIN      590
590             CALL MEMB (X,Y,Z,MA,MB,MC,MD,KTYPE,A,DR,STRENG,AL,ELENTH,SSTHK,ZAN MAIN      591
               1GLE,STNG,ENGL,NMAT,SSTRT,SSTRC,SSTRS,GSHE,AWIDE,BWIDE,ANEG,NANEG,P MAIN      592
               2ECT,NC,NZ,LOADS,NCC,NZK,NZERO)                                   MAIN      593
                IF (NSTBLTY.GE.LNSB) GO TO 98                                    MAIN      594
                IF (NSTBLTY.EQ.0) GO TO 98                                       MAIN      595
595             IF (LINK.EQ.1) CALL ALINK (A,AL,STRENG,STNG,ELENTH,NELEM,NLINK,NZ, MAIN      596
               1NC,NSKIN,NINT,NSTBLTY,NCC)                                       MAIN      597
                K1=NC+1                                                          MAIN      598
                NOLIS=0                                                          MAIN      599
                NOUM=1                                                           MAIN      600
600             NMZ=NC+1                                                         MAIN      601
                DO 96 L=NMZ,MEMBS                                                MAIN      602
                KK=L-NC                                                          MAIN      603
                IF (NANEG(KK).GT.0) A(L)=ANEG(KK)/(AABAS*E1)                     MAIN      604
                IF (A(L)*BASEAE.LT.BMIN(L)) A(L)=BMIN(L)/BASEAE                  MAIN      605
605             IF (A(L)*BASEAE.GT.BMAX(L)) A(L)=BMAX(L)/BASEAE                  MAIN      606
             96 CONTINUE                                                         MAIN      607
                GO TO 88                                                         MAIN      608
             97 CONTINUE                                                         MAIN      609
                NSTBLTY=NSTBLTY+1                                                MAIN      610
610             IF (NSTBLTY.EQ.LNSB) LAST=1                                      MAIN      611
                IF (NSTBLTY.LE.LNSB) GO TO 44                                    MAIN      612
             98 CONTINUE                                                         MAIN      613
                CALL PRNTOR (FR,OR,X,Y,Z,IBND,NN,MM,LOADS,JOINTS,NPAGE,NB,NZERO,NZ MAIN      614
               1K)                                                               MAIN      615
615             IF (NC.EQ.0) GO TO 101                                           MAIN      616
                DO 99 I=1,NC                                                     MAIN      617
                KM=NMAT(I)                                                       MAIN      618
                DO 99 J=1,NZ                                                     MAIN      619
                THKK=THEK(J,KM)                                                  MAIN      620
620             ANLRS=AL(I,J)*BASEA/THKK                                         MAIN      621
                NLYRS(I,J)=IFIX(ANLRS)+1                                         MAIN      622
             99 CONTINUE                                                         MAIN      623
                WRITE (6,136)                                                    MAIN      624
                K1=1                                                             MAIN      625
625             K2=5                                                             MAIN      626
                K3=NC/5+1                                                        MAIN      627
                DO 100 JKK=1,K3                                                  MAIN      628
```

```
                IF (K1.GT.NC) GO TO 100                                          MAIN      629
                IF (K2.GT.NC) K2=NC                                              MAIN      630
      630       IF (NZ.EQ.4) WRITE (6,137) ((I,(NLYRS(I,J),J=1,NZ)),I=K1,K2)     MAIN      631
                IF (NZ.EQ.3) WRITE (6,138) ((I,(NLYRS(I,J),J=1,NZ)),I=K1,K2)     MAIN      632
                K1=K1+5                                                          MAIN      633
                K2=K2+5                                                          MAIN      634
            100 CONTINUE                                                         MAIN      635
      635   101 CONTINUE                                                         MAIN      636
                DO 102 I=1,MEMBS                                                 MAIN      637
            102 A(I)=A(I)*BASEA                                                  MAIN      638
                WRITE (6,139)                                                    MAIN      639
                WRITE (6,140)                                                    MAIN      640
      640       K1=1                                                           MAIN      641
                K2=10                                                            MAIN      642
                K3=MEMBS/10+1                                                    MAIN      643
                DO 103 J=1,K3                                                    MAIN      644
                IF (K1.GT.MEMBS) GO TO 103                                       MAIN      645
      645       IF (K2.GT.MEMBS) K2=MEMBS                                      MAIN      646
                K4=J-1                                                           MAIN      647
                WRITE (6,141) K4,(A(I),I=K1,K2),K2                               MAIN      648
                K1=K1+10                                                         MAIN      649
                K2=K2+10                                                         MAIN      650
      650   103 CONTINUE                                                         MAIN      651
                DO 104 I=1,MEMBS                                                 MAIN      652
            104 A(I)=A(I)/BASEA                                                  MAIN      653
                LAST=0                                                           MAIN      654
                NSTBLTY=NSTBLTY+1                                                MAIN      655
      655       IF (NSTBLTY.EQ.1) GO TO 44                                     MAIN      656
                IF (NSTBLTY.GT.LNSB) MFORCE=1                                    MAIN      657
                IF (MFORCE.EQ.1) GO TO 44                                        MAIN      658
            105 CONTINUE                                                         MAIN      659
                IF (KSTR.EQ.NSTR) GO TO 106                                      MAIN      660
      660       KSTR=KSTR+1                                                    MAIN      661
                GO TO 1                                                          MAIN      662
            106 CONTINUE                                                         MAIN      663
                ATIME=SECOND(AAZ)                                                MAIN      664
                WRITE (6,146) ATIME                                              MAIN      665
      665       STOP                                                           MAIN      666
                C                                                                MAIN      667
            107 FORMAT (1HT)                                                     MAIN      668
            108 FORMAT (1H1)                                                     MAIN      669
            109 FORMAT (8A10)                                                    MAIN      670
      670   110 FORMAT (5X,11HPROBLEM NO=,I5,5X,8A10)                            MAIN      671
            111 FORMAT (5X,16I5)                                                 MAIN      672
            112 FORMAT (5X,6E10.4)                                               MAIN      673
            113 FORMAT (4F20.4)                                                  MAIN      674
            114 FORMAT (5X,4F20.4)                                               MAIN      675
      675   115 FORMAT (8E10.4)                                                  MAIN      676
            116 FORMAT (5X,8E10.4)                                               MAIN      677
            117 FORMAT (5F15.4)                                                  MAIN      678
            118 FORMAT (5X,5F15.4)                                               MAIN      679
            119 FORMAT (3E10.4)                                                  MAIN      680
      680   120 FORMAT (5X,3E10.4)                                               MAIN      681
            121 FORMAT (I5,I3,I2,4I5,5E10.4)                                     MAIN      682
            122 FORMAT (5X,I5,I3,I2,4I5,5E10.4)                                  MAIN      683
            123 FORMAT (5X,I5,3E10.4)                                            MAIN      684
            124 FORMAT (I5,3E10.4)                                               MAIN      685
```

```
      125   FORMAT (16I5)                                                    MAIN      686
      126   FORMAT (8E10.4)                                                  MAIN      687
      127   FORMAT (5X,3(E10.4,2I5))                                         MAIN      688
      128   FORMAT (3(F10.4,2I5))                                            MAIN      689
      129   FORMAT (//,10X,44HINSUFFICIENT CORE TO STORE STIFFNESS MATRIX.,25H MAIN      690
     1DIMENSION OF SK SHOULD BE,I15)                                         MAIN      691
      130   FORMAT (3X,/)                                                    MAIN      692
      131   FORMAT (2X,8E12.4,5X,2HCC)                                       MAIN      693
      132   FORMAT (1H0,10X,12HANALYSIS NO=,I5)                              MAIN      694
      133   FORMAT (1H0,6HBASEA=,1PE15.5,11HDIFFERENCE=,1PE15.5)             MAIN      695
      134   FORMAT (10X,9HELE SKIN=,I5,5X,6HABASE=,1E15.4,10X,11HELE STRUCT=,I MAIN      696
     15,10X,6HCBASE=,1E15.4)                                                 MAIN      697
      135   FORMAT (30X,21HMINIMUM WEIGHT CYCLE=,I5)                         MAIN      698
      136   FORMAT (//5X,39HNUMBER OF LAMINAE IN COMPOSITE ELEMENTS)         MAIN      699
      137   FORMAT (2X,(5(1H(,I3,1H),4I5,2X)))                               MAIN      700
      138   FORMAT (2X,(5(1H(,I3,1H),3I5,2X)))                               MAIN      701
      139   FORMAT (//5X,27HTOTAL THICKNESS OF ELEMENTS)                     MAIN      702
      140   FORMAT (1H0,18X,1H1,9X,1H2,9X,1H3,9X,1H4,9X,1H5,9X,1H6,9X,1H7,9X,1 MAIN      703
     1H8,9X,1H9,9X,1H0,//)                                                   MAIN      704
      141   FORMAT (3X,I5,4X,10E10.3,3X,I5)                                  MAIN      705
      142   FORMAT (5X,13HSTRUCTURE NO=,I5,9X,12HNO OF LOADS=,I5,10X,9HCYCLE N MAIN      706
     10=,I5,10X,12HEQ CYCLE NO=,I5,10X,8HNSTBLTY=,I5)                        MAIN      707
      143   FORMAT (1H ,10F12.6)                                             MAIN      708
      144   FORMAT (//5X,25HRELATIVE AREAS OF MEMBERS)                       MAIN      709
      145   FORMAT (//,5X,12HWEIGHT-SKIN=,1PE14.6,5X,16HWEIGHT-S-PANELS=,1PE14 MAIN      710
     1.6,5X,13HWEIGHT-POSTS=,1PE14.6,5X,13HTOTAL-WEIGHT=,1PE14.6)            MAIN      711
      146   FORMAT (//2X,22HTIME USED IN SECONDS =,F10.4)                    MAIN      712
            END                                                              MAIN      713
```

```
      SUBROUTINE MEMB (X,Y,Z,MA,MB,MC,MD,KTYPE,TH,OR,STRENG,AL,ELENTH,SS
     1THK,ZANGLE,STNG,ENGL,NMAT,SSTRT,SSTRC,SSTRS,GSHE,AWIDE,BWIDE,ANEG,
     2NANEG,PECT,NC,NZ,LD,NCC,NN,NOPRNT)
      COMMON /AA/ NEF,NAVG,NFULL,NCHK,NCRTIA,NSTBLTY,NLO,NFI,NZERO,NSTRN,
     1NFOR,NEWG,NBLNCE,LAST,LNSB,ABAS,CBAS,LSKIN,LINT,MEMBS,MM,E1,BASEAE
     2,BASEA,NFIBER,LSTCOL,LCHEK
      COMMON /BB/ MAA,MBB,MCC,EK,EKK,B,C,XI,ETA,ZI,XXI,YII,XD,YD,ZD,SSMA
     1X,THE,THETA,EKL,E,AEE,CC,AA,AAA,AE,AB,DA,EE,EO
C  DIMENSIONS OF THE VARIABLES NOT MEMTIONED IN THE COMMENT CARDS
C  ARE UNCHANGED
C  EOR,EOOR,COR,--(12,LOADS) NEEDS CHANGE IF LOADS IS GREATER THAN 10
C  AX,AY,AXY,--(1,LOADS)          ,,                ,,
C  SX,EX,EY,EXY,ELEENG,--(LOADS)  ,,                ,,
C  SSMAX,THE,THETA,E,AEE,CC,-- DIMENSIONS CONSISTENT WITH THOSE IN MAIN
C  SSX,SSY,SSXY,EFFSTR,ASX,ASY,ASXY,PX,PY,PXY,BSX,BSY,BSXY,EXFI,
C  EYFI,EXYFI,--(4,LOADS,NZ)--NEEDS CHANGE ONLY IF LOADS IS GREATER
C  THAN 10 AND NZ GREATER THAN 4
C  ENGSTR,--(LOADS,NZ)$$$BL,--(1,NZ)$$$STHK,PRCT,--(NZ)$$$
      DIMENSION X(1), Y(1), Z(1), MA(1), MB(1), MC(1), MD(1), KTYPE(1),
     1TH(1), OR(NN,LD), STRENG(NCC,NZ), AL(NCC,NZ), ELENTH(1), SSTHK(NCC
     2,NZ), ZANGLE(1), STNG(1), ENGL(1), NMAT(1), SSTRT(1), SSTRS(1), GS
     3HE(1), AWIDE(1), BWIDE(1), PECT(1), NANEG(1), ANEG(1), SSTRC(1)
      DIMENSION AA(3,3), AB(3), EK(12,12), XI(5), ETA(5), C(12,12), B(12
     1,12), XX(3), YY(3), XXI(5), YII(5), ZI(5), EKK(12,12), AAA(3,3), M
     2AA(4), MBB(4), MCC(4), AE(3,3), EE(3,3), EO(3), EKL(12,12), DA(3,3
     3), XD(3), YD(3), ZD(3), NCON(4)
      DIMENSION EOR(12,10), EOOR(12,10), COR(12,10), AX(1,10), AY(1,10),
     1 AXY(1,10), SX(10), EX(10), EY(10), EXY(10), ELEENG(10)
      DIMENSION SSMAX(5,4,4), THE(4,3), THETA(4,3), E(4), AEE(9,4,4), CC
     1(9,4,4)
      DIMENSION SSX(4,10,4), SSY(4,10,4), SSXY(4,10,4), EFFSTR(4,10,4),
     1ENGSTR(10,4), ASX(4,10,4), ASY(4,10,4), ASXY(4,10,4), PX(4,10,4),
     2PY(4,10,4), PXY(4,10,4), BSX(4,10,4), BSY(4,10,4), BSXY(4,10,4), E
     3XFI(4,10,4), EYFI(4,10,4), EXYFI(4,10,4), BL(1,4), STHK(4), PRCT(4
     4), TRANG(4), AD(3,3), A(3,3)
      NZERO=0
      LLDS=LOADS
      IF (NENG.EQ.3.OR.NENG.EQ.4) LLDS=1
      NI=MEMBS-NC
      IL1=NZ-1
      IL2=NZ
      LOADS=LD
      NON=1
      NTO=2
      NTH=3
      CBASE=0.0
      CBAS=0.0
      TBAS=BASEA
      TBASE=BASEAE
      ABASE=0.0
      ABAS=0.0
      NTW=12
      DO 1 I=1,NC
      DO 1 J=1,NZ
    1 STRENG(I,J)=0.0
      DO 2 I=1,NI
    2 STNG(I)=0.0
```

```
                DO 106 L=1,MEMBS                                                  MEMB   59
                KM=NMAT(L)                                                        MEMB   60
 60             BASEA=TBAS                                                        MEMB   61
                BASEAE=TBASE                                                      MEMB   62
                KNODE=4                                                           MEMB   63
                IF (KTYPE(L).LE.4) KNODE=KTYPE(L)                                 MEMB   64
                IF (NOPRNT.EQ.1) GO TO 3                                          MEMB   65
 65             IF (L.EQ.1) WRITE (6,126)                                         MEMB   66
           3    CONTINUE                                                          MEMB   67
                NCON(1)=MM*(MA(L)-1)+1                                            MEMB   68
                NCON(2)=MM*(MB(L)-1)+1                                            MEMB   69
                IF (KNODE.GE.3) NCON(3)=MM*(MC(L)-1)+1                            MEMB   70
 70             IF (KNODE.GE.4) NCON(4)=MM*(MD(L)-1)+1                            MEMB   71
                NDSP=1                                                            MEMB   72
                IF (KNODE.GT.2) NDSP=2                                            MEMB   73
                CALL COORD (MA(L),MB(L),MC(L),MD(L),X,Y,Z,AA,XI,ETA,PL,KNODE,NZERO MEMB   74
               1,AB)                                                              MEMB   75
 75             IF (L.GT.NC) GO TO 4                                              MEMB   76
                IF (NFIBER.EQ.1) PANGLE=ZANGLE(L)                                 MEMB   77
                CALL AVECT (XO,YO,ZO,THE,AA,THETA,NZ,PANGLE,NFIBER)               MEMB   78
           4    CONTINUE                                                          MEMB   79
                DO 5 J=1,NZ                                                       MEMB   80
 80        5    PROT(J)=0.0                                                       MEMB   81
                DO 6 J=1,LOADS                                                    MEMB   82
                DO 6 JL=1,NZ                                                      MEMB   83
           6    ENGSTR(J,JL)=0.0                                                  MEMB   84
                DO 8 K=1,LOADS                                                    MEMB   85
 85             KH=1                                                              MEMB   86
                DO 8 KK=1,KNODE                                                   MEMB   87
                DO 8 I=1,NDSP                                                     MEMB   88
                KX=NCON(KK)                                                       MEMB   89
                EDR(KH,K)=0                                                       MEMB   90
 90             DO 7 J=1,MM                                                       MEMB   91
                EDR(KH,K)=EDR(KH,K)+AA(I,J)*DR(KX,K)                              MEMB   92
           7    KX=KX+1                                                           MEMB   93
           8    KH=KH+1                                                           MEMB   94
                DO 10 K=1,LOADS                                                   MEMB   95
 95             LK=1                                                              MEMB   96
                DO 10 KK=1,KNODE                                                  MEMB   97
                KX=NCON(KK)                                                       MEMB   98
                DO 9 J=1,MM                                                       MEMB   99
                CDR(LK,K)=DR(KX,K)                                                MEMB  100
100             LK=LK+1                                                           MEMB  101
           9    KX=KX+1                                                           MEMB  102
          10    CONTINUE                                                          MEMB  103
                IF (KTYPE(L).EQ.2) GO TO 81                                       MEMB  104
                IF (KTYPE(L).EQ.5) GO TO 71                                       MEMB  105
105             DO 11 I=1,12                                                      MEMB  106
                DO 11 J=1,12                                                      MEMB  107
          11    EK(I,J)=0.                                                        MEMB  108
                QUAD=0.                                                           MEMB  109
                NT=4                                                              MEMB  110
110             IF (KTYPE(L).EQ.3) NT=1                                           MEMB  111
                NTRI=NT                                                           MEMB  112
                DO 20 I=1,NT                                                      MEMB  113
                IF (NT.EQ.4) GO TO 13                                             MEMB  114
                DO 12 J1=1,3                                                      MEMB  115
```

```
      XXI(J1)=XI(J1)                                                    MEMB  116
      YII(J1)=ETA(J1)                                                   MEMB  117
      DO 12 I1=1,3                                                      MEMB  118
      AAA(I1,J1)=0.0                                                    MEMB  119
   12 CONTINUE                                                          MEMB  120
      AAA(1,1)=1.0                                                      MEMB  121
      AAA(2,2)=1.0                                                      MEMB  122
      GO TO 14                                                          MEMB  123
   13 CONTINUE                                                          MEMB  124
      CALL CCORD (MAA(I),MBB(I),MCC(I),MD(I),XI,ETA,ZI,AAA,XXI,YII,PL,NT MEMB  125
     1H,NZERO,AB)                                                       MEMB  126
   14 CONTINUE                                                          MEMB  127
      DO 15 JK=1,6                                                      MEMB  128
      DO 15 IK=1,6                                                      MEMB  129
   15 EKK(IK,JK)=0.0                                                    MEMB  130
      DO 19 IL=1,NZ                                                     MEMB  131
      THK=AL(L,IL)                                                      MEMB  132
      DO 16 KL=1,3                                                      MEMB  133
   16 EO(KL)=THETA(IL,KL)                                               MEMB  134
      JK=0                                                              MEMB  135
      DO 17 J1=1,3                                                      MEMB  136
      DO 17 K1=1,3                                                      MEMB  137
      JK=JK+1                                                           MEMB  138
   17 AE(J1,K1)=AEE(JK,IL,KM)                                           MEMB  139
      CALL ELAS (AAA,AB,AE,EO,DA,EE)                                    MEMB  140
      CALL COMP (EKL,THK,TRIANG,XXI,YII,EE)                             MEMB  141
      DO 18 IK=1,6                                                      MEMB  142
      DO 18 JK=1,6                                                      MEMB  143
   18 EKK(IK,JK)=EKK(IK,JK)+EKL(IK,JK)                                  MEMB  144
   19 CONTINUE                                                          MEMB  145
      TRANG(I)=TRIANG                                                   MEMB  146
      QUAD=QUAD+TRIANG                                                  MEMB  147
      IF (NT.EQ.1) GO TO 20                                             MEMB  148
      CALL TRNSFM (EKK,AAA,B,C,NTO,NTH,NTW)                             MEMB  149
      CALL SUM (EK,C,MAA(I),MBB(I),MCC(I))                              MEMB  150
   20 CONTINUE                                                          MEMB  151
      ELENTH(L)=QUAD                                                    MEMB  152
      IF (NT.EQ.1) GO TO 25                                             MEMB  153
      DO 21 I=1,10                                                      MEMB  154
      DO 21 J=1,10                                                      MEMB  155
   21 EKL(I,J)=EK(I,J)                                                  MEMB  156
      NON=1                                                             MEMB  157
      CALL CONDNS (EK,EKK,MA(L),MB(L),MC(L),MD(L),NON)                  MEMB  158
      DO 23 K=1,LOADS                                                   MEMB  159
      KX=0                                                              MEMB  160
      DO 23 I=9,10                                                      MEMB  161
      KX=KX+1                                                           MEMB  162
      EDR(I,K)=0.                                                       MEMB  163
      DO 22 J=1,8                                                       MEMB  164
   22 EDR(I,K)=EDR(I,K)+EKK(KX,J)*EDR(J,K)                              MEMB  165
      EDR(I,K)=-EDR(I,K)                                                MEMB  166
   23 CONTINUE                                                          MEMB  167
      DO 24 K=1,LOADS                                                   MEMB  168
      EDDR(5,K)=EDR(9,K)                                                MEMB  169
   24 EDDR(6,K)=EDR(10,K)                                               MEMB  170
      XX(3)=XI(5)                                                       MEMB  171
      YY(3)=ETA(5)                                                      MEMB  172
```

```
                KX=1                                                                    MEMB   173
                KY=3                                                                    MEMB   174
           25   CONTINUE                                                                MEMB   175
      175       DO 42 I=1,NT                                                            MEMB   176
                XX(1)=XI(I)                                                             MEMB   177
                YY(1)=ETA(I)                                                            MEMB   178
                XX(2)=XI(I+1)                                                           MEMB   179
                YY(2)=ETA(I+1)                                                          MEMB   180
      180       IF (NT.EQ.4) GO TO 28                                                   MEMB   181
                XX(3)=XI(I+2)                                                           MEMB   182
                YY(3)=ETA(I+2)                                                          MEMB   183
                DO 26 I1=1,LO                                                           MEMB   184
                DO 26 J1=1,6                                                            MEMB   185
      185   26  EDDR(J1,I1)=EDR(J1,I1)                                                 MEMB   186
                DO 27 I1=1,6                                                            MEMB   187
                DO 27 J1=1,6                                                            MEMB   188
           27   EK(I1,J1)=EKK(I1,J1)                                                    MEMB   189
                GO TO 32                                                                MEMB   190
      190   28   CONTINUE                                                                MEMB   191
                IF (I.LT.4) GO TO 29                                                    MEMB   192
                XX(2)=XI(1)                                                             MEMB   193
                YY(2)=ETA(1)                                                            MEMB   194
                KX=7                                                                    MEMB   195
      195       KY=1                                                                    MEMB   196
           29   DO 31 J=1,2                                                             MEMB   197
                DO 30 K=1,LOADS                                                         MEMB   198
                EDDR(J,K)=EDR(KX,K)                                                     MEMB   199
           30   EDDR(J+2,K)=EDR(KY,K)                                                   MEMB   200
      200       KX=KX+1                                                                 MEMB   201
           31   KY=KY+1                                                                 MEMB   202
           32   CONTINUE                                                                MEMB   203
                CALL STRAIN (EDDR,XX,YY,EX,EY,EXY,LOADS,TRI)                            MEMB   204
                TRANG(I)=TRI                                                            MEMB   205
      205       IF (NT.EQ.4) GO TO 34                                                   MEMB   206
                DO 33 I1=1,3                                                            MEMB   207
                DO 33 J1=1,3                                                            MEMB   208
           33   AAA(I1,J1)=0.0                                                          MEMB   209
                AAA(1,1)=1.0                                                            MEMB   210
      210       AAA(2,2)=1.0                                                            MEMB   211
                GO TO 35                                                                MEMB   212
           34   CONTINUE                                                                MEMB   213
                IF (I.GT.1) GO TO 35                                                    MEMB   214
                CALL COORD (MAA(I),MBB(I),MCC(I),MD(I),XI,ETA,ZI,AAA,XXI,YII,PL,NT      MEMB   215
      215     1H,NZERO,AB)                                                              MEMB   216
           35   CONTINUE                                                                MEMB   217
                DO 41 IL=1,NZ                                                           MEMB   218
                DO 36 KL=1,3                                                            MEMB   219
           36   EO(KL)=THETA(IL,KL)                                                     MEMB   220
      220       JK=0                                                                    MEMB   221
                DO 37 J1=1,3                                                            MEMB   222
                DO 37 K1=1,3                                                            MEMB   223
                JK=JK+1                                                                 MEMB   224
           37   AE(J1,K1)=AEL(JK,IL,KM)                                                 MEMB   225
      225       CALL ELAS (AAA,AB,AE,EO,DA,EE)                                          MEMB   226
                IF (IL.EQ.1) GO TO 38                                                   MEMB   227
                GO TO 40                                                                MEMB   228
           38   DO 39 IK=1,3                                                            MEMB   229
```

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                      DO 39 J=1,3                                                    MEMB      230
230           39      AD(IK,J)=DA(IK,J)                                              MEMB      231
              40      CONTINUE                                                       MEMB      232
                      CALL STRES (EE,E1,EX,EY,EXY,SSX,SSY,SSXY,ASX,ASY,ASXY,EXFI,EYFI,EX MEMB   233
                     1YFI,BSX,BSY,BSXY,DA,AD,LOADS,I,IL)                             MEMB      234
                41    CONTINUE                                                       MEMB      235
235           42      CONTINUE                                                       MEMB      236
                      IF (NT.EQ.1) GO TO 43                                          MEMB      237
                      CALL AVSTRS (EXFI,TRANG,QUAD,LOADS,NZ)                         MEMB      238
                      CALL AVSTRS (EYFI,TRANG,QUAD,LOADS,NZ)                         MEMB      239
                      CALL AVSTRS (EXYFI,TRANG,QUAD,LOADS,NZ)                        MEMB      240
240                   CALL AVSTRS (SSX,TRANG,QUAD,LOADS,NZ)                          MEMB      241
                      CALL AVSTRS (SSY,TRANG,QUAD,LOADS,NZ)                          MEMB      242
                      CALL AVSTRS (SSXY,TRANG,QUAD,LOADS,NZ)                         MEMB      243
                      CALL AVSTRS (ASX,TRANG,QUAD,LOADS,NZ)                          MEMB      244
                      CALL AVSTRS (ASY,TRANG,QUAD,LOADS,NZ)                          MEMB      245
245                   CALL AVSTRS (ASXY,TRANG,QUAD,LOADS,NZ)                         MEMB      246
                      CALL AVSTRS (BSX,TRANG,QUAD,LOADS,NZ)                          MEMB      247
                      CALL AVSTRS (BSY,TRANG,QUAD,LOADS,NZ)                          MEMB      248
                      CALL AVSTRS (BSXY,TRANG,QUAD,LOADS,NZ)                         MEMB      249
                      NT=1                                                           MEMB      250
250                   TRI=QUAD                                                       MEMB      251
                      TRANG(1)=QUAD                                                  MEMB      252
                43    CONTINUE                                                       MEMB      253
                      IF (NORTIA.NE.2) CALL ENGS (SSMAX,BSX,BSY,BSXY,PX,PY,PXY,EXFI,EYFI MEMB  254
                     1,EXYFI,ENGSTR,EFFSTR,LOADS,NZ,KM,NORTIA,NENG,NEF)              MEMB      255
255                   IF (NORTIA.EQ.2) CALL ENGS (SSMAX,EXFI,EYFI,EXYFI,PX,PY,PXY,BSX,BS MEMB  256
                     1Y,BSXY,ENGSTR,EFFSTR,LOADS,NZ,KM,NORTIA,NENG,NEF)              MEMB      257
                      DO 44 J=1,NZ                                                   MEMB      258
                44    PRCT(J)=AL(L,J)/TH(L)                                          MEMB      259
                      NTRI=NT                                                        MEMB      260
260                   IF (LCHEK.EQ.0.AND.LSTCOL.EQ.0) GO TO 54                       MEMB      261
                      IF (NORTIA.EQ.1.OR.NORTIA.EQ.2) CALL SUGO (PX,PY,PXY,LOADS,BASEAE, MEMB   262
                     1LLOD,LCRI,LLYR,NZ,STHK,SSMAX)                                  MEMB      263
                      IF (NORTIA.EQ.3.OR.NORTIA.EQ.4) CALL SHELL (EFFSTR,LOADS,BASEAE,LL MEMB   264
265                  100,LCRI,LLYR,NZ,STHK)                                          MEMB      265
                      BASEA=BASEAE/E1                                                MEMB      266
                      RBASEA=BASEA/TBAS                                              MEMB      267
                      IF (LCHEK.GT.0.AND.RBASEA.GT.1) WRITE (6,107) L,RBASEA,LLOD,LCRI,L MEMB   268
                     1LYR                                                            MEMB      269
                      IF (LSTCOL.EQ.0) GO TO 54                                      MEMB      270
270                   DO 45 J=1,NZ                                                   MEMB      271
                45    SSTHK(L,J)=STHK(J)*AL(L,J)                                     MEMB      272
                      IF (NENG.EQ.3) GO TO 46                                        MEMB      273
                      IF (NENG.EQ.4) GO TO 49                                        MEMB      274
                      GO TO 51                                                       MEMB      275
275           46      DO 48 II=1,NZ                                                  MEMB      276
                      AMAX=0.0                                                       MEMB      277
                      DO 47 KK=1,LOADS                                               MEMB      278
                      IF (AMAX.LT.ENGSTR(KK,II)) AMAX=ENGSTR(KK,II)                  MEMB      279
                47    CONTINUE                                                       MEMB      280
280                   ENGSTR(1,II)=AMAX                                              MEMB      281
                48    CONTINUE                                                       MEMB      282
                      GO TO 51                                                       MEMB      283
                49    DO 50 J=1,NZ                                                   MEMB      284
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                IF (NBLICE.EQ.0) GO TO 53                                       MEMB     287
                IF (IL1.LE.0) GO TO 53                                          MEMB     288
                DO 52 J=1,LLOS                                                  MEMB     289
                ENGSTR(J,IL1)=(ENGSTR(J,IL1)+ENGSTR(J,IL2))/2.                  MEMB     290
290             ENGSTR(J,IL2)=ENGSTR(J,IL1)                                     MEMB     291
          52    CONTINUE                                                        MEMB     292
          53    CONTINUE                                                        MEMB     293
                IF (LAST.EQ.0) GO TO 54                                         MEMB     294
                WRITE (6,107) L,BASEA,LLOD,LGRI,LLYR,(PROT(J),J=1,NZ)           MEMB     295
295       54    CONTINUE                                                        MEMB     296
                IF (NOPRNT.EQ.1) GO TO 90                                       MEMB     297
                CALL BFORCE (PROT,AX,AY,AXY,ASX,ASY,ASXY,NZ,LOADS)              MEMB     298
                IF (KTYPE(L).EQ.3) GO TO 55                                     MEMB     299
                NTH=3                                                           MEMB     300
300             CALL COMONS (EKL,EKK,MA(L),MB(L),MC(L),MD(L),NTH)               MEMB     301
          55    CONTINUE                                                        MEMB     302
                NT1=2*KTYPE(L)                                                  MEMB     303
                DO 56 I=1,NT1                                                   MEMB     304
                DO 56 J=1,NT1                                                   MEMB     305
305             IF (KTYPE(L).EQ.3) EK(I,J)=EK(I,J)*BASEAE                       MEMB     306
                IF (KTYPE(L).EQ.4) EK(I,J)=EKL(I,J)*BASEAE                      MEMB     307
          56    CONTINUE                                                        MEMB     308
                IF (NFOR.EQ.1) GO TO 59                                         MEMB     309
                NTW=12                                                          MEMB     310
310             CALL TRNSFM (EK,AA,B,C,MM,KNODE,NTW)                            MEMB     311
                NT1=MM*KNODE                                                    MEMB     312
                DO 57 I=1,NT1                                                   MEMB     313
                DO 57 J=1,NT1                                                   MEMB     314
                EK(I,J)=C(I,J)                                                  MEMB     315
315       57    CONTINUE                                                        MEMB     316
                DO 58 K=1,LOADS                                                 MEMB     317
                DO 58 I=1,NT1                                                   MEMB     318
                EDR(I,K)=CDR(I,K)                                               MEMB     319
          58    CONTINUE                                                        MEMB     320
320       59    CONTINUE                                                        MEMB     321
                DO 61 K=1,LOADS                                                 MEMB     322
                DO 60 I=1,NT1                                                   MEMB     323
                EDDR(I,K)=0.0                                                   MEMB     324
                DO 60 J=1,NT1                                                   MEMB     325
325             EDDR(I,K)=EDDR(I,K)+EK(I,J)*EDR(J,K)                            MEMB     326
          60    CONTINUE                                                        MEMB     327
          61    CONTINUE                                                        MEMB     328
                WRITE (6,110)                                                   MEMB     329
                DO 62 I=1,NZ                                                    MEMB     330
330       62    BL(1,I)=AL(L,I)*BASEA                                           MEMB     331
                THKK=TH(L)*BASEA                                                MEMB     332
                WRITE (6,111) L,MA(L),MB(L),MC(L),MD(L),TRI,THKK,(BL(1,I),I=1,NZ) MEMB   333
                IF (NAVG.EQ.0) GO TO 63                                         MEMB     334
                WRITE (6,112)                                                   MEMB     335
335             WRITE (6,113) ((J,AX(1,J),AY(1,J),AXY(1,J)),J=1,LOADS)          MEMB     336
          63    CONTINUE                                                        MEMB     337
                IF (NLG.EQ.0) GO TO 64                                          MEMB     338
                WRITE (6,114)                                                   MEMB     339
                WRITE (6,115) (J,(IL,SSX(1,J,IL),SSY(1,J,IL),SSXY(1,J,IL),IL=1,NZ) MEMB  340
340           1,J=1,LOADS)                                                      MEMB     341
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      WRITE (6,116)                                                     MEMB   344
      WRITE (6,115) (J,(IL,BSX(1,J,IL),BSY(1,J,IL),BSXY(1,J,IL),IL=1,NZ) MEMB   345
     1,J=1,LOADS)                                                       MEMB   346
   65 CONTINUE                                                          MEMB   347
      IF (NZEJ.EQ.0) GO TO 66                                           MEMB   348
      WRITE (6,117)                                                     MEMB   349
      WRITE (6,115) (J,(IL,ASX(1,J,IL),ASY(1,J,IL),ASXY(1,J,IL),IL=1,NZ) MEMB   350
     1,J=1,LOADS)                                                       MEMB   351
   66 CONTINUE                                                          MEMB   352
      IF (NSTRN.EQ.0) GO TO 67                                          MEMB   353
      WRITE (6,118)                                                     MEMB   354
      WRITE (6,115) (J,(IL,EXFI(1,J,IL),EYFI(1,J,IL),EXYFI(1,J,IL),IL=1, MEMB   355
     1NZ),J=1,LOADS)                                                    MEMB   356
   67 CONTINUE                                                          MEMB   357
      IF (NEF.EQ.0) GO TO 68                                            MEMB   358
      WRITE (6,119)                                                     MEMB   359
      WRITE (6,115) (J,(IL,EFFSTR(1,J,IL),IL=1,NZ),J=1,LOADS)           MEMB   360
   68 CONTINUE                                                          MEMB   361
      IF (NFOR.EQ.0) GO TO 70                                           MEMB   362
      WRITE (6,120)                                                     MEMB   363
      DO 69 J=1,LOADS                                                   MEMB   364
   69 WRITE (6,109) J,(EDDR(I,J),I=1,NT1)                               MEMB   365
   70 CONTINUE                                                          MEMB   366
      GO TO 90                                                          MEMB   367
   71 CONTINUE                                                          MEMB   368
      CALL SSRS (EDR,XI,ETA,TH(L),DET,SX,GSHE(KM),LOADS,ELEENG)         MEMB   369
      ELENTH(L)=DET                                                     MEMB   370
      IF (LCHEK.EQ.0.AND.LSTCOL.EQ.0) GO TO 72                          MEMB   371
      CALL SURFACE (SX,BASEAE,SSTRS(KM),SSTRS(KM),LOADS,STHK,LLOD)      MEMB   372
      BASEA=BASEAE/E1                                                   MEMB   373
      RBASEA=BASEA/TBAS                                                 MEMB   374
      IF (LCHEK.GT.0.AND.RBASEA.GT.1) WRITE (6,125) L,RBASEA,LLOD       MEMB   375
      IF (LSTCOL.EQ.0) GO TO 73                                         MEMB   376
      IF (NCHK.EQ.1) GO TO 72                                           MEMB   377
      K1=L-NC                                                           MEMB   378
      NANEG(K1)=0                                                       MEMB   379
      IF (BASEAE.GT.ABASE) NANEG(K1)=1                                  MEMB   380
      ANEG(K1)=STHK(1)*TH(L)                                            MEMB   381
   72 CONTINUE                                                          MEMB   382
      IF (LAST.EQ.1) WRITE (6,125) L,BASEA,LLOD                         MEMB   383
   73 CONTINUE                                                          MEMB   384
      IF (NOPRNT.EQ.1) GO TO 95                                         MEMB   385
      THKK=TH(L)*BASEA                                                  MEMB   386
      WRITE (6,121) L,MA(L),MB(L),MC(L),MD(L),DET,THKK                  MEMB   387
      WRITE (6,122)                                                     MEMB   388
      WRITE (6,123) (I,SX(I),I=1,LOADS)                                 MEMB   389
      IF (NFOR.EQ.0) GO TO 95                                           MEMB   390
      CALL SCOMP (EK,TH(L),QUAD,XI,ETA,GSHE(KM),E1)                     MEMB   391
      DO 74 I=1,8                                                       MEMB   392
      DO 74 J=1,8                                                       MEMB   393
   74 EK(I,J)=EK(I,J)*BASEAE                                            MEMB   394
      NT1=8                                                             MEMB   395
      IF (NFOR.EQ.1) GO TO 77                                           MEMB   396
      NTH=12                                                            MEMB   397
```

```
      DO 75 I=1,NT1                                                     MEMB  401
      DO 75 J=1,NT1                                                     MEMB  402
      EK(I,J)=C(I,J)                                                    MEMB  403
   75 CONTINUE                                                          MEMB  404
      DO 76 K=1,LOADS                                                   MEMB  405
      DO 76 I=1,NT1                                                     MEMB  406
   76 EDR(I,K)=CDR(I,K)                                                 MEMB  407
   77 CONTINUE                                                          MEMB  408
      DO 79 K=1,LOADS                                                   MEMB  409
      DO 78 I=1,NT1                                                     MEMB  410
      EDDR(I,K)=0.0                                                     MEMB  411
      DO 78 J=1,NT1                                                     MEMB  412
      EDDR(I,K)=EDDR(I,K)+EK(I,J)*EDR(J,K)                              MEMB  413
   78 CONTINUE                                                          MEMB  414
   79 CONTINUE                                                          MEMB  415
      WRITE (6,108)                                                     MEMB  416
      DO 80 J=1,LOADS                                                   MEMB  417
   80 WRITE (6,109) J,(EDDR(I,J),I=1,NT1)                               MEMB  418
      GO TO 95                                                          MEMB  419
   81 CALL ELSTRS (EDR,AA,PL,SX,E(KM),LOADS,ELEENG)                     MEMB  420
      ELENTH(L)=PL                                                      MEMB  421
      IF (LCHEK.EQ.0.AND.LSTCOL.EQ.0) GO TO 83                          MEMB  422
      CALL SURFACE (SX,BASEAE,SSTRT(KM),SSTRC(KM),LOADS,STHK,LLOD)      MEMB  423
      BASEA=BASEAE/E1                                                   MEMB  424
      RBASEA=BASEA/TBAS                                                 MEMB  425
      IF (LCHEK.GT.0.AND.RBASEA.GT.1) WRITE (6,125) L,RBASEA,LLOD       MEMB  426
      IF (LSTCOL.EQ.0) GO TO 83                                         MEMB  427
      IF (NCHK.EQ.1) GO TO 82                                           MEMB  428
      K1=L-NC                                                           MEMB  429
      NANEG(K1)=0                                                       MEMB  430
      IF (BASEAE.GT.ABASE) NANEG(K1)=1                                  MEMB  431
      ANEG(K1)=STHK(1)*TH(L)                                            MEMB  432
   82 CONTINUE                                                          MEMB  433
   83 CONTINUE                                                          MEMB  434
      IF (LAST.EQ.1) WRITE (6,125) L,BASEA,LLOD                         MEMB  435
      IF (NOPRNT.EQ.1) GO TO 95                                         MEMB  436
      THKK=TH(L)*BASEA                                                  MEMB  437
      WRITE (6,124) L,MA(L),MB(L),PL,THKK                               MEMB  438
      WRITE (6,122)                                                     MEMB  439
      WRITE (6,123) (I,SX(I),I=1,LOADS)                                 MEMB  440
      IF (NFOR.EQ.0) GO TO 95                                           MEMB  441
      DO 84 J=1,LOADS                                                   MEMB  442
      EDDR(1,J)=(EDR(1,J)-EDR(2,J))*BASEAE/PL                           MEMB  443
      EDDR(1,J)=EDDR(1,J)*TH(L)                                         MEMB  444
   84 EDDR(2,J)=-EDDR(1,J)                                              MEMB  445
      NT1=2                                                             MEMB  446
      IF (NFOR.EQ.1) GO TO 88                                           MEMB  447
      CALL ELSTIF (AA,B,C,TH(L),MM,PL,E(KM),E1)                         MEMB  448
      NT1=MM*2                                                          MEMB  449
      DO 85 I=1,NT1                                                     MEMB  450
      DO 85 J=1,NT1                                                     MEMB  451
   85 EK(I,J)=C(I,J)*BASEAE                                             MEMB  452
      DO 87 K=1,LOADS                                                   MEMB  453
      DO 86 I=1,NT1                                                     MEMB  454
      EDDR(I,K)=0.0                                                     MEMB  455
```

```
      87    CONTINUE                                                          MEMB  458
      88    CONTINUE                                                          MEMB  459
            WRITE (6,120)                                                     MEMB  460
460         DO 89 J=1,LOADS                                                   MEMB  461
      89    WRITE (6,109) J,(EDOR(I,J),I=1,NT1)                               MEMB  462
            GO TO 95                                                          MEMB  463
      90    CONTINUE                                                          MEMB  464
            IF (ABASE.GT.BASEAE) GO TO 91                                     MEMB  465
465         LSKIN=L                                                           MEMB  466
            ABASE=BASEAE                                                      MEMB  467
            ABAS=BASEA                                                        MEMB  468
      91    CONTINUE                                                          MEMB  469
            IF (NSTBLTY.EQ.0) GO TO 101                                       MEMB  470
470         IF (NSTBLTY.GE.LNSB) GO TO 106                                    MEMB  471
            IF (NCHK.EQ.0) GO TO 101                                          MEMB  472
            JK=0                                                              MEMB  473
            DO 93 I=1,3                                                       MEMB  474
            DO 93 J=1,3                                                       MEMB  475
475         A(I,J)=0.0                                                        MEMB  476
            JK=JK+1                                                           MEMB  477
            THK=0.0                                                           MEMB  478
            DO 92 K=1,NZ                                                      MEMB  479
            A(I,J)=A(I,J)+CC(JK,K,KM)*AL(L,K)*BASEA                           MEMB  480
480         THK=AL(L,K)*BASEA+THK                                             MEMB  481
      92    CONTINUE                                                          MEMB  482
            A(I,J)=A(I,J)/THK                                                 MEMB  483
      93    CONTINUE                                                          MEMB  484
            CALL BFORCE (PRCT,AX,AY,AXY,ASX,ASY,ASXY,NZ,LOADS)                MEMB  485
485         CALL SBUCKL (A,AX,AY,AXY,THK,LOADS,AWIDE(L),BWIDE(L),TMAX)        MEMB  486
            TDIFF=(TMAX-THK)/BASEA*0.7                                        MEMB  487
            IF (TDIFF.LT.0.) GO TO 106                                        MEMB  488
            DO 94 I=1,NZ                                                      MEMB  489
      94    AL(L,I)=AL(L,I)+PECT(I)*TDIFF                                     MEMB  490
490         GO TO 106                                                         MEMB  491
      95    CONTINUE                                                          MEMB  492
            IF (NSTBLTY.NE.0) GO TO 105                                       MEMB  493
            DO 100 J=1,LLDS                                                   MEMB  494
            GO TO (96,97,99,99), NENG                                         MEMB  495
495     96  ENGSTR(J,1)=ELEENG(J)                                             MEMB  496
            GO TO 100                                                         MEMB  497
      97    CONTINUE                                                          MEMB  498
            IF (KTYPE(L).EQ.2) GO TO 98                                       MEMB  499
            ENGSTR(J,1)=ELEENG(J)/(SSTRS(KM)**2/GSHE(KM))                     MEMB  500
500         GO TO 100                                                         MEMB  501
      98    SSTRI=SSIRT(KM)                                                   MEMB  502
            IF (SX(J).LT.0.) SSTRI=SSTRC(KM)                                  MEMB  503
```

```
                IF (NFULL.EQ.1) STRENG(L,K)=AL(L,K)*BASEA                          MEMB      515
  515       102 CONTINUE                                                           MEMB      516
                GO TO 106                                                          MEMB      517
            103 CONTINUE                                                           MEMB      518
                K1=L-NC                                                            MEMB      519
                DO 104 J=1,LLOS                                                    MEMB      520
  520           STNG(K1)=STNG(K1)+ENGSTR(J,1)                                      MEMB      521
                IF (NFULL.EQ.1) STNG(K1)=TH(L)*BASEA                               MEMB      522
            104 CONTINUE                                                           MEMB      523
            105 CONTINUE                                                           MEMB      524
                IF (CBASE.GT.BASEAE) GO TO 106                                     MEMB      525
  525           LINT=L                                                             MEMB      526
                CBASE=BASEAE                                                       MEMB      527
                CBAS=BASEA                                                         MEMB      528
            106 CONTINUE                                                           MEMB      529
                BASEAE=AMAX1(CBASE,ABASE)                                          MEMB      530
  530           BASEA=AMAX1(CBAS,ABAS)                                             MEMB      531
                IF (LSTOOL.EQ.0) BASEA=TBAS                                        MEMB      532
                IF (LSTOOL.EQ.0) BASEAE=TBASE                                      MEMB      533
                RETURN                                                             MEMB      534
              C                                                                    MEMB      535
  535       107 FORMAT (2X,2HL=,I5,2X,6HBASEA=,1E12.5,2X,4HL-C=,I2,2X,4HCR1=,I2,2X MEMB      536
             1,4HLAR=,I3,2X,6HPRCNT=,9F8.3)                                        MEMB      537
            108 FORMAT (10X,12HNODAL FORCES)                                       MEMB      538
            109 FORMAT (1X,I2,12E11.4)                                             MEMB      539
            110 FORMAT (3X///)                                                     MEMB      540
  540       111 FORMAT (2X,4H1EMB,I5,2X,5HNODES,4I5,2X,4HAREA,1E10.4,2X,5HTHICK,1E MEMB      541
             19.4,2X,12HLAYER(THICK),4E10.4)                                       MEMB      542
            112 FORMAT (2X,33HAVERAGE STRESSES (ZERO FIBER DIRECTION))             MEMB      543
            113 FORMAT (1X,I2,2X,3E10.4)                                           MEMB      544
            114 FORMAT (2X,48HSTRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES))    MEMB      545
  545       115 FORMAT ((1H ,I2,4(I2,1X,3E10.4)))                                  MEMB      546
            116 FORMAT (2X,47HSTRESSES IN INDIVIDUAL LAYERS(FIBER DIRECTIONS))     MEMB      547
            117 FORMAT (2X,51HSTRESSES IN INDIVIDUAL LAYERS(ZERO FIBER DIRECTION)) MEMB      548
            118 FORMAT (2X,45HSTRAINS IN INDIVIDUAL LAYERS(FIBER DIRECTION))       MEMB      549
            119 FORMAT (2X,16HEFFECTIVE STRESS)                                    MEMB      550
  550       120 FORMAT (2X,12HNODAL FORCES)                                        MEMB      551
            121 FORMAT (2X,4HMEMB,I5,2X,5HNODES,4I5,2X,4HAREA,1E10.4,2X,5HTHICK,1E MEMB      552
             110.4)                                                                MEMB      553
            122 FORMAT (2X,8HSTRESSES)                                             MEMB      554
            123 FORMAT ((1H ,3(I2,1X,1E10.4)))                                     MEMB      555
  555       124 FORMAT (2X,4HMEMB,I5,2X,5HNODES,2I5,2X,6HLENGTH,1E10.4,2X,4HAREA,1 MEMB      556
             1E10.4)                                                               MEMB      557
            125 FORMAT (2X,2HL=,I5,2X,6HBASEA=,1E12.5,2X,4HL-C=,I2)                MEMB      558
            126 FORMAT (1H1,48X,25H*****S T R E S S E S*****,///)                  MEMB      559
                END                                                                MEMB      560
```

CARD NR. SEVERITY DETAILS DIAGNOSIS OF PROBLEM

```
 SUBROUTINE SUGD       74/74   OPT=1                    FTN 4.5+414        10/29/76  12.20.38        PAGE     1

 1                SUBROUTINE SUGD (PX,PY,PXY,LOADS,BASEAE,LLOD,LCRI,LLYR,NZ,STHK,SSM SUGD        2
                 1AX)                                                                SUGD        3
           C  DIMENSIONS OF PX,PY,PXY,SSMAX CONSISTENT WITH THOSE IN MEMB            SUGD        4
           C  SUBROUTINE                                                            SUGD        5
 5                DIMENSION PX(4,10,4), PY(4,10,4), PXY(4,10,4), SSMAX(5,4,4)      SUGD        6
                  DIMENSION STHK(1)                                                 SUGD        7
                  LLOD=0                                                            SUGD        8
                  LLYR=0                                                            SUGD        9
                  LCRI=0                                                            SUGD       10
 10               AMAX=0                                                            SUGD       11
                  STRSS=BASEAE                                                      SUGD       12
                  I=1                                                               SUGD       13
                  DO 4 J=1,LOADS                                                    SUGD       14
                  DO 4 K=1,NZ                                                       SUGD       15
 15               IF (PX(I,J,K).LT.AMAX) GO TO 1                                    SUGD       16
                  AMAX=PX(I,J,K)                                                    SUGD       17
                  LLOD=J                                                            SUGD       18
                  LLYR=K                                                            SUGD       19
                  LCRI=1                                                            SUGD       20
 20          1    CONTINUE                                                          SUGD       21
                  IF (PY(I,J,K).LT.AMAX) GO TO 2                                    SUGD       22
                  AMAX=PY(I,J,K)                                                    SUGD       23
                  LLOD=J                                                            SUGD       24
                  LLYR=K                                                            SUGD       25
 25               LCRI=2                                                            SUGD       26
             2    CONTINUE                                                          SUGD       27
                  IF (PXY(I,J,K).LT.AMAX) GO TO 3                                   SUGD       28
                  AMAX=PXY(I,J,K)                                                   SUGD       29
                  LLOD=J                                                            SUGD       30
 30               LLYR=K                                                            SUGD       31
                  LCRI=3                                                            SUGD       32
             3    CONTINUE                                                          SUGD       33
             4    CONTINUE                                                          SUGD       34
                  IF (STRSS.GE.AMAX) GO TO 5                                        SUGD       35
 35               RATIO=AMAX/STRSS                                                  SUGD       36
                  BASEAE=BASEAE*RATIO                                               SUGD       37
             5    CONTINUE                                                          SUGD       38
                  DO 10 K=1,NZ                                                      SUGD       39
                  AMAX=0.0                                                          SUGD       40
 40               I=1                                                               SUGD       41
                  DO 9 J=1,LOADS                                                    SUGD       42
                  IF (PX(I,J,K).LT.AMAX) GO TO 6                                    SUGD       43
```

```
      SUBROUTINE AVECT (XD,YD,ZD,THE,AA,THETA,NZ,PANGLE,NFIBER)          AVECT      2
C  DIMENSIONS OF THE, THETA CONSISTENT WITH THOSE IN MEMB SUBROUTINE     AVECT      3
      DIMENSION XD(3), YD(3), ZD(3), THE(4,3), AA(3,3), THETA(4,3)       AVECT      4
      EN1=AA(1,2)*AA(2,3)-AA(2,2)*AA(1,3)                                AVECT      5
      EN2=AA(1,3)*AA(2,1)-AA(1,1)*AA(2,3)                                AVECT      6
      EN3=AA(1,1)*AA(2,2)-AA(1,2)*AA(2,1)                                AVECT      7
      IF (NFIBER.EQ.0) GO TO 1                                           AVECT      8
      F1=COS(PANGLE)                                                     AVECT      9
      F2=SIN(PANGLE)                                                     AVECT     10
      F3=0.0                                                             AVECT     11
      G1=EN2*F3-EN3*F2                                                   AVECT     12
      G2=EN3*F1-EN1*F3                                                   AVECT     13
      ASIGN=1.                                                           AVECT     14
      GO TO 2                                                            AVECT     15
1     CONTINUE                                                           AVECT     16
      F1=XD(2)-XD(1)                                                     AVECT     17
      F2=YD(2)-YD(1)                                                     AVECT     18
      F3=ZD(2)-ZD(1)                                                     AVECT     19
      AL=SQRT(F1**2+F2**2+F3**2)                                         AVECT     20
      F1=F1/AL                                                           AVECT     21
      F2=F2/AL                                                           AVECT     22
      F3=F3/AL                                                           AVECT     23
      G1=XD(3)-XD(1)                                                     AVECT     24
      G2=YD(3)-YD(1)                                                     AVECT     25
      G3=ZD(3)-ZD(1)                                                     AVECT     26
      AL=SQRT(G1**2+G2**2+G3**2)                                         AVECT     27
      G1=G1/AL                                                           AVECT     28
      G2=G2/AL                                                           AVECT     29
      G3=G3/AL                                                           AVECT     30
      FN1=F2*G3-F3*G2                                                    AVECT     31
      FN2=F3*G1-F1*G3                                                    AVECT     32
      FN3=F1*G2-F2*G1                                                    AVECT     33
      TN=EN1*F1+EN2*F2+EN3*F3                                            AVECT     34
      TD=EN1*FN1+EN2*FN2+EN3*FN3                                         AVECT     35
      TT=-TN/TD                                                          AVECT     36
      BF1=F1+FN1*TT                                                      AVECT     37
      BF2=F2+FN2*TT                                                      AVECT     38
      BF3=F3+FN3*TT                                                      AVECT     39
      AL=SQRT(BF1**2+BF2**2+BF3**2)                                      AVECT     40
      BF1=BF1/AL                                                         AVECT     41
      BF2=BF2/AL                                                         AVECT     42
      BF3=BF3/AL                                                         AVECT     43
      F1=AA(1,1)*BF1+AA(1,2)*BF2+AA(1,3)*BF3                             AVECT     44
      F2=AA(2,1)*BF1+AA(2,2)*BF2+AA(2,3)*BF3                             AVECT     45
      F3=EN1*BF1+EN2*BF2+EN3*BF3                                         AVECT     46
      BG1=EN2*BF3-EN3*BF2                                                AVECT     47
      BG2=EN3*BF1-EN1*BF3                                                AVECT     48
      BG3=EN1*BF2-EN2*BF1                                                AVECT     49
      AL=SQRT(BG1**2+BG2**2+BG3**2)                                      AVECT     50
      BG1=BG1/AL                                                         AVECT     51
      BG2=BG2/AL                                                         AVECT     52
      BG3=BG3/AL                                                         AVECT     53
      G1=AA(1,1)*BG1+AA(1,2)*BG2+AA(1,3)*BG3                             AVECT     54
      G2=AA(2,1)*BG1+AA(2,2)*BG2+AA(2,3)*BG3                             AVECT     55
      G3=EN1*BG1+EN2*BG2+EN3*BG3                                         AVECT     56
      ASIGN=EN1*FN1+EN2*FN2+EN3*FN3                                      AVECT     57
      ASIGN=ASIGN/ABS(ASIGN)                                             AVECT     58
```

```
      2     CONTINUE
            G1=G1*ASIGN
60          G2=G2*ASIGN
            DO 3 N=1,NZ
            THETA(N,1)=F1*THE(N,1)+G1*THE(N,2)
            THETA(N,2)=F2*THE(N,1)+G2*THE(N,2)
      3     THETA(N,3)=0.0
65          RETURN
            END
```

```
AVECT      59
AVECT      60
AVECT      61
AVECT      62
AVECT      63
AVECT      64
AVECT      65
AVECT      66
AVECT      67
```

```
      SUBROUTINE SURFACE (SX,BASEAE,SSTT,SSTC,LOADS,STHK,LLOD)
C  SJX,--(LOADS) NEEDS TO BE GREATER THAN OR EQUAL TO LOADS IN
C  MAIN PROGRAM
      DIMENSION SX(1), SJX(10), STHK(1)
      AMAX=0.0
      LLOD=0
      DO 1 I=1,LOADS
      STRESS=SSTT
      IF (SX(I).LT.0.) STRESS=SSTC
1     SJX(I)=ABS(SX(I))/STRESS
      STRSS=BASEAE
      DO 2 I=1,LOADS
      IF (AMAX.GT.SJX(I)) GO TO 2
      AMAX=SJX(I)
      LLOD=I
2     CONTINUE
      STHK(1)=AMAX
      IF (STRSS.GE.AMAX) RETURN
      RATIO=AMAX/STRSS
      BASEAE=BASEAE*RATIO
      RETURN
      END
```

```
SURF  2
SURF  3
SURF  4
SURF  5
SURF  6
SURF  7
SURF  8
SURF  9
SURF  10
SURF  11
SURF  12
SURF  13
SURF  14
SURF  15
SURF  16
SURF  17
SURF  18
SURF  19
SURF  20
SURF  21
SURF  22
SURF  23
```

```
      SUBROUTINE COORD (MA,MB,MC,MD,X,Y,Z,AA,XI,ETA,AL,NND,NO,AB)
      DIMENSION X(1), Y(1), Z(1), AA(3,3), AB(3), XI(5), ETA(5)
      K1=MA
      K2=MB
      K3=MC
      K4=MD
      XCOMP=X(K2)-X(K1)
      YCOMP=Y(K2)-Y(K1)
      ZCOMP=Z(K2)-Z(K1)
      AL=SQRT(XCOMP**2+YCOMP**2+ZCOMP**2)
      AA(1,1)=XCOMP/AL
      AA(1,2)=YCOMP/AL
      AA(1,3)=ZCOMP/AL
      IF (NND.LT.3) RETURN
      XCOMP=X(K3)-X(K1)
      YCOMP=Y(K3)-Y(K1)
      ZCOMP=Z(K3)-Z(K1)
      AL=SQRT(XCOMP**2+YCOMP**2+ZCOMP**2)
      AB(1)=XCOMP/AL
      AB(2)=YCOMP/AL
      AB(3)=ZCOMP/AL
      AL=SQRT((AA(1,2)*AB(3)-AA(1,3)*AB(2))**2+(AA(1,3)*AB(1)-AA(1,1)*AB
     1(3))**2+(AA(1,1)*AB(2)-AA(1,2)*AB(1))**2)
      AA(2,1)=((AA(1,3)**2)*AB(1)-AA(1,1)*AA(1,3)*AB(3)-AA(1,1)*AA(1,2)*
     1AB(2)+((AA(1,2)**2)*AB(1))/AL
      AA(2,2)=((AA(1,1)**2)*AB(2)-AA(1,1)*AA(1,2)*AB(1)-AA(1,2)*AA(1,3)*
     1AB(3)+((AA(1,3)**2)*AB(2))/AL
      AA(2,3)=((AA(1,2)**2)*AB(3)-AA(1,2)*AA(1,3)*AB(2)-AA(1,1)*AA(1,3)*
     1AB(1)+((AA(1,1)**2)*AB(3))/AL
      IF (NO.EQ.1) RETURN
      XI(1)=0.0
      ETA(1)=0.0
      XI(2)=(X(K2)-X(K1))*AA(1,1)+(Y(K2)-Y(K1))*AA(1,2)+(Z(K2)-Z(K1))*AA
     1(1,3)
      ETA(2)=0.0
      XI(3)=(X(K3)-X(K1))*AA(1,1)+(Y(K3)-Y(K1))*AA(1,2)+(Z(K3)-Z(K1))*AA
     1(1,3)
      ETA(3)=(X(K3)-X(K1))*AA(2,1)+(Y(K3)-Y(K1))*AA(2,2)+(Z(K3)-Z(K1))*A
     1A(2,3)
      IF (NND.LE.3) GO TO 1
      XI(4)=(X(K4)-X(K1))*AA(1,1)+(Y(K4)-Y(K1))*AA(1,2)+(Z(K4)-Z(K1))*AA
     1(1,3)
      ETA(4)=(X(K4)-X(K1))*AA(2,1)+(Y(K4)-Y(K1))*AA(2,2)+(Z(K4)-Z(K1))*A
     1A(2,3)
      XI(5)=(XI(2)+XI(3)+XI(4))/4.0
      ETA(5)=(ETA(3)+ETA(4))/4.0
    1 CONTINUE
      RETURN
      END
```

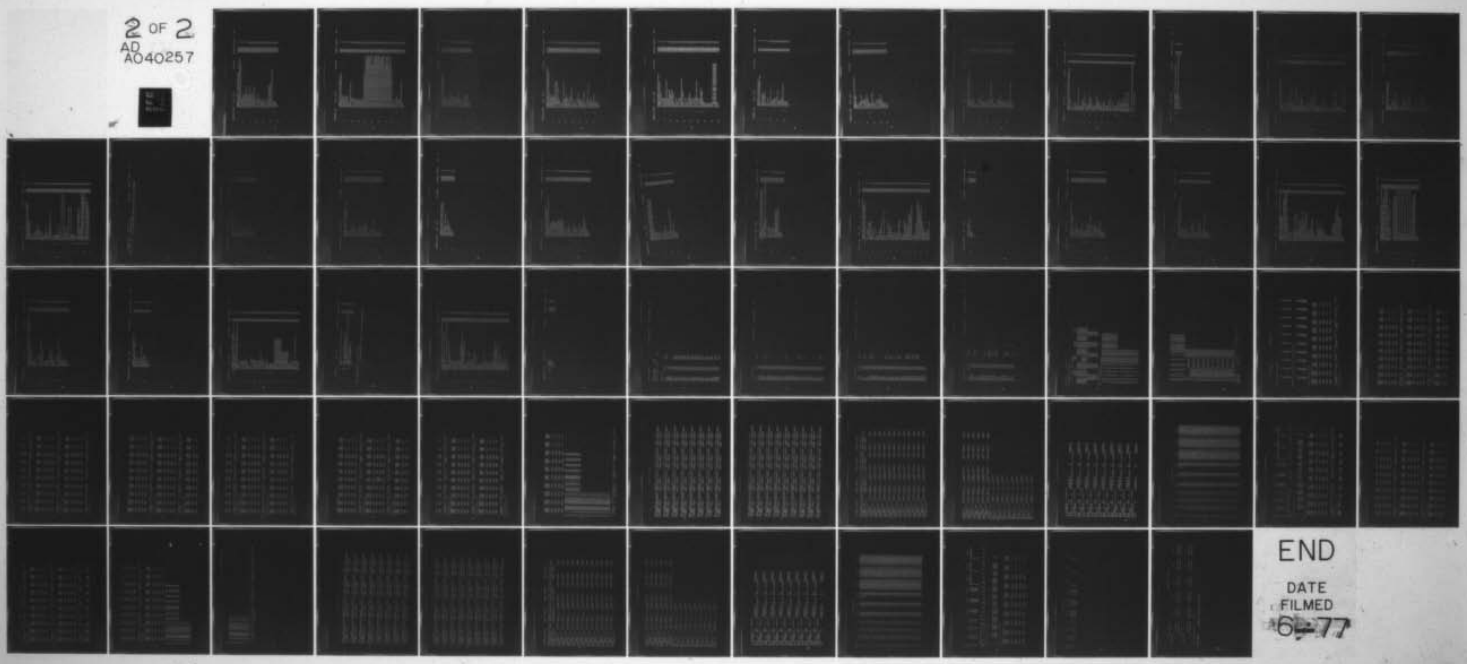
```
      SUBROUTINE ELAS (AA,AB,EE,EO,DA,E)                                ELAS       2
      DIMENSION AA(3,3), AB(1), EE(3,3), EO(3), DA(3,3), EA(3,3), E(3,3) ELAS       3
      DIMENSION EP(3,3)                                                 ELAS       4
      EOK=SQRT(EO(1)**2+EO(2)**2+EO(3)**2)                              ELAS       5
      DO 1 I=1,3                                                        ELAS       6
    1 EO(I)=EO(I)/EOK                                                   ELAS       7
      EN1=AA(1,2)*AA(2,3)-AA(2,2)*AA(1,3)                               ELAS       8
      EN2=AA(1,3)*AA(2,1)-AA(1,1)*AA(2,3)                               ELAS       9
      EN3=AA(1,1)*AA(2,2)-AA(1,2)*AA(2,1)                               ELAS      10
      AL=SQRT(EN1**2+EN2**2+EN3**2)                                     ELAS      11
      EN1=EN1/AL                                                        ELAS      12
      EN2=EN2/AL                                                        ELAS      13
      EN3=EN3/AL                                                        ELAS      14
      A1=AA(1,1)*EO(1)+AA(1,2)*EO(2)+AA(1,3)*EO(3)                      ELAS      15
      A2=AA(2,1)*EO(1)+AA(2,2)*EO(2)+AA(2,3)*EO(3)                      ELAS      16
      A3=EN1*EO(1)+EN2*EO(2)+EN3*EO(3)                                  ELAS      17
      B1=EN2*A3-EN3*A2                                                  ELAS      18
      B2=EN3*A1-EN1*A3                                                  ELAS      19
      B3=EN1*A2-EN2*A1                                                  ELAS      20
      AL=SQRT(B1**2+B2**2+B3**2)                                        ELAS      21
      B1=B1/AL                                                          ELAS      22
      B2=B2/AL                                                          ELAS      23
      B3=B3/AL                                                          ELAS      24
      AL11=A1                                                           ELAS      25
      AL12=A2                                                           ELAS      26
      AL21=B1                                                           ELAS      27
      AL22=B2                                                           ELAS      28
      DA(1,1)=AL11**2                                                   ELAS      29
      DA(2,1)=AL12**2                                                   ELAS      30
      DA(3,1)=AL11*AL12                                                 ELAS      31
      DA(1,2)=AL21**2                                                   ELAS      32
      DA(2,2)=AL22**2                                                   ELAS      33
      DA(3,2)=AL21*AL22                                                 ELAS      34
      DA(1,3)=2.*AL11*AL21                                              ELAS      35
      DA(2,3)=2.*AL22*AL12                                              ELAS      36
      DA(3,3)=AL12*AL21+AL11*AL22                                       ELAS      37
      DO 2 I=1,3                                                        ELAS      38
      DO 2 J=1,3                                                        ELAS      39
    2 EA(I,J)=0.0                                                       ELAS      40
      DO 3 I=1,3                                                        ELAS      41
      DO 3 K=1,3                                                        ELAS      42
      DO 3 J=1,3                                                        ELAS      43
    3 EA(I,K)=EA(I,K)+DA(I,J)*EE(J,K)                                   ELAS      44
      DO 4 I=1,3                                                        ELAS      45
      DO 4 J=1,3                                                        ELAS      46
    4 EP(I,J)=DA(J,I)                                                   ELAS      47
      DO 5 I=1,3                                                        ELAS      48
      DO 5 J=1,3                                                        ELAS      49
    5 DA(I,J)=0.0                                                       ELAS      50
      DO 6 I=1,3                                                        ELAS      51
      DO 6 J=1,3                                                        ELAS      52
    6 E(I,J)=0.0                                                        ELAS      53
      DO 7 I=1,3                                                        ELAS      54
      DO 7 K=1,3                                                        ELAS      55
      DO 7 J=1,3                                                        ELAS      56
    7 E(I,K)=E(I,K)+EA(I,J)*EP(J,K)                                     ELAS      57
      DO 8 I=1,3                                                        ELAS      58
```

```
                DO 8 J=1,3                                          ELAS       59
              8 DA(I,J)=EP(I,J)                                     ELAS       60
60              DA(1,3)=DA(1,3)*2.                                  ELAS       61
                DA(2,3)=DA(2,3)*2.                                  ELAS       62
                DA(3,1)=DA(3,1)/2.                                  ELAS       63
                DA(3,2)=DA(3,2)/2.                                  ELAS       64
                RETURN                                              ELAS       65
65              END                                                 ELAS       66
```

AD-A040 257 AIR FORCE FLIGHT DYNAMICS LAB WRIGHT-PATTERSON AFB OHIO F/G 9/2
COMPUTER PROGRAM (OPTCOMP) FOR OPTIMIZATION OF COMPOSITE STRUCT--ETC(U)
FEB 77 N S KHOT

UNCLASSIFIED AFFDL-TR-76-149 NL

2 OF 2
AD
A040257



END
DATE FILMED
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```
      SUBROUTINE STRAIN (UV,X,Y,EX,EY,EXY,L,TRI)                        STRAIN     2
      DIMENSION UV(12,L), X(3), Y(3), EX(1), EY(1), EXY(1), A(3,3)      STRAIN     3
      DET=X(1)*(Y(2)-Y(3))+X(2)*(Y(3)-Y(1))+X(3)*(Y(1)-Y(2))            STRAIN     4
      TRI=DET/2.0                                                       STRAIN     5
      A(1,1)=Y(2)-Y(3)                                                  STRAIN     6
      A(2,1)=X(3)-X(2)                                                  STRAIN     7
      A(3,1)=X(2)*Y(3)-X(3)*Y(2)                                        STRAIN     8
      A(1,2)=Y(3)-Y(1)                                                  STRAIN     9
      A(2,2)=X(1)-X(3)                                                  STRAIN    10
      A(3,2)=X(3)*Y(1)-X(1)*Y(3)                                        STRAIN    11
      A(1,3)=Y(1)-Y(2)                                                  STRAIN    12
      A(2,3)=X(2)-X(1)                                                  STRAIN    13
      A(3,3)=X(1)*Y(2)-X(2)*Y(1)                                        STRAIN    14
      DO 1 I=1,3                                                        STRAIN    15
      DO 1 J=1,3                                                        STRAIN    16
    1 A(I,J)=A(I,J)/DET                                                 STRAIN    17
      DO 3 K=1,L                                                        STRAIN    18
      EX(K)=0.0                                                         STRAIN    19
      EY(K)=0.0                                                         STRAIN    20
      EXY(K)=0.0                                                        STRAIN    21
      KX=0.0                                                            STRAIN    22
      DO 2 I=1,3                                                        STRAIN    23
      IX=I+KX                                                           STRAIN    24
      EX(K)=EX(K)+A(1,I)*UV(IX,K)                                       STRAIN    25
      EY(K)=EY(K)+A(2,I)*UV(IX+1,K)                                     STRAIN    26
      EXY(K)=EXY(K)+A(2,I)*UV(IX,K)+A(1,I)*UV(IX+1,K)                   STRAIN    27
    2 KX=KX+1                                                           STRAIN    28
    3 CONTINUE                                                          STRAIN    29
      RETURN                                                            STRAIN    30
      END                                                               STRAIN    31
```

```
      SUBROUTINE COMP (EK,THK,TRIANG,XI,ETA,E)                          COMP      2
      DIMENSION EK(12,12), XI(5), ETA(5), E(3,3)                        COMP      3
      X32=XI(3)-XI(2)                                                   COMP      4
      X31=XI(3)-0.0                                                     COMP      5
      X21=XI(2)-0.0                                                     COMP      6
      Y32=ETA(3)-0.0                                                    COMP      7
      Y31=ETA(3)-0.0                                                    COMP      8
      Y21=0.0                                                           COMP      9
      TRIANG=ABS(XI(2))*ABS(ETA(3))/2.                                  COMP     10
      DO 1 I=1,12                                                       COMP     11
      DO 1 J=1,12                                                       COMP     12
    1 EK(I,J)=0.0                                                       COMP     13
      E11=E(1,1)                                                        COMP     14
      E12=E(1,2)                                                        COMP     15
      E13=E(1,3)                                                        COMP     16
      E23=E(2,3)                                                        COMP     17
      E22=E(2,2)                                                        COMP     18
      E33=E(3,3)                                                        COMP     19
      EK(1,1)=E11*Y32**2-2.*E13*X32*Y32+E33*X32**2                      COMP     20
      EK(2,1)=-E12*X32*Y32+E23*X32**2+E13*Y32**2-E33*X32*Y32+EK(2,1)    COMP     21
      EK(3,1)=-E11*Y31*Y32+E13*X32*Y31+E13*X31*Y32-E33*X31*X32+EK(3,1)  COMP     22
      EK(4,1)=E12*Y32*X31-E23*X32*X31-E13*Y31*Y32+E33*X32*Y31+EK(4,1)   COMP     23
      EK(5,1)=E11*Y21*Y32-E13*X32*Y21-E13*X21*Y32+E33*X32*X21+EK(5,1)   COMP     24
      EK(6,1)=-E12*X21*Y32+E23*X32*X21+E13*Y32*Y21-E33*X32*Y21+EK(6,1)  COMP     25
      EK(2,2)=E22*X32**2-2.*E23*X32*Y32+E33*Y32**2+EK(2,2)              COMP     26
      EK(3,2)=-E13*Y31*Y32+E12*X32*Y31+E33*X31*Y32-E23*X32*X31+EK(3,2)  COMP     27
      EK(4,2)=E23*X31*Y32-E22*X32*X31-E33*Y32*Y31+E23*X32*Y31+EK(4,2)   COMP     28
      EK(5,2)=E13*Y32*Y21-E12*X32*Y21-E33*Y32*X21+E23*X32*X21+EK(5,2)   COMP     29
      EK(6,2)=-E23*Y32*X21+E22*X32*X21+E33*Y32*Y21-E23*X32*Y21+EK(6,2)  COMP     30
      EK(3,3)=-E13*X31*Y31+E11*Y31**2+E33*X31**2-E13*X31*Y31+EK(3,3)    COMP     31
      EK(4,3)=E23*X31**2-E12*Y31*X31-E33*X31*Y31+E13*Y31**2+EK(4,3)     COMP     32
      EK(5,3)=E13*X31*Y21-E11*Y31*Y21-E33*X31*X21+E13*Y31*X21+EK(5,3)   COMP     33
      EK(6,3)=-E23*X31*X21+E12*Y31*X21+E33*X31*Y21-E13*Y21*Y31+EK(6,3)  COMP     34
      EK(4,4)=E22*X31**2-2.*E23*X31*Y31+E33*Y31**2+EK(4,4)              COMP     35
      EK(5,4)=E12*X31*Y21-E13*Y31*Y21-E23*X31*X21+E33*Y31*X21+EK(5,4)   COMP     36
      EK(6,4)=-E22*X21*X31+E23*Y31*X21+E23*X31*Y21-E33*Y31*Y21+EK(6,4)  COMP     37
      EK(5,5)=E11*Y21**2-2.*E13*X21*Y21+E33*X21**2+EK(5,5)              COMP     38
      EK(6,5)=-E12*Y21*X21+E23*X21**2+E13*Y21**2-E33*X21*Y21+EK(6,5)    COMP     39
      EK(6,6)=-E23*Y21*X21*2.+E22*X21**2+E33*Y21**2                     COMP     40
      DO 2 I=1,6                                                        COMP     41
      IP=I+1                                                            COMP     42
      DO 2 J=IP,6                                                       COMP     43
    2 EK(I,J)=EK(J,I)                                                   COMP     44
      DO 3 I=1,6                                                        COMP     45
      DO 3 J=1,6                                                        COMP     46
    3 EK(I,J)=(EK(I,J)/TRIANG)*THK*0.25                                 COMP     47
      RETURN                                                            COMP     48
      END                                                               COMP     49
```

```
      SUBROUTINE ELSTIF (A,B,C,AE,MM,AL,EBAR,EC)                        ESTIF     2
      DIMENSION A(3,3), B(12,12), C(12,12)                              ESTIF     3
      CF=EBAR/EC                                                        ESTIF     4
      EK=AE*CF/AL                                                       ESTIF     5
      DO 1 I=1,MM                                                       ESTIF     6
      J=I+MM                                                            ESTIF     7
      B(1,I)=EK*A(1,I)                                                  ESTIF     8
      B(1,J)=-B(1,I)                                                    ESTIF     9
      B(2,I)=-B(1,I)                                                    ESTIF    10
    1 B(2,J)=B(1,I)                                                     ESTIF    11
      DO 2 I=1,MM                                                       ESTIF    12
      DO 2 J=1,MM                                                       ESTIF    13
    2 C(I,J)=A(1,I)*B(1,J)                                              ESTIF    14
      DO 3 I=1,MM                                                       ESTIF    15
      I1=I+MM                                                           ESTIF    16
      DO 3 J=1,M1                                                       ESTIF    17
      J1=J+MM                                                           ESTIF    18
      C(I,J1)=-C(I,J)                                                   ESTIF    19
      C(J1,I)=-C(I,J)                                                   ESTIF    20
    3 C(I1,J1)=C(I,J)                                                   ESTIF    21
      RETURN                                                            ESTIF    22
      END                                                               ESTIF    23
```

```
      1                SUBROUTINE ASEMBL (A,B,MA,MB,MC,MD,MM,ID,NNODES,M)                ASEMBL     2
                       DIMENSION A(1), B(M,M), ID(1), NA(4), NAA(3)                      ASEMBL     3
                       IX(I,J)=I*(J-1)+1                                                 ASEMBL     4
                       M2=NNODES*MM                                                      ASEMBL     5
      5                NA(1)=IX(MM,MA)                                                   ASEMBL     6
                       NA(2)=IX(MM,MB)                                                   ASEMBL     7
                       IF (NNODES.GE.3) NA(3)=IX(MM,MC)                                  ASEMBL     8
                       IF (NNODES.GE.4) NA(4)=IX(MM,MD)                                  ASEMBL     9
                       IF (NNODES.LE.3) GO TO 2                                          ASEMBL    10
     10                DO 1 I=1,3                                                        ASEMBL    11
                       KX=I/3                                                            ASEMBL    12
                       KY=I/2                                                            ASEMBL    13
                       IF (NA(KX+2).LT.NA(KY+3)) GO TO 1                                 ASEMBL    14
                       KH=NA(KX+2)                                                       ASEMBL    15
     15                NA(KX+2)=NA(KY+3)                                                 ASEMBL    16
                       NA(KY+3)=KH                                                       ASEMBL    17
               1       CONTINUE                                                          ASEMBL    18
               2       DO 3 I=2,NNODES                                                   ASEMBL    19
               3       NAA(I-1)=NA(I)-NA(I-1)-MM                                         ASEMBL    20
     20                KH=MM                                                             ASEMBL    21
                       IAA=NA(1)                                                         ASEMBL    22
                       KHH=1                                                             ASEMBL    23
                       DO 7 J=1,M2                                                       ASEMBL    24
                       IF (J.LE.KH) GO TO 4                                              ASEMBL    25
     25                KHH=KHH+1                                                         ASEMBL    26
                       IAA=NA(KHH)                                                       ASEMBL    27
                       KH=KH+MM                                                          ASEMBL    28
               4       JX=ID(IAA)-IAA+NA(1)                                              ASEMBL    29
                       KY=MM                                                             ASEMBL    30
     30                DO 6 I=1,J                                                        ASEMBL    31
                       IF (J.LE.KY.OR.I.LE.KY) GO TO 5                                   ASEMBL    32
                       KX=I/MM                                                           ASEMBL    33
                       JX=JX+NAA(KX)                                                     ASEMBL    34
                       KY=KY+MM                                                          ASEMBL    35
     35        5       A(JX)=A(JX)+B(I,J)                                                ASEMBL    36
               6       JX=JX+1                                                           ASEMBL    37
               7       IAA=IAA+1                                                         ASEMBL    38
                       RETURN                                                            ASEMBL    39
                       END                                                               ASEMBL    40
```

```
      SUBROUTINE CONDNS (EK,EKK,MA,MB,MC,MD,NO)                          CONDNS      2
      DIMENSION EK(12,12), EKK(12,12)                                    CONDNS      3
      IF (NO.EQ.2) GO TO 6                                               CONDNS      4
      DO 1 I=1,12                                                        CONDNS      5
      DO 1 J=1,12                                                        CONDNS      6
    1 EKK(I,J)=0.                                                        CONDNS      7
      DET=EK(9,9)*EK(10,10)-EK(9,10)**2                                  CONDNS      8
      AX=EK(9,9)                                                         CONDNS      9
      EK(9,9)=EK(10,10)/DET                                              CONDNS     10
      EK(10,10)=AX/DET                                                   CONDNS     11
      EK(9,10)=-EK(9,10)/DET                                             CONDNS     12
      EK(10,9)=EK(9,10)                                                  CONDNS     13
      KX=0                                                               CONDNS     14
      DO 2 I=9,10                                                        CONDNS     15
      KX=KX+1                                                            CONDNS     16
      DO 2 J=1,8                                                         CONDNS     17
      DO 2 K=9,10                                                        CONDNS     18
    2 EKK(KX,J)=EKK(KX,J)+EK(I,K)*EK(K,J)                                CONDNS     19
      IF (NO.EQ.1) RETURN                                                CONDNS     20
      KX=0                                                               CONDNS     21
      DO 3 I=9,10                                                        CONDNS     22
      KX=KX+1                                                            CONDNS     23
      DO 3 J=1,8                                                         CONDNS     24
      EK(I,J)=EKK(KX,J)                                                  CONDNS     25
    3 EKK(KX,J)=0                                                        CONDNS     26
      DO 4 I=1,8                                                         CONDNS     27
      DO 4 J=1,8                                                         CONDNS     28
      DO 4 K=9,10                                                        CONDNS     29
    4 EKK(I,J)=EKK(I,J)+EK(I,K)*EK(K,J)                                  CONDNS     30
      DO 5 I=1,8                                                         CONDNS     31
      DO 5 J=1,8                                                         CONDNS     32
    5 EK(I,J)=EK(I,J)-EKK(I,J)                                           CONDNS     33
      IF (NO.EQ.3) RETURN                                                CONDNS     34
    6 CONTINUE                                                           CONDNS     35
      NZE=0                                                              CONDNS     36
      NTH=3                                                              CONDNS     37
      NFO=4                                                              CONDNS     38
      NFI=5                                                              CONDNS     39
      NSE=7                                                              CONDNS     40
      NTW=12                                                             CONDNS     41
      IF (MC.LT.MB) CALL CHANGE (EK,NTH,NFI,NFO,NTW,NTW,NZE)             CONDNS     42
      IF (MD.LT.MB) CALL CHANGE (EK,NTH,NSE,NFO,NTW,NTW,NZE)             CONDNS     43
      IF (MD.LT.MC) CALL CHANGE (EK,NFI,NSE,NFO,NTW,NTW,NZE)             CONDNS     44
      RETURN                                                             CONDNS     45
      END                                                                CONDNS     46
```

```
      SUBROUTINE SUM (EK,EKK,MA,MB,MC)                                  SUM        2
      DIMENSION EK(12,12), EKK(12,12), NA(3)                            SUM        3
      M=2                                                               SUM        4
      NA(1)=2**(MA-1)+1                                                 SUM        5
      NA(2)=2**(MB-1)+1                                                 SUM        6
      NA(3)=2**(MC-1)+1                                                 SUM        7
      IH=0                                                              SUM        8
      DO 4 I=1,6                                                        SUM        9
      JH=0                                                              SUM       10
      IF (I.LE.IH) GO TO 1                                              SUM       11
      IH=IH+M                                                           SUM       12
      IHH=IH/M                                                          SUM       13
      KX=NA(IHH)                                                        SUM       14
    1 DO 3 J=1,6                                                        SUM       15
      IF (J.LE.JH) GO TO 2                                              SUM       16
      JH=JH+M                                                           SUM       17
      IHH=JH/M                                                          SUM       18
      KY=NA(IHH)                                                        SUM       19
    2 EK(KX,KY)=EK(KX,KY)+EKK(I,J)                                      SUM       20
    3 KY=KY+1                                                           SUM       21
    4 KX=KX+1                                                           SUM       22
      RETURN                                                            SUM       23
      END                                                               SUM       24
```

```
      SUBROUTINE CHANGE (EK,IX,IY,NND,M,L,IR)                          CHANG     2
      DIMENSION EK(M,L)                                                CHANG     3
      KX=IX                                                            CHANG     4
      KY=IY                                                            CHANG     5
      M2=2*NND                                                         CHANG     6
      IF (IR.EQ.1) M2=L                                                CHANG     7
      DO 2 I=1,2                                                       CHANG     8
      DO 1 J=1,M2                                                      CHANG     9
      AX=EK(KX,J)                                                      CHANG    10
      EK(KX,J)=EK(KY,J)                                                CHANG    11
    1 EK(KY,J)=AX                                                      CHANG    12
      KX=KX+1                                                          CHANG    13
    2 KY=KY+1                                                          CHANG    14
      IF (IR.EQ.1) RETURN                                              CHANG    15
      KX=KX-2                                                          CHANG    16
      KY=KY-2                                                          CHANG    17
      DO 4 I=1,2                                                       CHANG    18
      DO 3 J=1,M2                                                      CHANG    19
      AX=EK(J,KX)                                                      CHANG    20
      EK(J,KX)=EK(J,KY)                                                CHANG    21
    3 EK(J,KY)=AX                                                      CHANG    22
      KX=KX+1                                                          CHANG    23
    4 KY=KY+1                                                          CHANG    24
      RETURN                                                           CHANG    25
      END                                                              CHANG    26
```

```
      SUBROUTINE TRNSFM (EK,AA,B,C,MM,NNO,M)                            TRNSF    2
      DIMENSION EK(12,12), AA(3,3), B(M,M), C(M,M)                      TRNSF    3
      M2=2*NNO                                                          TRNSF    4
      M3=MM*NNO                                                         TRNSF    5
      DO 3 I=1,M2                                                       TRNSF    6
      JA=MM                                                             TRNSF    7
      KA=0                                                              TRNSF    8
      IA=0                                                              TRNSF    9
      DO 3 J=1,M3                                                       TRNSF   10
      B(I,J)=0.0                                                        TRNSF   11
      IF (J-JA) 2,2,1                                                   TRNSF   12
    1 JA=JA+MM                                                          TRNSF   13
      KA=KA+2                                                           TRNSF   14
      IA=IA+M1                                                          TRNSF   15
    2 JAA=J-IA                                                          TRNSF   16
      DO 3 K=1,2                                                        TRNSF   17
      KAA=K+KA                                                          TRNSF   18
    3 B(I,J)=B(I,J)+EK(I,KAA)*AA(K,JAA)                                 TRNSF   19
      DO 6 J=1,M3                                                       TRNSF   20
      JA=MM                                                             TRNSF   21
      KA=0                                                              TRNSF   22
      IA=0                                                              TRNSF   23
      DO 6 I=1,M3                                                       TRNSF   24
      C(I,J)=0.0                                                        TRNSF   25
      IF (I-JA) 5,5,4                                                   TRNSF   26
    4 JA=JA+M1                                                          TRNSF   27
      KA=KA+2                                                           TRNSF   28
      IA=IA+M1                                                          TRNSF   29
    5 JAA=I-IA                                                          TRNSF   30
      DO 6 K=1,2                                                        TRNSF   31
      KAA=K+KA                                                          TRNSF   32
    6 C(I,J)=C(I,J)+AA(K,JAA)*B(KAA,J)                                  TRNSF   33
      RETURN                                                            TRNSF   34
      END                                                               TRNSF   35
```

```
      SUBROUTINE POP (MMB,JN,MM,MA,MB,MC,MD,KTYPE,IC,ID,NZ)                  POP       2
      DIMENSION MA(1), MB(1), MC(1), MD(1), IC(1), ID(1), KTYPE(1)           POP       3
      IX(I,J)=I*(J-1)+1                                                      POP       4
      NZ=0                                                                   POP       5
      NN=MM*JN                                                               POP       6
      DO 1 I=1,NN                                                            POP       7
    1 IC(I)=NN                                                               POP       8
      DO 9 L=1,MMB                                                           POP       9
      KNODE=4                                                                POP      10
      IF (KTYPE(L).LE.4) KNODE=KTYPE(L)                                      POP      11
      NNODES=2                                                               POP      12
      ITRI=0                                                                 POP      13
      KX=IX(MM,MA(L))                                                        POP      14
      KY=IX(MM,MB(L))                                                        POP      15
    2 IF (IC(KY).LT.KX) GO TO 4                                              POP      16
      DO 3 I=1,MM                                                            POP      17
      IC(KY)=KX                                                              POP      18
    3 KY=KY+1                                                                POP      19
    4 IF (KNODE-3) 8,5,6                                                     POP      20
    5 IF (ITRI.EQ.1) GO TO 8                                                 POP      21
      KY=IX(MM,MC(L))                                                        POP      22
      ITRI=1                                                                 POP      23
      NNODES=3                                                               POP      24
      GO TO 2                                                                POP      25
    6 IF (ITRI.EQ.2) GO TO 8                                                 POP      26
      IF (ITRI.EQ.1) GO TO 7                                                 POP      27
      KY=IX(MM,MC(L))                                                        POP      28
      ITRI=ITRI+1                                                            POP      29
      NNODES=4                                                               POP      30
      GO TO 2                                                                POP      31
    7 KY=IX(MM,MD(L))                                                        POP      32
      ITRI=ITRI+1                                                            POP      33
      GO TO 2                                                                POP      34
    8 CONTINUE                                                               POP      35
    9 CONTINUE                                                               POP      36
      DO 11 I=1,NN,MM                                                        POP      37
      IF (IC(I).LT.I) GO TO 11                                               POP      38
      KX=I                                                                   POP      39
      DO 10 J=1,MM                                                           POP      40
      IC(KX)=I                                                               POP      41
   10 KX=KX+1                                                                POP      42
   11 CONTINUE                                                               POP      43
      DO 12 I=1,NN                                                           POP      44
      NZ=NZ+(I-IC(I)+1)                                                      POP      45
   12 ID(I)=NZ                                                               POP      46
      KX=(NN*(NN+1))/2                                                       POP      47
      WRITE (6,13)                                                           POP      48
      WRITE (6,14) KX,NZ                                                     POP      49
      WRITE (6,15)                                                           POP      50
      WRITE (6,16) (IC(I),I=1,NN)                                            POP      51
      WRITE (6,17)                                                           POP      52
      WRITE (6,16) (ID(I),I=1,NN)                                            POP      53
      RETURN                                                                 POP      54
C                                                                            POP      55
   13 FORMAT (1H1,////20X,16HGROSS POPULATION,24X,19HAPPARENT POPULATION     POP      56
     1)                                                                      POP      57
   14 FORMAT (//18X,I14,18X,I22//)                                           POP      58
```

```
      15    FORMAT (//2X,36HSTARTING ROW NUMBERS FOR EACH COLUMN///)          POP       59
      16    FORMAT (5X,10I12)                                                 POP       60
60    17    FORMAT (//2X,61HNUMBERS OF DIAGONAL ELEMENTS IN SINGLE ARRAYSTIFFN POP       61
     1ESS MATRIX ///)                                                         POP       62
      END                                                                     POP       63
```

66

```
      1             SUBROUTINE GAUSS (A,F,D,IC,ID,L,N,NN,NDCOMP)                    GAUSS     2
                    DIMENSION A(1), IC(1), ID(1), F(NN,L), D(NN,L)                  GAUSS     3
                    IF (NDCOMP.EQ.1) GO TO 5                                        GAUSS     4
                    DO 4 I=1,N                                                      GAUSS     5
      5             I1=I-1                                                          GAUSS     6
                    DO 3 J=I,N                                                      GAUSS     7
                    IF (IC(J).GT.I) GO TO 3                                         GAUSS     8
                    IX=ID(J)-J+I                                                    GAUSS     9
                    IF (I1.EQ.0) GO TO 2                                            GAUSS    10
     10             DO 1 K=1,I1                                                     GAUSS    11
                    IF (IC(J).GT.K.OR.IC(I).GT.K) GO TO 1                           GAUSS    12
                    KX=ID(I)-I+K                                                    GAUSS    13
                    KY=ID(J)-J+K                                                    GAUSS    14
                    KZ=ID(K)                                                        GAUSS    15
     15             A(IX)=A(IX)-(A(KX)*A(KZ)*A(KY))                                 GAUSS    16
           1        CONTINUE                                                        GAUSS    17
           2        IF (I.EQ.J) GO TO 3                                             GAUSS    18
                    KZ=ID(I)                                                        GAUSS    19
                    IF (A(KZ).EQ.0.) GO TO 12                                       GAUSS    20
     20             A(IX)=A(IX)/A(KZ)                                               GAUSS    21
           3        CONTINUE                                                        GAUSS    22
           4        CONTINUE                                                        GAUSS    23
           5        DO 8 K=1,L                                                      GAUSS    24
                    DO 7 I=1,N                                                      GAUSS    25
     25             D(I,K)=F(I,K)                                                   GAUSS    26
                    I1=I-1                                                          GAUSS    27
                    IF (I1.EQ.0) GO TO 7                                            GAUSS    28
                    DO 6 J=1,I1                                                     GAUSS    29
                    IF (IC(I).GT.J) GO TO 6                                         GAUSS    30
     30             IX=ID(I)-I+J                                                    GAUSS    31
                    D(I,K)=D(I,K)-A(IX)*D(J,K)                                      GAUSS    32
           6        CONTINUE                                                        GAUSS    33
           7        CONTINUE                                                        GAUSS    34
           8        CONTINUE                                                        GAUSS    35
     35             DO 9 I=1,N                                                      GAUSS    36
                    KX=ID(I)                                                        GAUSS    37
                    DO 9 K=1,L                                                      GAUSS    38
           9        D(I,K)=D(I,K)/A(KX)                                             GAUSS    39
                    DO 11 K=1,L                                                     GAUSS    40
     40             IX=N                                                            GAUSS    41
                    DO 11 I=2,N                                                     GAUSS    42
                    IX=IX-1                                                         GAUSS    43
                    I1=I-1                                                          GAUSS    44
                    KX=IX                                                           GAUSS    45
     45             DO 10 J=1,I1                                                    GAUSS    46
                    KX=KX+1                                                         GAUSS    47
                    IF (IC(KX).GT.IX) GO TO 10                                      GAUSS    48
                    KY=ID(KX)-KX+IX                                                 GAUSS    49
                    D(IX,K)=D(IX,K)-A(KY)*D(KX,K)                                   GAUSS    50
     50    10       CONTINUE                                                        GAUSS    51
           11       CONTINUE                                                        GAUSS    52
                    GO TO 13                                                        GAUSS    53
           12       WRITE (6,14)                                                    GAUSS    54
           13       RETURN                                                          GAUSS    55
     55    C                                                                       GAUSS    56
           14       FORMAT (///2X,21HSTRUCTURE IS UNSTABLE///)                      GAUSS    57
                    END                                                             GAUSS    58
```

```
      SUBROUTINE BOUND (A,IB,N,NB,ID,IC)                                BOUND     2
      DIMENSION A(1), IB(1), ID(1), IC(1)                               BOUND     3
      IH=NB                                                             BOUND     4
      NH=N                                                              BOUND     5
    5 DO 7 JA=1,NB                                                      BOUND     6
      IA=IB(IH)                                                         BOUND     7
      IF (IA.GE.NH) GO TO 6                                             BOUND     8
      KH=IA+1                                                           BOUND     9
      IF (IA.GT.1) GO TO 1                                              BOUND    10
   10 KX=1                                                              BOUND    11
      JX=1                                                              BOUND    12
      GO TO 2                                                           BOUND    13
    1 JX=ID(IA)-ID(IA-1)                                                BOUND    14
      KX=ID(IA-1)+1                                                     BOUND    15
   15 2 DO 5 I=KH,NH                                                    BOUND    16
      . KY=1                                                            BOUND    17
      IF (IC(I).LE.IA) GO TO 3                                          BOUND    18
      IC(I-1)=IC(I)-1                                                   BOUND    19
      I1=I                                                              BOUND    20
   20 KY=0                                                              BOUND    21
      GO TO 4                                                           BOUND    22
    3 IC(I-1)=IC(I)                                                     BOUND    23
      I1=I-1                                                            BOUND    24
    4 K=IC(I)                                                           BOUND    25
   25 ID(I-1)=ID(I)-JX-KY                                               BOUND    26
      DO 5 J=K,I1                                                       BOUND    27
      IF (J.E).IA) JX=JX+1                                              BOUND    28
      KXX=KX+JX                                                         BOUND    29
      A(KX)=A(KXX)                                                      BOUND    30
   30 5 KX=KX+1                                                         BOUND    31
    6 NH=NH-1                                                           BOUND    32
      IH=IH-1                                                           BOUND    33
    7 CONTINUE                                                          BOUND    34
      RETURN                                                            BOUND    35
   35 END                                                               BOUND    36
```

```
      SUBROUTINE PRNTDR (A,B,X,Y,Z,IB,N,M,L,NJ,NP,NB,NBB,NN)                PRNTD      2
      DIMENSION A(NN,L), B(NN,L), X(1), Y(1), Z(1), IB(1)                   PRNTD      3
      IF (NBB.EQ.0) WRITE (6,12)                                            PRNTD      4
      IF (NBB.NE.0) WRITE (6,13)                                            PRNTD      5
      NP=NP+1                                                               PRNTD      6
      K1=1                                                                  PRNTD      7
      JJN=70/L+1                                                            PRNTD      8
      WRITE (6,15)                                                          PRNTD      9
      DO 11 I=1,NJ                                                          PRNTD     10
      IF (NBB.NE.0) GO TO 1                                                 PRNTD     11
      IF (I.NE.JJN) GO TO 1                                                 PRNTD     12
      JJN=70/L+JJN                                                          PRNTD     13
      WRITE (6,14)                                                          PRNTD     14
      WRITE (6,15)                                                          PRNTD     15
      NP=NP+1                                                               PRNTD     16
    1 KH=M*I                                                                PRNTD     17
      KHH=KH-M+1                                                            PRNTD     18
      IF (NBB.EQ.0) GO TO 5                                                 PRNTD     19
      ICHK=0                                                                PRNTD     20
      DO 3 IJ=K1,NB                                                         PRNTD     21
      IF (IB(IJ).GE.KHH.AND.IB(IJ).LE.KH) GO TO 2                           PRNTD     22
      IF (IB(IJ).GT.KH) GO TO 4                                             PRNTD     23
      GO TO 3                                                               PRNTD     24
    2 K1=K1+1                                                               PRNTD     25
      ICHK=1                                                                PRNTD     26
    3 CONTINUE                                                              PRNTD     27
    4 CONTINUE                                                              PRNTD     28
      IF (ICHK.EQ.0) GO TO 11                                               PRNTD     29
    5 CONTINUE                                                              PRNTD     30
      IF (M.LT.3) GO TO 6                                                   PRNTD     31
      WRITE (6,16) I,X(I),Y(I),Z(I),(A(J,1),J=KHH,KH),(B(J,1),J=KHH,KH)     PRNTD     32
      GO TO 7                                                               PRNTD     33
    6 WRITE (6,17) I,X(I),Y(I),(A(J,1),J=KHH,KH),(B(J,1),J=KHH,KH)          PRNTD     34
    7 IF (L.EQ.1) GO TO 10                                                  PRNTD     35
      DO 9 K=2,L                                                            PRNTD     36
      IF (M.LT.3) GO TO 8                                                   PRNTD     37
      WRITE (6,18) (A(J,K),J=KHH,KH),(B(J,K),J=KHH,KH)                      PRNTD     38
      GO TO 9                                                               PRNTD     39
    8 WRITE (6,19) (A(J,K),J=KHH,KH),(B(J,K),J=KHH,KH)                      PRNTD     40
    9 CONTINUE                                                              PRNTD     41
   10 CONTINUE                                                              PRNTD     42
   11 CONTINUE                                                              PRNTD     43
      RETURN                                                                PRNTD     44
    C                                                                       PRNTD     45
   12 FORMAT (1H1,48X,23H*****DISPLACEMENTS*****,1X/)                       PRNTD     46
   13 FORMAT (1H1,48X,19H*****REACTIONS*****,1X,/)                          PRNTD     47
   14 FORMAT (1H1,////)                                                     PRNTD     48
   15 FORMAT (//1X,5HJOINT,8X,2H-X,8X,2H-Y,8X,2H-Z,8X,7HFORCE-X,7X,7HFOR    PRNTD     49
     1CE-Y,7X,7HFORCE-Z,8X,7HDISPL-X,10X,7HDISPL-Y,10X,7HDISPL-Z//)         PRNTD     50
   16 FORMAT (I5,F14.3,F10.3,F10.3,F12.3,F14.3,F14.3,1PE18.8,1PE17.8,1PE    PRNTD     51
     117.8)                                                                 PRNTD     52
   17 FORMAT (I5,F14.3,F10.3,10X,F12.3,F14.3,14X,1PE18.8,1PE17.8)           PRNTD     53
   18 FORMAT (39X,F12.3,F14.3,F14.3,1PE18.8,1PE17.8,1PE17.8)                PRNTD     54
   19 FORMAT (39X,F12.3,F14.3,14X,1PE18.8,1PE17.8)                          PRNTD     55
      END                                                                   PRNTD     56
```

CARD NR. SEVERITY DETAILS DIAGNOSIS OF PROBLEM

24 I K1 THIS STATEMENT REDEFINES A CURRENT LOOP CONTROL VARIABLE OR PARAMETER.

```
SUBROUTINE REDUCE     74/74   OPT=1                FTN 4.5+414      10/29/76  12.20.38      PAGE     1

      1               SUBROUTINE REDUCE (F,IB,N,NB,L,NN)                                  REDUCE     2
                      DIMENSION F(NN,L), IB(1)                                            REDUCE     3
                      DO 5 J=1,L                                                          REDUCE     4
                      IH=NB                                                               REDUCE     5
      5               NH=N                                                                REDUCE     6
                  1   I=IB(IH)                                                            REDUCE     7
                      IF (I-NH) 2,4,4                                                     REDUCE     8
                  2   NH1=NH-1                                                            REDUCE     9
                      DO 3 K=I,NH1                                                        REDUCE    10
     10               K1=K+1                                                              REDUCE    11
                  3   F(K,J)=F(K1,J)                                                      REDUCE    12
                  4   IH=IH-1                                                             REDUCE    13
                      NH=NH-1                                                             REDUCE    14
                      IF (IH.EQ.0) GO TO 5                                                REDUCE    15
     15               GO TO 1                                                             REDUCE    16
                  5   CONTINUE                                                            REDUCE    17
                      RETURN                                                              REDUCE    18
                      END                                                                 REDUCE    19
```

```
      SUBROUTINE RESTOR (D,IB,N,NB,L,NN)                                RESTOR     2
      DIMENSION D(NN,L), IB(1), TDR1(10), TDR2(10)                      RESTOR     3
      NH=N-NB                                                           RESTOR     4
      IH=1                                                              RESTOR     5
    1 I=IB(IH)                                                          RESTOR     6
      IF (I.GT.NH) GO TO 7                                              RESTOR     7
      DO 2 K=1,L                                                        RESTOR     8
      TDR1(K)=D(I,K)                                                    RESTOR     9
    2 D(I,K)=0.                                                         RESTOR    10
    3 J=I+1                                                             RESTOR    11
      IF (J.GT.NH) GO TO 5                                              RESTOR    12
      DO 4 K=1,L                                                        RESTOR    13
    4 TDR2(K)=D(J,K)                                                    RESTOR    14
    5 DO 6 K=1,L                                                        RESTOR    15
      D(J,K)=TDR1(K)                                                    RESTOR    16
    6 TDR1(K)=TDR2(K)                                                   RESTOR    17
      IF (I.GE.NH) GO TO 9                                              RESTOR    18
      I=I+1                                                             RESTOR    19
      GO TO 3                                                           RESTOR    20
    7 DO 8 K=1,L                                                        RESTOR    21
    8 D(I,K)=0.                                                         RESTOR    22
    9 IF (IH.GE.NB) GO TO 10                                            RESTOR    23
      IH=IH+1                                                           RESTOR    24
      NH=NH+1                                                           RESTOR    25
      GO TO 1                                                           RESTOR    26
   10 CONTINUE                                                          RESTOR    27
      RETURN                                                            RESTOR    28
      END                                                               RESTOR    29
```

```
      SUBROUTINE ELSTRS (EDR,A,AL,SX,E,L,ENG)                          ELSTRS     2
      DIMENSION EDR(12,L), A(3,3), SX(1), ENG(1)                       ELSTRS     3
      DO 1 K=1,L                                                       ELSTRS     4
      SX(K)=(EDR(1,K)-EDR(2,K))/AL                                     ELSTRS     5
      SX(K)=-SX(K)                                                     ELSTRS     6
      ENG(K)=SX(K)*SX(K)*E                                             ELSTRS     7
      SX(K)=E*SX(K)                                                    ELSTRS     8
    1 CONTINUE                                                         ELSTRS     9
      RETURN                                                           ELSTRS    10
      END                                                              ELSTRS    11
```

```
      SUBROUTINE SCOMP (EK,THK,QTR,X,Y,G,EC)                            SCOMP      2
      DIMENSION EK(12,12), X(5), Y(5)                                   SCOMP      3
      QTR=(X(2)*Y(3)+X(3)*Y(4)-X(3)*Y(2)-X(4)*Y(3))*0.5                 SCOMP      4
      XI=X(4)-X(2)                                                      SCOMP      5
      EK(1,1)=XI**2/4.                                                  SCOMP      6
      EK(2,1)=-Y(4)*XI/4.                                               SCOMP      7
      EK(3,1)=-X(3)*XI/4.                                               SCOMP      8
      EK(4,1)=XI*Y(3)/4.                                                SCOMP      9
      EK(2,2)=Y(4)**2/4.                                                SCOMP     10
      EK(3,2)=Y(4)*X(3)/4.                                              SCOMP     11
      EK(4,2)=-Y(4)*Y(3)/4.                                             SCOMP     12
      EK(3,3)=X(3)**2/4.                                                SCOMP     13
      EK(4,3)=-X(3)*Y(3)/4.0                                            SCOMP     14
      EK(4,4)=Y(3)**2/4.                                                SCOMP     15
      DO 1 I=1,3                                                        SCOMP     16
      K=I+1                                                             SCOMP     17
      DO 1 J=K,4                                                        SCOMP     18
    1 EK(I,J)=EK(J,I)                                                   SCOMP     19
      DO 2 I=1,4                                                        SCOMP     20
      L=I+4                                                             SCOMP     21
      DO 2 J=1,4                                                        SCOMP     22
    2 EK(L,J)=-EK(I,J)                                                  SCOMP     23
      DO 3 I=1,8                                                        SCOMP     24
      DO 3 J=1,4                                                        SCOMP     25
      K=J+4                                                             SCOMP     26
    3 EK(I,K)=-EK(I,J)                                                  SCOMP     27
      DO 4 I=1,8                                                        SCOMP     28
      DO 4 J=1,8                                                        SCOMP     29
      EK(I,J)=EK(I,J)*G*THK/QTR                                         SCOMP     30
      EK(I,J)=EK(I,J)/EC                                                SCOMP     31
    4 CONTINUE                                                          SCOMP     32
      RETURN                                                            SCOMP     33
      END                                                               SCOMP     34
```

SUBROUTINE SSRS 74/74 OPT=1

```
      SUBROUTINE SSRS (UV,X,Y,THK,AREA,TA,G,L,ENG)                      SSRS    2
1     DIMENSION UV(12,L), X(5), Y(5), TA(1), A(8), ENG(1)               SSRS    3
      AREA=(X(2)*Y(3)+X(3)*Y(4)-X(3)*Y(2)-X(4)*Y(3))*0.5                SSRS    4
      A(1)=X(4)-X(2)                                                    SSRS    5
      A(2)=-Y(4)                                                        SSRS    6
5     A(3)=-X(3)                                                        SSRS    7
      A(4)=Y(3)                                                         SSRS    8
      DO 1 I=1,4                                                        SSRS    9
      J=I+4                                                             SSRS   10
10    1 A(J)=-A(I)                                                      SSRS   11
      DO 2 I=1,8                                                        SSRS   12
      2 A(I)=A(I)*THK/2.                                                SSRS   13
      DO 3 K=1,L                                                        SSRS   14
      TA(K)=0.0                                                         SSRS   15
      DO 3 I=1,8                                                        SSRS   16
15    3 TA(K)=TA(K)+A(I)*UV(I,K)*G/(AREA*THK)                           SSRS   17
      DO 4 I=1,L                                                        SSRS   18
      ENG(I)=TA(I)**2/G                                                 SSRS   19
      4 CONTINUE                                                        SSRS   20
      RETURN                                                            SSRS   21
20    END                                                               SSRS   22
```

```
 SUBROUTINE BFORCE     74/74   OPT=1                    FTN 4.5+414        10/29/76  12.20.38        PAGE     1


 1                SUBROUTINE BFORCE (PRCT,AX,AY,AXY,ASX,ASY,ASXY,NZ,LOADS)          BFORCE      2
               C  DIMENSIONS OF AX,AY,AXY,ASX,ASY,ASXY, CONSISTENT WITH THOSE IN     BFORCE      3
               C  MEMB SUBROUTINE                                                   BFORCE      4
                  DIMENSION PRCT(1), AX(1,10), AY(1,10), AXY(1,10), ASX(4,10,4), ASY BFORCE      5
 5               1(4,10,4), ASXY(4,10,4)                                           BFORCE      6
                  I=1                                                               BFORCE      7
                  DO 1 J=1,LOADS                                                    BFORCE      8
                  AX(I,J)=0.0                                                       BFORCE      9
                  AY(I,J)=0.0                                                       BFORCE     10
 10               AXY(I,J)=0.0                                                      BFORCE     11
                  DO 1 K=1,NZ                                                       BFORCE     12
                  AX(I,J)=PRCT(K)*ASX(I,J,K)+AX(I,J)                                BFORCE     13
                  AY(I,J)=PRCT(K)*ASY(I,J,K)+AY(I,J)                                BFORCE     14
                  AXY(I,J)=PRCT(K)*ASXY(I,J,K)+AXY(I,J)                             BFORCE     15
 15            1  CONTINUE                                                         BFORCE     16
                  RETURN                                                            BFORCE     17
                  END                                                               BFORCE     18
```

```
      SUBROUTINE SBUCKL (A,AX,AY,AXY,THK,LOADS,AWIDE,BWIDE,TMAX)
      DIMENSION A(3,3), AX(1,10), AY(1,10), AXY(1,10)
C  ALL DIMENSIONS CONSISTENT WITH THOSE IN MEMB SUBROUTINE
      I=1
      DO 1 J=1,LOADS
      AX(I,J)=AX(I,J)*(-1.*THK)
      AY(I,J)=AY(I,J)*(-1.*THK)
    1 AXY(I,J)=AXY(I,J)*(-1.*THK)
      TMAX=THK
      APY=3.1415927**2
      I=1
      DO 7 J=1,LOADS
      AB=0.0
      AC=0.0
      ANXY=AXY(I,J)
      BETA=A(2,2)/A(1,1)
      ALPHA=2.*(A(1,2)+2.*A(3,3))/A(1,1)
      ANX=0.0
      IF (AX(I,J).LT.0..AND.AY(I,J).LT.0.) GO TO 5
      IY=0
      GAMA=0.
      IF (AY(I,J).LT.0.) GO TO 2
      IF (AX(I,J).LT.0.) GO TO 3
      GAMA=AY(I,J)/AX(I,J)
      IF (GAMA.GT.1.) IY=1
    2 CONTINUE
      ANX=AX(I,J)
      IF (IY.EQ.0) GO TO 4
    3 CONTINUE
      BETA=1./BETA
      ALPHA=ALPHA*A(1,1)/A(2,2)
      IF (GAMA.NE.0.) GAMA=1./GAMA
      ANX=AY(I,J)
      IY=1
    4 CONTINUE
      AAMU=GAMA**2-ALPHA*GAMA+BETA
      IF (AAMU.LT.0.) ANX=0.0
      IF (AAMU.LT.0.) GO TO 5
      AMU=-GAMA+AAMU**0.5
      AKX=(AMU**2+ALPHA*AMU+BETA)/(AMU+GAMA)
      ANXCR=AKX*APY*A(1,1)/(12.*AWIDE**2)
      IF (IY.EQ.1) ANXCR=AKX*APY*A(2,2)/(12.*BWIDE**2)
      GO TO 6
    5 CONTINUE
    6 CONTINUE
      THETA=2.*BETA**0.5/ALPHA
      AKXY=(4.742+0.216*THETA+0.38*THETA**2)*(ALPHA*BETA/2.)**0.5
      IF (THETA.GE.1.) AKXY=(3.293+2.047/THETA)*BETA**0.75
      ANXYCR=AKXY*APY*A(1,1)/(AWIDE**2.*12.)
      IF (IY.EQ.1) ANXYCR=AKXY*APY*A(2,2)/(BWIDE**2.*12.)
      IF (ANX.NE.0.) AB=ANX/ANXCR
      AC=(ANXY/ANXYCR)**2
      AA=AB**2+4.*AC
      AA=SQRT(AA)
      THK1=(AB+AA)/2.
      THK2=(AB-AA)/2.
      IF (THK1.LT.THK2) THK1=THK2
```

```
                TH3=THK1**0.33333                                       SBUCK      59
                IF (TMAX.LT.TH3) TMAX=TH3                               SBUCK      60
60          7   CONTINUE                                                SBUCK      61
                RETURN                                                  SBUCK      62
            C                                                           SBUCK      63
                END                                                     SBUCK      64
```

```
      SUBROUTINE ANORM (A,AL,MEMBS,AMAX,NC,NZ,NCC)                    ANORM    2
      DIMENSION A(1), AL(NCC,NZ)                                      ANORM    3
      AMAX=0.0                                                        ANORM    4
      DO 7 K=1,2                                                      ANORM    5
      IF (NC.EQ.0) GO TO 3                                            ANORM    6
      DO 2 I=1,NC                                                     ANORM    7
      A(I)=0.0                                                        ANORM    8
      DO 1 J=1,NZ                                                     ANORM    9
      A(I)=A(I)+AL(I,J)                                               ANORM   10
    1 CONTINUE                                                        ANORM   11
    2 CONTINUE                                                        ANORM   12
    3 CONTINUE                                                        ANORM   13
      IF (K.EQ.2) RETURN                                              ANORM   14
      DO 4 I=1,MEMBS                                                  ANORM   15
    4 IF (AMAX.LT.A(I)) AMAX=A(I)                                     ANORM   16
      K1=NC+1                                                         ANORM   17
      DO 5 I=K1,MEMBS                                                 ANORM   18
    5 A(I)=A(I)/AMAX                                                  ANORM   19
      IF (NC.EQ.0) GO TO 7                                            ANORM   20
      DO 6 I=1,NC                                                     ANORM   21
      DO 6 J=1,NZ                                                     ANORM   22
      AL(I,J)=AL(I,J)/AMAX                                            ANORM   23
    6 CONTINUE                                                        ANORM   24
    7 CONTINUE                                                        ANORM   25
      RETURN                                                          ANORM   26
      END                                                             ANORM   27
```

```
      SUBROUTINE MULT (SK,FR,DR,IC,ID,N,LD,NC)                          MULT        2
      DIMENSION IC(1), ID(1), SK(1), DR(NC,LD), FR(NC,LD)               MULT        3
      DO 7 I=1,N                                                        MULT        4
      DO 1 K=1,LD                                                       MULT        5
    1 FR(I,K)=0.0                                                       MULT        6
      K1=IC(I)                                                          MULT        7
      DO 7 J=K1,N                                                       MULT        8
      I1=I-1                                                            MULT        9
      J1=J-1                                                            MULT       10
      IF (J-I) 2,3,4                                                    MULT       11
    2 IF (IC(I).GT.J) GO TO 7                                           MULT       12
      KM=ID(I1)+J-IC(I)+1                                               MULT       13
      GO TO 5                                                           MULT       14
    3 KM=ID(J)                                                          MULT       15
      GO TO 5                                                           MULT       16
    4 IF (IC(J).GT.I) GO TO 7                                           MULT       17
      KM=ID(J1)+I-IC(J)+1                                               MULT       18
    5 CONTINUE                                                          MULT       19
      DO 6 L=1,LD                                                       MULT       20
      FR(I,L)=FR(I,L)+SK(KM)*DR(J,L)                                    MULT       21
    6 CONTINUE                                                          MULT       22
    7 CONTINUE                                                          MULT       23
      RETURN                                                            MULT       24
      END                                                               MULT       25
```

```
      SUBROUTINE ENGS (SSMAX,BSX,BSY,BSXY,PX,PY,PXY,EXFI,EYFI,EXYFI,ENG,
     1EFFSTR,LOADS,NZ,KM,NORTIA,NENG,NEF)
      COMMON /CC/ E11,E22,ANU1,ANU2,GSH
C  ALL DIMENSIONS TO BE CONSISTENT WITH THOSE IN MEMB SUBROUTINE
      DIMENSION BSX(4,10,4), BSY(4,10,4), BSXY(4,10,4), SSMAX(5,4,4), E1
     11(4,4), E22(4,4), ANU1(4,4), ANU2(4,4), GSH(4,4), EXFI(4,10,4), EY
     2FI(4,10,4), EXYFI(4,10,4), ENG(10,4), TRI(1), EFFSTR(4,10,4), PX(4
     3,10,4), PY(4,10,4), PXY(4,10,4)
      DO 3 J=1,LOADS
      DO 3 K=1,NZ
      ENG(J,K)=0.0
      I=1
      X1=SSMAX(1,K,KM)
      IF (BSX(I,J,K).LT.0.) X1=SSMAX(2,K,KM)
      X2=SSMAX(3,K,KM)
      IF (BSY(I,J,K).LT.0.) X2=SSMAX(4,K,KM)
      X3=SSMAX(5,K,KM)
      PX(I,J,K)=ABS(BSX(I,J,K)/X1)
      PY(I,J,K)=ABS(BSY(I,J,K)/X2)
      PXY(I,J,K)=ABS(BSXY(I,J,K)/X3)
      EF1=PX(I,J,K)**2+PY(I,J,K)**2+PXY(I,J,K)**2
      EF2=PX(I,J,K)*PY(I,J,K)
      IF (NEF.EQ.1) EFFSTR(I,J,K)=EF1-EF2
      IF (NEF.EQ.2) EFFSTR(I,J,K)=EF1-EF2*X2/X1
      EFH=EF1-EF2
      EFN=EF1-EF2*X2/X1
      IF (NORTIA.EQ.2) GO TO 1
      Y1=(X1-ANU1(K,KM)*X2)/E11(K,KM)
      Y2=(X2-ANU2(K,KM)*X1)/E22(K,KM)
      Y3=X3/GSH(K,KM)
      GO TO 2
    1 CONTINUE
      CNU=1.-ANU1(K,KM)*ANU2(K,KM)
      C11=E11(K,KM)/CNU
      C22=E22(K,KM)/CNU
      C12=E22(K,KM)*ANU1(K,KM)/CNU
      Y1=X1*C11+X2*C12
      Y2=X1*C12+X2*C22
      Y3=X3*GSH(K,KM)
    2 CONTINUE
      EC1=X1*Y1
      EC2=X2*Y2
      EC3=X3*Y3
      EC2=EC1
      EC3=EC1
      E1=BSX(I,J,K)*EXFI(I,J,K)
      E2=BSY(I,J,K)*EYFI(I,J,K)
      E3=BSXY(I,J,K)*EXYFI(I,J,K)
      IF (NENG.EQ.1) ENG(J,K)=ENG(J,K)+(E1+E2+E3)
      IF (NENG.EQ.2) ENG(J,K)=ENG(J,K)+E1/EC1+E2/EC2+E3/EC3
      IF(NENG.EQ.3) ENG(J,K)=ENG(J,K)+EFH
      IF(NENG.EQ.4) ENG(J,K)=ENG(J,K)+EFN
      EFFSTR(I,J,K)=EFFSTR(I,J,K)**0.5
    3 CONTINUE
      RETURN
      END
```

```
SUBROUTINE STRES      74/74   OPT=1                    FTN 4.5+414       10/29/76  12.20.38       PAGE     1

      1                SUBROUTINE STRES (E,E1,EX,EY,EXY,SXLO,SYLO,SXYLO,SXZO,SYZO,SXYZO,E STRESS      2
                      1XFI,EYFI,EXYFI,SXFI,SYFI,SXYFI,DA,AD,LDS,I,IL)                    STRESS      3
                C  ALL DIMENSIONS TO BE CONSISTENT WITH THOSE IN MEMB SUBROUTINE         STRESS      4
                   DIMENSION E(3,3), EX(10), EY(10), EXY(10), SXLO(4,10,4), SYLO(4,10 STRESS      5
      5           1,4), SXYLO(4,10,4), SXZO(4,10,4), SYZO(4,10,4), SXYZO(4,10,4), SXF STRESS      6
                   2I(4,10,4), SYFI(4,10,4), SXYFI(4,10,4), DA(3,3), AD(3,3), EXFI(4,1 STRESS      7
                   30,4), EYFI(4,10,4), EXYFI(4,10,4)                                 STRESS      8
                C     COMMENT I=TRIANGLE   IL=  LOADING CONDITION  K=  LAYER           STRESS      9
                      DO 1 K=1,LDS                                                    STRESS     10
     10           C                                                                    STRESS     11
                      SXLO(I,K,IL)=(E(1,1)*EX(K)+E(1,2)*EY(K)+E(1,3)*EXY(K))*E1       STRESS     12
                      SYLO(I,K,IL)=(E(2,1)*EX(K)+E(2,2)*EY(K)+E(2,3)*EXY(K))*E1       STRESS     13
                      SXYLO(I,K,IL)=(E(3,1)*EX(K)+E(3,2)*EY(K)+E(3,3)*EXY(K))*E1      STRESS     14
                      SXFI(I,K,IL)=DA(1,1)*SXLO(I,K,IL)+DA(1,2)*SYLO(I,K,IL)+DA(1,3)*SXY STRESS     15
     15               1LO(I,K,IL)                                                     STRESS     16
                      SYFI(I,K,IL)=DA(2,1)*SXLO(I,K,IL)+DA(2,2)*SYLO(I,K,IL)+DA(2,3)*SXY STRESS     17
                      1LO(I,K,IL)                                                     STRESS     18
                      SXYFI(I,K,IL)=DA(3,1)*SXLO(I,K,IL)+DA(3,2)*SYLO(I,K,IL)+DA(3,3)*SX STRESS     19
                      1YLO(I,K,IL)                                                    STRESS     20
     20               SXZO(I,K,IL)=AD(1,1)*SXLO(I,K,IL)+AD(1,2)*SYLO(I,K,IL)+AD(1,3)*SXY STRESS     21
                      1LO(I,K,IL)                                                     STRESS     22
                      SYZO(I,K,IL)=AD(2,1)*SXLO(I,K,IL)+AD(2,2)*SYLO(I,K,IL)+AD(2,3)*SXY STRESS     23
                      1LO(I,K,IL)                                                     STRESS     24
                      SXYZO(I,K,IL)=AD(3,1)*SXLO(I,K,IL)+AD(3,2)*SYLO(I,K,IL)+AD(3,3)*SX STRESS     25
     25               1YLO(I,K,IL)                                                    STRESS     26
                      EXFI(I,K,IL)=DA(1,1)*EX(K)+DA(1,2)*EY(K)+DA(1,3)*EXY(K)/2.0     STRESS     27
                      EYFI(I,K,IL)=DA(2,1)*EX(K)+DA(2,2)*EY(K)+DA(2,3)*EXY(K)/2.0     STRESS     28
                      EXYFI(I,K,IL)=DA(3,1)*EX(K)*2.+DA(3,2)*EY(K)*2.+DA(3,3)*EXY(K)  STRESS     29
                1     CONTINUE                                                        STRESS     30
     30               RETURN                                                          STRESS     31
                      END                                                             STRESS     32
```

```
      SUBROUTINE SHILL (EFFSTR,LOADS,BASEAE,LLOD,LCRI,LLYR,NZ,STHK)
C  EFFSTR DIMENSION CONSISTENT WITH THAT IN MEMB SUBROUTINE
      DIMENSION STHK(1)
      DIMENSION EFFSTR(4,10,4)
      LCRI=1
      AMAX=0.0
      STRSS=BASEAE
      I=1
      DO 2 J=1,LOADS
      DO 2 K=1,NZ
      IF (AMAX.GT.EFFSTR(I,J,K)) GO TO 1
      AMAX=EFFSTR(I,J,K)
      LLOD=J
      LLYR=K
    1 CONTINUE
    2 CONTINUE
      IF (STRSS.GE.AMAX) GO TO 3
      RATIO=AMAX/STRSS
      BASEAE=BASEAE*RATIO
    3 CONTINUE
      DO 6 K=1,NZ
      I=1
      DO 5 J=1,LOADS
      IF (EFFSTR(I,J,K).LT.AMAX) GO TO 4
      AMAX=EFFSTR(I,J,K)
    4 CONTINUE
    5 CONTINUE
      STHK(K)=AMAX
    6 CONTINUE
      RETURN
      END
```

```
      SUBROUTINE AVSTRS (ABC,TRANG,QUAD,LOS,NZ)                    AVG    2
      DIMENSION ABC(4,10,4), TRANG(4)                              AVG    3
      DO 2 J=1,LOS                                                 AVG    4
      DO 2 K=1,NZ                                                  AVG    5
      AMAX=0.0                                                     AVG    6
      DO 1 I=1,4                                                   AVG    7
      AMAX=AMAX+ABC(I,J,K)*TRANG(I)                                AVG    8
    1 CONTINUE                                                     AVG    9
      AMAX=AMAX/QUAD                                               AVG   10
      ABC(1,J,K)=AMAX                                              AVG   11
    2 CONTINUE                                                     AVG   12
      RETURN                                                       AVG   13
      END                                                          AVG   14
```

```
      SUBROUTINE AEQ (X,Y,Z,FR,IBND,NN,LD,JOINTS,NB,MM)                  AEQ       2
C  DIMENSIONS OF AML,AMR,AFL,AFR,AL,AR, NEEDS CHANGE ONLY IF LOADS IN    AEQ       3
C  MAIN IS GREATER THAN 10                                               AEQ       4
      DIMENSION X(1), Y(1), Z(1), FR(NN,LD), IBND(1)                     AEQ       5
      DIMENSION AML(3,10), AMR(3,10), AFL(3,10), AFR(3,10), AL(3,10), AR AEQ       6
     1(3,10)                                                             AEQ       7
      WRITE (6,13)                                                       AEQ       8
      DO 1 I=1,LD                                                        AEQ       9
      DO 1 J=1,MM                                                        AEQ      10
      AML(J,I)=0.0                                                       AEQ      11
      AMR(J,I)=0.0                                                       AEQ      12
      AFL(J,I)=0.0                                                       AEQ      13
      AFR(J,I)=0.0                                                       AEQ      14
    1 CONTINUE                                                           AEQ      15
      K1=1                                                               AEQ      16
      IP=0                                                               AEQ      17
      DO 10 I=1,JOINTS                                                   AEQ      18
      DO 2 I1=1,MM                                                       AEQ      19
      DO 2 J1=1,LD                                                       AEQ      20
      AL(I1,J1)=0.0                                                      AEQ      21
    2 AR(I1,J1)=0.0                                                      AEQ      22
      DO 8 J=1,MM                                                        AEQ      23
      IP=IP+1                                                            AEQ      24
      DO 6 K=K1,NB                                                       AEQ      25
      IF (IBND(K).EQ.IP) GO TO 4                                         AEQ      26
      DO 3 L=1,LD                                                        AEQ      27
    3 AL(J,L)=FR(IP,L)                                                   AEQ      28
      GO TO 6                                                            AEQ      29
    4 DO 5 L=1,LD                                                        AEQ      30
    5 AR(J,L)=FR(IP,L)                                                   AEQ      31
      K1=K1+1                                                            AEQ      32
      GO TO 7                                                            AEQ      33
    6 CONTINUE                                                           AEQ      34
    7 CONTINUE                                                           AEQ      35
    8 CONTINUE                                                           AEQ      36
      DO 9 J=1,LD                                                        AEQ      37
      AMR(1,J)=AMR(1,J)+Y(I)*AR(3,J)-Z(I)*AR(2,J)                        AEQ      38
      AML(1,J)=AML(1,J)+Y(I)*AL(3,J)-Z(I)*AL(2,J)                        AEQ      39
      AMR(2,J)=AMR(2,J)+Z(I)*AR(1,J)-X(I)*AR(3,J)                        AEQ      40
      AML(2,J)=AML(2,J)+Z(I)*AL(1,J)-X(I)*AL(3,J)                        AEQ      41
      AMR(3,J)=AMR(3,J)+X(I)*AR(2,J)-Y(I)*AR(1,J)                        AEQ      42
      AML(3,J)=AML(3,J)+X(I)*AL(2,J)-Y(I)*AL(1,J)                        AEQ      43
      AFL(1,J)=AFL(1,J)+AL(1,J)                                          AEQ      44
      AFR(1,J)=AFR(1,J)+AR(1,J)                                          AEQ      45
      AFL(2,J)=AFL(2,J)+AL(2,J)                                          AEQ      46
      AFR(2,J)=AFR(2,J)+AR(2,J)                                          AEQ      47
      AFL(3,J)=AFL(3,J)+AL(3,J)                                          AEQ      48
      AFR(3,J)=AFR(3,J)+AR(3,J)                                          AEQ      49
    9 CONTINUE                                                           AEQ      50
   10 CONTINUE                                                           AEQ      51
      WRITE (6,14)                                                       AEQ      52
      WRITE (6,15)                                                       AEQ      53
      DO 11 J=1,LD                                                       AEQ      54
   11 WRITE (6,16) J,(AML(I,J),I=1,3),(AFL(I,J),I=1,3)                   AEQ      55
      WRITE (6,17)                                                       AEQ      56
      WRITE (6,15)                                                       AEQ      57
      DO 12 J=1,LD                                                       AEQ      58
```

```
      12    WRITE (6,16) J,(AMR(I,J),I=1,3),(AFR(I,J),I=1,3)                  AEQ   59
            RETURN                                                            AEQ   60
60    C                                                                       AEQ   61
      13    FORMAT (1H1,54X,19HSUMMATION OF FORCES,1X/)                       AEQ   62
      14    FORMAT (10X,13HAPPLIED LOADS,1X,/)                                AEQ   63
      15    FORMAT (3X,9HLOAD COND,5X,2HMX,13X,2HMY,13X,2HMZ,13X,2HFX,13X,2HFY AEQ   64
           1,13X,2HFZ/)                                                       AEQ   65
65    16    FORMAT (/,4X,I5,6E15.6)                                           AEQ   66
      17    FORMAT (/,10X,9HREACTIONS,1X,/)                                   AEQ   67
            END                                                               AEQ   68
```

CARD NR. SEVERITY DETAILS DIAGNOSIS OF PROBLEM

31 I K1 THIS STATEMENT REDEFINES A CURRENT LOOP CONTROL VARIABLE OR PARAMETER.

```
      1            SUBROUTINE ALINK (A,AL,STRENG,STNG,ELENTH,NELEM,NLINK,NZ,NC,NSKIN, ALINK      2
                  1NINT,NSTBLTY,NCC)                                                  ALINK      3
                C  DIMENSION OF NELEM CONSISTENT WITH THAT IN MAIN PROGRAM             ALINK      4
                C  ASUM,SAREA,--(NZ)                                                  ALINK      5
      5            DIMENSION A(1), AL(NCC,NZ), STRENG(NCC,NZ), STNG(1), ELENTH(1), NL ALINK      6
                  1INK(1)                                                             ALINK      7
                   DIMENSION NELEM(5,10), ASUM(4), SAREA(4)                           ALINK      8
                   IF (NSKIN.EQ.0) GO TO 9                                            ALINK      9
                   DO 8 I=1,NSKIN                                                     ALINK     10
     10            IK=NLINK(I)                                                        ALINK     11
                   DO 1 IL=1,NZ                                                       ALINK     12
                   ASUM(IL)=0.0                                                       ALINK     13
                1  SAREA(IL)=0.0                                                      ALINK     14
                   DO 3 J=1,IK                                                        ALINK     15
     15            MEM=NELEM(I,J)                                                     ALINK     16
                   DO 2 IL=1,NZ                                                       ALINK     17
                   IF (NSTBLTY.GT.0) STRENG(MEM,IL)=1.0                               ALINK     18
                   ASUM(IL)=ASUM(IL)+ELENTH(MEM)*STRENG(MEM,IL)*AL(MEM,IL)            ALINK     19
                   IF (NSTBLTY.GT.0) AL(MEM,IL)=1.0                                   ALINK     20
     20            SAREA(IL)=SAREA(IL)+ELENTH(MEM)*AL(MEM,IL)                         ALINK     21
                2  CONTINUE                                                          ALINK     22
                3  CONTINUE                                                          ALINK     23
                   DO 4 IL=1,NZ                                                       ALINK     24
                4  ASUM(IL)=ASUM(IL)/SAREA(IL)                                       ALINK     25
     25            DO 7 J=1,IK                                                        ALINK     26
                   MEM=NELEM(I,J)                                                     ALINK     27
                   DO 6 IL=1,NZ                                                       ALINK     28
                   IF (NSTBLTY.GT.0) GO TO 5                                          ALINK     29
                   STRENG(MEM,IL)=ASUM(IL)                                            ALINK     30
     30            GO TO 6                                                            ALINK     31
                5  AL(MEM,IL)=ASUM(IL)                                               ALINK     32
                6  CONTINUE                                                          ALINK     33
                7  CONTINUE                                                          ALINK     34
                8  CONTINUE                                                          ALINK     35
     35         9  CONTINUE                                                          ALINK     36
                   IF (NINT.EQ.0) GO TO 14                                            ALINK     37
                   NP=NSKIN+1                                                         ALINK     38
                   DO 13 I=NP,NINT                                                    ALINK     39
                   IK=NLINK(I)                                                        ALINK     40
     40            ASUM(1)=0.0                                                        ALINK     41
                   SAREA(1)=0.0                                                       ALINK     42
                   DO 10 J=1,IK                                                       ALINK     43
                   MEM=NELEM(I,J)                                                     ALINK     44
                   IP=MEM-NC                                                          ALINK     45
     45            IF (NSTBLTY.GT.0) STNG(IP)=1.0                                     ALINK     46
                   ASUM(1)=ASUM(1)+ELENTH(MEM)*STNG(IP)*A(MEM)                        ALINK     47
                   IF (NSTBLTY.GT.0) A(MEM)=1.0                                       ALINK     48
                   SAREA(1)=SAREA(1)+ELENTH(MEM)*A(MEM)                               ALINK     49
               10  CONTINUE                                                          ALINK     50
     50            ASUM(1)=ASUM(1)/SAREA(1)                                           ALINK     51
                   DO 12 J=1,IK                                                       ALINK     52
                   MEM=NELEM(I,J)                                                     ALINK     53
                   IP=MEM-NC                                                          ALINK     54
                   IF (NSTBLTY.GT.0) GO TO 11                                         ALINK     55
     55            STNG(IP)=ASUM(1)                                                   ALINK     56
                   GO TO 12                                                           ALINK     57
               11  A(IP)=ASUM(1)                                                     ALINK     58
```

```
                12    CONTINUE                                          ALINK      59
                13    CONTINUE                                          ALINK      60
60              14    CONTINUE                                          ALINK      61
                      RETURN                                            ALINK      62
                      END                                               ALINK      63
```

FWA OF THE LOAD 101
LWA+1 OF THE LOAD 75060

TRANSFER ADDRESS -- OPTCOMP 6662

ENTRY POINTS.

ENTRY	ADDRESS	PROGRAM
INPUT#	2551	OPTCOMP
TAPE5#	2551	
OUTPUT#	4612	
TAPE6#	4612	
OPTCOMP	6662	
MEMB	36231	MEMB
SUGD	50604	SUGD
AVECT	50773	AVECT
SURFACE	51241	SURFACE
COORD	51325	COORD
ELAS	51601	ELAS
STRAIN	52166	STRAIN
COMP	52357	COMP
ELSTIF	53026	ELSTIF
ASEMBL	53202	ASEMBL
CONDNS	53416	CONDNS
SUM	53725	SUM
CHANGE	54044	CHANGE
TRNSFM	54173	TRNSFM
POP	54365	POP
GAUSS	54710	GAUSS
BOUND	55233	BOUND
PRNTDR	55373	PRNTDR
REDUCE	56020	REDUCE
RESTOR	56121	RESTOR
ELSTRS	56260	ELSTRS
SCOMP	56306	SCOMP
SSRS	56511	SSRS
BFORCE	56663	BFORCE
SBUCKL	56763	SBUCKL
ANORM	57271	ANORM
MULT	57435	MULT
ENGS	57601	ENGS
STRES	60157	STRES
SHILL	60400	SHILL
AVSTRS	60522	AVSTRS
AEQ	60606	AEQ
ALINK	61467	ALINK
RANDOM.	62011	FORUTL=
LINLIM.	62015	
Q8NTRY.	62055	Q8NTRY=
FECCHR.	62166	COMIO=
FECPRT.	62206	
FECMSK.	62245	FECMSK=
FEOFAL.	62306	FLTOUT=

ENTRY	ADDRESS	PROGRAM
FEOEOV.	62330	
FEOEXP.	62332	
FEORND.	62367	
FEOSCA.	62424	
FEOZRO.	62510	
END.	62646	FORSYS=
EXIT	62673	
STOP.	62675	
ABNORM.	62704	
SYSARG=	62734	
IOERR.	62753	
SYSEND.	62777	
SYP=5	63001	
CLSLNK.	63014	
SYSE3.	63043	
SYSERR.	63057	
SYST1A.	63121	
SYP=1	63125	
SYP=3	63201	
SYP=4	63207	
SYS=6	63234	
SYS2=	63260	
FEOOPE.	63327	
FEIGNC.	63421	INCOM=
FEISBL.	63436	
FEINUM.	63457	
FEIFSG.	63470	
FEIBLK=	63533	
FEIBLK.	63543	
FEIFST.	63557	
ERRSET	63562	
FEIERR.	63572	
INPCI.	63740	INPC=
INPCR.	64021	
KOJPT.	64077	KODEK=
KODWRT=	64537	
KOREP.	64544	
FEOL.	64554	OUTCOM=
FEOI.	64557	
FEOXFL.	64626	
FEOAFM.	64634	
FEOBLS.	64641	
FEOCNV.	64654	
FEOR1F.	64705	
FEOR10.	64711	
FEONTL.	64716	
CLOCK	64730	CLOCK=
TIME	64730	
DATE	64735	
JDATE	64742	
SECOND	64747	
GOTOER.	64762	GOTOER=
ALOG	64776	ALOG
ALOG10	65002	
ALOG.	65007	

ENTRY	ADDRESS	PROGRAM
ALOG10.	65027	
EXP	65071	EXP
EXP.	65107	
COS	65166	SINCOS=
SIN	65171	
COS.	65174	
SIN.	65204	
SYSAID=	65253	SYSAID=
FEIEXP.	65254	FLTIN=
FEIFSC.	65276	
FECNAP.	65440	FMTAP=
FECAP.	65446	
FECFMT.	65465	
FECFMU.	65470	
FECJP=	65573	
FECLP.	65574	
FECRP.	65617	
FECEE.	65634	
FECV.	65702	
FECBUG.	65711	
CBD.	66005	FORUTL=
BFN.	66012	
GETFIT.	66023	GETFIT=
NAME.	66060	
KRINIT.	66415	KRAKER=
OUTCI.	66505	OUTC=
OUTCR.	66603	
SQRT	66663	SQRT
SQRT.	66702	
SYS1ST.	66730	SYS=1ST
MORGUE.	66732	
XTOI.	67012	XTOI=
XTOY.	67022	XTOY=
RM.CIO	67035	CIO.RM
RM.RCLA	67045	
RM.RCLP	67052	
RM.SYS=	67065	
MOVE.RM	67104	MOVE.RM
MCT.RM	67171	MCT.RM
OSUB.RM	67417	OSUB.RM
OPEN.SQ	67524	OPEN.SQ
OPXX.SQ	67641	
OPEX.SQ	70006	OPEX.SQ
RLEQ.RM	70033	RLEQ.RM
CLSF.SQ	70104	CLSF.SQ
RSPT.SQ	70172	
CLSV.SQ	70246	CLSV.SQ
REW.SQ	70376	REW.SQ
GET.SQ	70456	GET.SQ
SKGT.SQ	70527	
GCNT.SQ	70566	
GXIT.SQ	70636	
GRTJ.SQ	70717	
AINI.SQ	70751	
ANBL.SQ	70756	

ENTRY	ADDRESS	PROGRAM
AMAC.SQ	70762	
OXIT.SQ	71463	
GET.Z	71510	Z.SQ
GET.S	71611	FSU.SQ
GET.U	71615	
GET.F	71617	
RMU.SQ	71623	
RMU0.SQ	71630	
RMU2.SQ	71650	
RMU1.SQ	71651	
ERR.RM	71775	ERR.RM
ERR1.RM	72001	
ERR2.RM	72157	
CHWR.SQ	72323	CHWR.SQ
PUT.SQ	72343	PUT.SQ
FLSH.SQ	73415	
WAR.SQ	73721	WAR.SQ
REPO.SQ	74120	
CLSF.RM	74201	CLSF.RM
PUT.I	74224	BTRT.SQ
PUT.K	74224	
PUT.E	74224	
BTRT.SQ	74224	
PUT.C	74224	
WEOP.SQ	74340	WEOX.SQ
WEOS.SQ	74345	
SKFL.SQ	74511	SKFL.SQ
SYS=	74562	SYS.RM
RCL=	74575	
WNB=	74601	
MSG=	74611	
OPEN.RM	74623	OPEN.RM

```
1
 PROBLEM NO=     1      CANTILEVER BOX

TIME USED IN SECONDS =    25.015
      54   18   36   40    12    2     3    4     0    1    2    3    0    1    1    0
       0    0   15   10     8    1
       1    1    0    0     0    0     0    2     0
  0.            0.          .5000E+00 .5000E+00
                  10.5000                 .3000                0.0000              25.0000
                  20.0000               15.0000                 .1000
                  30.1000                 .3000                0.0000              10.0000
                  10.0000                8.0000                 .2600
   .3200E+02 .3500E+01 .2080E+000.                .9300E+00 .7250E-01 .5200E-02 .1040E-01
   .3200E+02 .3500E+01 .2080E+000.                .9300E+00 .7250E-01 .5200E-02 .1040E-01
   .3200E+02 .3500E+01 .2080E+000.                .9300E+00 .7250E-01 .5200E-02 .1040E-01
   .3200E+02 .3500E+01 .2080E+000.                .9300E+00 .7250E-01 .5200E-02 .1040E-01
   .3200E+02 .3500E+01 .2080E+000.                .9300E+00 .7250E-01 .5200E-02 .1040E-01
   .1850E+02 .1600E+01 .2500E+00 .2030E-01 .6500E+00 .5500E+00 .5200E-02 .1040E-01
   .1850E+02 .1600E+01 .2500E+00 .2030E-01 .6500E+00 .5500E+00 .5200E-02 .1040E-01
   .1850E+02 .1600E+01 .2500E+00 .2030E-01 .6500E+00 .5500E+00 .5200E-02 .1040E-01
   .1850E+02 .1600E+01 .2500E+00 .2030E-01 .6500E+00 .5500E+00 .5200E-02 .1040E-01
   .1850E+02 .1600E+01 .2500E+00 .2030E-01 .6500E+00 .5500E+00 .5200E-02 .1040E-01
   .1850E+02 .1600E+01 .2500E+00 .2030E-01 .6500E+00 .5500E+00 .5200E-02 .1040E-01
   .1850E+02 .1600E+01 .2500E+00 .2030E-01 .6500E+00 .5500E+00 .5200E-02 .1040E-01
         166.0000            92.4000          6.0000           29.7000          3.9600
         166.0000            92.4000          6.0000           29.7000          3.9600
         166.0000            92.4000          6.0000           29.7000          3.9600
         166.0000            92.4000          6.0000           29.7000          3.9600
         166.0000            92.4000          6.0000           29.7000          3.9600
         139.0000            86.0000          4.9500           11.8600          4.6800
         139.0000            86.0000          4.9500           11.8600          4.6800
         139.0000            86.0000          4.9500           11.8600          4.6800
         139.0000            86.0000          4.9500           11.8600          4.6800
         139.0000            86.0000          4.9500           11.8600          4.6800
         139.0000            86.0000          4.9500           11.8600          4.6800
  0.            0.          0.
  .1000E+010.               0.
  0.          .1000E+010.
  0.          .3000E+02 .4500E+02-.4500E+02
     1   4   3     1     3     7     5 .1000E+02 .1000E-01 .3000E+01 .1200E+02-.0
     2   4   3     2     4     8     6 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
     3   4   3     5     7    11     9 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
     4   4   3     6     8    13    10 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
     5   4   3     9    11    15    13 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
     6   4   3    10    12    16    14 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
     7   4   2    13    15    19    17 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
     8   4   2    14    16    20    18 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
     9   4   2    17    19    23    21 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
    10   4   2    18    20    24    22 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
    11   4   2    21    23    27    25 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
    12   4   2    22    24    28    26 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
    13   4   1    25    27    31    29 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
    14   4   1    26    28    32    30 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
    15   4   1    29    31    35    33 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
    16   4   1    30    32    36    34 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
    17   4   1    33    35    39    37 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
    18   4   1    34    36    40    38 .1000E+02 .1000E-01 .9000E+01 .1200E+02-.0
    19   5   2     1     2     6     5 .1000E+02 .1000E-01
    20   5   2     3     4     8     7 .1000E+02 .1000E-01
    21   5   2     5     6    10     9 .1000E+02 .1000E-01
    22   5   2     7     8    12    11 .1000E+02 .1000E-01
    23   5   2     9    10    14    13 .1000E+02 .1000E-01
    24   5   2    11    12    16    15 .1000E+02 .1000E-01
    25   5   2    13    14    18    17 .1000E+02 .1000E-01
    26   5   2    15    16    20    19 .1000E+02 .1000E-01
    27   5   2    17    18    22    21 .1000E+02 .1000E-01
    28   5   2    19    20    24    23 .1000E+02 .1000E-01
    29   5   2    21    22    26    25 .1000E+02 .1000E-01
    30   5   2    23    24    28    27 .1000E+02 .1000E-01
    31   5   2    25    26    30    29 .1000E+02 .1000E-01
    32   5   2    27    28    32    31 .1000E+02 .1000E-01
    33   5   2    29    30    34    33 .1000E+02 .1000E-01
    34   5   2    31    32    36    35 .1000E+02 .1000E-01
    35   5   2    33    34    38    37 .1000E+02 .1000E-01
    36   5   2    35    36    40    39 .1000E+02 .1000E-01
    37   2   1     1     2     0     0 .1000E+02 .1000E-01
    38   2   1     3     4     0     0 .1000E+02 .1000E-01
    39   2   1     5     6     0     0 .1000E+02 .1000E-01
    40   2   1     7     8     0     0 .1000E+02 .1000E-01
    41   2   1     9    10     0     0 .1000E+02 .1000E-01
    42   2   1    11    12     0     0 .1000E+02 .1000E-01
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 43   2  1    13    14     0     0  .10000E+02 .1000E-01
 44   2  1    15    16     0     0  .10000E+02 .1000E-01
 45   2  1    17    18     0     0  .10000E+02 .1000E-01
 46   2  1    19    20     0     0  .10000E+02 .1000E-01
 47   2  1    21    22     0     0  .10000E+02 .1000E-01
 48   2  1    23    24     0     0  .10000E+02 .1000E-01
 49   2  1    25    26     0     0  .10000E+02 .1000E-01
 50   2  1    27    28     0     0  .10000E+02 .1000E-01
 51   2  1    29    30     0     0  .10000E+02 .1000E-01
 52   2  1    31    32     0     0  .10000E+02 .1000E-01
 53   2  1    33    34     0     0  .10000E+02 .1000E-01
 54   2  1    35    36     0     0  .10000E+02 .1000E-01
  10.            0.                .7500E+00
  20.            0.                .5000E+00
  30.             .1000E+01        .7500E+00
  40.             .1000E+01        .5000E+00
   5 .1000E+010.                   .7500E+00
   6 .1000E+010.                   .5000E+00
   7 .1000E+01 .1000E+01           .7500E+00
   8 .1000E+01 .1000E+01           .5000E+00
   9 .2000E+010.                   .7500E+00
  10 .2000E+010.                   .5000E+00
  11 .2000E+01 .1000E+01           .7500E+00
  12 .2000E+01 .1000E+01           .5000E+00
  13 .3000E+010.                   .7500E+00
  14 .3000E+010.                   .5000E+00
  15 .3000E+01 .1000E+01           .7500E+00
  16 .3000E+01 .1000E+01           .5000E+00
  17 .4000E+010.                   .7500E+00
  18 .4000E+010.                   .5000E+00
  19 .4000E+01 .1000E+01           .7500E+00
  20 .4000E+01 .1000E+01           .5000E+00
  21 .5000E+010.                   .7500E+00
  22 .5000E+010.                   .5000E+00
  23 .5000E+01 .1000E+01           .7500E+00
  24 .5000E+01 .1000E+01           .5000E+00
  25 .6000E+010.                   .7500E+00
  26 .6000E+010.                   .5000E+00
  27 .6000E+01 .1000E+01           .7500E+00
  28 .6000E+01 .1000E+01           .5000E+00
  29 .7000E+010.                   .7500E+00
  30 .7000E+010.                   .5000E+00
  31 .7000E+01 .1000E+01           .7500E+00
  32 .7000E+01 .1000E+01           .5000E+00
  33 .8000E+010.                   .7500E+00
  34 .8000E+010.                   .5000E+00
  35 .8000E+01 .1000E+01           .7500E+00
  36 .8000E+01 .1000E+01           .5000E+00
  37 .9000E+010.                   .7500E+00
  38 .9000E+010.                   .5000E+00
  39 .9000E+01 .1000E+01           .7500E+00
  40 .9000E+01 .1000E+01           .5000E+00
 109  110  111  112  113  114  115  116  117  118  119  120
   4    2
-.1000E+01    3    1-.1000E+01    3    3-.1000E+01    3    2
-.1000E+01    3    4
-.5000E+00    2    2-.5000E+00    2    4
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GROSS POPULATION

7260

APPARENT POPULATION

1986

STARTING ROW NUMBERS FOR EACH COLUMN

1	1	1	1	1	1	1	1	1	4
4	4	1	1	1	1	1	1	1	1
1	1	4	4	13	13	13	13	13	13
13	13	13	16	16	16	25	25	25	25
25	25	25	25	25	28	28	28	37	37
37	37	37	37	37	37	37	40	40	40
49	49	49	49	49	49	49	49	49	52
52	52	61	61	61	61	61	61	61	61
61	64	64	64	73	73	73	73	73	73
73	73	73	76	76	76	85	85	85	85
85	85	85	85	85	88	88	88	97	97
97	97	97	97	97	97	97	100	100	100

NUMBERS OF DIAGONAL ELEMENTS IN SINGLE ARRAYSTIFFNESS MATRIX

1	3	6	10	15	21	28	36	45	52
60	69	82	96	111	127	144	162	181	201
222	241	261	282	295	309	324	340	357	375
394	414	435	454	474	495	508	522	537	553
570	588	607	627	648	667	687	708	721	735
750	766	783	801	820	840	861	880	900	921
934	948	963	979	996	1014	1033	1053	1074	1093
1113	1134	1147	1161	1176	1192	1209	1227	1246	1266
1287	1306	1326	1347	1360	1374	1389	1405	1422	1440
1459	1479	1500	1519	1539	1560	1573	1587	1602	1618
1635	1653	1672	1692	1713	1732	1752	1773	1786	1800
1815	1831	1848	1866	1885	1905	1926	1945	1965	1986

TIME USED IN SECONDS = 25.4660

RELATIVE AREAS OF MEMBERS

.100000	.100000	.100000	.100000	.100000	.100000	.100000	.100000	.100000	.100000
.100000	.100000	.100000	.100000	.100000	.100000	.100000	.100000	.100000	.100000
.100000	.100000	.100000	.100000	.100000	.100000	.100000	.100000	.100000	.100000
.100000	.100000	.100000	.100000	.100000	.100000	1.000000	1.000000	1.000000	1.000000
1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000
1.000000	1.000000	1.000000	1.000000						

.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000
.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000		
.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000
.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000		
.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000
.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000		
.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000
.025000	.025000	.025000	.025000	.025000	.025000	.025000	.025000		

WEIGHT-SKIN= 4.408608E+02 WEIGHT-S-PANELS= 8.791053E+01 WEIGHT-POSTS= 2.616385E+01 TOTAL-WEIGHT= 5.549352E+02
ELE SKIN= 17 ABASE= .4845E+01 ELE STRUCT= 35 CBASE= .8333E+00
STRUCTURE NO= 1 NO OF LOADS= 2 CYCLE NO= 1 EQ CYCLE NO= 0 NSTBLTY= 0

TIME USED IN SECONDS = 29.0680

RELATIVE AREAS OF MEMBERS

.083197	.083197	.241169	.241169	.397770	.397770	.438054	.438054	.559666	.559666
.683194	.683194	.793629	.793629	.921358	.921358	1.000000	1.000000	.069126	.069126
.069126	.069126	.069126	.069126	.069126	.069126	.069126	.069126	.069126	.069126
.069126	.069126	.069126	.069126	.069126	.069126	.002064	.002064	.002064	.002064
.002064	.002064	.002064	.002064	.002064	.002064	.002064	.002064	.002064	.002064
.002064	.002064	.002064	.002064						
.036081	.036081	.105008	.105008	.173187	.173187	.220612	.220612	.281913	.281913
.344131	.344131	.344543	.344543	.400159	.400159	.428330	.428330		
.017271	.017271	.043665	.043665	.068438	.068438	.071194	.071194	.087370	.087370
.105769	.105769	.154835	.154835	.184564	.184564	.157994	.157994		
.014923	.014923	.046248	.046248	.078072	.078072	.073124	.073124	.035192	.035192
.116647	.116647	.147126	.147126	.168318	.168318	.206838	.206838		
.014923	.014923	.046248	.046248	.078072	.078072	.073124	.073124	.035192	.035192
.116647	.116647	.147126	.147126	.168318	.168318	.206838	.206838		

WEIGHT-SKIN= 3.868514E+02 WEIGHT-S-PANELS= 1.512000E+01 WEIGHT-POSTS= 1.343570E-02 TOTAL-WEIGHT= 4.019848E+02
ELE SKIN= 17 ABASE= .3581E+00 ELE STRUCT= 20 CBASE= .1206E+01
STRUCTURE NO= 1 NO OF LOADS= 2 CYCLE NO= 2 EQ CYCLE NO= 0 NSTBLTY= 0

TIME USED IN SECONDS = 32.7060

RELATIVE AREAS OF MEMBERS

.079069	.083424	.236679	.238201	.391970	.392871	.401192	.402302	.513339	.514134
.628313	.629009	.773064	.778353	.906351	.906605	.999809	1.000000	.232681	.232681
.232681	.232681	.232681	.232681	.232681	.232681	.232681	.232681	.232681	.232681
.232681	.232681	.232681	.232681	.232681	.232681	.008295	.008295	.008295	.008295
.008295	.008295	.008295	.008295	.008295	.008295	.008295	.008295	.008295	.008295
.008295	.008295	.008295	.008295						
.050607	.050902	.151635	.151725	.250960	.251013	.303045	.303137	.387640	.387710
.474523	.474580	.496388	.496402	.578574	.578587	.624366	.624375		
.009746	.010092	.026503	.026593	.040240	.040292	.031512	.031576	.036585	.036635
.045526	.045566	.095369	.095984	.121864	.121877	.085433	.085448		
.009358	.011215	.023270	.029942	.050365	.050783	.033313	.033794	.044557	.044920
.054132	.054432	.092856	.092984	.102956	.103070	.145003	.145089		
.009358	.011215	.023270	.029942	.050365	.050783	.033313	.033794	.044557	.044920
.054132	.054432	.092856	.092984	.102956	.103070	.145003	.145089		

WEIGHT-SKIN= 9.062313E+01 WEIGHT-S-PANELS= 1.512000E+01 WEIGHT-POSTS= 1.604269E-02 TOTAL-WEIGHT= 1.057592E+02
ELE SKIN= 17 ABASE= .2802E+00 ELE STRUCT= 35 CBASE= .3581E+00
STRUCTURE NO= 1 NO OF LOADS= 2 CYCLE NO= 3 EQ CYCLE NO= 0 NSTBLTY= 0

TIME USED IN SECONDS = 36.2890

RELATIVE AREAS OF MEMBERS

.149769	.149769	.275128	.275196	.398406	.398826	.443758	.444051	.544019	.544236
.646373	.646552	.769674	.769262	.943052	.943567	.999627	1.000000	.297358	.297358
.297358	.297358	.297358	.297358	.297358	.297358	.297358	.297358	.297358	.297358
.297358	.297358	.297358	.297358	.297358	.297358	.027922	.027922	.027922	.027922
.027922	.027922	.027922	.027922	.027922	.027922	.027922	.027922	.027922	.027922
.027922	.027922	.027922	.027922						
.062654	.062653	.183012	.188060	.311690	.311710	.356642	.356335	.456903	.457121
.559257	.559436	.616179	.616181	.716392	.716395	.784011	.783998		
.029039	.029039	.029039	.029039	.029039	.029039	.029039	.029039	.029039	.029039
.029039	.029039	.043942	.049985	.067441	.067481	.039485	.039501		

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 .029039   .029039   .029039   .029039   .029039   .029039   .029039   .029039   .029039   .029039
 .029039   .029039   .051276   .051548   .054610   .054856   .088066   .088250

 .029039   .029039   .029039   .029039   .029039   .029039   .029039   .029039   .029039   .029039
 .029039   .029039   .051276   .051548   .054610   .054856   .088066   .088250

 WEIGHT-SKIN= 7.174065E+01    WEIGHT-S-PANELS= 1.512000E+01    WEIGHT-POSTS= 4.225466E-02    TOTAL-WEIGHT= 8.694290E+01
     ELE SKIN=    17    ABASE=      .2391E+00    ELE STRUCT=    36    CBASE=      .2802E+00
 STRUCTURE NO=     1    NO OF LOADS=     2    CYCLE NO=     4    EQ CYCLE NO=     0    NSTBLTY=     0

 TIME USED IN SECONDS =    39.8340

 RELATIVE AREAS OF MEMBERS
  .169380   .163465   .303364   .309452   .450927   .451470   .483023   .483623   .591231   .531804
  .770600   .701171   .786255   .786301   .944013   .944073   .999429  1.000000   .348290   .348290
  .348290   .348290   .343290   .348290   .348290   .348290   .348290   .348290   .348290   .348290
  .035656   .035656   .035656   .035656   .035656   .035656   .035656   .035656   .035656   .035656
  .035656   .035656   .035656   .035656   .035656   .035656   .035656   .035656   .035656   .035656

  .056934   .057218   .197717   .148206   .333680   .340224   .371777   .372376   .479984   .430558
  .589373   .533924   .675009   .675059   .782767   .782827   .867169   .867167

  .037082   .037082   .037082   .037082   .037082   .037082   .037082   .037082   .037082   .037082
  .037082   .037082   .037082   .037082   .037082   .037082   .037082   .037082

  .037082   .037082   .037082   .037082   .037082   .037082   .037082   .037082   .037082   .037082
  .037082   .037082   .037082   .037082   .037082   .037082   .047587   .047875

  .037082   .037082   .037082   .037082   .037082   .037082   .037082   .037082   .037082   .037082
  .037082   .037082   .037082   .037082   .037082   .037082   .047587   .047875

 WEIGHT-SKIN= 6.843983E+01    WEIGHT-S-PANELS= 1.512000E+01    WEIGHT-POSTS= 4.606840E-02    TOTAL-WEIGHT= 8.360590E+01
     ELE SKIN=    17    ABASE=      .2237E+00    ELE STRUCT=    31    CBASE=      .2393E+00
 STRUCTURE NO=     1    NO OF LOADS=     2    CYCLE NO=     5    EQ CYCLE NO=     0    NSTBLTY=     0

 TIME USED IN SECONDS =    43.4890

 RELATIVE AREAS OF MEMBERS
  .160527   .150761   .314647   .319252   .457633   .458103   .489545   .490036   .595094   .545578
  .701487   .731357   .797782   .796046   .905134   .905476   .999343  1.000000   .369640   .369640
  .369640   .369640   .364640   .369640   .369640   .369640   .369640   .369640   .369640   .369640
  .369640   .369640   .369640   .369640   .369640   .369640   .041467   .041467   .041467   .041467
  .041467   .041467   .041467   .041467   .041467   .041467   .041467   .041467   .041467   .041467

  .051143   .051383   .182468   .189674   .328255   .328725   .360167   .360656   .465716   .466200
  .572104   .572579   .663403   .668666   .775756   .776030   .870565   .870622

  .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126
  .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126

  .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126
  .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126

  .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126
  .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126

 WEIGHT-SKIN= 6.736404E+01    WEIGHT-S-PANELS= 1.512000E+01    WEIGHT-POSTS= 5.048243E-02    TOTAL-WEIGHT= 8.253458E+01
     ELE SKIN=    17    ABASE=      .2235E+00    ELE STRUCT=    35    CBASE=      .2254E+00
 STRUCTURE NO=     1    NO OF LOADS=     2    CYCLE NO=     6    EQ CYCLE NO=     0    NSTBLTY=     0

 TIME USED IN SECONDS =    47.1701
```

RELATIVE AREAS OF MEMBERS

.183956	.184136	.321726	.321040	.457885	.458262	.491083	.491487	.535420	.535826
.700612	.701013	.794674	.794905	.900552	.900736	.999775	1.000000	.369339	.369339
.369339	.369339	.369333	.369339	.369339	.369339	.369333	.369339	.369333	.369339
.369339	.369339	.369333	.369339	.369339	.369339	.043932	.043932	.043932	.043932
.043932	.043932	.043932	.043932	.043932	.043932	.043932	.043932	.043932	.043932
.043932	.043932	.043932	.043932						
.046889	.047068	.183659	.183923	.320818	.321195	.354017	.354420	.458353	.458759
.563545	.563946	.657608	.657839	.763485	.763719	.862709	.862934		
.045689	.045689	.045689	.045689	.045689	.045689	.045689	.045689	.045689	.045689
.045689	.045689	.045689	.045689	.045689	.045689	.045689	.045689		
.045689	.045689	.045689	.045689	.045689	.045689	.045689	.045689	.045689	.045689
.045689	.045689	.045689	.045689	.045689	.045689	.045689	.045689		
.045689	.045689	.045689	.045689	.045689	.045689	.045689	.045689	.045689	.045689
.045689	.045689	.045689	.045689	.045689	.045689	.045689	.045689		

WEIGHT-SKIN= 6.829636E+01 WEIGHT-S-PANELS= 1.512000E+01 WEIGHT-POSTS= 5.352591E-02 TOTAL-WEIGHT= 8.346989E+01
ELE SKIN= 17 ABASE= .2249E+00 ELE STRUCT= 32 CBASE= .2256E+00
STRUCTURE NO= 1 NO OF LOADS= 2 CYCLE NO= 7 EQ CYCLE NO= 0 NSTBLTY= 0

TIME USED IN SECONDS = 50.8520

RELATIVE AREAS OF MEMBERS

.182697	.182697	.314187	.319463	.456673	.457013	.490811	.491182	.535354	.535731
.700795	.701171	.794273	.794487	.900400	.900616	.999783	1.000000	.367097	.367097
.367097	.367097	.367097	.367097	.367097	.367097	.367097	.367097	.367097	.367097
.367097	.367097	.367097	.367097	.367097	.367097	.043918	.043918	.043918	.043918
.043918	.043918	.043918	.043918	.043918	.043918	.043918	.043918	.043918	.043918
.043918	.043918	.043918	.043918						
.045674	.045674	.182164	.182440	.319650	.319990	.353783	.354159	.458331	.458708
.563773	.564148	.657251	.657464	.763377	.763593	.862760	.862977		
.045674	.045674	.045674	.045674	.045674	.045674	.045674	.045674	.045674	.045674
.045674	.045674	.045674	.045674	.045674	.045674	.045674	.045674		
.045674	.045674	.045674	.045674	.045674	.045674	.045674	.045674	.045674	.045674
.045674	.045674	.045674	.045674	.045674	.045674	.045674	.045674		
.045674	.045674	.045674	.045674	.045674	.045674	.045674	.045674	.045674	.045674
.045674	.045674	.045674	.045674	.045674	.045674	.045674	.045674		

WEIGHT-SKIN= 6.855708E+01 WEIGHT-S-PANELS= 1.512000E+01 WEIGHT-POSTS= 5.383573E-02 TOTAL-WEIGHT= 8.373091E+01
ELE SKIN= 17 ABASE= .2249E+00 ELE STRUCT= 23 CBASE= .2270E+00
STRUCTURE NO= 1 NO OF LOADS= 2 CYCLE NO= 8 EQ CYCLE NO= 0 NSTBLTY= 0

TIME USED IN SECONDS = 54.5490

RELATIVE AREAS OF MEMBERS

.181616	.181616	.313377	.318648	.456079	.456414	.490327	.490597	.534971	.535348
.700520	.700896	.794063	.794276	.900301	.900518	.999783	1.000000	.367170	.367170
.367170	.367170	.367170	.367170	.367170	.367170	.367170	.367170	.367170	.367170
.367170	.367170	.367170	.367170	.367170	.367170	.043658	.043658	.043658	.043658
.043658	.043658	.043658	.043658	.043658	.043658	.043658	.043658	.043658	.043658
.043658	.043658	.043658	.043658						
.045404	.045404	.182165	.182436	.319867	.320202	.354115	.354485	.458759	.459136
.564308	.564684	.657851	.658064	.764090	.764306	.863571	.863788		
.045404	.045404	.045404	.045404	.045404	.045404	.045404	.045404	.045404	.045404
.045404	.045404	.045404	.045404						

```
 .045404   .045404   .045404   .045404   .045404   .045404   .045404   .045404   .045404   .045404
 .045404   .045404   .045404   .045404   .045404   .045404   .045404   .045404

 .045404   .045404   .045404   .045404   .045404   .045404   .045404   .045404   .045404   .045404
 .045404   .045404   .045404   .045404   .045404   .045404   .045404   .045404

 WEIGHT-SKIN=  6.837103E+01   WEIGHT-S-PANELS=  1.512000E+01   WEIGHT-POSTS=  5.350642E-02   TOTAL-WEIGHT=  8.354459E+01
    ELE SKIN=    17              ABASE=          .2248E+00          ELE STRUCT=    27            CBASE=          .2270E+00
 STRUCTURE NO=    1           NO OF LOADS=       2                 CYCLE NO=     9            EQ CYCLE NO=     0          NSTBLTY=     0

 TIME USED IN SECONDS =   56.1763

 RELATIVE AREAS OF MEMBERS
  .190527   .180761   .314347   .319252   .457633   .458103   .489545   .490036   .595094   .535578
  .701487   .701957   .797762   .736046   .905134   .905408   .999943  1.000000   .369640   .369640
  .369640   .369640   .369640   .369640   .369640   .369640   .369640   .369640   .369640   .369640
  .369640   .369640   .369640   .369640   .369640   .369640   .369640   .369640   .369640   .369640
  .041467   .041467   .041467   .041467   .041467   .041467   .041467   .041467   .041467   .041467
  .041467   .041467   .041467   .041467

  .351149   .351383   .183469   .183874   .328255   .328725   .360167   .360556   .465716   .466200
  .572108   .572579   .663403   .663668   .775756   .776030   .870565   .870622

  .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126
  .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126

  .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126
  .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126

  .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126
  .043126   .043126   .043126   .043126   .043126   .043126   .043126   .043126

 WEIGHT-SKIN=  6.736403E+01   WEIGHT-S-PANELS=  1.512000E+01   WEIGHT-POSTS=  5.048243E-02   TOTAL-WEIGHT=  8.253458E+01
    ELE SKIN=    17              ABASE=          .2235E+00          ELE STRUCT=    21            CBASE=          .2254E+00
 STRUCTURE NO=    1           NO OF LOADS=       2                 CYCLE NO=    10            EQ CYCLE NO=     0          NSTBLTY=     0

 TIME USED IN SECONDS =   61.8113

 RELATIVE AREAS OF MEMBERS
  .184296   .184296   .263716   .229470   .362782   .237713   .325985   .353352   .383457   .417012
  .433430   .430954   .773777   .538090   .879122   .602241  1.000000   .664170   .372453   .372453
  .372453   .372453   .372453   .372453   .372453   .372453   .372453   .372453   .372453   .372453
  .372453   .372453   .372453   .372453   .372453   .372453   .372453   .372453   .372453   .372453
  .044302   .044302   .044302   .044302   .044302   .044302   .044302   .044302   .044302   .044302
  .044302   .044302   .044302   .044302   .044302   .044302   .044302   .044302

  .046074   .046074   .127494   .091247   .224560   .159491   .187763   .215130   .245235   .278789
  .301208   .342732   .643554   .399666   .740900   .464019   .861778   .525948

  .046074   .046074   .046074   .046074   .046074   .046074   .046074   .046074   .046074   .046074
  .046074   .046074   .046074   .046074   .046074   .046074   .046074   .046074

  .046074   .046074   .046074   .046074   .046074   .046074   .046074   .046074   .046074   .046074
  .046074   .046074   .046074   .046074   .046074   .046074   .046074   .046074

  .046074   .046074   .046074   .046074   .046074   .046074   .046074   .046074   .046074   .046074
  .046074   .046074   .046074   .046074   .046074   .046074   .046074   .046074

 WEIGHT-SKIN=  5.611572E+01   WEIGHT-S-PANELS=  1.520566E+01   WEIGHT-POSTS=  5.382916E-02   TOTAL-WEIGHT=  7.137521E+01
    ELE SKIN=    17              ABASE=          .2250E+00          ELE STRUCT=    33            CBASE=          .2237E+00
 STRUCTURE NO=    1           NO OF LOADS=       2                 CYCLE NO=    11            EQ CYCLE NO=     1          NSTBLTY=     0

 TIME USED IN SECONDS =   69.4442
```

RELATIVE AREAS OF MEMBERS

.184870	.184870	.258576	.218701	.354317	.286052	.319663	.348353	.375820	.411776
.434230	.475578	.774344	.528507	.879173	.592890	1.000000	.653637	.370170	.370170
.370170	.370170	.370170	.370170	.370170	.370170	.370170	.370170	.370170	.370170
.370170	.370170	.370170	.370170	.370170	.370170	.044440	.044440	.044440	.044440
.044440	.044440	.044440	.044440	.044440	.044440	.044440	.044440	.044440	.044440
.044440	.044440	.044440	.044440						
.046218	.046218	.111323	.080049	.215664	.147400	.181010	.209701	.237167	.273123
.295578	.337226	.635591	.389055	.740520	.454237	.861347	.514385		
.046218	.046218	.046218	.046218	.046218	.046218	.046218	.046218	.046218	.046218
.046218	.046218	.046218	.046218	.046218	.046218	.046218	.046218		
.046218	.046218	.046218	.046218	.046218	.046218	.046218	.046218	.046218	.046218
.046218	.046218	.046218	.046218	.046218	.046218	.046218	.046218		
.046218	.046218	.046218	.046218	.046218	.046218	.046218	.046218	.046218	.046218
.046218	.046218	.046218	.046218	.046218	.046218	.046218	.046218		

WEIGHT-SKIN= 5.536520E+01 WEIGHT-S-PANELS= 1.512000E+01 WEIGHT-POSTS= 5.402369E-02 TOTAL-WEIGHT= 7.053922E+01
ELE SKIN= 17 ABASE= .2251E+00 ELE STRUCT= 35 CBASE= .2251E+00
STRUCTURE NO= 1 NO OF LOADS= 2 CYCLE NO= 12 EQ CYCLE NO= 2 NSTBLTY= 0

TIME USED IN SECONDS = 69.1290

RELATIVE AREAS OF MEMBERS

.184789	.184783	.257205	.216064	.353230	.284249	.319044	.347369	.375257	.411405
.433824	.475594	.773933	.527776	.879103	.592293	1.000000	.652962	.370217	.370217
.370217	.370217	.370217	.370217	.370217	.370217	.370217	.370217	.370217	.370217
.370217	.370217	.370217	.370217	.370217	.370217	.044420	.044420	.044420	.044420
.044420	.044420	.044420	.044420	.044420	.044420	.044420	.044420	.044420	.044420
.044420	.044420	.044420	.044420						
.046197	.046197	.113614	.077473	.214638	.145657	.180452	.209377	.236665	.272313
.295282	.337002	.635335	.389164	.740461	.453701	.861347	.514370		
.046197	.046197	.046197	.046197	.046197	.046197	.046197	.046197	.046197	.046197
.046197	.046197	.046199	.046197	.046214	.046197	.046218	.046197		
.046197	.046197	.046197	.046197	.046197	.046197	.046197	.046197	.046197	.046197
.046197	.046197	.046199	.046197	.046214	.046197	.046218	.046197		
.046197	.046197	.046197	.046197	.046197	.046197	.046197	.046197	.046197	.046197
.046197	.046197	.046199	.046197	.046214	.046197	.046218	.046197		

WEIGHT-SKIN= 5.521488E+01 WEIGHT-S-PANELS= 1.512000E+01 WEIGHT-POSTS= 5.399312E-02 TOTAL-WEIGHT= 7.038888E+01
ELE SKIN= 17 ABASE= .2251E+00 ELE STRUCT= 19 CBASE= .2251E+00
STRUCTURE NO= 1 NO OF LOADS= 2 CYCLE NO= 13 EQ CYCLE NO= 3 NSTBLTY= 0

TIME USED IN SECONDS = 72.7470

RELATIVE AREAS OF MEMBERS

.184813	.184813	.257003	.215424	.353136	.284024	.319023	.347979	.375249	.411412
.433829	.475510	.773942	.527760	.879102	.592293	1.000000	.652956	.370218	.370218
.370218	.370218	.370218	.370218	.370218	.370218	.370218	.370218	.370218	.370218
.370218	.370218	.370218	.370218	.370218	.370218	.044426	.044426	.044426	.044426
.044426	.044426	.044426	.044426	.044426	.044426	.044426	.044426	.044426	.044426
.044426	.044426	.044426	.044426						
.046203	.046203	.113393	.076814	.214526	.145415	.180413	.209369	.236639	.272802
.295219	.337001	.635333	.389150	.740461	.453634	.861347	.514349		
.046203	.046203	.046203	.046203	.046203	.046203	.046203	.046203	.046203	.046203
.046203	.046203	.046203	.046203	.046214	.046203	.046218	.046203		
.046203	.046203	.046203	.046203	.046203	.046203	.046203	.046203	.046203	.046203
.046203	.046203	.046203	.046203						

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.046203     .046203     .046203     .046203     .046214     .046203     .046218     .046203

.046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203
.046203     .046203     .046203     .046203     .046214     .046203     .046218     .046203

 WEIGHT-SKIN=  5.519660E+01    WEIGHT-S-PANELS=  1.512000E+01    WEIGHT-POSTS=  5.399996E-02    TOTAL-WEIGHT=  7.037060E+01
    ELE SKIN=    17          ABASE=      .2251E+00        ELE STRUCT=    24          CBASE=      .2251E+00
 STRUCTURE NO=     1          NO OF LOADS=     2          CYCLE NO=    14          EQ CYCLE NO=     4          NSTBLTY=     0

TIME USED IN SECONDS =    76.3830

 RELATIVE AREAS OF MEMBERS
 .184813     .184813     .256961     .215244     .353118     .283990     .319017     .347977     .375245     .411409
 .433826     .475608     .773940     .527754     .679102     .592289    1.000000     .652453     .370218     .370218
 .370218     .370218     .370218     .370218     .370218     .370218     .370218     .370218     .370218     .370218
 .370218     .370218     .370218     .370218     .370218     .370218     .044426     .044426     .044426     .044426
 .044426     .044426     .044426     .044426     .044426     .044426     .044426     .044426     .044426     .044426
 .044426     .044426     .044426     .044426

 .046203     .046203     .113351     .076635     .214509     .145381     .180408     .209368     .236636     .272800
 .295216     .336999     .635330     .389145     .740461     .453680     .861347     .514344

 .046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203
 .046203     .046203     .046203     .046203     .046214     .046203     .046218     .046203

 .046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203
 .046203     .046203     .046203     .046203     .046214     .046203     .046218     .046203

 .046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203
 .046203     .046203     .046203     .046203     .046214     .046203     .046218     .046203

 WEIGHT-SKIN=  5.519166E+01    WEIGHT-S-PANELS=  1.512000E+01    WEIGHT-POSTS=  5.400000E-02    TOTAL-WEIGHT=  7.036566E+01
    ELE SKIN=    17          ABASE=      .2251E+00        ELE STRUCT=    27          CBASE=      .2251E+00
 STRUCTURE NO=     1          NO OF LOADS=     2          CYCLE NO=    15          EQ CYCLE NO=     5          NSTBLTY=     0

TIME USED IN SECONDS =    80.0340

 RELATIVE AREAS OF MEMBERS
 .184813     .184813     .256353     .215195     .353116     .283987     .319017     .347977     .375245     .411409
 .433826     .475608     .773939     .527754     .679102     .592289    1.000000     .652453     .370218     .370218
 .370218     .370218     .370218     .370218     .370218     .370218     .370218     .370218     .370218     .370218
 .370218     .370218     .370218     .370218     .370218     .370218     .044426     .044426     .044426     .044426
 .044426     .044426     .044426     .044426     .044426     .044426     .044426     .044426     .044426     .044426
 .044426     .044426     .044426     .044426

 .046203     .046203     .113344     .076586     .214506     .145378     .180408     .209368     .236635     .272799
 .295216     .336999     .635330     .389144     .740461     .453680     .861347     .514343

 .046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203
 .046203     .046203     .046203     .046203     .046214     .046203     .046218     .046203

 .046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203
 .046203     .046203     .046203     .046203     .046214     .046203     .046218     .046203

 .046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203     .046203
 .046203     .046203     .046203     .046203     .046214     .046203     .046218     .046203

 WEIGHT-SKIN=  5.519061E+01    WEIGHT-S-PANELS=  1.512002E+01    WEIGHT-POSTS=  5.400006E-02    TOTAL-WEIGHT=  7.036463E+01
    ELE SKIN=     6          ABASE=      .2251E+00        ELE STRUCT=    20          CBASE=      .2251E+00
 STRUCTURE NO=     1          NO OF LOADS=     2          CYCLE NO=    16          EQ CYCLE NO=     6          NSTBLTY=     0

TIME USED IN SECONDS =    83.6960

 RELATIVE AREAS OF MEMBERS
```

.184813	.184813	.256953	.215195	.353116	.283387	.319017	.347977	.375245	.411484
.433826	.475608	.773339	.527754	.879102	.592289	1.000000	.652953	.370218	.370218
.370218	.370218	.370218	.370218	.370218	.370218	.370218	.370218	.370218	.370218
.370218	.370218	.370218	.370218	.370218	.370218	.370218	.370218	.370218	.370218
.044426	.044426	.044426	.044426	.044426	.044426	.044426	.044426	.044426	.044426
.044426	.044426	.044426	.044426						
.046203	.046203	.113344	.076586	.214506	.145378	.180408	.209368	.236635	.272799
.295216	.336999	.635330	.389144	.740461	.453680	.861347	.514343		
.046203	.046203	.046203	.046203	.046203	.046203	.046203	.046203	.046203	.046203
.046203	.046203	.046203	.046203	.046214	.046203	.046218	.046203		
.046203	.046203	.046203	.046203	.046203	.046203	.046203	.046203	.046203	.046203
.046203	.046203	.046203	.046203	.046214	.046203	.046218	.046203		
.046203	.046203	.046203	.046203	.046203	.046203	.046203	.046203	.046203	.046203
.046203	.046203	.046203	.046203	.046214	.046203	.046218	.046203		

L= 1	BASEA= .14395E+00	L-O= 1	CRI= 2	LAR= 2	PRCNT=	.250	.250	.250	.250
L= 2	BASEA= .10935E+00	L-O= 1	CRI= 1	LAR= 1	PRCNT=	.250	.250	.250	.250
L= 3	BASEA= .22509E+00	L-O= 1	CRI= 2	LAR= 2	PRCNT=	.461	.180	.180	.180
L= 4	BASEA= .22505E+00	L-O= 1	CRI= 1	LAR= 1	PRCNT=	.356	.215	.215	.215
L= 5	BASEA= .22509E+00	L-O= 1	CRI= 2	LAR= 2	PRCNT=	.607	.131	.131	.131
L= 6	BASEA= .22509E+00	L-O= 1	CRI= 1	LAR= 1	PRCNT=	.512	.163	.163	.163
L= 7	BASEA= .22509E+00	L-O= 1	CRI= 2	LAR= 2	PRCNT=	.566	.145	.145	.145
L= 8	BASEA= .22509E+00	L-O= 1	CRI= 1	LAR= 1	PRCNT=	.602	.133	.133	.133
L= 9	BASEA= .22509E+00	L-O= 1	CRI= 2	LAR= 2	PRCNT=	.631	.123	.123	.123
L= 10	BASEA= .22509E+00	L-O= 1	CRI= 1	LAR= 1	PRCNT=	.663	.112	.112	.112
L= 11	BASEA= .22509E+00	L-O= 1	CRI= 2	LAR= 2	PRCNT=	.680	.107	.107	.107
L= 12	BASEA= .22509E+00	L-O= 1	CRI= 1	LAR= 1	PRCNT=	.709	.097	.097	.097
L= 13	BASEA= .22509E+00	L-O= 1	CRI= 2	LAR= 2	PRCNT=	.821	.060	.060	.060
L= 14	BASEA= .22509E+00	L-O= 1	CRI= 1	LAR= 1	PRCNT=	.737	.088	.088	.088
L= 15	BASEA= .22509E+00	L-O= 1	CRI= 2	LAR= 2	PRCNT=	.842	.053	.053	.053
L= 16	BASEA= .22509E+00	L-O= 1	CRI= 1	LAR= 1	PRCNT=	.766	.078	.078	.078
L= 17	BASEA= .22509E+00	L-O= 1	CRI= 2	LAR= 2	PRCNT=	.861	.046	.046	.046
L= 18	BASEA= .22509E+00	L-O= 1	CRI= 1	LAR= 1	PRCNT=	.788	.071	.071	.071
L= 19	BASEA= .22509E+00	L-O= 1							
L= 20	BASEA= .22509E+00	L-O= 1							
L= 21	BASEA= .22509E+00	L-O= 1							
L= 22	BASEA= .22509E+00	L-O= 1							
L= 23	BASEA= .22509E+00	L-O= 1							
L= 24	BASEA= .22509E+00	L-O= 1							
L= 25	BASEA= .22509E+00	L-O= 1							
L= 26	BASEA= .22509E+00	L-O= 1							
L= 27	BASEA= .22509E+00	L-O= 1							
L= 28	BASEA= .22509E+00	L-O= 1							
L= 29	BASEA= .22509E+00	L-O= 1							
L= 30	BASEA= .22509E+00	L-O= 1							
L= 31	BASEA= .22509E+00	L-O= 1							
L= 32	BASEA= .22509E+00	L-O= 1							
L= 33	BASEA= .22509E+00	L-O= 1							
L= 34	BASEA= .22509E+00	L-O= 1							
L= 35	BASEA= .22509E+00	L-O= 1							
L= 36	BASEA= .22509E+00	L-O= 1							
L= 37	BASEA= .95238E-05	L-O= 1							
L= 38	BASEA= .95238E-05	L-O= 1							
L= 39	BASEA= .95238E-05	L-O= 1							
L= 40	BASEA= .95238E-05	L-O= 1							
L= 41	BASEA= .95238E-05	L-O= 1							
L= 42	BASEA= .95238E-05	L-O= 1							
L= 43	BASEA= .95238E-05	L-O= 1							
L= 44	BASEA= .95238E-05	L-O= 1							
L= 45	BASEA= .95238E-05	L-O= 1							
L= 46	BASEA= .95238E-05	L-O= 1							
L= 47	BASEA= .95238E-05	L-O= 1							
L= 48	BASEA= .95238E-05	L-O= 1							
L= 49	BASEA= .95238E-05	L-O= 1							
L= 50	BASEA= .95238E-05	L-O= 1							
L= 51	BASEA= .95238E-05	L-O= 1							
L= 52	BASEA= .95238E-05	L-O= 1							
L= 53	BASEA= .95238E-05	L-O= 1							
L= 54	BASEA= .95238E-05	L-O= 1							

WEIGHT-SKIN= 5.519061E+01 WEIGHT-S-PANELS= 1.512002E+01 WEIGHT-POSTS= 5.400006E-02 TOTAL-WEIGHT= 7.036463E+01
ELE SKIN= 6 ABASE= .2251E+00 ELE STRUCT= 20 CBASE= .2251E+00
STRUCTURE NO= 1 NO OF LOADS= 2 CYCLE NO= 17 EQ CYCLE NO= 6 NSTBLTY= 0
MINIMUM WEIGHT CYCLE= 16

*****S T R E S S E S*****

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MEMB    1  NODES    1    3    7    5  AREA .1440E+03  THICK.4160E-01  LAYER(THICK) .1040E-01 .1040E-01 .1040E-01 .1040E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.3218E+03 .4136E+05-.4765E-08 2 -.1324E+05 .3298E+04 .5970E-07 3  .5824E+04 .9725E+04 .6286E+04 4  .5824E+04 .9725E+04-.6286E+04
2 1 -.2018E-10-.3069E-08 .6884E-10 2  .4702E-09-.2548E-09 .6884E-10 3 -.1422E-09-.3951E-09-.6728E-10 4 -.1042E-08-.1294E-08 .1094E-08
NODAL FORCES
1 -.4000E+04  .2136E-08 0.          -.4000E+04 -.1255E-09 0.           .4000E+04 -.2383E+03 0.           .4000E+04  .2383E+03 0.
2 -.3958E-09 -.5763E-10 0.           .1021E-08 -.8774E-10 0.          -.8760E-09 -.3838E-11 0.           .2504E-09  .1492E-09 0.


MEMB    2  NODES    2    4    8    6  AREA .1440E+03  THICK.4160E-01  LAYER(THICK) .1040E-01 .1040E-01 .1040E-01 .1040E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1  .4377E+03-.4178E+05 .5316E-08 2  .1468E+05-.3305E+04-.6588E-07 3 -.5475E+04-.9509E+04-.6058E+04 4 -.5475E+04-.9509E+04 .6058E+04
2 1  .1930E-08 .7140E-08 .4735E+03 2 -.4201E-07 .6750E-09 .4735E+03 3  .3094E+04 .3094E+04 .3533E+04 4 -.3094E+04-.3094E+04 .3533E+04
NODAL FORCES
1  .4000E+04 -.1603E-08 0.           .4000E+04 -.3438E-09 0.          -.4000E+04  .5200E+03 0.          -.4000E+04 -.5200E+03 0.
2 -.2736E-08 -.5000E+03 0.          -.1164E-08 -.5000E+03 0.           .1000E+04  .5000E+03 0.          -.1000E+04  .5000E+03 0.


MEMB    3  NODES    5    7   11    9  AREA .1440E+03  THICK.5784E-01  LAYER(THICK) .2664E-01 .1040E-01 .1040E-01 .1040E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.2067E+03 .6130E+05-.7727E-08 2 -.1648E+05 .4950E+04 .7326E-07 3  .9613E+04 .1517E+05 .1002E+05 4  .9613E+04 .1517E+05-.1002E+05
2 1  .2687E-11 .2254E-07-.2042E-09 2 -.5143E-08 .1638E-08-.2042E-09 3  .2485E-08 .4463E-08 .2365E-08 4  .5153E-08 .7131E-08-.5411E-08
NODAL FORCES
1 -.1200E+05 -.2383E+03 0.          -.1200E+05  .2383E+03 0.           .1200E+05  .3860E+02 0.           .1200E+05 -.3860E+02 0.
2 -.4847E-08 -.2926E-09 0.          -.4033E-08  .7635E-09 0.           .3562E-08 -.4513E-09 0.           .5318E-08 -.1964E-10 0.


MEMB    4  NODES    6    8   12   10  AREA .1440E+03  THICK.4844E-01  LAYER(THICK) .1724E-01 .1040E-01 .1040E-01 .1040E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1  .2421E+03-.8593E+05 .7490E-08 2  .2256E+05-.6954E+04-.1035E-06 3 -.1366E+05-.2141E+05-.1418E+05 4 -.1366E+05-.2141E+05 .1418E+05
2 1  .8715E-09-.2134E-07 .4558E+03 2 -.4544E-07-.1677E-08 .4558E+03 3  .2978E+04 .2978E+04 .3401E+04 4 -.2978E+04-.2978E+04 .3401E+04
NODAL FORCES
1  .1200E+05  .5200E+03 0.           .1200E+05 -.5200E+03 0.          -.1200E+05 -.2359E+02 0.          -.1200E+05  .2359E+02 0.
2  .1000E+04 -.5000E+03 0.          -.1000E+04 -.5000E+03 0.           .2000E+04  .5000E+03 0.          -.2000E+04  .5000E+03 0.


MEMB    5  NODES    9   11   15   13  AREA .1440E+03  THICK.7948E-01  LAYER(THICK) .4828E-01 .1040E-01 .1040E-01 .1040E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.2756E+03 .6150E+05-.6738E-08 2 -.1732E+05 .4950E+04 .7819E-07 3  .9396E+04 .1503E+05 .9875E+04 4  .9396E+04 .1503E+05-.9875E+04
2 1 -.3385E-09 .3807E-07-.1492E-09 2 -.1268E-07 .3026E-08-.1492E-09 3  .4233E-08 .7860E-08 .4564E-08 4  .6183E-08 .9809E-08-.6791E-08
NODAL FORCES
1 -.2000E+05  .3860E+02 0.          -.2000E+05 -.3860E+02 0.           .2000E+05  .6222E+02 0.           .2000E+05 -.6222E+02 0.
2 -.2971E-07  .2569E-09 0.           .5072E-08  .1261E-09 0.          -.5455E-08 -.6043E-09 0.           .3010E-07  .2214E-09 0.


MEMB    6  NODES   10   12   16   14  AREA .1440E+03  THICK.6392E-01  LAYER(THICK) .3272E-01 .1040E-01 .1040E-01 .1040E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1  .2206E+03-.8600E+05 .6231E-08 2  .2231E+05-.6960E+04-.1037E-06 3 -.1374E+05-.2148E+05-.1424E+05 4 -.1374E+05-.2148E+05 .1424E+05
2 1  .8084E-09-.4884E-07 .4202E+03 2 -.3511E-07-.4107E-08 .4202E+03 3  .2745E+04 .2745E+04 .3135E+04 4 -.2745E+04-.2745E+04 .3135E+04
NODAL FORCES
1  .2000E+05 -.2359E+02 0.           .2000E+05  .2359E+02 0.          -.2000E+05 -.5815E+03 0.          -.2000E+05  .5815E+03 0.
2  .2000E+04 -.5000E+03 0.          -.2000E+04 -.5000E+03 0.           .3000E+04  .5000E+03 0.          -.3000E+04  .5000E+03 0.


MEMB    7  NODES   13   15   19   17  AREA .1440E+03  THICK.7161E-01  LAYER(THICK) .4061E-01 .1040E-01 .1040E-01 .1040E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.8925E+03 .1059E+06-.7071E-08 2 -.1620E+05 .4950E+04 .7477E-07 3  .9683E+04 .1522E+05 .1007E+05 4  .9683E+04 .1522E+05-.1007E+05
2 1 -.9738E-09 .1203E-06 .1752E-09 2 -.1820E-07 .5631E-08 .1225E-09 3  .1187E-07 .1815E-07 .1241E-07 4  .1027E-07 .1659E-07-.1058E-07
NODAL FORCES
1 -.2800E+05  .6222E+02 0.          -.2800E+05 -.6222E+02 0.           .2800E+05  .2206E+02 0.          -.2800E+05 -.2206E+02 0.
2 -.6280E-07 -.5281E-09 0.           .2913E-07  .1993E-09 0.          -.2881E-07 -.1813E-09 0.           .9247E-07  .5100E-09 0.


MEMB    8  NODES   14   16   20   18  AREA .1440E+03  THICK.7833E-01  LAYER(THICK) .4713E-01 .1040E-01 .1040E-01 .1040E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1  .1108E+04-.9240E+05 .5476E-08 2  .1589E+05-.4286E+04-.7386E-07 3 -.7907E+04-.1286E+05-.8397E+04 4 -.7907E+04-.1286E+05 .8397E+04
2 1  .2686E-08-.8695E-07 .5117E+03 2 -.2376E-07-.4126E-08 .3576E+03 3  .2336E+04 .2336E+04 .2668E+04 4 -.2336E+04-.2336E+04 .2668E+04
NODAL FORCES
1  .2800E+05 -.5815E+03 0.           .2800E+05  .5815E+03 0.          -.2800E+05  .5515E+02 0.          -.2800E+05 -.5515E+02 0.
2  .3000E+04 -.5000E+03 0.          -.3000E+04 -.5000E+03 0.           .4000E+04  .5000E+03 0.          -.4000E+04  .5000E+03 0.
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MEMB 9 NODES 17 19 23 21 AREA .1440E+03 THICK.8447E-01 LAYER(THICK) .5326E-01 .1040E-01 .1040E-01 .1040E-01

STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)

1	1	-.8263E+03	.1057E+06	-.5837E-08	2	-.1564E+05	.4950E+04	.7388E-07	3	.4778E+04	.1528E+05	.1013E+05	4	.9778E+04	.1528E+05	-.1013E+05
2	1	-.1317E-08	.1753E-06	.1558E-09	2	-.2598E-07	.8216E-08	.1089E-09	3	.1702E-07	.2612E-07	.1768E-07	4	.1560E-07	.2470E-07	-.1606E-07

NODAL FORCES

1	-.3600E+05	.2206E+02	0.		-.3600E+05	-.2206E+02	0.		.3600E+05	-.4192E+02	0.		.3600E+05	.4192E+02	0.	
2	-.1829E-06	-.5014E-09	0.		.6349E-07	.2854E-09	0.		-.6317E-07	-.2992E-09	0.		.1826E-06	.6151E-09	0.	

MEMB 10 NODES 18 20 24 22 AREA .1440E+03 THICK.9261E-01 LAYER(THICK) .6141E-01 .1040E-01 .1040E-01 .1040E-01

STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)

1	1	.6003E+03	-.3240E+05	.4234E-08	2	.1319E+05	-.4339E+04	-.6221E-07	3	-.8748E+04	-.1351E+05	-.9000E+04	4	-.8748E+04	-.1351E+05	.9000E+04
2	1	.2267E-08	-.1374E-06	.4704E+03	2	-.1669E-07	-.6555E-08	.3288E+03	3	.2148E+04	.2148E+04	.2453E+04	4	-.2148E+04	-.2148E+04	.2453E+04

NODAL FORCES

1	.3600E+05	.5515E+02	0.		.3600E+05	-.5515E+02	0.		-.3600E+05	-.3947E+02	0.		-.3600E+05	.3947E+02	0.	
2	.4000E+04	-.5000E+03	0.		-.4000E+04	-.5000E+03	0.		.5000E+04	.5000E+03	0.		-.5000E+04	.5000E+03	0.	

MEMB 11 NODES 21 23 27 25 AREA .1440E+03 THICK.9765E-01 LAYER(THICK) .6645E-01 .1040E-01 .1040E-01 .1040E-01

STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)

1	1	-.3459E+03	.1047E+06	-.4927E-08	2	-.1317E+05	.4950E+04	.6216E-07	3	.1046E+05	.1573E+05	.1059E+05	4	.1046E+05	.1573E+05	-.1059E+05
2	1	-.5768E-09	.2194E-06	.2040E-09	2	-.2682E-07	.1039E-07	.1426E-09	3	.2311E-07	.3409E-07	.2344E-07	4	.2124E-07	.3223E-07	-.2131E-07

NODAL FORCES

1	-.4400E+05	-.4192E+02	0.		-.4400E+05	.4192E+02	0.		.4400E+05	.6498E+03	0.		.4400E+05	-.6498E+03	0.	
2	-.2905E-06	-.7442E-09	0.		.1060E-06	.2983E-09	0.		-.1056E-06	.1430E-08	0.		.2901E-06	-.9836E-09	0.	

MEMB 12 NODES 22 24 28 26 AREA .1440E+03 THICK.1071E+00 LAYER(THICK) .7586E-01 .1040E-01 .1040E-01 .1040E-01

STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)

1	1	.6698E+03	-.9240E+05	.3858E-06	2	.1356E+05	-.4332E+04	-.6419E-07	3	-.8633E+04	-.1342E+05	-.8917E+04	4	-.8633E+04	-.1342E+05	.8917E+04
2	1	.2703E-08	-.1802E-06	.4350E+03	2	-.6448E-08	-.8529E-08	.3040E+03	3	.1986E+04	.1986E+04	.2268E+04	4	-.1986E+04	-.1986E+04	.2268E+04

NODAL FORCES

1	.4400E+05	-.3947E+02	0.		.4400E+05	.3947E+02	0.		-.4400E+05	.1081E+03	0.		-.4400E+05	-.1081E+03	0.	
2	.5000E+04	-.5000E+03	0.		-.5000E+04	-.5000E+03	0.		.6000E+04	.5000E+03	0.		-.6000E+04	.5000E+03	0.	

MEMB 13 NODES 25 27 31 29 AREA .1440E+03 THICK.1742E+00 LAYER(THICK) .1430E+00 .1040E-01 .1040E-01 .1040E-01

STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)

1	1	-.6005E+03	.5813E+05	-.3304E-08	2	-.1633E+05	.6000E+04	.8818E-07	3	.9595E+04	.1400E+05	.9099E+04	4	.9595E+04	.1400E+05	-.9099E+04
2	1	-.1386E-08	.1401E-06	.1221E-09	2	-.3880E-07	.1447E-07	.1221E-09	3	.2424E-07	.3483E-07	.2317E-07	4	.2236E-07	.3295E-07	-.2093E-07

NODAL FORCES

1	-.5200E+05	.6498E+03	0.		-.5200E+05	-.6498E+03	0.		.5200E+05	-.2424E+02	0.		.5200E+05	.2424E+02	0.	
2	-.4064E-06	.1007E-09	0.		.1557E-06	-.1406E-08	0.		-.1552E-06	.1128E-12	0.		.4059E-06	.5051E-09	0.	

MEMB 14 NODES 26 28 32 30 AREA .1440E+03 THICK.1188E+00 LAYER(THICK) .8759E-01 .1040E-01 .1040E-01 .1040E-01

STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)

1	1	.7383E+03	-.9240E+05	.5004E-08	2	.2398E+05	-.9578E+04	-.1311E-06	3	-.1587E+05	-.2276E+05	-.1490E+05	4	-.1587E+05	-.2276E+05	.1490E+05
2	1	.3153E-08	-.2121E-06	.2861E+03	2	.2172E-07	-.2029E-07	.2861E+03	3	.2218E+04	.2218E+04	.2649E+04	4	-.2218E+04	-.2218E+04	.2649E+04

NODAL FORCES

1	.5200E+05	.1081E+03	0.		.5200E+05	-.1081E+03	0.		-.5200E+05	-.8486E+02	0.		-.5200E+05	.8486E+02	0.	
2	.6000E+04	-.5000E+03	0.		-.6000E+04	-.5000E+03	0.		.7000E+04	.5000E+03	0.		-.7000E+04	.5000E+03	0.	

MEMB 15 NODES 29 31 35 33 AREA .1440E+03 THICK.1979E+00 LAYER(THICK) .1667E+00 .1040E-01 .1040E-01 .1040E-01

STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)

1	1	-.4355E+03	.5784E+05	-.2800E-08	2	-.1476E+05	.6000E+04	.8123E-07	3	.1001E+05	.1431E+05	.9377E+04	4	.1001E+05	.1431E+05	-.9377E+04
2	1	-.1167E-08	.1535E-06	.1433E-09	2	-.3928E-07	.1592E-07	.1433E-09	3	.2763E-07	.3904E-07	.2618E-07	4	.2543E-07	.3684E-07	-.2354E-07

NODAL FORCES

1	-.6000E+05	-.2424E+02	0.		-.6000E+05	.2424E+02	0.		.6000E+05	-.2389E+03	0.		.6000E+05	.2389E+03	0.	
2	-.5282E-06	-.5998E-09	0.		.2098E-06	-.3379E-10	0.		-.2092E-06	-.5802E-09	0.		.5276E-06	.1214E-08	0.	

MEMB 16 NODES 30 32 36 34 AREA .1440E+03 THICK.1333E+00 LAYER(THICK) .1021E+00 .1040E-01 .1040E-01 .1040E-01

STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)

1	1	.9158E+03	-.9240E+05	.4329E-06	2	.2561E+05	-.9545E+04	-.1388E-06	3	-.1536E+05	-.2235E+05	-.1454E+05	4	-.1536E+05	-.2235E+05	.1454E+05
2	1	.4042E-08	-.2365E-06	.2743E+03	2	.3666E-07	-.2273E-07	.2743E+03	3	.2112E+04	.2112E+04	.2522E+04	4	-.2112E+04	-.2112E+04	.2522E+04

NODAL FORCES

1	.6000E+05	-.3486E+02	0.		.6000E+05	.8486E+02	0.		-.6000E+05	.3986E+03	0.		-.6000E+05	-.3986E+03	0.	
2	.7000E+04	-.5000E+03	0.		-.7000E+04	-.5000E+03	0.		.8000E+04	.5000E+03	0.		-.8000E+04	.5000E+03	0.	

MEMB 17 NODES 33 35 39 37 AREA .1440E+03 THICK.2251E+00 LAYER(THICK) .1939E+00 .1040E-01 .1040E-01 .1040E-01

STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)

1	1	.3538E+03	.5644E+05	-.1604E-08	2	-.7257E+04	.6000E+04	.4681E-07	3	.1200E+05	.1577E+05	.1071E+05	4	.1200E+05	.1577E+05	-.1071E+05
2	1	.1068E-08	.1601E-06	.1330E-09	2	-.1999E-07	.1703E-07	.1330E-09	3	.3524E-07	.4590E-07	.3172E-07	4	.3320E-07	.4386E-07	-.2928E-07

NODAL FORCES

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1 -.6800E+05 -.2389E+03 0.          -.6800E+05  .2389E+03 0.          .6800E+05  .2674E+04 0.          .5600E+05 -.2674E+04 0.
2 -.6511E-06 -.1213E-08 0.           .2653E-06  .5816E-09 0.         -.2647E-06  .7351E-08 0.          .6505E-06 -.7320E-08 0.


MEMB   18  NODES   34   36   40   38  AREA .1440E+03  THICK.1470E+00  LAYER(THICK) .1158E+00 .1040E-01 .1040E-01 .1040E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.5104E+03-.3243E+05 .2707E-08 2  .1251E+05-.9610E+04-.7450E-07 3 -.1945E+05-.2566E+05-.1739E+05 4 -.1945E+05-.2566E+05 .1739E+05
2 1 -.5667E-09-.2545E-06 .2625E+03 2 -.4139E-09-.2553E-07 .2625E+03 3  .2021E+04 .2021E+04 .2414E+04 4 -.2021E+04-.2021E+04 .2414E+04
NODAL FORCES
1  .6800E+05  .3986E+03 0.          .6800E+05 -.3986E+03 0.         -.6800E+05 -.3605E+04 0.         -.6800E+05  .3605E+04 0.
2 -.8000E+04 -.5000E+03 0.         -.8000E+04 -.5000E+03 0.          .9000E+04  .5000E+03 0.         -.9000E+04  .5000E+03 0.
MEMB   19  NODES    1    2    6    5  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2 -.3211E-08
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.5588E-08 0.          -.1397E-08 -.5588E-08 0.           .1397E-08  .5588E-08 0.         -.1397E-08
MEMB   20  NODES    3    4    8    7  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.4000E+04 2  .2578E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.7451E-08 0.           .1863E-08  .7451E-08 0.           .1863E-08  .7451E-08 0.         -.1863E-08 -.7451E-08 0.         -.1863E-08
MEMB   21  NODES    5    6   10    9  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2 -.2223E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.1304E-07 0.          -.3260E-08 -.1304E-07 0.          -.3260E-08 -.1304E-07 0.          .3260E-08  .1304E-07 0.          .3260E-08
MEMB   22  NODES    7    8   12   11  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.4000E+04 2  .2022E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.1304E-07 0.           .3260E-08  .1304E-07 0.           .3260E-08  .1304E-07 0.         -.3260E-08 -.1304E-07 0.         -.3260E-08
MEMB   23  NODES    9   10   14   13  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2 -.7133E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.3632E-07 0.          -.9080E-08 -.3632E-07 0.          -.9080E-08 -.3632E-07 0.          .9080E-08  .3632E-07 0.          .9080E-08
MEMB   24  NODES   11   12   16   15  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2  .3983E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.1863E-07 0.           .4657E-08  .1863E-07 0.           .4657E-08  .1863E-07 0.         -.4657E-08 -.1863E-07 0.         -.4657E-08
MEMB   25  NODES   13   14   18   17  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.4000E+04 2 -.8496E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.4191E-07 0.          -.1048E-07 -.4191E-07 0.          -.1048E-07 -.4191E-07 0.          .1048E-07  .4191E-07 0.          .1048E-07
MEMB   26  NODES   15   16   20   19  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.4000E+04 2  .4485E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.2282E-07 0.           .5704E-08  .2282E-07 0.           .5704E-08  .2282E-07 0.         -.5704E-08 -.2282E-07 0.         -.5704E-08
MEMB   27  NODES   17   18   22   21  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2 -.1078E-06
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.5309E-07 0.          -.1327E-07 -.5309E-07 0.          -.1327E-07 -.5309E-07 0.          .1327E-07  .5309E-07 0.          .1327E-07
MEMB   28  NODES   13   20   24   23  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2  .4728E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.2282E-07 0.           .5704E-08  .2282E-07 0.           .5704E-08  .2282E-07 0.         -.5704E-08 -.2282E-07 0.         -.5704E-08
MEMB   29  NODES   21   22   26   25  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.4000E+04 2 -.1131E-06
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.5658E-07 0.          -.1414E-07 -.5658E-07 0.          -.1414E-07 -.5658E-07 0.          .1414E-07  .5658E-07 0.          .1414E-07
MEMB   30  NODES   23   24   28   27  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2  .5265E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.2584E-07 0.           .6461E-08  .2584E-07 0.           .6461E-08  .2584E-07 0.         -.6461E-08 -.2584E-07 0.         -.6461E-08
MEMB   31  NODES   25   26   30   29  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2 -.1139E-06
        NODAL FORCES
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1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.6054E-07 0.          -.1513E-07 -.6054E-07 0.          -.1513E-07 -.6054E-07 0.          .1513E-07  .6054E-07 0.          .1513E-07
MEMB   32  NODES   27   28   32   31  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2  .5462E-07
          NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.2765E-07 0.           .6912E-08  .2765E-07 0.           .6912E-08  .2765E-07 0.         -.6912E-08 -.2765E-07 0.         -.6912E-08
MEMB   33  NODES   29   30   34   33  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2 -.1226E-06
          NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.6132E-07 0.          -.1533E-07 -.6132E-07 0.          -.1533E-07 -.6132E-07 0.          .1533E-07  .6132E-07 0.          .1533E-07
MEMB   34  NODES   31   32   36   35  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2  .5574E-07
          NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.2791E-07 0.           .6978E-08  .2791E-07 0.           .6978E-08  .2791E-07 0.         -.6978E-08 -.2791E-07 0.         -.6978E-08
MEMB   35  NODES   33   34   38   37  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.8000E+04 2 -.1231E-06
          NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.6155E-07 0.          -.1539E-07 -.6155E-07 0.          -.1539E-07 -.6155E-07 0.          .1539E-07  .6155E-07 0.          .1539E-07
MEMB   36  NODES   35   36   40   39  AREA .3600E+02  THICK .8333E-01
STRESSES
1 -.4000E+04 2  .5605E-07
          NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.2804E-07 0.           .7010E-08  .2804E-07 0.           .7010E-08  .2804E-07 0.         -.7010E-08 -.2804E-07 0.         -.7010E-08
MEMB   37  NODES    1    2  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1 -.3948E-06 2  .1990E-06
NODAL FORCES
1 0.          0.           .1118E-07 0.          0.          -.1118E-07
2 0.          0.           .1863E-08 0.          0.          -.1863E-08
MEMB   38  NODES    3    4  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1 -.1194E-05 2 -.1741E-06
NODAL FORCES
1 0.          0.           .1304E-07 0.          0.          -.1304E-07
2 0.          0.          -.1863E-08 0.          0.           .1863E-08
MEMB   39  NODES    5    6  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1 -.5969E-06 2  .1243E-06
NODAL FORCES
1 0.          0.           .5588E-08 0.          0.          -.5588E-08
2 0.          0.           .1397E-08 0.          0.          -.1397E-08
MEMB   40  NODES    7    8  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1 -.5969E-06 2 -.1243E-06
NODAL FORCES
1 0.          0.           .5588E-08 0.          0.          -.5588E-08
2 0.          0.          -.1164E-08 0.          0.           .1164E-08
MEMB   41  NODES    9   10  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1 -.2984E-06 2  .6217E-07
NODAL FORCES
1 0.          0.           .2794E-08 0.          0.          -.2794E-08
2 0.          0.           .5821E-09 0.          0.          -.5821E-09
MEMB   42  NODES   11   12  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1 -.3979E-06 2 -.4974E-07
NODAL FORCES
1 0.          0.           .3725E-08 0.          0.          -.3725E-08
2 0.          0.          -.4657E-09 0.          0.           .4657E-09
MEMB   43  NODES   13   14  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1 -.1990E-06 2  .3730E-07
NODAL FORCES
1 0.          0.           .1863E-08 0.          0.          -.1863E-08
2 0.          0.           .3492E-09 0.          0.          -.3492E-09
MEMB   44  NODES   15   16  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1 -.1990E-06 2 -.2487E-07
NODAL FORCES
1 0.          0.           .1863E-08 0.          0.          -.1863E-08
2 0.          0.          -.2328E-09 0.          0.           .2328E-09
MEMB   45  NODES   17   18  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1 -.4976E-07 2  .1865E-07
NODAL FORCES
1 0.          0.           .4657E-09 0.          0.          -.4657E-09
2 0.          0.           .1746E-09 0.          0.          -.1746E-09
MEMB   46  NODES   19   20  LENGTH .3000E+01  AREA .1000E-01
STRESSES
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1  .1990E-06 2 -.2487E-07
NODAL FORCES
1 0.          0.           .1863E-08 0.          0.          -.1863E-08
2 0.          0.          -.2328E-09 0.          0.           .2328E-09
MEMB   47  NODES   21   22  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1  .1492E-06 2  .6217E-08
NODAL FORCES
1 0.          0.           .1630E-08 0.          0.          -.1630E-08
2 0.          0.           .5821E-10 0.          0.          -.5821E-10
MEMB   48  NODES   23   24  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1  .7461E-07 2 -.1865E-07
NODAL FORCES
1 0.          0.           .6985E-09 0.          0.          -.6985E-09
2 0.          0.          -.1746E-09 0.          0.           .1746E-09
MEMB   49  NODES   25   26  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1  .2487E-07 2  .1554E-07
NODAL FORCES
1 0.          0.           .2328E-09 0.          0.          -.2328E-09
2 0.          0.           .1455E-09 0.          0.          -.1455E-09
MEMB   50  NODES   27   28  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1  .4974E-07 2 -.1554E-07
NODAL FORCES
1 0.          0.           .4657E-09 0.          0.          -.4657E-09
2 0.          0.          -.1455E-09 0.          0.           .1455E-09
MEMB   51  NODES   29   30  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1  .3109E-07 2  .6217E-08
NODAL FORCES
1 0.          0.           .3492E-09 0.          0.          -.3492E-09
2 0.          0.           .5821E-10 0.          0.          -.5821E-10
MEMB   52  NODES   31   32  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1  .3109E-07 2 -.7772E-08
NODAL FORCES
1 0.          0.           .3492E-09 0.          0.          -.3492E-09
2 0.          0.          -.8731E-10 0.          0.           .8731E-10
MEMB   53  NODES   33   34  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1  .4663E-08 2  .1166E-08
NODAL FORCES
1 0.          0.           .2910E-10 0.          0.          -.2910E-10
2 0.          0.           .1091E-10 0.          0.          -.1091E-10
MEMB   54  NODES   35   36  LENGTH .3000E+01  AREA .1000E-01
STRESSES
1  .6217E-08 2 -.1166E-08
NODAL FORCES
1 0.          0.           .8731E-10 0.          0.          -.8731E-10
2 0.          0.          -.1091E-10 0.          0.           .1091E-10
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*****DISPLACEMENTS*****

JOINT	-X	-Y	-Z	FORCE-X	FORCE-Y	FORCE-Z	DISPL-X	DISPL-Y	DISPL-Z
1	0.000	0.000	9.000	0.000	0.000	-1000.000	-2.30095213E-01	3.86149529E-03	-1.07835986E+01
2	0.000	0.000	6.000	0.000	0.000	0.000	-2.02038625E-12	1.92863466E-11	-1.43200009E+00
3	0.000	12.000	9.000	0.000	0.000	-1000.000	3.47024027E-01	-3.50328835E-03	-1.07835986E+01
4	0.000	12.000	6.000	0.000	-500.000	0.000	8.22862698E-02	-7.69843973E-01	-1.43200009E+00
5	12.000	0.000	9.000	0.000	0.000	-1000.000	-2.90095213E-01	-3.86149515E-03	-1.07835986E+01
6	12.000	0.000	6.000	0.000	0.000	0.000	1.21639519E-12	1.92870540E-11	1.43200009E+00
7	12.000	12.000	9.000	0.000	0.000	-1000.000	3.47024027E-01	3.50328818E-03	-1.07835986E+01
8	12.000	12.000	6.000	0.000	-500.000	0.000	-8.22862698E-02	-7.69843973E-01	1.43200009E+00
9	24.000	0.000	9.000	0.000	0.000	0.000	-2.63208732E-01	5.26119190E-03	-3.33493412E+00
10	24.000	0.000	6.000	0.000	0.000	0.000	-2.01490466E-12	1.60566664E-11	-1.11460114E+00
11	24.000	12.000	9.000	0.000	0.000	0.000	3.19844267E-01	-6.55736956E-03	-8.33493412E+00
12	24.000	12.000	6.000	0.000	0.000	0.000	7.64132081E-02	-6.02402628E-01	-1.11460114E+00
13	36.000	0.000	9.000	0.000	0.000	0.000	-2.63208732E-01	-5.26119179E-03	-3.33493411E+00
14	36.000	0.000	6.000	0.000	0.000	0.000	1.20893805E-12	1.60566518E-11	1.11460114E+00
15	36.000	12.000	9.000	0.000	0.000	0.000	3.19844267E-01	6.55736942E-03	-8.33493411E+00
16	36.000	12.000	6.000	0.000	0.000	0.000	-7.64132081E-02	-6.02402628E-01	1.11460114E+00
17	48.000	0.000	9.000	0.000	0.000	0.000	-2.23398960E-01	6.23334525E-03	-6.18568511E+00
18	48.000	0.000	6.000	0.000	0.000	0.000	-1.99629980E-12	1.28366582E-11	-8.34545363E-01
19	48.000	12.000	9.000	0.000	0.000	0.000	2.64012549E-01	-9.20694330E-03	-6.18568511E+00
20	48.000	12.000	6.000	0.000	0.000	0.000	6.36146796E-02	-4.53959877E-01	-8.34545363E-01
21	60.000	0.000	9.000	0.000	0.000	0.000	-2.23398960E-01	-6.23334516E-03	-6.18568511E+00
22	60.000	0.000	6.000	0.000	0.000	0.000	1.21957733E-12	1.28294019E-11	8.34545363E-01
23	60.000	12.000	9.000	0.000	0.000	0.000	2.64012549E-01	9.20694319E-03	-6.18568511E+00
24	60.000	12.000	6.000	0.000	0.000	0.000	-6.36146796E-02	-4.53959877E-01	8.34545363E-01
25	72.000	0.000	9.000	0.000	0.000	0.000	-1.83451684E-01	5.80979214E-03	-4.41928983E+00
26	72.000	0.000	6.000	0.000	0.000	0.000	-1.90461777E-12	9.66640881E-12	-6.06429426E-01
27	72.000	12.000	9.000	0.000	0.000	0.000	2.08174451E-01	-6.39862228E-03	-4.41928983E+00
28	72.000	12.000	6.000	0.000	0.000	0.000	5.04432885E-02	-3.32144096E-01	-6.06429426E-01
29	84.000	0.000	9.000	0.000	0.000	0.000	-1.83451684E-01	-5.80979208E-03	-4.41928983E+00
30	84.000	0.000	6.000	0.000	0.000	0.000	1.17741424E-12	9.67623296E-12	6.06429426E-01
31	84.000	12.000	9.000	0.000	0.000	0.000	2.08174451E-01	6.39862219E-03	-4.41928983E+00
32	84.000	12.000	6.000	0.000	0.000	0.000	-5.04432885E-02	-3.32144096E-01	6.06429426E-01
33	96.000	0.000	9.000	0.000	0.000	0.000	-1.43685329E-01	5.50705251E-03	-2.99346962E+00
34	96.000	0.000	6.000	0.000	0.000	0.000	-1.69344755E-12	6.77515863E-12	-4.21350934E-01
35	96.000	12.000	9.000	0.000	0.000	0.000	1.73438045E-01	-4.60871715E-03	-2.99346962E+00
				0.000	0.000	0.000	4.20959576E-02	-2.33002462E-01	-4.21350934E-01
				0.000	0.000	0.000	-1.43665929E-01	-5.50705246E-03	-2.99346962E+00
				0.000	0.000	0.000	1.05663865E-12	6.75988664E-12	4.21350934E-01
				0.000	0.000	0.000	1.73438045E-01	4.60871709E-03	-2.99346962E+00
				0.000	0.000	0.000	-4.20959576E-02	-2.33002462E-01	4.21350934E-01
				0.000	0.000	0.000	-1.03979761E-01	5.57142769E-03	-1.86545964E+00
				0.000	0.000	0.000	-1.36530271E-12	4.29229075E-12	-2.69781552E-01
				0.000	0.000	0.000	1.38741259E-01	-4.55662132E-03	-1.86545964E+00
				0.000	0.000	0.000	3.36887337E-02	-1.51147560E-01	-2.69781552E-01
				0.000	0.000	0.000	-1.03979761E-01	-5.57142766E-03	-1.86545964E+00
				0.000	0.000	0.000	8.60205919E-13	4.27118049E-12	2.69781552E-01
				0.000	0.000	0.000	1.38741259E-01	4.65662128E-03	-1.86545964E+00
				0.000	0.000	0.000	-3.36887337E-02	-1.51147560E-01	2.69781552E-01
				0.000	0.000	0.000	-6.47058437E-02	3.77804463E-03	-1.03420782E+00
				0.000	0.000	0.000	-9.39283214E-13	2.41110289E-12	-1.51882257E-01
				0.000	0.000	0.000	1.04039052E-01	-4.84703847E-03	-1.03420782E+00
				0.000	0.000	0.000	2.52609136E-02	-8.65555538E-02	-1.51882257E-01
				0.000	0.000	0.000	-6.47058437E-02	-3.77804461E-03	-1.03420782E+00
				0.000	0.000	0.000	5.98804590E-13	2.39403622E-12	1.51882257E-01
				0.000	0.000	0.000	1.04039052E-01	4.84703844E-03	-1.03420782E+00
				0.000	0.000	0.000	-2.52609136E-02	-8.65555538E-02	1.51882257E-01
				0.000	0.000	0.000	-4.28604366E-02	2.81495925E-03	-4.64014155E-01
				0.000	0.000	0.000	-6.57357134E-13	1.10248628E-12	-6.76189459E-02
				0.000	0.000	0.000	6.93315034E-02	-4.68150124E-03	-4.64014155E-01
				0.000	0.000	0.000	1.68707419E-02	-4.07364532E-02	-6.76189459E-02
				0.000	0.000	0.000	-4.28604366E-02	-2.81495924E-03	-4.64014155E-01
				0.000	0.000	0.000	4.22166595E-13	1.08819324E-12	6.76189459E-02
				0.000	0.000	0.000	6.93315034E-02	4.68150123E-03	-4.64014155E-01
				0.000	0.000	0.000	-1.68707419E-02	-4.07364532E-02	6.76189459E-02
				0.000	0.000	0.000	-2.11374625E-02	3.18942282E-03	-1.19815138E-01
				0.000	0.000	0.000	-3.39524029E-13	2.86680956E-13	-1.69387310E-02
				0.000	0.000	0.000	3.46101108E-02	-5.45550175E-03	-1.19815138E-01
				0.000	0.000	0.000	8.46936551E-03	-1.18567436E-02	-1.69387310E-02
				0.000	0.000	0.000	-2.11374625E-02	-3.18942282E-03	-1.19815138E-01
				0.000	0.000	0.000	2.19615969E-13	2.69029845E-13	1.69387310E-02

JOINT	-X	-Y	-Z	FORCE-X	FORCE-Y	FORCE-Z	DISPL-X	DISPL-Y	DISPL-Z
36	96.000	12.000	6.000	0.000	0.000	0.000	3.46101108E-02	5.45550175E-03	-1.19815136E-01
37	108.000	0.000	6.000	0.000	0.000	0.030	-8.46936551E-03	-1.18567436E-02	1.69387310E-02
38	108.000	0.000	6.000	0.000	0.000	0.000	0.	0.	0.
39	108.000	12.000	6.000	0.000	0.000	0.000	0.	0.	0.
40	108.000	12.000	6.000	0.000	0.000	0.000	0.	0.	0.
				0.000	0.000	0.000	0.	0.	0.
				0.000	0.000	0.000	0.	0.	0.

NUMBER OF LAMINAE IN COMPOSITE ELEMENTS

(1)	3	3	3	3	(2)	3	3	3	(3)	6	3	3	3	(4)	4	3	3	3	(5)	10	3	3	3		
(6)	7	3	3	3	(7)	8	3	3	(8)	10	3	3	3	(9)	11	3	3	3	(10)	12	3	3	3		
(11)	13	3	3	3	(12)	15	3	3	(13)	20	3	3	3	(14)	17	3	3	3	(15)	33	3	3	3		
(16)	20	3	3	3	(17)	33	3	3	(18)	23	3	3	3	(											

TOTAL THICKNESS OF ELEMENTS

	1	2	3	4	5	6	7	8	9	0	
0	.416E-01	.416E-01	.578E-01	.484E-01	.795E-01	.639E-01	.718E-01	.783E-01	.845E-01	.926E-01	10
1	.977E-01	.107E+00	.176E+00	.119E+00	.198E+00	.133E+00	.225E+00	.147E+00	.833E-01	.833E-01	20
2	.833E-01	.833E-01	.833E-01	.833E-01	.833E-01	.833E-01	.833E-01	.833E-01	.833E-01	.833E-01	30
3	.833E-01	.833E-01	.833E-01	.833E-01	.833E-01	.833E-01	.833E-01	.833E-01	.833E-01	.833E-01	40
4	.100E-01	.100E-01	.100E-01	.100E-01	.100E-01	.100E-01	.100E-01	.100E-01	.100E-01	.100E-01	50
5	.100E-01	.100E-01	.100E-01	.100E-01	0.						

TIME USED IN SECONDS = 90.0130

RELATIVE AREAS OF MEMBERS

.184813	.184813	.256353	.215195	.353116	.283987	.319017	.347977	.375245	.411409
.433926	.475604	.773939	.527754	.879102	.592289	1.000000	.652953	.370218	.370218
.370218	.370218	.370218	.370218	.370218	.370218	.370218	.370218	.370218	.370218
.370218	.370218	.370218	.370218	.370218	.370218	.044426	.044426	.044426	.044426
.044426	.044426	.044426	.044426	.044426	.044426	.044426	.044426	.044426	.044426
.044426	.044426	.044426	.044426						
.046203	.046203	.113344	.076586	.214506	.145378	.180408	.209368	.236635	.272799
.295216	.336999	.635330	.369144	.740461	.453680	.861347	.514343		
.046203	.046203	.046203	.046203	.046203	.046203	.046203	.046203	.046203	.046203
.046203	.046203	.046203	.046203	.046214	.046203	.046218	.046203		
.046203	.046203	.046203	.046203	.046203	.046203	.046203	.046203	.046203	.046203
.046203	.046203	.046203	.046203	.046214	.046203	.046218	.046203		
.046203	.046203	.046203	.046203	.046203	.046203	.046203	.046203	.046203	.046203
.046203	.046203	.046203	.046203	.046214	.046203	.046218	.046203		

WEIGHT-SKIN= 5.519061E+01 WEIGHT-S-PANELS= 1.512002E+01 WEIGHT-POSTS= 5.400006E-02 TOTAL-WEIGHT= 7.036463E+01
ELE SKIN= 6 ABASE= .2251E+00 ELE STRUCT= 20 CBASE= .2251E+00
STRUCTURE NO= 1 NO OF LOADS= 2 CYCLE NO= 17 EQ CYCLE NO= 6 NSTBLTY= 1

TIME USED IN SECONDS = 95.0810

RELATIVE AREAS OF MEMBERS

.186630	.395344	.233665	.555125	.320003	.680494	.291161	.722222	.338721	.799255
.388271	.867606	.675952	.868799	.764875	.928119	.867126	1.000000	.313144	.313144
.313144	.313144	.313144	.313144	.313144	.313144	.313144	.313144	.313144	.313144

.313144	.313144	.313144	.313144	.313144	.313144	.044412	.044412	.044412	.044412
.044412	.044412	.044412	.044412	.044412	.044412	.044412	.044412	.044412	.044412
.044412	.044412	.044412	.044412						
.046189	.046189	.101100	.064779	.101438	.122966	.152595	.177891	.200155	.230744
.249706	.246046	.237356	.329153	.626310	.383739	.728560	.435051		
.046189	.046189	.046189	.046189	.046189	.046189	.046189	.046189	.046189	.046189
.046189	.046189	.046189	.046189	.046189	.046189	.046189	.046189		
.047127	.151484	.046189	.222078	.046189	.255670	.046189	.249471	.046189	.261161
.046189	.268186	.046189	.246729	.046189	.249095	.046189	.259380		
.047127	.151484	.046189	.222078	.046189	.255670	.046189	.249471	.046189	.261161
.046189	.268186	.046189	.246729	.046189	.249095	.046189	.259380		

WEIGHT-SKIN= 1.123766E+02 WEIGHT-S-PANELS= 1.512000E+01 WEIGHT-POSTS= 6.382194E-02 TOTAL-WEIGHT= 1.275604E+02
ELE SKIN= 17 ABASE= .2643E+00 ELE STRUCT= 19 CBASE= .2661E+00
STRUCTURE NO= 1 NO OF LOADS= 2 CYCLE NO= 17 EQ CYCLE NO= 6 NSTBLTY= 2

TIME USED IN SECONDS = 100.1490

RELATIVE AREAS OF MEMBERS

.184867	.411463	.223911	.592172	.300224	.714882	.273164	.767559	.317784	.841249
.364271	.304121	.634171	.455565	.717548	.406211	.813528	1.000000	.315252	.315252
.315252	.315252	.315252	.315252	.315252	.315252	.315252	.315252	.315252	.315252
.315252	.315252	.315252	.315252	.315252	.315252	.041667	.041667	.041667	.041667
.041667	.041667	.041667	.041667	.041667	.041667	.041667	.041667	.041667	.041667
.041667	.041667	.041667	.041667						
.043334	.043334	.193912	.060775	.170223	.115365	.143163	.166145	.187783	.216482
.234270	.267427	.504170	.308808	.567597	.360020	.683527	.408160		
.043334	.043334	.043334	.043334	.043334	.043334	.043334	.043334	.043334	.043334
.043334	.043334	.043334	.043334	.043334	.043334	.043334	.043334		
.049100	.162398	.043334	.244032	.043334	.278092	.043334	.279040	.043334	.230717
.043334	.296680	.043334	.251712	.043334	.251429	.043334	.274253		
.049100	.162398	.043334	.244032	.043334	.278092	.043334	.279040	.043334	.230717
.043334	.296680	.043334	.251712	.043334	.251429	.043334	.274253		

WEIGHT-SKIN= 1.225107E+02 WEIGHT-S-PANELS= 1.611615E+01 WEIGHT-POSTS= 6.333521E-02 TOTAL-WEIGHT= 1.386903E+02
ELE SKIN= 17 ABASE= .2819E+00 ELE STRUCT= 28 CBASE= .2643E+00
STRUCTURE NO= 1 NO OF LOADS= 2 CYCLE NO= 17 EQ CYCLE NO= 6 NSTBLTY= 3

TIME USED IN SECONDS = 105.1730

RELATIVE AREAS OF MEMBERS

.142827	.413534	.213193	.601667	.293894	.723640	.267405	.780066	.311085	.852602
.356592	.317736	.620301	.650642	.702469	.899123	.796377	1.000000	.308606	.308606
.308606	.308606	.308606	.308606	.308606	.308606	.308606	.308606	.308606	.308606
.308606	.308606	.308606	.308606	.308606	.308606	.040789	.040789	.040789	.040789
.040789	.040789	.040789	.040789	.040789	.040789	.040789	.040789	.040789	.040789
.040789	.040789	.040789	.040789						
.042420	.042420	.091932	.059494	.166634	.112933	.140145	.162642	.183824	.211918
.229331	.261789	.493540	.302297	.575209	.362430	.669117	.399555		
.042420	.042420	.042420	.042420	.042420	.042420	.042420	.042420	.042420	.042420
.042420	.042420	.042420	.042420	.042420	.042420	.042420	.042420		
.048994	.165399	.042420	.243876	.042420	.284164	.042420	.287502	.042420	.239132
.042420	.304763	.042420	.292962	.042420	.252136	.042420	.279012		
.048994	.165399	.042420	.243876	.042420	.284164	.042420	.287502	.042420	.239132

.042421 .304787 .042420 .252462 .042420 .252136 .042420 .279016

WEIGHT-SKIN= 1.260007E+02 WEIGHT-S-PANELS= 1.611615E+01 WEIGHT-POSTS= 6.339521E-02 TOTAL-WEIGHT= 1.421803E+02
ELE SKIN= 17 ABASE= .2878E+00 ELE STRUCT= 27 CBASE= .2700E+00
STRUCTURE NO= 1 NO OF LOADS= 2 CYCLE NO= 17 EQ CYCLE NO= 6 NSTBLTY= 4

TIME USED IN SECONDS = 110.1960

RELATIVE AREAS OF MEMBERS

.181997	.416779	.217926	.604242	.292196	.726068	.265860	.783730	.309287	.855868
.354531	.916427	.617213	.848798	.698410	.896660	.791775	1.000000	.306822	.306822
.306822	.306822	.306822	.306822	.306822	.306822	.306822	.306822	.306822	.306822
.306822	.306822	.306822	.306822	.306822	.306822	.040553	.040553	.040553	.040553
.040553	.040553	.040553	.040553	.040553	.040553	.040553	.040553	.040553	.040553
.040553	.040553	.040553	.040553						
.042175	.042175	.091401	.059150	.165671	.112280	.139335	.161702	.182762	.210693
.228006	.260276	.490688	.300550	.571865	.350393	.665250	.397246		
.042175	.042175	.042175	.042175	.042175	.042175	.042175	.042175	.042175	.042175
.042175	.042175	.042175	.042175	.042175	.042175	.042175	.042175		
.048824	.166215	.042175	.251459	.042175	.285806	.042175	.289926	.042175	.301500
.042175	.306988	.042175	.253037	.042175	.252046	.042175	.280289		
.048824	.166215	.042175	.251459	.042175	.285806	.042175	.289926	.042175	.301500
.042175	.306988	.042175	.253037	.042175	.252046	.042175	.280289		

WEIGHT-SKIN= 1.269635E+02 WEIGHT-S-PANELS= 1.611615E+01 WEIGHT-POSTS= 6.339521E-02 TOTAL-WEIGHT= 1.431491E+02
ELE SKIN= 17 ABASE= .2895E+00 ELE STRUCT= 33 CBASE= .2716E+00
STRUCTURE NO= 1 NO OF LOADS= 2 CYCLE NO= 17 EQ CYCLE NO= 6 NSTBLTY= 5

TIME USED IN SECONDS = 115.1890

RELATIVE AREAS OF MEMBERS

.181778	.417096	.217577	.604353	.291728	.726727	.265434	.784818	.308791	.856821
.353963	.917192	.616224	.848165	.697291	.895852	.790506	1.000000	.306331	.306331
.306331	.306331	.306331	.306331	.306331	.306331	.306331	.306331	.306331	.306331
.306331	.306331	.306331	.306331	.306331	.306331	.040488	.040488	.040488	.040488
.040488	.040488	.040488	.040488	.040488	.040488	.040488	.040488	.040488	.040488
.040488	.040488	.040488	.040488						
.042107	.042107	.091255	.059055	.165406	.112101	.139112	.161443	.182469	.210355
.227641	.259859	.489902	.300069	.570969	.349832	.664184	.396610		
.042107	.042107	.042107	.042107	.042107	.042107	.042107	.042107	.042107	.042107
.042107	.042107	.042107	.042107	.042107	.042107	.042107	.042107		
.048759	.166441	.042107	.251895	.042107	.286260	.042107	.290634	.042107	.302179
.042107	.307613	.042107	.252994	.042107	.251956	.042107	.280641		
.048759	.166441	.042107	.251895	.042107	.286260	.042107	.290634	.042107	.302179
.042107	.307613	.042107	.252994	.042107	.251956	.042107	.280641		

WEIGHT-SKIN= 1.272406E+02 WEIGHT-S-PANELS= 1.611615E+01 WEIGHT-POSTS= 6.339521E-02 TOTAL-WEIGHT= 1.434202E+02
ELE SKIN= 17 ABASE= .2900E+00 ELE STRUCT= 20 CBASE= .2720E+00
STRUCTURE NO= 1 NO OF LOADS= 2 CYCLE NO= 17 EQ CYCLE NO= 6 NSTBLTY= 6

TIME USED IN SECONDS = 120.2430

RELATIVE AREAS OF MEMBERS

.181656	.417184	.217480	.605149	.291598	.726911	.265316	.785141	.308654	.857100
.353805	.917410	.615950	.847959	.696960	.895597	.790154	1.000000	.306194	.306194
.306194	.306194	.306194	.306194	.306194	.306194	.306194	.306194	.306194	.306194
.306194	.306194	.306194	.306194	.306194	.306194	.040470	.040470	.040470	.040470

.040470	.040470	.040470	.040470	.040470	.040470	.040470	.040470	.040470	.040470
.040470	.040470	.040470	.040470						
.042089	.042089	.091714	.059029	.165332	.112051	.139050	.161371	.182388	.210262
.227934	.259744	.481684	.299935	.570714	.343676	.663888	.396433		
.042089	.042089	.042089	.042089	.042089	.042089	.042089	.042089	.042089	.042089
.042089	.042089	.042089	.042089	.042089	.042089	.042089	.042089		
.048740	.166503	.042089	.252016	.042089	.286386	.042089	.290841	.042089	.302375
.042089	.307789	.042089	.252967	.042089	.251916	.042089	.280739		
.048740	.166503	.042089	.252016	.042089	.286386	.042089	.290841	.042089	.302375
.042089	.307789	.042089	.252967	.042089	.251916	.042089	.280739		

WEIGHT-SKIN= 1.271686E+02 WEIGHT-S-PANELS= 1.611615E+01 WEIGHT-POSTS= 6.339521E-02 TOTAL-WEIGHT= 1.434963E+02
ELE SKI= 17 ABASE= .2901E+00 ELE STRUCT= 26 CBASE= .2722E+00
STRUCTURE NO= 1 NO OF LOADS= 2 CYCLE NO= 17 EQ CYCLE NO= 6 NSTBLTY= 7

TIME USED IN SECONDS = 125.3280

RELATIVE AREAS OF MEMBERS

.181634	.417208	.217453	.605204	.291561	.726361	.265283	.785237	.308615	.357182
.363761	.417472	.615873	.647394	.696893	.835519	.790056	1.000000	.306156	.306156
.306156	.306156	.306156	.306156	.306156	.306156	.306156	.306156	.306156	.306156
.306156	.306156	.306156	.306156	.306156	.306156	.040465	.040465	.040465	.040465
.040465	.040465	.040465	.040465	.040465	.040465	.040465	.040465	.040465	.040465
.040465	.040465	.040465	.040465						
.042083	.042083	.091203	.059022	.165311	.112037	.139033	.161351	.182365	.210235
.227511	.259711	.483623	.299898	.570643	.349633	.663806	.396384		
.042083	.042083	.042083	.042083	.042083	.042083	.042083	.042083	.042083	.042083
.042083	.042083	.042083	.042083	.042083	.042083	.042083	.042083		
.048734	.166521	.042083	.252050	.042083	.286421	.042083	.290401	.042083	.302431
.042083	.307439	.042083	.252956	.042083	.251902	.042083	.280766		
.048734	.166521	.042083	.252050	.042083	.286421	.042083	.290401	.042083	.302431
.042083	.307439	.042083	.252956	.042083	.251902	.042083	.280766		

1	BASEA=	.15770E+00	L-O= 1	ORI= 2	LAR= 2	PRONT=	.232	.232	.268	.268
2	BASEA=	.850786-01	L-O= 1	ORI= 3	LAR= 4	PRONT=	.101	.101	.339	.399
3	BASEA=	.28363E+00	L-O= 1	ORI= 2	LAR= 2	PRONT=	.413	.194	.134	.194
4	BASEA=	.16395E+00	L-O= 1	ORI= 3	LAR= 4	PRONT=	.098	.070	.416	.416
5	BASEA=	.28630E+00	L-O= 1	ORI= 2	LAR= 2	PRONT=	.567	.144	.144	.144
6	BASEA=	.16517E+00	L-O= 1	ORI= 3	LAR= 4	PRONT=	.154	.058	.394	.394
7	BASEA=	.28775E+00	L-O= 1	ORI= 2	LAR= 2	PRONT=	.524	.159	.159	.159
8	BASEA=	.23102E+00	L-O= 1	ORI= 1	LAR= 1	PRONT=	.205	.054	.370	.370
9	BASEA=	.29863E+00	L-O= 1	ORI= 2	LAR= 2	PRONT=	.541	.136	.136	.136
10	BASEA=	.27584E+00	L-O= 1	ORI= 1	LAR= 1	PRONT=	.245	.049	.353	.353
11	BASEA=	.28914E+00	L-O= 1	ORI= 2	LAR= 2	PRONT=	.643	.119	.119	.119
12	BASEA=	.24432E+00	L-O= 1	ORI= 1	LAR= 1	PRONT=	.283	.046	.336	.336
13	BASEA=	.28368E+00	L-O= 1	ORI= 2	LAR= 2	PRONT=	.735	.068	.068	.068
14	BASEA=	.26175E+00	L-O= 1	ORI= 1	LAR= 1	PRONT=	.354	.050	.298	.298
15	BASEA=	.28993E+00	L-O= 1	ORI= 2	LAR= 2	PRONT=	.619	.060	.060	.060
16	BASEA=	.27777E+00	L-O= 1	ORI= 3	LAR= 3	PRONT=	.398	.047	.281	.281
17	BASEA=	.29013E+00	L-O= 1	ORI= 2	LAR= 2	PRONT=	.840	.053	.053	.053
18	BASEA=	.23187E+00	L-O= 1	ORI= 1	LAR= 1	PRONT=	.396	.042	.241	.281
19	BASEA=	.27219E+00	L-O= 1							
20	BASEA=	.27219E+00	L-O= 1							
21	BASEA=	.27219E+00	L-O= 1							
22	BASEA=	.27219E+00	L-O= 1							
23	BASEA=	.27219E+00	L-O= 1							
24	BASEA=	.27219E+00	L-O= 1							
25	BASEA=	.27219E+00	L-O= 1							
26	BASEA=	.27219E+00	L-O= 1							
27	BASEA=	.27219E+00	L-O= 1							
28	BASEA=	.27219E+00	L-O= 1							
29	BASEA=	.27219E+00	L-O= 1							
30	BASEA=	.27219E+00	L-O= 1							
31	BASEA=	.27219E+00	L-O= 1							
32	BASEA=	.27219E+00	L-O= 1							
33	BASEA=	.27219E+00	L-O= 1							

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E=    34  BASEA=   .272195E+00  L-O= 1
E=    35  BASEA=   .272195E+00  L-O= 1
E=    36  BASEA=   .272195E+00  L-O= 1
E=    37  BASEA=   .952338E-05  L-O= 1
E=    38  BASEA=   .952338E-05  L-O= 1
E=    39  BASEA=   .952338E-05  L-O= 1
E=    40  BASEA=   .952338E-05  L-O= 1
E=    41  BASEA=   .952338E-05  L-O= 1
E=    42  BASEA=   .952338E-05  L-O= 1
E=    43  BASEA=   .952338E-05  L-O= 1
E=    44  BASEA=   .952338E-05  L-O= 1
E=    45  BASEA=   .952338E-05  L-O= 1
E=    46  BASEA=   .952338E-05  L-O= 1
E=    47  BASEA=   .952338E-05  L-O= 1
E=    48  BASEA=   .952338E-05  L-O= 1
E=    49  BASEA=   .952338E-05  L-O= 1
E=    50  BASEA=   .952338E-05  L-O= 1
E=    51  BASEA=   .952338E-05  L-O= 1
E=    52  BASEA=   .952338E-05  L-O= 1
E=    53  BASEA=   .952338E-05  L-O= 1
E=    54  BASEA=   .952338E-05  L-O= 1

 WEIGHT-SKIN=  1.273332E+02    WEIGHT-S-PANELS=  1.611615E+01    WEIGHT-POSTS=  6.339521E-02    TOTAL-WEIGHT=  1.435177E+02
     ELE SKIN=    17      ABASE=      .2901E+00      ELE STRUCT=    28      CBASE=      .2722E+00
 STRUCTURE NO=     1          NO OF LOADS=     2      CYCLE NO=    17    EQ CYCLE NO=     6      NSTBLTY=     8
                    MINIMUM WEIGHT CYCLE=    16
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*****S T R E S S E S*****

MEMB 1 NODES 1 3 7 5 AREA .1440E+03 THICK.5270E-01 LAYER(THICK) .1221E-01 .1221E-01 .1414E-01 .1414E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.3684E+03 .3404E+05-.3270E-08 2 -.1210E+05 .2691E+04 .5537E-07 3 .4418E+04 .7715E+04 .4906E+04 4 .4418E+04 .7715E+04-.4906E+04
2 1 -.3260E-10-.2586E-08-.2654E-11 2 .9715E-09-.2034E-09-.2654E-11 3 -.3366E-09-.5908E-09-.3808E-09 4 -.3019E-09-.5562E-09 .3411E-09
NODAL FORCES
1 -.4000E+04 .7130E-09 0. -.4000E+04 -.8713E-09 0. .4000E+04 -.3271E+03 0. .4000E+04 .3271E+03 0.
2 -.1170E-08 .1584E-09 0. .1773E-08 -.1513E-09 0. -.1780E-08 .1901E-09 0. .1177E-08 -.1976E-09 0.

MEMB 2 NODES 2 4 8 6 AREA .1440E+03 THICK.1210E+00 LAYER(THICK) .1221E-01 .1221E-01 .4831E-01 .4831E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 .8242E+03-.2345E+05 .1235E-08 2 .1496E+05-.1722E+04-.6990E-07 3 -.9741E+03-.3719E+04-.1897E+04 4 -.9741E+03-.3719E+04 .1897E+04
2 1 -.9875E-09 .2002E-07 .1118E+03 2 -.3091E-07 .1323E-08 .1118E+03 3 .7305E+03 .7305E+03 .8342E+03 4 -.7305E+03-.7305E+03 .8342E+03
NODAL FORCES
1 .4000E+04 .1632E-08 0. -.4000E+04 -.2321E-08 0. -.4000E+04 .1183E+04 0. -.4000E+04 -.1183E+04 0.
2 -.4307E-08 -.5000E+03 0. -.4657E-09 -.5000E+03 0 .1000E+04 .5000E+03 0. -.1000E+04 .5000E+03 0.

MEMB 3 NODES 5 7 11 9 AREA .1440E+03 THICK.6309E-01 LAYER(THICK) .2646E-01 .1221E-01 .1221E-01 .1221E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.1888E+03 .5963E+05-.3904E-08 2 -.1590E+05 .4823E+04 .7429E-07 3 .3406E+04 .1481E+05 .9790E+04 4 .9406E+04 .1481E+05-.9790E+04
2 1 -.1613E-10-.1185E-07-.2357E-09 2 .2534E-08-.9696E-09-.2357E-09 3 -.3602E-08-.4630E-08-.3842E-08 4 -.5218E-09-.1550E-08 .3241E-09
NODAL FORCES
1 -.1200E+05 -.3271E+03 0. -.1200E+05 .3271E+03 0. .1200E+05 -.3942E+02 0. .1200E+05 -.3942E+02 0.
2 -.1303E-08 .3683E-09 0. .6113E-08 .2565E-09 0. -.6738E-08 -.4945E-09 0. .1927E-08 -.1302E-09 0.

MEMB 4 NODES 6 8 12 10 AREA .1440E+03 THICK.1756E+00 LAYER(THICK) .1712E-01 .1221E-01 .7313E-01 .7313E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.1376E+04-.4609E+05 .1715E-08 2 -.2657E+05-.3441E+04-.1250E-06 3 -.2799E+04-.7991E+04-.4363E+04 4 -.2799E+04-.7991E+04 .4363E+04
2 1 -.4332E-08 .2248E-07 .7437E+02 2 -.3051E-07 .1473E-08 .7437E+02 3 .4859E+03 .4859E+03 .5549E+03 4 -.4859E+03-.4859E+03 .5549E+03
NODAL FORCES
1 .1200E+05 .1183E+04 0. .1200E+05 -.1183E+04 0. -.1200E+05 .4476E+03 0. -.1200E+05 -.4476E+03 0.
2 .1000E+04 -.5000E+03 0. -.1000E+04 -.5000E+03 0. .2000E+04 .5000E+03 0. -.2000E+04 .5000E+03 0.

MEMB 5 NODES 9 11 15 13 AREA .1440E+03 THICK.8459E-01 LAYER(THICK) .4796E-01 .1221E-01 .1221E-01 .1221E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.2836E+03 .5072E+05-.5874E-08 2 -.1724E+05 .4885E+04 .7660E-07 3 .9235E+04 .1481E+05 .9720E+04 4 .9235E+04 .1481E+05-.9720E+04
2 1 .7790E-10 .8228E-09-.3471E-09 2 -.8680E-09 .6310E-09-.3471E-09 3 -.5576E-09 .9243E-10-.9440E-09 4 .3977E-08 .4627E-08-.4235E-08
NODAL FORCES
1 -.2000E+05 .3342E+02 0. -.2000E+05 -.3942E+02 0. .2000E+05 .5668E+02 0. .2000E+05 -.5668E+02 0.
2 -.2647E-07 .3405E-10 0. .3294E-07 .3753E-09 0. -.2335E-07 -.5509E-09 0. .2548E-07 -.4535E-09 0.

MEMB 6 NODES 10 12 16 14 AREA .1440E+03 THICK.2109E+00 LAYER(THICK) .3250E-01 .1221E-01 .8310E-01 .8310E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.1555E+04-.5329E+05 .1380E-08 2 .3031E+05-.3987E+04-.1432E-06 3 -.3367E+04-.9341E+04-.5136E+04 4 -.3367E+04-.9341E+04 .5136E+04
2 1 -.1011E-08 .1688E-07 .6487E+02 2 -.2419E-07 .1095E-08 .6487E+02 3 .4235E+03 .4238E+03 .4840E+03 4 -.4238E+03-.4238E+03 .4840E+03
NODAL FORCES
1 .2000E+05 .4476E+03 0. -.2000E+05 -.4476E+03 0. -.2000E+05 -.1220E+04 0. -.2000E+05 .1220E+04 0.
2 .2000E+04 -.5000E+03 0. -.2000E+04 -.5000E+03 0. .3000E+04 .5000E+03 0. -.3000E+04 .5000E+03 0.

MEMB 7 NODES 11 15 10 17 AREA .1440E+03 THICK.7697E-01 LAYER(THICK) .4034E-01 .1221E-01 .1221E-01 .1221E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.9242E+03 .1051E+05-.7219E-08 2 -.1629E+05 .4310E+04 .7503E-07 3 .9550E+04 .1506E+05 .9949E+04 4 .9550E+04 .1506E+05-.9949E+04
2 1 -.2721E-09 .3386E-07-.2253E-09 2 -.8654E-08 .1823E-08-.1575E-09 3 .2618E-08 .4629E-08 .2587E-08 4 .4676E-08 .6686E-08-.4937E-08
NODAL FORCES
1 -.2800E+05 .5668E+02 0. -.2800E+05 -.5668E+02 0. .2800E+05 .2126E+02 0. .2800E+05 -.2126E+02 0.
2 -.7925E-07 -.3534E-10 0. .5851E-07 .5017E-09 0. -.5879E-07 -.3330E-09 0. .7973E-07 -.3334E-10 0.

MEMB 8 NODES 14 16 20 18 AREA .1440E+03 THICK.2278E+00 LAYER(THICK) .4681E-01 .1221E-01 .8440E-01 .8440E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 .7411E+04-.7358E+05 .9031E-09 2 .2600E+05-.3149E+04-.1239E-06 3 -.2108E+04-.7014E+04-.3688E+04 4 -.2108E+04-.7014E+04 .3688E+04
2 1 -.1746E-08 .8485E-08 .8907E+02 2 -.1846E-07 .1779E-09 .6226E+02 3 .4067E+03 .4067E+03 .4645E+03 4 -.4067E+03-.4067E+03 .4645E+03
NODAL FORCES
1 .2800E+05 -.1220E+04 0. -.2800E+05 .1220E+04 0. -.2800E+05 .2486E+03 0. -.2800E+05 -.2486E+03 0.
2 .3000E+04 -.5000E+03 0. -.3000E+04 -.5000E+03 0. .4000E+04 .5000E+03 0. -.4000E+04 .5000E+03 0.

MEMB 9 NODES 17 19 23 21 AREA .1440E+03 THICK.8954E-01 LAYER(THICK) .5291E-01 .1221E-01 .1221E-01 .1221E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.8710E+03 .1053E+06-.5374E-08 2 -.1603E+05 .4324E+04 .7511E-07 3 .9657E+04 .1515E+05 .1003E+05 4 .9657E+04 .1515E+05-.1003E+05
2 1 -.5035E-09 .5771E-07-.1569E-09 2 -.8923E-08 .2697E-08-.1047E-09 3 .4534E-08 .7558E-08 .4650E-08 4 .5963E-08 .8331E-08-.6287E-08
NODAL FORCES
1 -.3600E+05 .2126E+02 0. -.3600E+05 -.2126E+02 0. .3600E+05 -.4386E+02 0. .3600E+05 .4386E+02 0.
2 -.1513E-06 .6773E-10 0. .1118E-06 .2077E-09 0. -.1122E-06 -.3761E-09 0. .1516E-06 .2053E-10 0.

MEMB 10 NODES 18 20 24 22 AREA .1440E+03 THICK.2437E+00 LAYER(THICK) .6099E-01 .1221E-01 .8774E-01 .8774E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 .3063E+04-.7843E+05 .7619E-09 2 .2443E+05-.3274E+04-.1160E-06 3 -.2380E+04-.7746E+04-.4296E+04 4 -.2880E+04-.7746E+04 .4296E+04
2 1 .4834E-09-.1286E-07 .8463E+02 2 -.3868E-08-.6015E-09 .5915E+02 3 .3865E+03 .3865E+03 .4413E+03 4 -.3865E+03-.3865E+03 .4413E+03
NODAL FORCES
1 .3600E+05 .2486E+03 0. -.3600E+05 -.2486E+03 0. -.3600E+05 .4951E+01 0. -.3600E+05 -.4951E+01 0.
2 .4000E+04 -.5000E+03 0. -.4000E+04 -.5000E+03 0. .5000E+04 .5000E+03 0. -.5000E+04 .5000E+03 0.

MEMB 11 NODES 21 23 27 25 AREA .1440E+03 THICK.1026E+00 LAYER(THICK) .6601E-01 .1221E-01 .1221E-01 .1221E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.3912E+03 .1344E+06-.3345E-08 2 -.1339E+05 .4933E+04 .6352E-07 3 .1036E+05 .1563E+05 .1051E+05 4 .1036E+05 .1563E+05-.1051E+05
2 1 -.2143E-09 .7467E-07-.2320E-09 2 -.9224E-08 .3535E-08-.1621E-09 3 .6459E-08 .1020E-07 .6384E-08 4 .8579E-08 .1232E-07-.8804E-08
NODAL FORCES
1 -.4400E+05 -.4386E+02 0. -.4400E+05 .4986E+02 0. .4400E+05 .7152E+03 0. .4400E+05 -.7152E+03 0.
2 -.9361E-06 .4641E-10 0. .1732E-06 .5151E-09 0. -.1737E-06 .1668E-08 0. .2367E-06 -.7234E-09 0.

MEMB 12 NODES 22 24 28 26 AREA .1440E+03 THICK.2662E+00 LAYER(THICK) .7535E-01 .1221E-01 .8931E-01 .8931E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 .3157E+04-.7781E+05 .6155E-09 2 .2516E+05-.3376E+04-.1146E-06 3 -.2984E+04-.6000E+04-.4441E+04 4 -.2984E+04-.6000E+04 .4441E+04
2 1 .7066E-09-.2986E-07 .8207E+02 2 -.6079E-09-.1391E-08 .5736E+02 3 .3748E+03 .3748E+03 .4280E+03 4 -.3748E+03-.3748E+03 .4280E+03
NODAL FORCES
1 .4400E+05 .4951E+01 0. .4400E+05 -.4951E+01 0. -.4400E+05 .1452E+03 0. -.4400E+05 -.1452E+03 0.
2 .6000E+04 -.5000E+03 0. -.6000E+04 -.5000E+03 0. .6000E+04 .5000E+03 0. -.6000E+04 .5000E+03 0.

MEMB 13 NODES 25 27 31 29 AREA .1440E+03 THICK.1787E+00 LAYER(THICK) .1421E+00 .1221E-01 .1221E-01 .1221E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.6359E+03 .5310E+05-.2792E-08 2 -.1665E+05 .5491E+04 .3013E-07 3 .3489E+04 .1391E+05 .9024E+04 4 .9489E+04 .1391E+05-.9024E+04
2 1 -.5078E-09 .4344E-07-.8872E-10 2 -.1368E-07 .4498E-08-.8872E-10 3 .7231E-08 .1097E-07 .6752E-08 4 .8657E-08 .1233E-07-.8343E-08
NODAL FORCES
1 -.5200E+05 .7152E+03 0. -.5200E+05 -.7152E+03 0. .5200E+05 -.2831E+02 0. .5200E+05 .2831E+02 0.
2 -.3296E-06 .6309E-09 0. .2424E-06 -.2276E-09 0. -.2433E-06 -.3053E-09 0. .3300E-06 -.4802E-10 0.

MEMB 14 NODES 26 28 32 30 AREA .1440E+03 THICK.2460E+00 LAYER(THICK) .8701E-01 .1221E-01 .7334E-01 .7334E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 .3221E+04-.7683E+05 .1259E-08 2 .4387E+05-.7479E+04-.2243E-06 3 -.5732E+04-.1288E+05-.7176E+04 4 -.5732E+04-.1288E+05 .7176E+04
2 1 .1575E-08-.4230E-07 .5752E+02 2 .1301E-07-.3864E-08 .5752E+02 3 .4427E+03 .4427E+03 .5269E+03 4 -.4427E+03-.4427E+03 .5269E+03
NODAL FORCES
1 .5200E+05 .1452E+03 0. .5200E+05 -.1452E+03 0. -.5200E+05 -.1602E+03 0. -.5200E+05 .1602E+03 0.
2 .6000E+04 -.5000E+03 0. -.6000E+04 -.5000E+03 0. .7000E+04 .6000E+03 0. -.7000E+04 .6000E+03 0.

MEMB 15 NODES 29 31 35 33 AREA .1440E+03 THICK.2022E+00 LAYER(THICK) .1656E+00 .1221E-01 .1221E-01 .1221E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 -.4694E+03 .5736E+05-.2389E-08 2 -.1508E+05 .5936E+04 .8317E-07 3 .3918E+04 .1424E+05 .9314E+04 4 .9313E+04 .1424E+05-.9314E+04
2 1 -.4363E-09 .5359E-07-.6724E-10 2 -.1396E-07 .5544E-08-.6724E-10 3 .3647E-08 .1264E-07 .7560E-08 4 .9682E-08 .1364E-07-.9226E-08
NODAL FORCES
1 -.6000E+05 -.2831E+02 0. -.6000E+05 .2831E+02 0. .6000E+05 -.2639E+03 0. .6000E+05 .2639E+03 0.
2 -.4273E-06 .4390E-10 0. .3163E-06 .2807E-09 0. -.3167E-06 -.5079E-09 0. .4276E-06 .1833E-09 0.

MEMB 16 NODES 30 32 36 34 AREA .1440E+03 THICK.2593E+00 LAYER(THICK) .1014E+00 .1221E-01 .7308E-01 .7308E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 .3519E+04-.7929E+05 .1435E-08 2 .4705E+05-.7672E+04-.2397E-06 3 -.5336E+04-.1281E+05-.6999E+04 4 -.5335E+04-.1281E+05 .6999E+04
2 1 .2551E-08-.5513E-07 .5717E+02 2 .2446E-07-.5033E-08 .5717E+02 3 .4401E+03 .4401E+03 .5257E+03 4 -.4401E+03-.4401E+03 .5257E+03
NODAL FORCES
1 .6000E+05 -.1602E+03 0. .6000E+05 .1602E+03 0. -.6000E+05 .1653E+04 0. -.6000E+05 -.1653E+04 0.
2 .7000E+04 -.5000E+03 0. -.7000E+04 -.5000E+03 0. .8000E+04 .5000E+03 0. -.8000E+04 .5000E+03 0.

MEMB 17 NODES 33 35 39 37 AREA .1440E+03 THICK.2292E+00 LAYER(THICK) .1926E+00 .1221E-01 .1221E-01 .1221E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1 .3356E+03 .5647E+05-.1218E-08 2 -.7430E+04 .6000E+04 .4801E-07 3 .1195E+05 .1574E+05 .1068E+05 4 .1195E+05 .1574E+05-.1068E+05
2 1 .3573E-09 .5598E-07-.6299E-10 2 -.7136E-08 .5952E-08-.6299E-10 3 .1143E-07 .1517E-07 .1005E-07 4 .1240E-07 .1614E-07-.1121E-07
NODAL FORCES

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1 -.6800E+05 -.2639E+03 0.          -.6800E+05  .2639E+03 0.          .6800E+05  .2326E+04 0.          .6800E+05 -.2926E+04 0.
2 -.5265E-06 -.1893E-09 0.           .3917E-06  .5138E-09 0.         -.3920E-06  .2759E-08 0.          .5269E-06 -.3083E-08 0.


MEMB   18  NODES    34   36   40   38  AREA .1440E+03  THICK.2901E+00  LAYER(THICK) .1150E+00 .1221E-01 .8146E-01 .3146E-01
STRESSES IN INDIVIDUAL LAYERS(LOCAL COORDINATES)
1 1  .1158E+04-.7385E+05 .4463E-04 2  .2473E+05-.7549E+04-.1326E-06 3 -.1106E+05-.1687E+05-.1077E+05 4 -.1106E+05-.1687E+05 .1077E+05
2 1  .9329E-09-.5873E-07 .5127E+02 2  .1115E-07-.5738E-08 .5127E+02 3  .3947E+03 .3947E+03 .4715E+03 4 -.3947E+03-.3947E+03 .4715E+03
NODAL FORCES
1  .6800E+05  .1653E+04 0.          .6800E+05 -.1653E+04 0.          -.6800E+05 -.1473E+05 0.          -.6800E+05  .1473E+05 0.
2  .8000E+04 -.5000E+03 0.          -.8000E+04 -.5000E+03 0.          .9000E+04  .5000E+03 0.          -.9000E+04  .5000E+03 0.
MEMB   19  NODES     1    2    6    5  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2 -.1510E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.6519E-08 0.          -.1630E-08 -.6519E-08 0.          .1630E-08  .6519E-08 0.          -.1630E-08
MEMB   20  NODES     3    4    8    7  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2  .5253E-08
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.5588E-08 0.          .1397E-08  .5588E-08 0.          -.1397E-08 -.5588E-08 0.          -.1397E-08
MEMB   21  NODES     5    6   10    9  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2 -.3737E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.2049E-07 0.          .5122E-08  .2049E-07 0.          -.5122E-08 -.2049E-07 0.          .5122E-08
MEMB   22  NODES     7    8   12   11  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2  .3338E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.1770E-07 0.          .4424E-08  .1770E-07 0.          -.4424E-08 -.1770E-07 0.          -.4424E-08
MEMB   23  NODES     9   10   14   13  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2 -.4227E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.2282E-07 0.          .5704E-08  .2282E-07 0.          -.5704E-08 -.2282E-07 0.          .5704E-08
MEMB   24  NODES    11   12   16   15  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2  .4439E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.2654E-07 0.          .6636E-08  .2654E-07 0.          -.6636E-08 -.2654E-07 0.          -.6636E-08
MEMB   25  NODES    13   14   18   17  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2 -.6404E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2  .3446E-07 0.          -.8615E-08 -.3446E-07 0.          .8615E-08  .3446E-07 0.          .8615E-08
MEMB   26  NODES    15   16   20   19  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2  .5127E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.3073E-07 0.          .7683E-08  .3073E-07 0.          -.7683E-08 -.3073E-07 0.          -.7683E-08
MEMB   27  NODES    17   18   22   21  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2 -.7534E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2  .4005E-07 0.          -.1001E-07 -.4005E-07 0.          .1001E-07  .4005E-07 0.          .1001E-07
MEMB   28  NODES    19   20   24   23  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2  .6053E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.3329E-07 0.          .8324E-08  .3329E-07 0.          -.8324E-08 -.3329E-07 0.          -.8324E-08
MEMB   29  NODES    21   22   26   25  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2 -.8530E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2  .4610E-07 0.          -.1153E-07 -.4610E-07 0.          .1153E-07  .4610E-07 0.          .1153E-07
MEMB   30  NODES    23   24   28   27  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2  .6664E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.3679E-07 0.          .9197E-08  .3679E-07 0.          -.9197E-08 -.3679E-07 0.          -.9197E-08
MEMB   31  NODES    25   26   30   29  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2 -.9013E-07
        NODAL FORCES
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1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2  .4773E-07 0.          -.1193E-07 -.4773E-07 0.          -.1193E-07 -.4773E-07 0.          .1193E-07  .4773E-07 0.          .1193E-07
MEMB   32  NODES   27    28    32    31  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2  .6348E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.3690E-07 0.           .9226E-08  .3690E-07 0.           .9226E-08  .3690E-07 0.         -.9226E-08 -.3690E-07 0.         -.9226E-08
MEMB   33  NODES   29    30    34    33  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2 -.3216E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2  .4920E-07 0.          -.1230E-07 -.4920E-07 0.          -.1230E-07 -.4920E-07 0.          .1230E-07  .4920E-07 0.          .1230E-07
MEMB   34  NODES   31    32    36    35  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2  .7002E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.3747E-07 0.           .9366E-08  .3747E-07 0.           .9366E-08  .3747E-07 0.         -.9366E-08 -.3747E-07 0.         -.9366E-08
MEMB   35  NODES   33    34    38    37  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2 -.3284E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2  .4951E-07 0.          -.1238E-07 -.4951E-07 0.          -.1238E-07 -.4951E-07 0.          .1238E-07  .4951E-07 0.          .1238E-07
MEMB   36  NODES   35    36    40    39  AREA .3600E+02  THICK .8882E-01
STRESSES
1 -.7506E+04 2  .7037E-07
        NODAL FORCES
1  .4000E+04 0.          -.1000E+04 -.4000E+04 0.          -.1000E+04 -.4000E+04 0.          .1000E+04  .4000E+04 0.          .1000E+04
2 -.3753E-07 0.           .9382E-08  .3753E-07 0.           .9382E-08  .3753E-07 0.         -.9382E-08 -.3753E-07 0.         -.9382E-08
MEMB   37  NODES    1     2  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .7988E-06 2  .1243E-06
NODAL FORCES
1 0.          0.           .9313E-08 0.          0.          -.9313E-08
2 0.          0.           .1630E-08 0.          0.          -.1630E-08
MEMB   38  NODES    3     4  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .3948E-06 2 -.1741E-06
NODAL FORCES
1 0.          0.           .1304E-07 0.          0.          -.1304E-07
2 0.          0.          -.2095E-08 0.          0.           .2095E-08
MEMB   39  NODES    5     6  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .3479E-06 2  .1113E-06
NODAL FORCES
1 0.          0.           .3725E-08 0.          0.          -.3725E-08
2 0.          0.           .1164E-08 0.          0.          -.1164E-08
MEMB   40  NODES    7     8  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .5569E-06 2 -.3704E-07
NODAL FORCES
1 0.          0.           .7451E-08 0.          0.          -.7451E-08
2 0.          0.          -.9313E-09 0.          0.           .9313E-09
MEMB   41  NODES    9    10  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .3979E-06 2  .2487E-07
NODAL FORCES
1 0.          0.           .4657E-08 0.          0.          -.4657E-08
2 0.          0.           .2328E-09 0.          0.          -.2328E-09
MEMB   42  NODES   11    12  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .3979E-06 2 -.7461E-07
NODAL FORCES
1 0.          0.           .4657E-08 0.          0.          -.4657E-08
2 0.          0.          -.9313E-09 0.          0.           .9313E-09
MEMB   43  NODES   13    14  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .2487E-06 2  .2487E-07
NODAL FORCES
1 0.          0.           .2734E-08 0.          0.          -.2734E-08
2 0.          0.           .3492E-09 0.          0.          -.3492E-09
MEMB   44  NODES   15    16  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .2984E-06 2 -.2487E-07
NODAL FORCES
1 0.          0.           .3725E-08 0.          0.          -.3725E-08
2 0.          0.          -.3492E-09 0.          0.           .3492E-09
MEMB   45  NODES   17    18  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .4974E-07 2  .3109E-07
NODAL FORCES
1 0.          0.           .4657E-09 0.          0.          -.4657E-09
2 0.          0.           .3492E-09 0.          0.          -.3492E-09
MEMB   46  NODES   19    20  LENGTH .3000E+01  AREA .1174E-01
STRESSES
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1  .1492E-06 2 -.2487E-07
NODAL FORCES
1 0.          0.           .1397E-08 0.          0.          -.1397E-08
2 0.          0.          -.2910E-09 0.          0.           .2910E-09
MEMB   47  NODES   21   22  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .7461E-07 2  .1865E-07
NODAL FORCES
1 0.          0.           .9313E-09 0.          0.          -.9313E-09
2 0.          0.           .2328E-09 0.          0.          -.2328E-09
MEMB   48  NODES   23   24  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .4974E-07 2 -.2798E-07
NODAL FORCES
1 0.          0.           .4657E-09 0.          0.          -.4657E-09
2 0.          0.          -.2910E-09 0.          0.           .2910E-09
MEMB   49  NODES   25   26  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .7461E-07 2  .6217E-08
NODAL FORCES
1 0.          0.           .6985E-09 0.          0.          -.6985E-09
2 0.          0.           .5821E-10 0.          0.          -.5821E-10
MEMB   50  NODES   27   28  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .6217E-07 2 -.1554E-07
NODAL FORCES
1 0.          0.           .9313E-09 0.          0.          -.9313E-09
2 0.          0.          -.1746E-09 0.          0.           .1746E-09
MEMB   51  NODES   29   30  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .1865E-07 2  .5440E-08
NODAL FORCES
1 0.          0.           .2328E-09 0.          0.          -.2328E-09
2 0.          0.           .5821E-10 0.          0.          -.5821E-10
MEMB   52  NODES   31   32  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .3109E-07 2 -.7772E-08
NODAL FORCES
1 0.          0.           .3492E-09 0.          0.          -.3492E-09
2 0.          0.          -.8731E-10 0.          0.           .8731E-10
MEMB   53  NODES   33   34  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .1088E-07 2  .3714E-09
NODAL FORCES
1 0.          0.           .1455E-09 0.          0.          -.1455E-09
2 0.          0.           .1455E-10 0.          0.          -.1455E-10
MEMB   54  NODES   35   36  LENGTH .3000E+01  AREA .1174E-01
STRESSES
1  .9326E-08 2 -.3886E-09
NODAL FORCES
1 0.          0.           .1164E-09 0.          0.          -.1164E-09
2 0.          0.          -.3638E-11 0.          0.           .3638E-11
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*****DISPLACEMENTS*****

JOINT	-X	-Y	-Z	FORCE-X	FORCE-Y	FORCE-Z	DISPL-X	DISPL-Y	DISPL-Z
1	0.000	0.000	3.000	0.000	0.000	-1000.000	-2.832886614E-01	3.354886671E-03	-9.517178531E+00
2	0.000	0.000	6.000	0.000	0.000	0.000	-1.850763211E-12	2.003674444E-11	-1.147501271E+00
3	0.000	12.000	3.000	0.000	0.000	-1000.000	2.529383801E-01	-3.097218911E-03	-9.517178531E+00
4	0.000	12.000	6.000	0.000	-500.000	0.000	6.061535441E-02	-5.838271671E-01	-1.147501271E+00
5	12.000	0.000	3.000	0.000	0.000	-1000.000	-2.832886614E-01	-3.354886651E-03	-9.517178531E+00
6	12.000	0.000	6.000	0.000	0.000	0.000	1.611760731E-12	2.003572671E-11	1.147501271E+00
7	12.000	12.000	3.000	0.000	0.000	-1000.000	2.529383801E-01	3.097218871E-03	-9.517178531E+00
8	12.000	12.000	6.000	0.000	-500.000	0.000	-6.061535441E-02	-5.838271671E-01	1.147501271E+00
9	24.000	0.000	3.000	0.000	0.000	0.000	-2.611398261E-01	4.931203701E-03	-7.439460511E+00
10	24.000	0.000	6.000	0.000	0.000	0.000	-1.838252401E-12	1.658668451E-11	-9.114505211E-01
11	24.000	12.000	3.000	0.000	0.000	0.000	2.375893221E-01	-6.890041251E-03	-7.439460511E+00
12	24.000	12.000	6.000	0.000	0.000	0.000	5.741001901E-02	-4.637376421E-01	-9.114505211E-01
13	36.000	0.000	3.000	0.000	0.000	0.000	-2.611398261E-01	-4.931203661E-03	-7.439460511E+00
14	36.000	0.000	6.000	0.000	0.000	0.000	1.595863241E-12	1.658902691E-11	9.114505211E-01
15	36.000	12.000	3.000	0.000	0.000	0.000	2.375893221E-01	6.890041211E-03	-7.439460511E+00
16	36.000	12.000	6.000	0.000	0.000	0.000	-5.741001901E-02	-4.637376421E-01	9.114505211E-01
17	48.000	0.000	3.000	0.000	0.000	0.000	-2.223757791E-01	6.166621911E-03	-5.574525211E+00
18	48.000	0.000	6.000	0.000	0.000	0.000	-1.821831961E-12	1.317286771E-11	-6.959654781E-01
19	48.000	12.000	3.000	0.000	0.000	0.000	2.074598581E-01	-1.091165151E-02	-5.574525211E+00
20	48.000	12.000	6.000	0.000	0.000	0.000	5.033250231E-02	-3.546221201E-01	-6.959654781E-01
21	60.000	0.000	3.000	0.000	0.000	0.000	-2.223757791E-01	-6.166621871E-03	-5.574525211E+00
22	60.000	0.000	6.000	0.000	0.000	0.000	1.564068261E-12	1.317412621E-11	6.359654781E-01
23	60.000	12.000	3.000	0.000	0.000	0.000	2.074598561E-01	1.091165151E-02	-5.574525211E+00
24	60.000	12.000	6.000	0.000	0.000	0.000	-5.033250231E-02	-3.546221201E-01	6.359654781E-01
25	72.000	0.000	3.000	0.000	0.000	0.000	-1.829313331E-01	5.809042991E-03	-3.995929011E+00
26	72.000	0.000	6.000	0.000	0.000	0.000	-1.718548811E-12	9.880452261E-12	-5.114319521E-01
27	72.000	12.000	3.000	0.000	0.000	0.000	1.726282621E-01	-9.401462331E-03	-3.995929011E+00
28	72.000	12.000	6.000	0.000	0.000	0.000	4.193426071E-02	-2.611578221E-01	-5.114319521E-01
29	84.000	0.000	3.000	0.000	0.000	0.000	-1.829313331E-01	-5.809042961E-03	-3.995929011E+00
30	84.000	0.000	6.000	0.000	0.000	0.000	1.471434821E-12	9.877843151E-12	5.114319521E-01
31	84.000	12.000	3.000	0.000	0.000	0.000	1.726282621E-01	9.401462391E-03	-3.995929011E+00
32	84.000	12.000	6.000	0.000	0.000	0.000	-4.193426071E-02	-2.611578221E-01	5.114319521E-01
33	96.000	0.000	3.000	0.000	0.000	0.000	-1.434505171E-01	5.556592171E-03	-2.700560331E+00
34	96.000	0.000	6.000	0.000	0.000	0.000	-1.517390861E-12	6.875479921E-12	-3.568275831E-01
35	96.000	12.000	3.000	0.000	0.000	0.000	1.447713621E-01	-8.033396871E-03	-2.700560331E+00
				0.000	0.000	0.000	3.536792411E-02	-1.827062981E-01	-3.568275831E-01
				0.000	0.000	0.000	-1.434505171E-01	-5.556592151E-03	-2.700560331E+00
				0.000	0.000	0.000	1.299466801E-12	6.870160671E-12	3.568275831E-01
				0.000	0.000	0.000	1.447713621E-01	8.033398851E-03	-2.700560331E+00
				0.000	0.000	0.000	-3.536792411E-02	-1.827062981E-01	3.568275831E-01
				0.000	0.000	0.000	-1.039055461E-01	5.640840171E-03	-1.676007001E+00
				0.000	0.000	0.000	-1.216995551E-12	4.336220501E-12	-2.291027941E-01
				0.000	0.000	0.000	1.162463741E-01	-8.351633091E-03	-1.676007001E+00
				0.000	0.000	0.000	2.849447041E-02	-1.177518431E-01	-2.291027941E-01
				0.000	0.000	0.000	-1.039055461E-01	-5.640840151E-03	-1.676007001E+00
				0.000	0.000	0.000	1.042431931E-12	4.329084761E-12	2.291027941E-01
				0.000	0.000	0.000	1.162463741E-01	8.351633071E-03	-1.676007001E+00
				0.000	0.000	0.000	-2.849447041E-02	-1.177518431E-01	2.291027941E-01
				0.000	0.000	0.000	-6.472352201E-02	3.844017721E-03	-9.248086421E-01
				0.000	0.000	0.000	-8.350049201E-13	2.427195821E-12	-1.293115901E-01
				0.000	0.000	0.000	8.682086741E-02	-8.524336231E-03	-9.248086421E-01
				0.000	0.000	0.000	2.140113131E-02	-6.679721841E-02	-1.293115901E-01
				0.000	0.000	0.000	-6.472352201E-02	-3.844017711E-03	-9.248086421E-01
				0.000	0.000	0.000	7.164761001E-13	2.421214201E-12	1.293115901E-01
				0.000	0.000	0.000	8.682086741E-02	8.524336231E-03	-9.248086421E-01
				0.000	0.000	0.000	-2.140113131E-02	-6.679721841E-02	1.293115901E-01
				0.000	0.000	0.000	-4.288500741E-02	2.868271211E-03	-4.126305791E-01
				0.000	0.000	0.000	-5.835516081E-13	1.107357081E-12	-5.771619741E-02
				0.000	0.000	0.000	5.775676801E-02	-8.511370981E-03	-4.126305791E-01
				0.000	0.000	0.000	1.439656521E-02	-3.025737381E-02	-5.771619741E-02
				0.000	0.000	0.000	-4.288500741E-02	-2.868271211E-03	-4.126305791E-01
				0.000	0.000	0.000	5.014300891E-13	1.102300691E-12	5.771619741E-02
				0.000	0.000	0.000	5.775676801E-02	8.511370671E-03	-4.126305791E-01
				0.000	0.000	0.000	-1.439656521E-02	-3.025737381E-02	5.771619741E-02
				0.000	0.000	0.000	-2.115093471E-02	3.254067271E-03	-1.056735141E-01
				0.000	0.000	0.000	-3.012916311E-13	2.842826161E-13	-1.446153351E-02
				0.000	0.000	0.000	2.778295571E-02	-9.730331591E-03	-1.056735141E-01
				0.000	0.000	0.000	7.230766741E-03	-7.892375931E-03	-1.446153351E-02
				0.000	0.000	0.000	-2.115093471E-02	-3.254067271E-03	-1.056735141E-01
				0.000	0.000	0.000	2.593659911E-13	2.780006371E-13	1.446153351E-02

JOINT	-X	-Y	-Z	FORCE-X	FORCE-Y	FORCE-Z	DISPL-X	DISPL-Y	DISPL-Z
36	96.000	12.000	6.000	0.000	0.000	0.000	2.77829557E-02	9.73093158E-03	-1.05673514E-01
37	108.000	0.000	9.000	0.000	0.000	0.000	-7.23076674E-03	-7.89237553E-03	1.44615335E-02
38	108.000	0.000	6.000	0.000	0.000	0.000	0.	0.	0.
39	108.000	12.000	9.000	0.000	0.000	0.000	0.	0.	0.
40	108.000	12.000	6.000	0.000	0.000	0.000	0.	0.	0.
				0.000	0.000	0.	0.	0.	

NUMBER OF LAMINAE IN COMPOSITE ELEMENTS

(1)	3	3	3	3	(2)	3	3	10	10	(3)	6	3	3	3	(4)	4	3	15	15	(5)	10	3	3	3
(6)	7	3	16	16	(7)	8	3	3	3	(8)	10	3	17	17	(9)	11	3	3	3	(10)	12	3	17	17
(11)	13	3	3	3	(12)	15	3	18	18	(13)	28	3	3	3	(14)	17	3	15	15	(15)	32	3	3	3
(16)	20	3	15	15	(17)	38	3	3	3	(18)	23	3	16	16	(									

TOTAL THICKNESS OF ELEMENTS

	1	2	3	4	5	6	7	8	9	0	
0	.527E-01	.121E+00	.631E-01	.176E+00	.846E-01	.211E+00	.770E-01	.228E+00	.895E-01	.249E+00	10
1	.103E+00	.266E+00	.179E+00	.246E+00	.202E+00	.260E+00	.229E+00	.290E+00	.888E-01	.888E-01	20
2	.888E-01	.888E-01	.888E-01	.888E-01	.888E-01	.888E-01	.888E-01	.888E-01	.888E-01	.888E-01	30
3	.888E-01	.888E-01	.888E-01	.888E-01	.888E-01	.888E-01	.117E-01	.117E-01	.117E-01	.117E-01	40
4	.117E-01	.117E-01	.117E-01	.117E-01	.117E-01	.117E-01	.117E-01	.117E-01	.117E-01	.117E-01	50
5	.117E-01	.117E-01	.117E-01	.117E-01	0.						

TIME USED IN SECONDS = 131.6260

RELATIVE AREAS OF MEMBERS

.181634	.417208	.217453	.605204	.291561	.726961	.265283	.785237	.308615	.657182
.353761	.917472	.615373	.847894	.696893	.895519	.790056	1.000000	.306156	.306156
.306156	.306156	.306156	.306156	.306156	.306156	.306156	.306156	.306156	.306156
.306156	.306156	.306156	.306156	.306156	.306156	.040465	.040465	.040465	.040465
.040465	.040465	.040465	.040465	.040465	.040465	.040465	.040465	.040465	.040465
.040465	.040465	.040465	.040465						
.042083	.042083	.091203	.059022	.165311	.112037	.139033	.161351	.182365	.210235
.227511	.259711	.483623	.239898	.570643	.349633	.663806	.396384		
.042083	.042083	.042083	.042083	.042083	.042083	.042083	.042083	.042083	.042083
.042083	.042083	.042083	.042083	.042083	.042083	.042083	.042083		
.048734	.166521	.042083	.252050	.042083	.286421	.042083	.290901	.042083	.302431
.042083	.307839	.042083	.252956	.042083	.251902	.042083	.280766		
.048734	.166521	.042083	.252050	.042083	.286421	.042083	.290901	.042083	.302431
.042083	.307839	.042083	.252956	.042083	.251902	.042083	.280766		

*****REACTIONS*****

JOINT	-X	-Y	-Z	FORCE-X	FORCE-Y	FORCE-Z	DISPL-X	DISPL-Y	DISPL-Z
37	108.000	0.000	9.000	72000.000	-2925.050	1000.000	0.	0.	0.
				.000	-.000	.000	0.	0.	0.
38	108.000	0.000	6.000	-72000.000	14793.688	1000.000	0.	0.	0.
				-9000.000	500.000	.000	0.	0.	0.
39	108.000	12.000	9.000	72000.000	2925.380	1000.000	0.	0.	0.
				-.000	.000	-.000	0.	0.	0.
40	108.000	12.000	6.000	-72000.000	-14793.688	1000.000	0.	0.	0.
				9000.000	500.000	-.000	0.	0.	0.

SUMMATION OF FORCES

APPLIED LOADS

LOAD COND	MX	MY	MZ	FX	FY	FZ
1	-.240000E+05	.113062E-04	-.144342E-05	.226279E-06	.486921E-08	-.400000E+04
2	.600000E+04	-.139336E-07	-.251407E-06	-.250387E-07	-.100000E+04	-.389991E-08

REACTIONS

LOAD COND	MX	MY	MZ	FX	FY	FZ
1	.240000E+05	-.134669E-04	.131130E-05	-.137836E-06	-.383709E-08	.400000E+04
2	-.600000E+04	-.451681E-07	-.200467E-06	.267755E-07	.100000E+04	.598811E-08

TIME USED IN SECONDS = 133.1600

********** X1NN0A4 //// END OF LIST ////
********** X1NN0A4 //// END OF LIST ////

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