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A STRUCTURAL WEIGHT ESTIMATION PROGRAM (SWEEP) FOR AIRCRAFT. VOLUME X - FLUTTER OPTIMIZATION STAND-ALONE PROGRAM

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Three computer programs were written with the objective of predicting the structural weight of aircraft through analytical methods. The first program, the structural weight estimation program (SWEEP), is a completely integrated program including routines for airloads, loads spectra, skin temperatures, material properties, flutter stiffness requirements, fatigue life, structural sizing, and for weight estimation of each of the major aircraft structural components. The program produces first-order weight estimates

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered) and indicates trends when parameters are varied. Fighters, bombers, and cargo aircraft can be analyzed by the program. The program operates within 100,000 octal units on the Control Data Corporation 6600 computer. Two stand-alone programs operating within 100,000 octal units were also developed to provide optional data sources for SWEEP. These include (1) the flexible airloads program to assess the effects of flexibility on lifting surface airloads, and (2) the flutter optimization program to optimize the stiffness distribution required for lifting surface flutter prevention.

The final report is composed of 11 volumes. This volume (volume X) contains the methodology, program description, and user's information for the flutter optimization stand-alone program.

PREFACE

This report was prepared by Rockwell International Corporation, Los Angeles Aircraft Division, Los Angeles, California, under Contract F33615-71-C-1922, No. FX2826-71-01876/C093. The work was performed for the Deputy for Development Planning, Air Force System Command, Wright-Patterson Air Force Base, Ohio, and extended from September 1971 to June 1974.

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The final report was published in 11 volumes; the complete list is as follows:

Volume	
I	"Executive Summary"
II	"Program Integration and Data Management Module"
III	"Airloads Estimation Module"
IV	"Material Properties, Structure Temperature, Flutter, and Fatigue"
V	"Air Induction System and Landing Gear Modules"
VI	"Wing and Empennage Module"
VII	"Fuselage Module"
VIII	"Programmer's Manual"
IX	"User's Manual"
X	"Flutter Optimization Stand-Alone Program"
XI	"Flexible Airloads Stand-Alone Program"

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Section I

INTRODUCTION

The structural optimization program (STROP) was developed to provide classical flutter stability of an airfoil at a given required speed with minimum structural weight consistent with strength requirements. STROP was programmed to obtain flutter stability in one pass through the digital computer. Incremental structural changes are automatically performed in each iteration. The criterion for these changes is based on the concept that the most efficient distribution of structural material for a given loading is one that provides uniform stress or constant strain energy per unit structural volume throughout the deformed structure. The deformed structure occurs in the critical flutter mode, which is automatically calculated by STROP.

To achieve the optimized structure of an airfoil, STROP requires the establishment of a structural mathematical model and calculates the necessary vibration modes, flutter analysis, and strain energy distribution in the critical flutter mode. These processes are discussed in Section II, "Methods and Formulation," of this volume.

STROP has been coded in FORTRAN IV language for use on the CDC 6600 digital computer. Core storage usage for this program is under 100,000 octal word units. To stay within this storage capacity, the program sets up a mathematical model for up to 15 control stations and uses disk storage for intermediate data.

The description of the program, its subroutines, and listings of flow charts are presented in Section III. Program usage is detailed in Section IV.

STROP is designed to accept punched cards from the output of the basic SWEEP program (refer to Volume VI) to provide a convenient data input for STROP. The output of STROP is also designed to produce data in the form of punched cards for SWEEP to replace its preprogrammed flutter requirements, when selected by the user. Initial data from SWEEP consist of plan form and structural geometry, bending (EI), and torsional (GJ) stiffnesses for a strength-only designed wing, as well as mass and inertia.

Section II

METHODS AND FORMULATION

STRUCTURAL MATHEMATICAL MODEL

STROP calculates vibration modes which are incorporated into a modal flutter analysis. These modes are determined by means of a lumped parameter system that involves sectionalizing an airfoil into an appropriate number of strips extending from the leading to trailing edges with sides perpendicular to the airfoil elastic axis (EA). The section mass and stiffness properties are formulated into matrices representing inertia and stiffness forces at selected spanwise points. The three-degrees-of-freedom of each of these points - translation, spanwise slope, and chordwise slope - characterize the motions of the corresponding sections.

The geometry of a sample airfoil mathematical model is illustrated in Figures 1 and 2. Figure 1, which is a planform view of an airfoil, identifies the EA, front spar, rear spar, and section centers of gravity (CG's). Figure 2, which represents a typical cross section of the airfoil perpendicular to the EA, identifies the required structural box geometry used in the computer program.

CONTROL STATIONS

STROP requires control stations (CS's) to be set up on the EA. The positions of these CS's are determined by the intersections of the EA with lines running perpendicular to the EA from the CG's of the section masses. Additional CS's are added to the mathematical model as needed to account for stiffness inserts, added masses, and EA sweep angle changes. The first and last CS are used as reference points only, and no masses may be assumed at these points. The first CS must be at the most inboard end of the structure, and the last CS must be at the most outboard end of the airfoil.

The intersection of a given mass reference line from the CG of any external store or added mass with the EA is defined as a CS. This CS may coincide with any other CS except one that is used to designate an EA sweep change.

If root stiffness is required for the airfoil, CS 1 and CS 2 must be positioned at the root with zero distance between them. A mass may be assumed at CS 2.

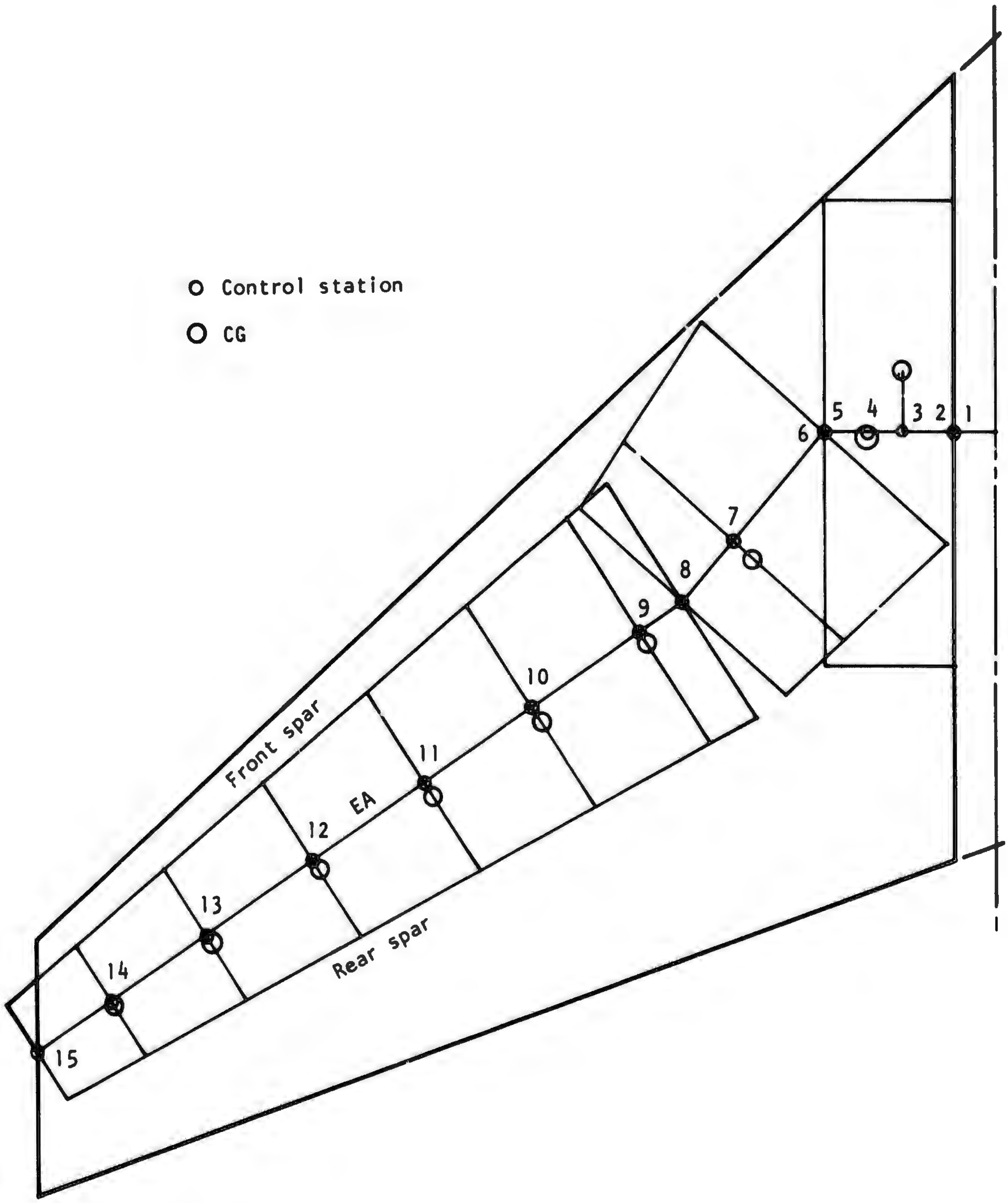

Figure 1. Sample structural mathematical model.

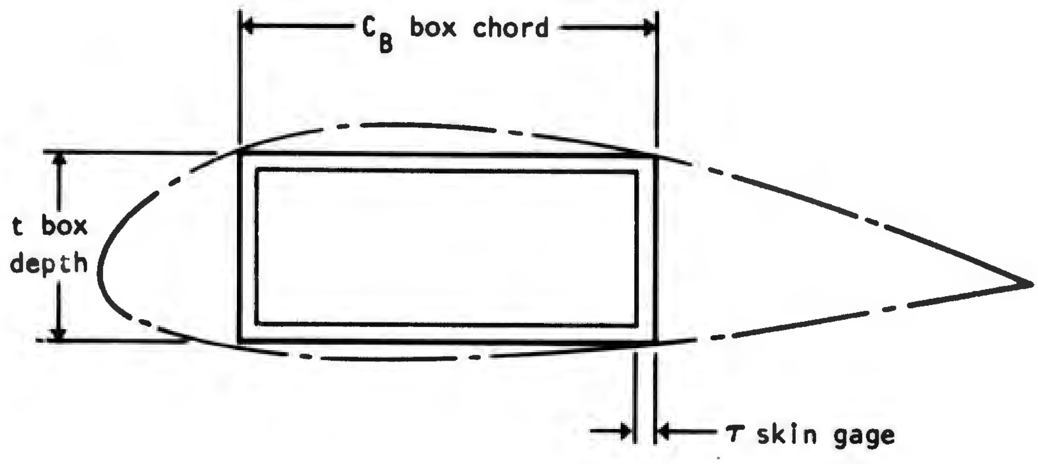

Figure 2. Typical airfoil cross section.

If the airfoil has a structural discontinuity (e.g., an outboard all-movable panel or a pivot point), a stiffness may be inserted by assuming two CS's at the same position on the EA. The length between them must be zero, and the stiffness must be placed at the outboard CS.

INERTIA FORCES

The mass data requirements for each section include the total section weight (m), the CG distance with respect to the EA (d), the total roll moment of inertia (I_ϕ) with respect to the CG about an axis perpendicular to the EA, and the total section pitch moment of inertia (I_θ) with respect to the CG about an axis parallel to the EA. These data are incorporated into a third-order mass matrix (M_R) which becomes a subarray on the diagonal of the total airfoil mass matrix (M_C).

$$M_R = \begin{bmatrix} m & 0 & md \\ 0 & I_\phi & 0 \\ dm & 0 & I_\theta \end{bmatrix} \tag{1}$$

$$M_C = \begin{bmatrix} M_{R_1} & 0 & \cdots & \cdot \\ 0 & M_{R_2} & & \\ \cdot & & \ddots & \\ \cdot & & & \\ \cdot & & & M_{R_n} \end{bmatrix} \tag{2}$$

where

n = the last mass section

All mass additions, such as external stores or balance weights, are input to the program as third-order matrices. The third-order matrix (M_A) for a given added mass is added to the values already existing at the same CS or will be placed in the proper location at a new CS if selected. The matrix (M_A) is calculated external to the program using equation 3 and the terminology of Figure 3.

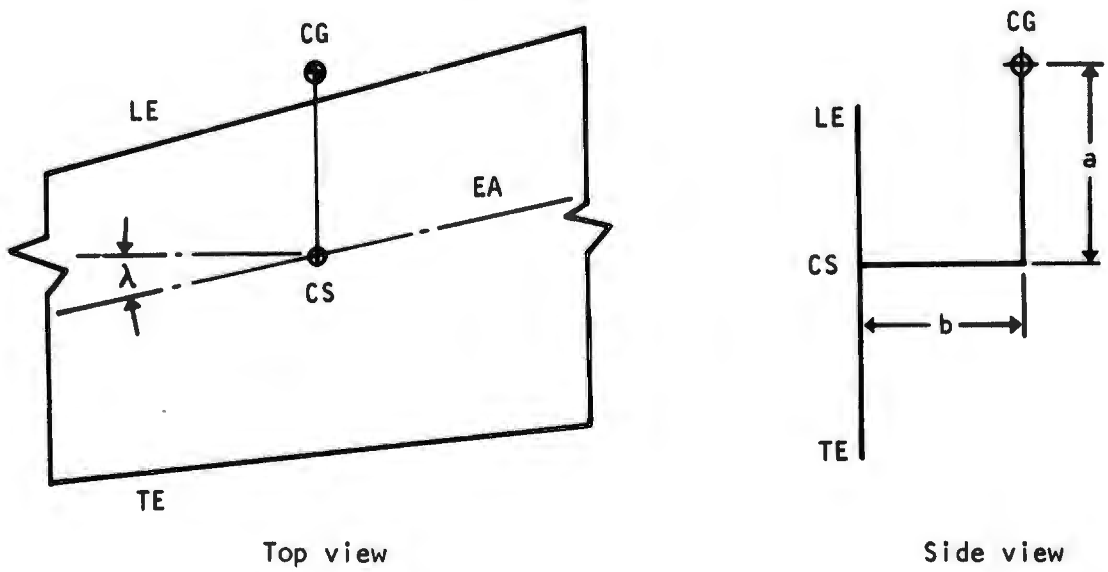

Figure 3. Geometry for mass addition of an airfoil section control station.

$$M_A = \begin{bmatrix} m & am \sin\lambda & am \cos\lambda \\ am \sin\lambda & ms_1 + I_\phi \cos^2\lambda + I_\theta \sin^2\lambda & (ma^2 - I_\phi + I_\theta) \sin\lambda \cos\lambda \\ am \cos\lambda & (ma^2 - I_\phi + I_\theta) \sin\lambda \cos\lambda & ms_2 + I_\phi \sin^2\lambda + I_\theta \cos^2\lambda \end{bmatrix} \quad (3)$$

where

$$s_1 = b^2 + a^2 \sin^2\lambda$$

$$s_2 = b^2 + a^2 \cos^2\lambda$$

As indicated in Figure 3, the angle (λ) is the sweep angle of the EA at the control station, the distance (b) is the length in inches that the mass CG is below the airfoil plane at the CS, the distance (a) is the length in inches that the CG is aft of the CS, (m) is the mass of the mass addition in pounds, (I_ϕ) is the rolling moment of inertia (lb in.^{2}) with respect to the CG about a streamwise axis, and (I_θ) is the pitching moment of inertia (lb in.^{2}) with respect to the CG about an axis perpendicular to the airstream.

STIFFNESS FORCES

Stiffness data requirements for STROP include the bending and torsion stiffness values of the airfoil defined in terms of EI and GJ at the beginning and end of each beam element, the beam length (ℓ), the sweep angle (λ) of the beam with respect to the adjacent inboard beam, and the average chord (c) and average depth (t) of the structural box. The normal stiffnesses that are assumed in the program require that the EI and GJ at the outboard end of a beam element be equal to the EI and GJ at the inboard end of the adjacent outboard beam element.

In the development of the structural mathematical model, each beam element is treated initially as if it were fixed at its inboard end. A third-order stiffness matrix (K_R), as defined by equation 4, can be written under the assumption that the stiffness varies linearly along the span of the beam element.

$$\begin{Bmatrix} Z \\ L \\ M \end{Bmatrix}_R = K_R \begin{Bmatrix} z \\ \phi \\ \theta \end{Bmatrix}_R = \begin{bmatrix} Z/z & Z/\phi & 0 \\ L/z & L/\phi & 0 \\ 0 & 0 & M/\theta \end{bmatrix} \begin{Bmatrix} z \\ \phi \\ \theta \end{Bmatrix} \quad (4)$$

where

z, Z = bending translation, shear force

ϕ, L = bending slope, bending moment

θ, M = twist angle, twisting moment

The elements of K_R are expressed as functions of the inboard (ib) and outboard (ob) stiffness properties as follows:

$$\left.\begin{aligned} Z/z &= \frac{36}{\gamma \ell^3}\left[(EI)_{ib} + (EI)_{ob}\right] \\ L/z = Z/\phi &= \frac{-12}{\gamma \ell^2}\left[(EI)_{ib} + 2(EI)_{ob}\right] \\ L/\phi &= \frac{6}{\gamma \ell}\left[(EI)_{ib} + 3(EI)_{ob}\right] \\ M/\theta &= \frac{2}{\ell}\left[(GJ)^{-1}_{ib} + (GJ)^{-1}_{ob}\right]^{-1} \end{aligned}\right\} \quad (5)$$

where

$$\gamma = 4 + \frac{(EI)_{ib}}{(EI)_{ob}} + \frac{(EI)_{ob}}{(EI)_{ib}}$$

The K_R matrices are used to calculate the strain energy in the critical flutter mode as well as to calculate the vibration modes.

The stiffness matrix for the complete airfoil is formed through a coordinate transformation matrix (D_{RC}) that synthesizes the beam element stiffness matrices (K_R) to form the complete stiffness matrix (K_C). The matrix (D_{RC}) and its transpose relate the relative deflections, $q_R = \{z, \phi, \theta\}_R$, and loads, $Q_R = \{Z, L, M\}_R$ of equation 4 to the integrated deflections and loads, q_C and Q_C, to give equation 6.

$$q_R = D_{RC} q_C \quad \text{and} \quad Q_C = D_{RC}^T Q_R \qquad (6)$$

The total stiffness matrix for the airfoil (K_C) can be written in terms of equation 6 as follows:

$$Q_C = K_C q_C = \left(D_{RC}^T \; K_{RR} D_{RC}\right) q_C \qquad (7)$$

where

$$K_C = D_{RC}^T \; K_{RR} D_{RC}$$

K_{RR} = matrix of subarrays (K_R), one for each beam element placed along the main diagonal

The transformation matrix (D_{RC}) can be written as a lower triangular matrix shown by equation 8 for a three-beam element structural example.

$$D_{RC} = \begin{bmatrix} I & 0 & 0 \\ h_2 & I & 0 \\ 0 & h_3 & I \end{bmatrix} \qquad (8)$$

where

I = identify matrix of third order

$$h_i = \begin{bmatrix} -1 & -\ell_i \cos \lambda_i & -\ell_i \sin \lambda_i \\ 0 & -\cos \lambda_i & -\sin \lambda_i \\ 0 & \sin \lambda_i & -\cos \lambda_i \end{bmatrix}$$

The inclusion of root stiffness and stiffness insertions is achieved by expanding D_{RC} and K_{RR} appropriately.

VIBRATION MODES

The vibration equations of motion for a structure with free-free boundary conditions can be written in terms of M_C, K_C, and the rigid body modes, D_0, as follows:

$$K_C q_C = \omega^2 \bar{M} q_C \qquad (9)$$

where

$$\bar{M} = M_C - M_C D_0 (D_0^T M_C D_0 + M_0)^{-1} D_0^T M_C$$

M_0 = rigid body mass matrix

ω = vibration frequency

The rigid body modes are automatically calculated by STROP. Vertical translation and pitch degrees of freedom are used for the symmetric case, and roll is used for the antisymmetric case.

Equation 9 is reformed for STROP to obtain a symmetric dynamic matrix for solution. The lower triangular inverse of K_{RR} (equation 4) is formed directly from the elements of equation 5, and the inverse of D_{RC} (equation 8) is formed directly from the basic geometric input data. Equation 10 expresses these changes based on the expression for K_C from equation 7,

$$K_C^{-1} = E_C = D_{RC}^{-1} E_{RR} \left(D_{RC}^{-1}\right)^T = D_{RC}^{-1} E_{RR_L} E_{RR_U} \left(D_{RC}^{-1}\right)^T \qquad (10)$$

where

$$E_C = \left[D_{RC}^{-1} E_{RR_L}\right]\left[E_{RR_U} \left(D_{RC}^{-1}\right)^T\right]$$

E_{RR_L} = lower triangular matrix

E_{RR_U} = upper triangular matrix, $E_{RR_L}^T$

Let $S_C = D_{RC}^{-1} E_{RR_L}$, then $S_C^T = E_{RR_U} \left(D_{RC}^{-1}\right)^T$

Also $E_C = S_C S_C^T$ and $E_C^{-1} = \left(S_C^T\right)^{-1} \left(S_C^{-1}\right)$

Substituting into equation 9 and letting $q_C = S_C t_C$, where t_C is a new set of coordinates, the symmetric dynamic matrix of equation 12 is obtained.

$$t_C = {}^2 S_C^T \bar{M} S_C t_C \tag{12}$$

The roots of equation 12 also satisfy equation 9, and the solution vecotrs (T) of equation 12 must be transformed to the original coordinate system to give the solution vectors (V_C) of equation 9.

$$V_C = S_C T \tag{13}$$

The rigid body modes solution coefficients (V) are obtained from equation 14.

$$V_0 = - \left(D_0^T M_C D_0 + M_0\right)^{-1} D_0^T M_C V_C \tag{14}$$

The total motions of the original coordinates (V_A), are a summation of the rigid body degrees of freedom and the relative degrees of freedom of equation 13.

$$V_A = V_C + D_0 V_0 \tag{15}$$

The cantilever condition with or without root flexibility occurs when $\bar{M} = M_C$ in equations 9 and 12. The vibration modes are the vectors (V_C) of equation 13.

For reduced computer time in the flutter analysis and for simplification in programming, the vibration modes are scaled so that the generalized mass for each mode is unity. If the generalized mass matrix (m_g), which is a diagonal matrix, is defined by equation 16, then the scaled modes (V_s) can be defined by equation 17.

$$m_g = V_C^T M_C V_C \tag{16}$$

$$V_s = V_C \left(m_g^{-1/2}\right) \tag{17}$$

FLUTTER ANALYSIS

The modal approach is used in the flutter analysis to obtain the speed (ν_f) at which the airfoil goes unstable during each cycle of the iteration process. STROP automatically selects the spectrum of the aerodynamic frequency parameter (k) based on the frequency range of the vibration modes selected. The flutter solutions of the dynamic matrices for every other value are obtained until a mode goes unstable; then the program automatically switches to every k value. The solution is turned off when the flutter speeds of all the modes for a given k value exceed 175 percent of the required speed (ν_{req}). The program then searches and converges on the flutter mode that just goes unstable at the lowest speed at newly calculated k values in the range of interest.

MODAL EQUATIONS

The flutter equations of motion are expressed in matrix form by equation 18 for the free-free case.

$$\lambda q_f = f^{-2} \left[(I + a) - a_{12} \left(m_{00} + a_{00} \right)^{-1} a_{21} \right] q_f \tag{18}$$

where

$a = \rho V_A^T A V_A$

$a_{12} = \rho V_A^T A D_0$

$a_{21} = \rho D_0^T A V_A$

$a_{00} = \rho D_0^T A D_0$

$m_{00} = D_0^T M_0 D_0$

A = aerodynamic coefficient matrix from strip theory

ρ = density of air

f = vibration mode frequencies

λ = complex eigenvalue

q_f = generalized flutter mode

For the cantilever case, equation 18 is simplified to equation 19.

$$\lambda q_f = f^{-2} (I + a) q_f \tag{19}$$

The solutions to the flutter equations 18 and 19 follow the method of Danilevsky [1] in which the complex dynamic matrix is expanded by double precision arithmetic into its characteristic polynomial, and the roots (λ_i) are resolved through a Newton interpolation scheme. The damping coefficient (g), the flutter frequency (f_f), and the flutter speed (ν_f) are obtained for each mode from the following expressions:

$$g = \lambda_R/\lambda_I$$

$$f_f = \left(\lambda_R\right)^{-1/2} \text{ Hz}$$

$$\nu_f = 0.3098\ b_r f_f\ k^{-1} \text{ knots}$$

where

λ_R = real part of the complex root

λ_I = imaginary part of the complex root

b_r = reference length, inches

The eigenvector or characteristic vector is calculated from the original dynamic matrix through the use of a modified gaussian reduction process on a linear set of equations.

Since the eigenvector of interest occurs for the mode that goes unstable at the lowest speed, only one eigenvector per cycle of iteration is calculated by the program. This eigenvector is obtained in the generalized coordinate system of equations 18 or 19.

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(1) Faddeeva, V. N., Computational Methods of Linear Algebra, Dover Publication, 1959

The oscillatory aerodynamic coefficients of matrix A in equation 18 are calculated from the theory of Theodorsen [(2)]. These coefficients can be modified to reflect the effects of aspect ratio, taper ratio, sweep, and compressibility. The coefficients are modified by the use of appropriate local aerodynamic center (AC) and lift curve slope (C_{ℓ_α}). The local AC location and C_{ℓ_α} are introduced into the program by including the distance from the AC to the EA and the C_{ℓ_α} value per radian for each control station (CS). In addition, the local streamwise chord at each CS is required. Data for the first and last stations are omitted as in the case for the mass data.

CONTROL STATION (CS) BOUNDARIES

The spanwise aerodynamic strip width and spanwise structural box width for mass evaluation are specified by selecting the appropriate CS numbers. These CS numbers are used to describe the inboard and outboard boundaries of each aerodynamic strip and structural box. The example of Figure 1 is used to describe the selection of the control station boundaries. This example has 15 control stations, 13 of which are active, with CS 1 and CS 15 being inactive. The root stiffness is assumed at CS 2, and changes in sweep of the EA occur at CS 6 and 9. A possible selection of CS numbers for boundaries for each active CS is as follows:

CS	Inboard 1	Inboard 2	Outboard 1	Outboard 2
2	0	0	0	0
3	2	2	3	4
4	3	4	5	5
5	0	0	0	0
6	0	0	0	0
7	6	6	8	8
8	0	0	0	0
9	8	8	9	10
10	9	10	10	11
11	10	11	11	12
12	11	12	12	13
13	12	13	13	14
14	13	14	15	15

---

(2) Theodorsen, T., "General Theory of Aerodynamic Instability and the Mechanism of Flutter," NACA Report 496, 1935

The selection of zeros for CS 2, 5, 6, and 8 provides zero length for the structural box as well as zero width for the aerodynamic strip. The zero length for CS 2 is associated with the root stiffness, which is not considered part of the structural box. The zeros for CS 5 are needed to account for the flexibility insert. The zeros for CS 6 and 8 are needed to reflect the changes in sweep angle of the EA. The structural box for CS 3 starts at CS 2 and extends outboard to midway between CS 3 and CS 4. The structural box for CS 4 starts at midway between CS 3 and CS 4 and extends outboard to CS 5. The structural box for CS 7 starts at CS 6 and extends outboard to CS 8. The structural box for CS 9 starts at CS 8 and extends midway between CS 9 and CS 10. The boxes for CS's 10 through 13 extend from midway between the preceding CS and the CS under consideration to midway between the CS under consideration and the subsequent CS. The box for CS 14 starts midway between CS 13 and CS 14 and extends to the tip station CS 15. The corresponding aerodynamic strip widths are equal to the structural box widths multiplied by the cosine of the sweep angle of the EA.

It should be apparent that the proper selection of these boundaries is required in order to include the entire airfoil for the aerodynamic forces in the flutter analyses. These boundaries are also required for the calculation of the structural box volumes which are used to determine the structural mass properties and to evaluate the strain energies per unit structural volume of the beam elements in the flutter mode.

STRUCTURAL OPTIMIZATION

The heart of the optimization part of the program is the criterion which follows the well known structural concept that the most efficient distribution of structural material for any loading is one that will provide constant strain energy per unit structural volume (e). Furthermore, the minimum structural weight will be obtained when the criterion is satisfied. As applied to flutter of an airfoil, the criterion must be satisfied for the relative values of e over the entire structure in the critical flutter mode, the one that just goes unstable at the lowest speed. However, since strength requirements must be satisfied, and since the strength design is the usual starting point of the program, only stiffness increases are permitted, and the criterion of constant e over the structure can be approached but not fully satisfied.

The relative strain energies for each beam element (E) can be expressed as the product of relative deflections (p_f) and loads (P_f) as expressed by equation 20

$$\{E\} = \left\lfloor \bar{p}_f \right\rceil \{P_f\} \tag{20}$$

where

$$p_f = V_C \, q_f$$

$$\bar{p}_f = \bar{q}_f \, V_C^T$$

$\bar{q}_f$ = complex conjugate of q_f

$\lfloor \, \rceil$ = diagonal matrix

The loads can be described in terms of the beam element stiffness to give the expression of equation 21.

$$\{E\} = \left[\lfloor \bar{p}_f \rfloor \, D_{RC} \right]^T \left\{ K_{RR} D_{RC} q_f \right\} \tag{21}$$

The structural volume (V_{ST}) for each beam element is calculated by STROP using beam length (ℓ) and the inboard (subscript R) and outboard (subscript T) values of the box chord, depth, and skin gage. The box chord (C_B), depth (t), and skin gage (τ) are assumed to vary linearly along the beam element. The total volume is expressed as a sum of the top and bottom slabs (V_1) and the side slabs (V_2) of a typical structural box as shown in Figure 4 and defined by equation 22.

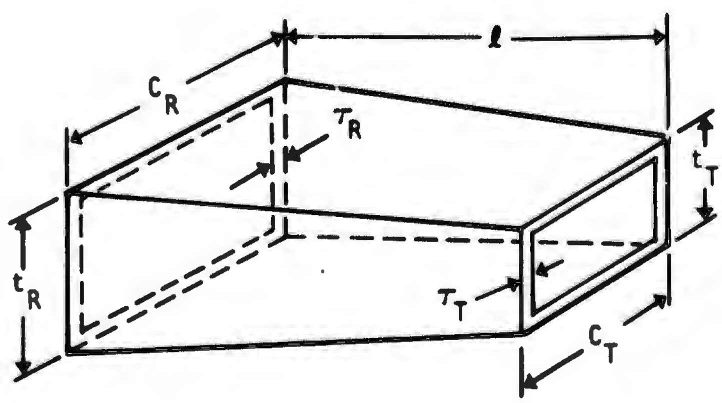


Figure 4. Typical structural box element.

$$
\left.
\begin{aligned}
V_1 &= \frac{\ell}{3}\left[C_R\left(2\tau_R + \tau_T\right) + C_T\left(\tau_R + \tau_T\right)\right] \\
V_2 &= \ell/3\left[\left(t_R - 2\tau_R\right)\tau_R + \left(t_T - 2\tau_T\right)\tau_T + \right. \\
&\quad \left. + \left[\left(t_R - 2\tau_R + t_T - 2\tau_T\right)\left(\tau_R + \tau_T\right)\right]\right] \\
V_{ST} &= V_1 + V_2
\end{aligned}
\right\} \qquad (22)
$$

The skin gage (τ) is determined from the cross-section geometry and the bending area moment of inertia (I) as shown by equation 23.

$$
\tau = \beta - \sqrt{\beta^2 - \frac{I}{t\left(t + C_B\right)}} \qquad (23)
$$

where

$$
\beta = \frac{t^2 + 3tC_B}{12(t + C_B)}
$$

The strain energy per unit structural volume for the ith beam element (e_i) is the quotent of the E of equation 21 and the V_{ST} of equation 22 as shown by equation 24.

$$
e_i = \left(\frac{E}{V_{ST}}\right)_i \qquad (24)
$$

Skin gage adjustments are made whenever the required speed exceeds the calculated critical flutter speed in any cycle of iteration. The structure is adjusted for the next cycle by increasing the skin gages of those beam elements that exceed the average strain energy (e_{AVAV}) of those beam elements that exceed the average strain energy (e_{AV}) of all the beam elements. The new skin gages and, consequently, the new structural stiffness and mass are determined from the expression of equation 25, in which the square of the speed ratio of the required speed (ν_{req}) to the calculated speed (ν_f) is included.

$$\left(\tau_{new}\right)_i = \left(\tau_{old}\right)_i \left(\frac{\nu_{req}}{\nu_f}\right)^2 \sqrt{\frac{(e)_i}{e_{AVAV}}} \tag{25}$$

The subscript i in equation 25 refers to those beam elements whose values of e exceed e_{AVAV}.

PROGRAM CAPABILITIES

STROP is applicable for analysis of one cantilevered, free-free (symmetric or antisymmetric), or fixed-free airfoil. Fixed-free is defined as a structure that is free at its outboard end and sprung at its inboard end with shear, roll, and pitch springs. The program will handle a single airfoil with rigidly attached stores and with all-movable airfoil sections. The structure can have multiple sweep changes in the EA. The structural stiffness is described in terms of EI and GJ, and the ratio between EI and GJ, as initially set by strength requirements for each beam element, remains constant during the optimization process.

The airfoil planforms that can be analyzed by STROP correspond to those that are amenable to modified strip theory unsteady aerodynamics. Experience has shown that planforms with medium to high aspect ratios and medium to low sweep angles are applicable. The speed range of applicability extends to the high subsonic/low transonic mach range.

Section III

PROGRAM DESCRIPTION

This section contains a listing and an auto flow chart of the STROP computer program, as formulated in Section II. In addition, a flow chart of the major subroutines is shown in Figure 5, and a description of the operations of each subroutine is given in Table I.

SUBROUTINE FLOW AND DESCRIPTIONS

The MAIN or executive subroutine provides for the initialization of the five intermediate data storage disks and calls for the major subroutines, as indicated by Figure 5, to perform the optimization process. The first subroutine called by MAIN is DATAN, which provides for the reading and listing of the control, structural, and geometrical input data. DATAN also processes some of the data for the stiffness and flexibility matrices, which are generated in the STIFN subroutine, and for the mass matrices, which are generated in the MASS subroutine. The VIBRN subroutine is called next by MAIN. Here the vibration modes, in terms of the modal vectors, frequencies, and generalized masses, are calculated and fed through MAIN to the FLTR subroutine, in which the flutter solutions are obtained. FLTR determines the mode that just goes unstable at the lowest speed through the subroutine EIGN, which calls for the aerodynamic subroutines AERO and AEROI and the complex dynamic matrix solution subroutines, CEIGN, ROOTS, and CGLSQ. FLTR then feeds the necessary flutter data to the ENERGY subroutine to calculate the relative strain energies per unit structural volume. If the flutter speed is equal to or greater than the required speed, the OUTPUT subroutine is called to print and punch the appropriate data. If the flutter speed is less than the required speed, the cyclic process is initiated after new structural box skin gages are calculated. Control is transferred to MAIN and the process is repeated.

PROGRAM LISTINGS AND FLOW DIAGRAMS

Pages 30 through 158 include program listings and flow diagrams for STROP showing the operation of the various subroutines. These were obtained using the Autoflow process and represent the program as supplied to the Air Force on May 15, 1973. Pages 26 through 29 contain descriptions of the coding used in the Autoflow process.

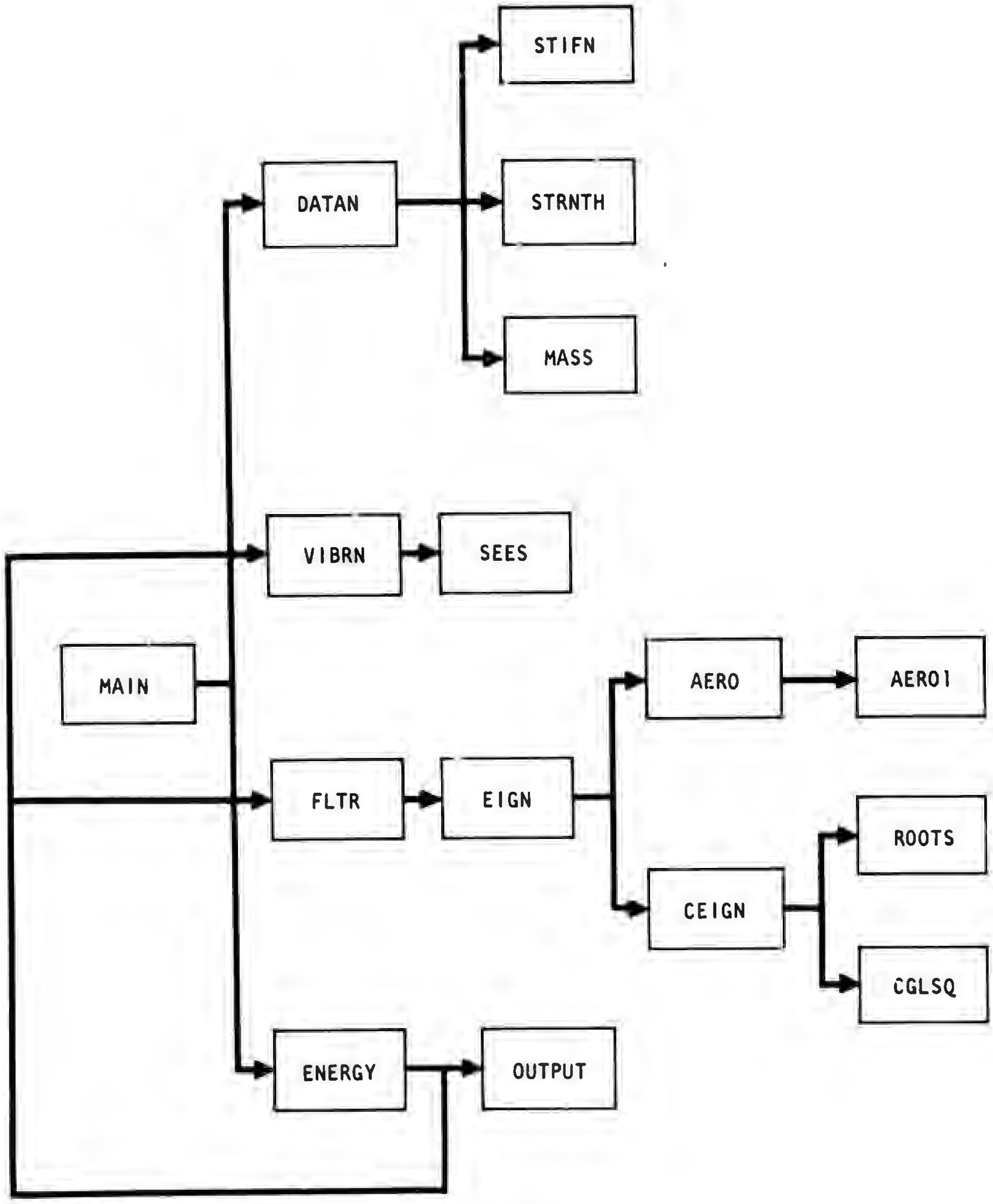


Figure 5. Major subroutine flow chart.

TABLE 1. DESCRIPTION OF SUBROUTINES

AERO	Takes the output of AERO1 and transforms the aerodynamic coefficients from the aerodynamic coordinates to the elastic axis coordinates for modal flutter analyses.
AERO1	Obtains the subsonic incompressible aerodynamic coefficients for each aerodynamic strip for use in subroutine AERO.
CEIGN	Calling subroutine to obtain the eigenvalues and eigenvectors of the flutter dynamic matrix. CEIGN also manipulates the dynamic matrix for use in subroutines ROOTS and CGLSQ.
CGLSQ	Obtains the eigenvectors for the flutter mode by a simultaneous linear equation solution.
CMULC	Computes [A] [B] or $[A]^T$ [B] where [A] and [B] are both complex.
CMULR	Computes [A] [B] or $[A]^T$ [B] where [A] is complex and [B] real.
DATAN	Reads the input data and checks for errors related to program calculation. It also sets up root stiffness and geometrical transformation matrices for use in stiffness calculations. DATAN is the calling subroutine to obtain the mass and triangularized inverted stiffness matrices.
DTSD	Computes $[D]^T$ [S] [D] where [D] is real and [S] can be either real or complex.
EIGN	Sets up the flutter stability determinant and extracts the velocity, frequency, and damping from the eigenvalue solutions of the complex characteristic equation. It also finds the flutter mode for the critical flutter speed during each interation.
ENERGY	Calcualtes the structural volume and the relative strain energy per unit structural volume of each beam element in the critical flutter mode. If the speed of the critical flutter mode is below the required speed, ENERGY modifies the skin gages of the structure and sets up a cycling process to form new stiffness and mass matrices and to perform new vibration and flutter analyses. This cycle is repeated until the required speed is reached or other means terminate the program.
FLTR	Obtains the flutter solutions for each reduced frequency. Calculates and prints the speeds, frequencies, and damping values for each mode. It uses an iterative process to rapidly converge on the zero-damping flutter velocity.

TABLE 1. DESCRIPTION OF SUBROUTINES (CONT)

MASS	Sets up the mass matrix for use in the vibration analysis. It also separates the initial nonstructural mass from the total mass for use in the optimization process. Calculates initial structural volume for each beam element.
MMULT	Computes [A] [B] or $[A]^T$ [B] where [A] and [B] are real matrices.
NPRINT	Prints out a given matrix with a title in matrix format. The rows and columns are numbered.
OUTPUT	Exhibits the vibration analyses output of the initial and final iterations.
RMULC	Computes [A] [B] or $[A]^T$ [B] where [B] is complex and [A] real.
ROOTS	Expands the flutter stability determinant by the Danilevsky method to obtain the complex characteristic equation and solves this equation by Newton's method to obtain the eigenvalue solutions.
SEES	Utilizes the dynamic matrix from VIBRN to obtain eigenvalues and eigenvectors which are used in VIBRN to obtain vibration frequencies and mode shapes. The method used by SEES is a matrix iteration and deflation technique.
STIFN	Sets up the inverted triangularized stiffness matrix for use in the vibration analysis. The subroutine also forms matrices necessary for the strain energy calculations.
STRNTH	Calculates bending area moment of inertia (I) and single cell torsion constant (J) for use in the skin gage distribution and strain energy calculations.
VIBRN	Forms rigid body modes and sets up the symmetric dynamic matrix from the inverted triangularized stiffness and mass matrices. Vibration frequencies and mode shapes are then determined. The modes are used to form an identity generalized mass matrix. The range and values of the reduced frequencies are determined for use in the flutter analysis.

FLOW CHART USAGE

The automatically generated computer program flow charts (AUTOFLOW) presented in this document include a table of contents, flow charts, and FORTRAN lists of all routines in the module. The 80-column card lists are sequenced and grouped by routine.

Cross Reference List

The AUTOFLOW Table of Contents, which follows the FORTRAN lists and precedes the flow charts, serves to cross reference the two. This table lists the following from left to right:

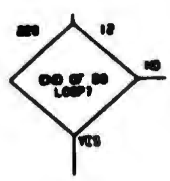
- The card identification from columns 73 through 80 of this card, or card sequence number. When sequence number is used in place of card identification, it is enclosed in parentheses.
- The page and box number where this card is displayed in a flow chart.
- The FORTRAN statement number from columns 1 through 5 of this card.
- The card identification(s) or sequence number(s) of the card(s) referring to this card (repeated as required).
- The page and box numbers where the cards referring to this card are displayed in a flow chart (repeated as required).

Flow Charts

The flow charts produced by AUTOFLOW use USASI conventional symbols. Since the flow charts are mechanically drawn from the program source deck, there are no omissions or vague generalizations about the processing within the boxes.

Every box on each page is uniquely numbered and may be referred to from elsewhere in the program. The source of a reference to a box will be indicated by showing the page and box number. If the number is followed by an asterisk, there are multiple references to this point, and the others may be found by using the cross-reference list.

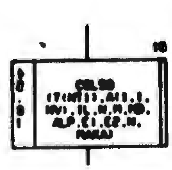
The most-often-used symbol is the decision box. Like all boxes, its box number is above and to the right of the box. Its FORTRAN statement number is above and to the left of the box. The decision choices for the paths are printed.



The unconditional transfer connecter has its page number destination printed above or to the left of the box number destination within the connecter. If there is a FORTRAN statement number at the destination, it is printed below the connecter.

The exit box example shows a connecter from page 9, box 15.

The subroutine call box includes the calling sequence. The page and box numbers of the flow chart of the called subroutine are shown on the left-hand side of the box. The page number is above the box number.



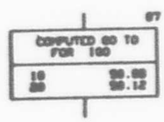
The note box encloses comments of a functional nature,

as differentiated from the 21 column comments, which are left justified without a box, that show the comment cards included in the FORTRAN deck.

The process box is used to enclose FORTRAN arithmetic statements.

Input and output are shown as communicating with a device. The list used follows, if appropriate:

The computed GØ TØ becomes a branch table showing the page and box number of each of the ordered branches.



The column connecters and initial connecters are the only boxes without external box numbers. The function of the initial connecter is always clear, but the label given is the symbol in the next FORTRAN card, which is often blank.

The column connecter identifies the page and box number to which it connects.

BEST
POSSIBLE
SCAN

S: ROP PROGRAM LISTING

```
08/15/73        INPUT LISTING                     AUTOFLOW CHART SET - SWEEP 1  '  SWEEP

FORTRAN MODULE      (LIST,BCD)

CARD NO     ****                     CONTENTS                                   ****

            C                 ***MASTER CONTROL PROGRAM***
            C
            C        STRUCTURAL OPTIMIZATION BY STRAIN ENERGY METHODS
            C
            C         AUTHORS   S. SIEGEL, W  M. MILLS, A. LIU
            C         DATE      FEBRUARY 9, 1970
            C         FUNCTION  COMPLETE VIBRATION AND FLUTTER ANALYSIS
            C                   OF A GIVEN AIR VEHICLE COMPONENT WITH
            C                   AN OPTIMIZATION FEATURE TO ATTAIN
            C                   ANY REQUIRED FLUTTER VELOCITY.
            C
                  COMMON TCX(7340 ),TAU(16,15),EI(16),GJ(16),FREQ(45),CP,NCP,NEL,   STROP014
                 *NMODE,ITER,IPNCH,FFLTR,XMDD(2,2),MA,XMD(2,2),DD(2,16),ISYM,       STROP015
                 *DD(45,2),DELY                                                     STROP016
                  COMMON/BLOCK1/TITLE(7),AK(45,45),AM(45,45),F(3,3,15),VM(15),      STROP017
                 *EIDER(16),GJDER(16),T(16),Y(16), C(16),E,G,VROF,NEL3,NITER,       STROP018
                 *ROOTK(3,3),IFLX,ADK(4,3,3),NKD,  LKD(4),EX(16),GX(16)             STROP019
                  COMMON/BLOCK2/AMBDA(16),D2(16),  CLA(16),CA(16),YA(15),CAV(50),   STROP021
                 *CAM,RHO,VMIN,VMAX,ICASE,NEWJOB,NSUP2,NSUP3,GAMA(100),P(45,10),    STROP022
                 *PMAX(10),RMU(6),NALT                                              STROP023
                  COMMON/BLOCK3/WTS(15,3),DCG(15),YM(15),RHOM,NI1(16),NI2(16),      STROP024
                 *ND1(16),ND2(16),WST(15,3),SIM,SAM,SOM,DCGWS(15),TOTWT,ADM(4,3,3), STROP025
                 *NMD,LMD(4),WTT(15,3),RHOS(15)                                     STROP026
                  REWIND 1
                  REWIND 2
                  REWIND 3
                  REWIND 4
                  REWIND 7
                  IPNCH=0
              500 NEWJOB=0
                  ICASE=0
                  CALL DATAN
                  IF(NEWJOB EQ 1) GO TO 500
              300 CALL VIBRN                                                        MAIN0200
                  IF(NEWJOB.EQ.1) GO TO 500
                  CALL FLTR
                  IF(NEWJOB EQ 1) GO TO 500
                  CALL ENERGY
                  IF(NEWJOB EQ 1) GO TO 500
                  CALL STIFN
                  CALL MASS
                  GO TO 300
                  END
                  SUBROUTINE AERO(VBAR)                                             FLUT1200
                  COMMON AN(3,3,15),XLH(15),XLA(15),XMH(15),XMA(15),BMH,BLA,BMA,BBMAAERO0003
                 *,TCX(1942),TAU(16,15),EI(16),GJ(16),FREQ(45),CP,NCP,NEL,NMODE,ITERAERO0004
                  COMMON/BLOCK2/AMBDA(16),D2(16),CLA(16),CA(16),YA(15),CAV(50),CAM, AERO0006
                 *RHO,VMIN,VMAX,ICASE                                               AERO0007
                  COMPLEX AN,XLH,XLA,XMH,XMA,BMH,BLA,BMA,BBMA                       AERO0008
                  CALL AERO1(NEL,CA(2),CA(2),XLH,XLA,XMH,XMA,VBAR)                  FLUT1340
                  SUPL = AMBDA(1)                                                   FLUT1345
                  DO 100 N= 1,NEL                                                   FLUT1350
                  SUPL = SUPL + AMBDA(N+1)                                          FLUT 460
                  IF (YA(N+1))30,20,30                                              FLUT1360
               20 DO 25 I=1,3                                                       FLUT1370
                  DO 25 J=1,3                                                       FLUT1380
               25 AN(I,J,N) =(0.0,0.0)                                              FLUT1390
                  GO TO 100                                                         FLUT1400
               30 H    = 0.5*RHO*(CA(N+1)*0.5)**2*YA(N+1)*CLA(N+1)                  FLUT1410
                  BMH = D2(N+1)*XLH(N) + 0.5*CA(N+1)*XMH(N)                         FLUT1420
                  BLA = D2(N+1)*XLH(N) + 0.5*CA(N+1)*XLA(N)                         FLUT1430
                  BMA = 0.5*CA(N+1)*( D2(N+1)*XLA(N)+.5*CA(N+1)*XMA(N) )            FLUT1440
                  BBMA= D2(N+1)*BMH + BMA                                           FLUT1450
                  SL = SIND (SUPL)                                                  FLUT 461
                  CL = COSD (SUPL)                                                  FLUT 462
                  AN(1,1,N) =XLH(N)*H                                               FLUT1470
                  AN(2,1,N) =BMH*SL     *H                                          FLUT1480
                  AN(3,1,N) =BMH*CL     *H                                          FLUT1490
                  AN(1,2,N) =BLA*SL     *H                                          FLUT1500
                  AN(2,2,N) =BBMA*SL      **2*H                                     FLUT1510
```

```
      ****                            CONTENTS                        ****
           AM(3,2,N) =GBMA*CL     *SL     *N                        FLUT1520
           AM(1,3,N) =BLA*CL     *N                                 FLUT1530
           AM(2,3,N) =AM(3,2,N)                                     FLUT1540
           AM(3,3,N)= MA*CL     **2 *N                              FLUT1550
      C                                                             FLUT1600
        100 CONTINUE                                                FLUT1610
           RETURN                                                   FLUT1630
           END                                                      FLUT1635
           SUBROUTINE AERO1(NST, BR, B,       XLM, XLA, XMM, XMA,VBMR )  18985002
      C    NST= NO. OF STRIPS                                       18985006
      C    B= ARRAY OF LOCAL B                                      18985008
      C    VBMR= (V/BW)REF                                          18985014
           DIMENSION B(NST)   ,XLM(2,1)  ,XLA(2,1)  ,XMM(2,1)  ,XMA(2,1)  18985016
          1          ,VBM(10)                                       18985018
           DO 0401 I=1,10                                           18985020
       0401 VBM(I) =0.0                                             18985030
           IF(VBMR)0402,0402,0404                                   18985040
       0402 VKR   = 0.0                                             18985050
           GO TO  0406                                              18985060
       0404 VKR  = 1.0 /VBMR                                        18985070
       0406 CONTINUE                                                18985080
           DO 300  L =1,NST                                         18985090
           VK = VKR * (B(L)/ BR )                                   18985100
           IF (VK) 280, 280, 261                                    18985110
        261 VBM (1) = 1. /VK                                        18985120
           TEST = VBM(1) -20.                                       18985130
           IF (TEST) 262,284,284                                    18985140
        262 DO 263 I= 2,10                                          18985150
           J = I -1                                                 18985160
        263 VBM (I)  =VBM(J) * VBM (1)                              18985170
        286 TEST =1.- VBM (1)                                       18985180
           IF(TEST) 287, 1230 ,1210                                 18985190
        287 TEST = 20. - VBM (1)                                    18985200
           IF (TEST) 284 ,284 ,1220                                 18985210
      C                                                             18985220
       1210 F = .499994  + .975210E-3* VBM(1)  + .0416086 *  VBM (2)     18985230
          1  + .103001  *  VBM (3)         - 1.07024  *  VBM (4)    18985240
          2  + 3.18859  *  VBM (5)         - 8.07936  *  VBM (6)    18985250
          3  + 7.58554  *  VBM (7)         - 5.92565  *  VBM (8)    18985260
          4  + 2.62908  *  VBM (9)         - .905177  *  VBM (10)   18985270
      C                                                             18985280
           G = -.13807E-5   -.126113 *VBM(1)  + .0257750 *  VBM (2)      18985290
          1  - .108852  *  VBM (3)         + 1.25871  *  VBM (4)    18985300
          2  - 4.09921  *  VBM (5)         + 8.11802  *  VBM (6)    18985310
          3  - 10.1705  *  VBM (7)         + 7.07342  *  VBM (8)    18985320
          4  - 3.43926  *  VBM (9)         + .848541  *  VBM (10)   18985330
           GO TO 1240                                               18985340
      C                                                             18985350
       1220 F = .484679 + .0450509 *  VBM (1)  + .01944     * VBM (2)    18985360
          1  - .715958E-2 * VBM (3)        + .0014915   * VBM (4)   18985370
          2  - .191818E-3 * VBM (5)        + .16104E-4  * VBM (6)   18985380
          3  - .888613E-6    * VBM (7)     + .308039E-7    * VBM (8)     18985390
          4  - .812495E-9      * VBM (9)   + .531004E-11     * VBM (10)18985400
      C                                                             18985410
           G = .228048E-2- .142481 * VBM (1)  + .0491812  * VBM (2)     18985420
          1  - .0100173   * VBM (3)        + .167358E-2 * VBM (4)   18985430
          2  - .103178E-3 * VBM (5)        + .139866E-4  * VBM (6)  18985440
          3  - .784527E-6    * VBM (7)     + .24178E-7    * VBM (8)      18985450
          4  - .46777E-9      * VBM (9)    + .397833E-11     * VBM (10)18985460
      C                                                             18985470
           GO TO 1240                                               18985480
        284       VBM(1) =VK                                        18985490
           DO 285 I =2,5                                            18985500
           J = I -1                                                 18985510
        285 VBM (I) = VBM (J) * VBM (1)                             18985520
       1230 F = -1054.134    * VBM (4)         + 283.1892    * VBM (3)   18985530
          1  - 12.44628    * VBM (2)         - 1.063397    * VBM (1)     18985540
          2  + 1.000048                                             18985550
      C                                                             18985560
           G = 17560.30    * VBM (4)         - 2360.973    * VBM (3)     18985570
          1  + 135.1524    * VBM (2)         - 9.817904    * VBM (1)     18985580
```

CARD NO **** CONTENTS ****

```
      Z  -  .10252215E-2                                             10885590
C                                                                    10885600
 1240 CONTINUE                                                       10885610
  280 XLH(1,L)= 1. +(2.* G1/VK                                       10 85650
      XLH(2,L) = -2.* (F/VK)                                         10885660
      XLA(1,L) =  -.5       +XLH(1,L) +XLH(2,L)/VK                   10885680
      XLA(2,L) =   XLH(2,L) - XLH(1,L)/VK                            10885690
      XMA(2,L) = - (1. / VK )                                        10885690
      GO TO 295                                                      10885700
  290 XLH(1,L) = 1.0                                                 10885710
      XLH(2,L) = 0.0                                                 10885720
      XLA(1,L) =  .5                                                 10885730
      XLA(2,L) = 0.0                                                 10885740
      XMA(2,L) = 0.0                                                 10885750
  295 XMA(1,L) = 0.375                                               10885760
      XMH(2,L) =0.0                                                  10885770
      XMH(1,L) =0.5                                                  10885780
  300 CONTINUE                                                       10885790
      RETURN                                                         10885800
      END                                                            10885810
      SUBROUTINE CEIGN (A ,R ,T ,      N,NR ,MAXA ,NC ,NERR ,IOO)    EIGN0020
C                                                                    EIGN0030
      DIMENSION A(NC,MAXA,N),R(NC,N),T(1),IL(15)                     CEIGN004
      COMPLEX    ALP                                                 EIGN0045
C                                                                    EIGN0050
C     A    =    INPUT  COMPLEX CHARACTERISTIC MATRIX                 EIGN0060
C          =    OUTPUT COMPLEX VECTORS                               EIGN0070
C     R    =    OUTPUT COMPLEX ROOTS                                 EIGN0080
C     T    =    TEMPORARY STORAGE  =  8* (N**2) LOCATIONS (EVEN ORIGIN)EIGN0090
C     N    =    ORDER OF INPUT MATRIX                                EIGN0100
C     NR   =    NO. OF ROOTS AND VECTORS DESIRED                     EIGN0110
C     MAXA =    NO OF ROWS IN THE DIMENSION OA A                     EIGN0120
C     NC   =    MUST EQUAL 2                                         EIGN0130
C     NERR      (ERROR CODE) ,=-1 NO   SOLUTIONS                     EIGN0140
C     IOO  =0, ROOTS ONLY                                            EIGN0150
C                                                                    EIGN0160
C               COMPUTE EIGEN VALUES                                 EIGN0170
C                                                                    EIGN0180
      NT = 4 * N * N                                                 EIGN0190
      NT1 = NT + 1                                                   EIGN0200
      NT2 = NT + 2                                                   EIGN0210
      DO 100 L =1,NT2                                                EIGN0220
  100 T(L) = 0.0                                                     EIGN0230
      L = -1                                                         EIGN0240
      DO 110 J =1,N                                                  EIGN0250
      DO 110 I =1,N                                                  EIGN0260
      DO 110 K =1,2                                                  EIGN0270
      L = L + 2                                                      EIGN0280
  110 T(L) = A(K,I,J)                                                EIGN0290
      CALL ROOTS (T ,R ,T(NT1) ,N ,N , 2 ,NERR )                     EIGN0300
C                                                                    EIGN0310
      IF (NERR)  300 ,150 , 120                                      EIGN0320
  120 IF (NERR-NR)130,150 , 150                                      EIGN0330
  130 NR = NERR                                                      EIGN0340
C                                                                    EIGN0350
C                                                                    EIGN0360
C               SAVE A IN 1ST  (2*N*N) ELEMENTS OF T                 EIGN0370
C                                                                    EIGN0380
  150 L = 0                                                          EIGN0390
      DO 160 J=1,N                                                   EIGN0400
      DO 160 I=1,N                                                   EIGN0410
      DO 160 K=1,2                                                   EIGN0420
      L = L+1                                                        EIGN0430
  160 T(L) = A(K,I,J)                                                EIGN0440
C                                                                    EIGN0450
      NT = L                                                         EIGN0460
      NT1= NT + 1                                                    EIGN0470
C                                                                    EIGN0480
      IF(IOO) 200,300,200                                            EIGN0485
C               CALCULATE EIGENVECTORS -  STORE IN A MATRIX          EIGN0490
C                                                                    EIGN0500
```

CARD NO **** CONTENTS ****

```
  200 M = M-1                                                          E10N0510
      DO 290 NV =1,NR                                                  E10N0520
      L = 0                                                            E10N0530
      DO 220 J =1,N                                                    E10N0540
      DO 220 I =1,N                                                    E10N0550
      DO 220 K= 1,2                                                    E10N0560
      L = L + 1                                                        E10N0570
      LT= L + NT                                                       E10N0580
      T(LT)  = T(L)                                                    E10N0590
      IF (I.EQ.J)   T(LT) = T(LT) - R(K,NV)                            E10N0600
      IF (J.EQ.N)   T(LT) = - T(LT)                                    E10N0610
  220 CONTINUE                                                         E10N0620
      MD = 1                                                           E10N0630
      E1 = .00000001                                                   E10N0640
      E2 = .00000001                                                   E10N0650
      CALL COLSO (T(NT1) ,A(1,1,NV) ,IL ,N ,M ,MD ,ALP ,E1 ,E2 ,N ,MAXA(E10N0660
      A(1,N NV) =1.0                                                   E10N0670
  290 A(2,N NV) =0.0                                                   E10N0680
  300 RETURN                                                           E10N0690
      END                                                              E10N0700
      SUBROUTINE COLSO(A,X,IL,N,M,MD,ALPHA,E1, 2 ,MAXA,MAXX)           E10N2520
C                                                                      E10N2530
      COMPLEX    A(MAXA,1) ,X(MAXX,1) ,ALPHA(1)  ,S  ,T1 ,C  ,T2 ,T3   E10N2540
      DIMENSION  IL(1)                                                 E10N2550
C                                                                      E10N2560
C                 SOLVE AX =B FOR X                                    E10N2570
C     N =NUMBER OF ROWS OF A                                           E10N2580
C     M =NUMBER OF COLUMNS OF A                                        E10N2590
C     MD=NUMBER OF COLUMNS OF B                                        E10N2600
C     A = FIRST  M COLUMNS OF A                                        E10N2610
C     B =(M+1) TO(M+MD)COLUMNS OF A                                    E10N2620
C     IL=                                                              E10N2630
C     ALPHA=                                                           E10N2640
C      E1 =                                                            E10N2650
C      E2 =                                                            E10N2660
C                                                                      E10N2670
      MM = M + 1                                                       E10N2680
      MMD= M + MD                                                      E10N2690
      DO 10  J= 1,MM                                                   E10N2700
   10 IL(J) = 0                                                        E10N2710
      I=1                                                              E10N2720
      DO 100 K =1,MMD                                                  E10N2730
      IF (K-MM) 20,20,30                                               E10N2740
   20 I1 = I + 1                                                       E10N2750
   30 CONTINUE                                                         E10N2760
      IF(I1-N)  35,35,105                                              E10N2770
   35 DO 80 J = I1,N                                                   E10N2780
      IF(CABS(A(K,J) - E1 ))80,80,40                                   E10N2790
   40 T1=CSQRT(A(J,K)**2  + A(I,K)**2 )                                E10N2800
      S  = A(J,K) / T1                                                 E10N2810
      C  = A(I,K)  / T1                                                E10N2820
      IF(K -MM ) 60,50,50                                              E10N2830
   50 T2      = C * A(I,K)  +  S * A(J,K)                              E10N2840
      A(I,K) =T2                                                       E10N2850
      IL(K) = I                                                        E10N2860
      GO TO 75                                                         E10N2870
   60 DO 70 L = K,MMD                                                  E10N2880
      T2      = C * A(I,L)  +  S * A(J,L)                              E10N2890
      T3      =-S * A(I,L)  +  C * A(J,L)                              E10N2900
      A(I,L) = T2                                                      E10N2910
   70 A(J,L) = T3                                                      E10N2920
   75 MAXR2 = 2 * MAXR                                                 E10N2930
   80 CONTINUE                                                         E10N2940
      IF(K-MM)85,100,100                                               E10N2950
   85 IF( CABS(A(I,K)) - E2)100,100,90                                 E10N2960
   90 IL(K) = 1                                                        E10N2970
      I= I + 1                                                         E10N2980
  100 CONTINUE                                                         E10N2990
  105 CONTINUE                                                         E10N3000
C                                                                      E10N3010
      IF (I-MM) 110,120,120                                            E10N3020
```

```
CARD NO  ****                      CONTENTS                          ****
          110 IR = I - 1                                              E10N3030
              WRITE      (6,115)    IR                                E10N3040
          115 FORMAT (30H- THE RANK OF THE A MATRIX IS   I15    )     E10N3050
        C                                                             E10N3060
          120 DO  200 L =1,MD                                         E10N3070
              II = M                                                  E10N3080
              LD = M + L                                              E10N3090
              DO 130 I=1,M                                            E10N3100
          130 X(I,L) = (0.0 ,0.0)                                     E10N3110
              DO 180 J=1,M                                            E10N3120
              IF(IL(II)) 180,180,140                                  E10N3130
          140 S      = (0.0 ,0.0)                                     E10N3140
              LL = II +1                                              E10N3150
              I= IL(II)                                               E10N3160
              IF(LL-M )150,150,170                                    E10N3170
          150 DO 160 K = LL,M                                         E10N3180
          160 S = S + A(I,K) * X(K,L)                                 E10N3190
          170 S =      A(I,LD) - S                                    E10N3200
              X(II,L) = S /A(I,II)                                    E10N3210
        C                                                             E10N3220
          180 II = II - 1                                             E10N3230
          190 I  = IL(MM)                                             E10N3240
              IF(I ) 194, 192,194                                     E10N3250
          192 ALPHA(L) = (0.0 ,0.0)                                   E10N3260
              GO TO 200                                               E10N3270
          194 ALPHA(L) = A(I,LD)                                      E10N3280
        C                                                             E10N3290
          200 CONTINUE                                                E10N3300
              RETURN                                                  E10N3310
              END                                                     E10N3320
              SUBROUTINE CMULC (A,B,C,NI,NK,NJ,MA,MB,MC,IOO)
              DIMENSION A(1),B(1),C(1)
              COMPLEX A,B,C
              IF (IOO.LE.0.OR.IOO.GT.2) GO TO 70
              DO 40 I = 1,NI                                          23007580
              DO 40 J = 1,NJ                                          23007590
              IC = MC *(J-1) + I                                      23007600
              C(IC)=0.0
              DO 40 K=1,NK
              IB  = MB *(J-1) + K                                     23007630
              GO TO (10,20),IOO
           10 IA = MA * (K-1) + I                                     23007650
              GO TO 30                                                23007660
           20 IA = MA * (I-1) + K                                     23007670
           30 C(IC)=C(IC)+A(IA)*B(IB)
           40 CONTINUE                                                23007690
              RETURN                                                  23007710
           70 WRITE      (6,80)      IOO                              23007720
           80 FORMAT (30H0 ERROR CODE FROM MMULT =            I8  )   23007730
              CALL EXIT                                               23007740
              STOP                                                    23007750
              END                                                     23007760
              SUBROUTINE CMULR (A,B,C,NI,NK,NJ,MA,MB,MC,IOO)
              DIMENSION A(1),B(1),C(1)
              COMPLEX A,C
              IF (IOO.LE.0.OR.IOO.GT.2) GO TO 70
              DO 40 I = 1,NI                                          23007580
              DO 40 J = 1,NJ                                          23007590
              IC = MC *(J-1) + I                                      23007600
              C(IC)=(0.0,0.0)
              DO 40 K=1,NK
              IB  = MB *(J-1) + K                                     23007630
              GO TO (10,20),IOO
           10 IA = MA * (K-1) + I                                     23007650
              GO TO 30                                                23007660
           20 IA = MA * (I-1) + K                                     23007670
           30 C(IC)=C(IC)+A(IA)*B(IB)
           40 CONTINUE                                                23007690
              RETURN                                                  23007710
           70 WRITE      (6,80)      IOO                              23007720
           80 FORMAT (30H0 ERROR CODE FROM MMULT =            I8  )   23007730
```

```
CARD NO   ****                         CONTENTS                         ****

          CALL EXIT                                                  23007740
          STOP                                                       23007750
          END                                                        23007760
          SUBROUTINE DATAN                                               5260
          DIMENSION SINL(16),COSL(16),A(3,3)                         DATAN003
          COMMON TCX(2340 ),TAU(16,15),EI(16),GJ(16),FREQ(45),CP,NCP,NEL, DATAN004
         *NMODE,ITER,IPNCH,FFLTR,XMOD(2,2),MA,XMD(2,2),OD(2,16),ISYM,DD(45,8DATAN005
         *),DELY                                                     DATAN006
          COMMON/BLOCK1/TITLE(7),AK(45,45),AM(45,45),F(3,3,15),VM(15), DATAN007
         *EIDER(16),GJDER(16),T(16),Y(16),C(16),E,G,VREF,NEL3,NITER,  DATAN008
         *ROOTK(3,3),IFLX,ADK(4,3,3),NKD,LKD(4),EX(16),GX(16)         DATAN009
          COMMON/BLOCK2/AMBDA(16),D2(16),CLA(16),CA(16),YA(15),CAY(50),IZS, DATAN011
         *RHO,VMIN,VMAX,ICASE,NEWJOB,NSUP2,NSUP3,Z(560),RHU(6),NALT   DATAN012
          COMMON/BLOCK3/WTS(15,3),DCG(15),WM(15),RHOM,NI1(16),NI2(16),NO1(16DATAN013
         *),NO2(16),WST(15,3),SIM,SAM,SOM,DCONS(15),TOTWT,ADM(4,3,3),NMD,LMDDATAN014
         *(4),WTT(15,3),RHOO(15)                                     DATAN015
          IZS=0
          NS=45
          IPNCH=IPNCH+1
          ITER =1                                                        5390
          READ(5,9200)  TITLE
          IF(EOF,5) 4000,1
        1 READ(5,9209) E,G,RHOM,RHO,VREF,NCP,NMODE,NKD,
         1NMD,NITER,IFLX,NSY,NALT,NSUP1,NSUP2,NSUP3
          IF(NSY.EQ.0) ISYM=-1
          IF(NSY.EQ.1) ISYM=0
          IF(NSY.EQ.2) ISYM=1
          CP=NCP                                                         9422
          SYM=1.
          WRITE (6,9205) TITLE                                           9460
          WRITE(6,9203)
          WRITE(6,9215) E,G,RHOM,RHO,VREF,NCP,NMODE,NKD,
         1NMD,NITER,IFLX,NSY,NSUP1,NSUP3
          IF(ISYM)904,920,920
C-----SYMMETRIC FREE-FREE DATA  WT, CG DIST (+AFT), I THETA
C-----ANTIS FREE-FREE DATA  I ROLL
  920 READ(5,900)DELY,XMD(1,1),XMD(2,1),XMD(2,2)
      IF(ISYM.EQ 0) WRITE(6,2001) DELY,XMD(1,1),XMD(2,1),XMD(2,2)
      IF(ISYM.EQ 1) WRITE(6,2002) DELY,XMD(1,1)
      IF(ISYM)902,901,903
  901 XMD(1,2)=XMD(2,1) * XMD(1,1)
      XMD(2,2) = XMD(2,2) + XMD(1,2) * XMD(2,1)
      XMD(2,1)=XMD(1,2)
      MA=2
      GO TO 902
  903 MA=1
  902 CONTINUE
  904 TOTWT=0.0
      NEL=NCP-2                                                          9940
      DO 10 N=1,NEL
   10 RHOG(N)=RHOM
      NEL1=NCP-1
      VMIN = 0.25*VREF                                                   9920
      VMAX = 1.5*VREF                                                    9910
      NEL3 = NEL*3                                                       9950
      DO 940 N=1,NEL                                                     8210
      READ (5,9210) (WTS(N,J), J=1,3),DCG(N),RHOG(N)
  940 IF(RHOG(N).EQ 0 0) RHOG(N)=RHOM
      WRITE(6,9010)
      DO 700 N=1,NEL
      M=N+1
  700 WRITE(6,9011) M,(WTS(N,J),J=1,3),DCG(N),RHOG(N)
  210 IF(NMD.EQ.0) GO TO 170
C     WRITE(6,8999)
      DO 180 K=1,NMD
      READ(5,9000) LMD(K),((ADM(K,I,J),I=1,3),J=1,3)
      JJ=LMD(K)
  180 WRITE(6,9003) JJ,((ADM( K,I,J),I=1,3),J=1,3)
  170 DO 220 N=1,NCP
      READ(5,9212) T(N),Y(N),C(N),AMBDA(N),EI(N),GJ(N),EX(N),GX(N)
      IF(EX(N).EQ 0.0) EX(N)=E
```

```
CARD NO  ****                       CONTENTS                              ****
           IF(GX(N).EQ.0.0) GX(N)=G
           IF (AMBDA(N)) 212,214,212
       212 COSL(N) =COSD(AMBDA(N))                                        5650
           SINL(N) =SIND(AMBDA(N))                                        5660
           GO TO 220                                                      5670
       214 COSL(N) =1.0                                                   5680
           SINL(N) =0.0                                                   5690
       220 CONTINUE                                                       5700
           DO 50 I=1,NEL                                                  5710
           FI(1,1,I)=-1.0                                                 5720
           FI(3,3,I)=-COSL(I+1)                                           5730
           FI(2,3,I)=-SINL(I+1)                                           5740
           FI(1,3,I)=-Y(I)*SINL(I+1)                                      5750
           FI(3,2,I)= SINL(I+1)                                           5760
           FI(2,2,I)=-COSL(I+1)                                           5770
           FI(1,2,I)=-Y(I)*COSL(I+1)                                      5780
           FI(2,1,I)= 0.0                                                 5790
           FI(3,1,I)= 0.0                                                 5800
        50 CONTINUE                                                       5810
C          FI IS SET UP AS 3*3'S                                          5820
           IF(IFLX.NE.0) READ(5,9210) ((    A(I,J),I=1,3),J=1,3)          5825
           IF(IFLX.NE.2) GO TO 250                                        5830
           PI=A(1,1)*A(2,2)*A(3,3)+2.*A(1,2)*A(1,3)*A(2,3)-A(1,3)**2*A(2,2)-A 5831
          1(2,3)**2*A(1,1)-A(1,2)**2*A(3,3)                               5832
           ROOTK(1,1)=(A(2,2)*A(3,3)-A(2,3)**2)/PI                        5836
           ROOTK(2,2)=(A(1,1)*A(3,3)-A(1,3)**2)/PI                        5838
           ROOTK(3,3)=(A(1,1)*A(2,2)-A(1,2)**2)/PI                        5840
           ROOTK(1,2)=(A(1,3)*A(2,3)-A(1,2)*A(3,3))/PI                    5842
           ROOTK(1,3)=(A(1,2)*A(2,3)-A(1,3)*A(2,2))/PI                    5844
           ROOTK(2,3)=(A(1,3)*A(1,2)-A(1,1)*A(2,3))/PI                    5846
           ROOTK(2,1)=ROOTK(1,2)                                          5848
           ROOTK(3,1)=ROOTK(1,3)                                          5850
           ROOTK(3,2)=ROOTK(2,3)                                          5852
       250 IF(IFLX.NE.1) GO TO 252                                        5854
           DO 251 J=1,3                                                   5856
           DO 251 I=1,3                                                   5858
       251 ROOTK(I,J)=A(I,J)                                              5860
       252 CONTINUE                                                       5862
           IF(NMD.EQ 0.AND IFLX.NE.0) WRITE(6,8999)
           IF(IFLX.NE.0) WRITE(6,9192) ((ROOTK(I,J),J=1,3),I=1,3)         5865
           IF(NKD.EQ.0) GO TO 270
           IF(IFLX.EQ.0.AND.NMD.EQ.0) WRITE(6,8999)
           DO 260 K=1,NKD
           READ(5,9000) LKD(K),((ADK(K,I,J),I=1,3),J=1,3)
           JJ=LKD(K)-1
       260 WRITE(6,9002) JJ,((ADK( K,I,J),I=1,3),J=1,3)
       270 CONTINUE
           CALL STIFN                                                     6080
           WRITE(6,9251) (I,T(I),Y(I),C(I),AMBDA(I),EI(I),GJ(I),EX(I),GX(I),I
          1=1,NCP)
           CALL STRNTH
           DO 982 I=1,NCP
           IF(T(I).EQ.0.0) T(I)=6.0
       982 IF(C(I).EQ.0.0) C(I)=6.0
           READ(5,9230) (N11(I),N12(I),ND1(I), ND2(I),        I=2,NEL1)   5930
           WRITE(6,9300)(I,N11(I),N12(I),ND1(I),ND2(I),        I=2,NEL1)
           CALL MASS                                                      6090
           IF(NITER.EQ.0) GO TO 600
       515 DO 520 I=2,NEL1                                                6060
       520 READ (5,9210) CA(I),D2(I),CLA(I)                               6070
           SUML =AMBDA(1)                                                 6100
           DO 530 I=1,NEL                                                 6110
           SUML = SUML+AMBDA(I+1)                                         6120
       530 YA(I+1)=YM(I)*COSD(SUML)                                       6130
           YA(1)=0.0                                                      6150
           YM(NCP-1)=0.0                                                  6141
           YA(NCP)=0.0                                                    6160
           IF(NSY EQ.0) GO TO 599
           IF(IFLX.EQ.0) YA(2)=YA(2)+DELY
           IF(IFLX.NE.0) YA(3)=YA(3)+DELY
       599 CONTINUE
```

```
CARD NO   ****                        CONTENTS                                  ****

          WRITE(6,9260) (I,     YA(I),CA(I),D2(I),CLA(I),I=2,NEL))
          IF(IFLX.NE.0) CA(2)=CA(3)                                             6167
          IF(NALT.EQ.0) GO TO 600
          READ(5,9210) (RHO(I),I=1,NALT)
          WRITE(6,9351) (I,RHO(I),I=1,NALT)
          IF(NITER.EQ.1) GO TO 600
          WRITE(6,9350)
          NALT=0
      600 CONTINUE                                                              6170
          IF(NITER.EQ.100) NEWJOB=1
          IF(NEWJOB.EQ.1) RETURN
          DO 610 I=1,NCP                                                        6180
      610 GJDER(I)=GJ(I)/GJDER(I)                                               6182
      620 IF(NSUPL.EQ.1) GO TO 630
          CALL NPRINT(AM,NEL3,NEL3,NS,1,10H0  MASS    )
      630 CONTINUE
     900  FORMAT(6E12.8)
     2001 FORMAT(1H1,42X,24HFREE-FREE SYMMETRIC DATA//26X, 4HDELY,13X,10HWEI
         1GHT(LB), 8X,13HDEA(IN)(-FWD), 5X,18HIPITCHCG(LB-IN**2)//14X,4E20.7
         2)
     2002 FORMAT(1H1,39X,29HFREE-FREE ANTI-SYMMETRIC DATA//47X,4HDELY,11X,18
         1HI-ROLL(LB-IN**2)//34X,2E20.7)
     8999 FORMAT(1H1)
     9000 FORMAT(I12,5E12.8/4E12.8)
     9002 FORMAT(1H0,38X,32HSTIFFNESS INSERTION BEAM ELEMENT,I3//(29X,3E17.7
         1))
     9003 FORMAT(1H0,37X,21HMASS ADDED TO STATION,I3//(29X,3E17.7))
     9010 FORMAT(1H0,40X,29HINPUT DISTRIBUTED WEIGHT DATA//105H STATION
         1 WT(LB)          IROLLCG(LB-IN**2)  IPITCHCG(LB-IN**2)    DEA(IN)
         2(-FWD)      RHOG(LB/IN**2) / )
     9011 FORMAT(4X, I2,5E20.7)
     9192 FORMAT(1H0,43X,20HINPUT ROOT STIFFNESS/(29X,3E17.7))
     9198 FORMAT(30X,I5,E15.7)
     9200 FORMAT(7A10)
     9203  FORMAT(1H0,///10X,72(1H*)/10X,72H* STRENGTH CRITERION----  THE EI-
         1GJ CURVE IS INPUT AND INCREASED UNTIL */10X,72H* THE FLUTTER VELOC
         2ITY IS GREATER  THAN THE INPUT  REFERENCE VELOCITY. */10X,72(1H*))
     9205 FORMAT(1H1///10X,7A10)
     9209  FORMAT(5E12.8/8I6,4I1)
     9210 FORMAT(6E12.8)
     9211 FORMAT(4F6.2,E12.8,12X,2E12.8)
     9212 FORMAT(4F8.2,4E12.8)
     9215 FORMAT(1H0,44X,18H*** INPUT DATA ***///19X,23HMODULUS OF ELASTICIT
         1Y,E,17X,1H=,E15.7, 9H LB/IN**2/19X,21HMODULUS OF SHEAR,G   ,19X,1H
         2=,E15.7, 9H LB/IN**2/19X,30HDENSITY OF STRUCTURAL MATERIAL,10X,1H=
         3,E15.7,10H LBF/IN**3/19X,14HDENSITY OF AIR,26X,1H=,E15.7,10H LBF/I
         4N**3/19X,24HFLUTTER VELOCITY DESIRED,16X,1H=,E15.7,6H KNOTS/19X,
         526HNUMBER OF CONTROL STATIONS,14X,1H=,I3/19X,
         615HNUMBER OF MODES,25X,1H=,I3/19X,
         730HNUMBER OF STIFFNESS INSERTIONS,10X,1H=,I3/19X,
         824HNUMBER OF MASS ADDITIONS,16X,1H=,I3/19X,28HMAXIMUM NUMBER OF IT
         9ERATIONS,12X,1H=,I3/19X,26HROOT FLEXIBILITY INDICATOR,14X,1H=,I3/
         A19X,26HFREE-FREE OPTION INDICATOR,14X,1H=,I3/
         B19X,28H M         PRINTOUT INDICATOR,12
         CX,1H=,I3/19X,33HVIBRATION MODE PRINTOUT INDICATOR,7X,1H=,I3)
     9230 FORMAT(4I12)
     9250 FORMAT(1H1,37X,23HSTRUCTURAL BOX GEOMETRY//1X,3HSTA,3X, 9HDEPTH(IN
         1),8X,10HLENGTH(IN),5X, 9HWIDTH(IN),7X,10HANGLE(DEG),4X, 7HTAU(IN),
         210X,12HEI(LB-IN**2),3X,12HGJ(LB-IN**2)//(1H ,I2,7E15.6))
     9251 FORMAT(1H1,24X,48HSTRUCTURAL BOX GEOMETRY AND CONTROL STATION DATA
         1//78H STA DEPTH(IN)  LENGTH(IN) WIDTH(IN)  ANGLE(DEG)   EI(LB-IN**
         22)   GJ(LB-IN**2),4X,25HE(LB/IN**2)   G(LB/IN**2)//(1H ,I2,1X,4(F9
         3.3,2X),4E15.6))
     9260 FORMAT(1H1,42X,15HAERO STRIP DATA//2X, 7HSTATION, 6X,  9HWIDTH(IN)
         17X, 13HAVG CHORD(IN),5X  9HAC TO EA(IN) (-FWD),6X, 7HCLALPHA
         2 //(1H ,I4,4E20.7))
     9300  FORMAT(1H0,25X,49HSTRUCTURAL BOX AND AERO STRIP BOUNDARY INDICATOR
         1S // 27X, 7HSTATION,5X,3HNI1,7X,3HNI2,7X,3HNO1,7X,3HNO2//
         2(21X,5I10))
     9350 FORMAT(1H0,2X,103H***ERROR*** EXTRA ALTITUDES MAY BE SPECIFIED ONL
         1Y IF NITER=1  THIS CASE RUN FOR ORIGIONAL DENSITY ONLY    )
```

CARD NO **** CONTENTS ****

```
 9351 FORMAT(1H1,41X, 23HEXTRA ALTITUDEDENSITIES  //145X,I3,E17.7))
 9999 FORMAT(1H1,41X, 19H*****END OF PROGRAM  )
      RETURN                                                            0230
 2000 WRITE(6,9999)
      STOP
      END                                                               0240
      SUBROUTINE DTSD (S,SC,R,RC,D,M,N,NRC,MD,ND)
C     PRODUCT OF MATRIX S BY MATRIX D AND ITS TRANSPOSE. S MAY BE REAL  0DTSD0200
C     R COMPLEX.                                                        DTSD0300
      DIMENSION S(MD,MD),D(MD,ND),R(ND,ND),SC(MD,MD),RC(ND,ND)          DTSD0500
      COMPLEX SC,RC,XC                                                  DTSD0600
      IF (NRC .GT. 1) GO TO 100                                         DTSD0700
      DO 20 LX = 1,N                                                    DTSD0800
      DO 20 JX = 1,N                                                    DTSD0900
   20 R(LX,JX) = 0.0                                                    DTSD1000
      DO 40 JX = 1,N                                                    DTSD1100
      DO 40 IX = 1,M                                                    DTSD1207
      X = 0.0                                                           DTSD1300
      DO 30 KX = 1,M                                                    DTSD1400
   30 X = X + S(IX,KX) * D(KX,JX)
      DO 40 LX = 1,N                                                    DTSD1600
   40 R(LX,JX)=R(LX,JX)+D(IX,LX)*X
      GO TO 200                                                         DTSD1800
  100 DO 120 LX = 1,N                                                   DTSD1900
      DO 120 JX = 1,N                                                   DTSD2000
  120 RC(LX,JX) = (0.0,0.0)                                             DTSD2100
      DO 140 JX = 1,N                                                   DTSD2200
      DO 140 IX = 1,M                                                   DTSD2300
      XC = (0.0,0.0)                                                    DTSD2400
      DO 130 KX = 1,M                                                   DTSD2500
  130 XC=XC+SC(IX,KX)*D(KX,JX)
      DO 140 LX = 1,N                                                   DTSD2700
  140 RC(LX,JX)=RC(LX,JX)+D(IX,LX)*XC
  200 RETURN                                                            DTSD2900
      END                                                               DTSD3000
      SUBROUTINE EIGN(CAY, G, V, F, IMIN, IVECT)                        EIGN0010
      DIMENSION   QB(3,10),Q(10),V(10),F(10),T3(10,10)                  EIGN0015
      DIMENSION QAN(10,3),T4(10,2),DTAD(2,2),T5(10,10),
     * DO1(3,2),CF(2,2),CG(10,2),CH(2,10),XM(2,2),XMDVOT(10,2),
     *XMDVO(2,10)
      DIMENSION TXT(800)
      COMMON AN(3,3,15),CE(10,10),OF(45),RT(10),T1(45),T2(45),ENRGY(15),EIGN0007
     *TXTT(1550),TAU(16,15),EI(16),GJ(16),FREQ(45),CP,NCP,NEL,NMODE,ITER
     *,
     *IPNCH,FFLTR,XMDD(2,2),NRBM,XMD(2,2),DD(2,10),ISYM,DD(45,2),DELY   EIGN0009
      COMMON/BLOCK1/TITLE(7),AK(45,45),Q(45,45),F(3,3,15),VM(15),       EIGN 10A
     *EIDER(16),GJDER(16),T(16),Y(16),C(16),E,GGG,VRGF,NEL3,NITER,      EIGN 10B
     *ROOTK(3,3),IFLX,ADK(4,3,3),NOD,LKD(4)                             EIGN 10C
      COMMON/BLOCK2/AMBDA(16),D2(16),CLA(16),CA(16),YA(15),GAY(50),
     *CAM,RHO,VMIN,VMAX,ICASE
      COMPLEX AN,RT,CE,OF,T1,T2,ENRGY,T3                                EIGN0013
      COMPLEX QAN,T4,DTAD,T5,CF,CG,CH,XM,DEN
      EQUIVALENCE (QB(1),Q(1,45)),(T1(1),T3(1))
      VBWR =1.0/CAY                                                     EIGN0080
      CALL AERO(VBWR)                                                   EIGN0090
      COEF = VBWR*    3.1416*CA(2)*661.0/ (1117.0*12.0)                 EIGN0105
      DO 100 J=1,NMODE                                                  EIGN0120
      DO 100 I=1,NMODE                                                  EIGN0130
  100 CE(I,J)=(0.0,0.0)                                                 EIGN0140
      IF(ISYM.LT.0) GO TO 103
      DO 101 I = 1,NRBM
      DO 101 J = 1,NRBM
  101 CF(I,J) = (0.,0.)
      DO 102 I = 1,NRBM
      DO 102 J = 1,NMODE
      CG(J,I) = (0.,0.)
  102 CH(I,J) = (0.,0.)
C     GENERALIZED AERO                                                  EIGN0160
  103 DO 200 N=1,NEL                                                    EIGN0170
      IF(YA(N+1) .EQ. 0.0) GO TO 200                                    EIGN0171
      IN= 3*(N-1)+1                                                     EIGN0180
```

```
CARD NO   ****                        CONTENTS                              ****

          C                                                                 E10N0230
          C     FORM Q-TRANSPOSE*A*Q                                        E10N0240
                DO 120 I=1,3                                                E10N0250
                DO 110 J=1,NMODE                                            E10N0255
            110 QB(I,J)=Q(IN,J)                                             E10N0270
                IF(ISYM.LT.0) GO TO 120
                DO 111 K=1,NRBM
          111   DQ1(I,K)=DQ(IN,K)
            120 IN = IN +1                                                  E10N0280
                CALL DTSD(AN(1,1,N),AN(1,1,N), T3,T3,QB, 3,NMODE,  2,  3, 10  )   E17N0290
          C     SUM UP A                                                    E10N0280
                DO 140 J=1,NMODE                                            E10N0300
                DO 140 I=1,NMODE                                            E10N0310
            140 CE(I,J) =       CE(I,J)      + T3(I,J)                      E10N0320
                IF(ISYM)200,8001,8001
          8001  CALL RMULC(QB,AN(1,1,N),QAN,NMODE,3,3,3,3,10,2)
                CALL CMULR(QAN,DQ1,T4,NMODE,3,NRBM,10,3,10,1)
                CALL DTSD(AN(1,1,N),AN(1,1,N),DTAD,DTAD,DQ1,3,NRBM,2,3,2)
                CALL RMULC(DQ1,AN(1,1,N),QAN,NRBM,3,3,3,3,10,2)
                CALL CMULR(QAN,QB,T5,NRBM,3,NMODE,10,3,10,1)
                DO 3000 I=1,NRBM
                DO 3000 J=1,NRBM
          3000  CF(I,J)=CF(I,J)+DTAD(I,J)
                DO 3001 I=1,NMODE
                DO 3001 J=1,NRBM
          3001  CG(I,J)=CG(I,J)+T4(I,J)
                DO 3002 I=1,NRBM
                DO 3002 J=1,NMODE
          3002  CH(I,J)=CH(I,J)+T5(I,J)
            200 CONTINUE                                                    E1GN0360
          C                                                                 E1GN0380
          C                                                                 E1GN0350
                DO 210 J=1,NMODE                                            E1GN0390
            210 CE(J,J) =CE(J,J)+(1.0,0 0)                                  E1GN0400
                IF(ISYM)9500,9501,9501
           9501 DO 3005 I=1,NRBM
                DO 3005 J=1,NRBM
           3005 XM(I,J)=XMDO(I,J)+CF(I,J)
                IF(NRBM.EQ 2) GO TO 3007
                XM(1,1)=1.0/XM(1,1)
                GO TO 3008
          3007  DEN=XM(1,1)*XM(2,2)-XM(1,2)*XM(2,1)
                CF(1,1)=XM(1,1)
                XM(1,1)=XM  (2,2)/DEN
                XM(1,2)=-XM(1,2)/DEN
                XM(2,1)=-XM(2,1)/DEN
                XM(2,2)=CF(1,1)/DEN
          3008  CALL CMULC(CG,XM,T4,NMODE,NRBM,NRBM,10,2,10,1)
                CALL CMULC(T4,CH,T5,NMODE,NRBM,NMODE,10,2,10,1)
                DO 3009 I=1,NMODE
                DO 3009 J=1,NMODE
          3009  CE(I,J)=CE(I,J)-T5(I,J)
           9500 DO 230 I=1,NMODE
                DO 220 J=1,NMODE
            220 CE(I,J)=CE(I,J)/ FREQ(I)**2                                 E10N0430
            230 CONTINUE                                                    E10N0440
                IF(NMODE EQ 1) GO TO 20
          C     CALL FOR ROOTS                                              E10N0480
                NDIC=NMODE
          300   CALL CEIGN(CE,RT,TXT,NMODE,NDIC,10,2,NERR,IVECT)
          C                                                                 E10N0480
             20 IF(NMODE GT.1) GO TO 21
                RT(1)=CE(1,1)
                IF(IVECT EQ.1) CE(1,1)=(1.0,0 0)
             21 CONTINUE
          C     COMPUTE F,G,V                                               E10N0490
                DO 350 I=1,NMODE                                            E10N0500
                IF(REAL(RT(I)) .LE  0.0) GO TO 350                          E10N0508
                G(I) = AIMAG(RT(I))/REAL(RT(I))                             E10N0510
                F(I) = 1 0/SQRT(REAL(RT(I)))                                E1GN0520
                V(I) = COEF*F(I)                                            E10N0530
```

```
CARD NO  ****                          CONTENTS                              ****
      1     FORMAT(8E17.7)
        350 CONTINUE                                                         EIGN0540
            IF(IVECT.EQ.1) RETURN                                            EIGN0545
            IF(ICASE .GT.  0) GO TO 365                                      EIGN0550
            IMIN=1                                                           FDYN0551
            IF(NMODE.EQ.1) RETURN
            DIFF = ABS(CP - V(1))                                            FDYN0552
            DO 360 I=2,NMODE                                                 FDYN0553
               IF( ABS(CP-V(I)) .GT. DIFF) GO TO 360                         FDYN0554
                 DIFF = ABS(CP-V(I))                                         FDYN0555
                 IMIN=I                                                      FDYN0556
      C     SELECT THE MODE WITH THE SPEED CLOSEST TO PREDICTED VALUE CP     FDYN0557
        360 CONTINUE                                                         FDYN0558
            GO TO 400                                                        FDYN0559
      C                                                                      EIGN0560
      C     SELECT POSITIVE G WITH MINIMUM V                                 EIGN0570
        365 DO 370 I=1,NMODE                                                 EIGN0590
            LLLLL=I                                                          EIGN0595
            IF(G(I)) 370,370,380                                             EIGN0600
        370 CONTINUE                                                         EIGN0605
            GO TO 400                                                        EIGN0606
        380 IMIN=LLLLL                                                       EIGN0610
            DO 390 I=LLLLL,NMODE                                             EIGN0620
            IF(G(I) .GT. 0.0 .AND. V(I).LT.V(IMIN) ) IMIN=I                  EIGN0630
        390 CONTINUE                                                         EIGN0640
        400 RETURN                                                           EIGN0660
            END                                                              EIGN0670
            SUBROUTINE ENERGY
            DIMENSION ZERO(5),RATEV(15),VOLUM(15),TAUA(15),PX(45)            ENERGY03
            COMMON AN(3,3,15),CE(10,10),OF(45),RT(10),T1(45),T2(45),ENRGY(15),ENERGY05
           *F(10,50),G(10,50),V(10,50),IMIN(50),TAU(16,15),EI(16),           ENERGY06
           *GJ(16),FREQ(45),CP,NCP,NEL,NMODE,ITER,IPNCH,FFLTR                ENERGY07
            COMMON/BLOCK1/TITL(7),AK(45,45),Q(45,45),F1(3,3,15),VM(15),      ENERGY 8
           *EIDER(16),GJDER(16),T(16),Y(16),C(16),E,GEE,VREF,NEL3,NITER,     ENERGY09
           *ROOTK(3,3),IFLX                                                  ENERGY10
            COMMON/BLOCK2/A(129),IZS,RHO,VMIN,VMAX,ICASE,NEWJOB,NSUP2,NSUP3, ENERGY11
           *GAMA(100),P(45,10),PMAX(10),RHU(6),NALT
            COMMON/BLOCK3/MTS(15,3),DCG(15),YM(15),RHOM,NI1(16),NI2(16),NO1(16
           *),NO2(16),MST(15,3),SIM,SAM,SOM,DCONS(15)
            EQUIVALENCE (VFLTR,CP)                                               0130
            COMPLEX AN,RT,CE,OF,T1,T2,ENRGY                                  ENERGY16
            NS=45
      1     FORMAT(8E17.7)
            IF(NITER.EQ.0) GO TO 221
            CALL RMULC(Q(1,11),OF,T1,NEL3,NMODE,1,NS,NMODE,NS,1)             ENERGY18
            REWIND 7
            WRITE(7)((Q(I,J+10),I=1,NEL3),J=1,NMODE)
            REWIND 7
            READ(1)((Q(I,J),I=1,NEL3),J=1,NEL3)
            CALL RMULC(Q,T1,T2,NEL3,NEL3,1,NS,NS,NS,1)                       ENERGY19
            READ(2)((AK(I,J),I=1,NEL3),J=1,NEL3)
            CALL RMULC(AK,T2,T1,NEL3,NEL3,1,NS,NS,NS,1)                      ENERGY20
      C     DI-TRANSPOSE IN KR                                                   0210
            DO 100 J=1,NEL3                                                      0220
            DO 100 I=1,NEL3                                                      0230
      100   AK(I,J)=Q(J,I)                                                   ENERGY24
            READ(7)((Q(I,J+10),I=1,NEL3),J=1,NMODE)
            CALL RMULT(Q(1,11),AK,Q(1,21),NMODE,NEL3,NEL3,NS,NS,NMODE,2)     ENERGY25
      C     CONJUGATE OF OF                                                      0260
            DO 110 I=1,NMODE                                                     0270
        110 OF(I) = CONJG(OF(I))                                                 0280
            CALL CMULR (OF,Q(1,21 ),T2,1,NMODE,NEL3,1,NMODE,1,1)
      C     STRAIN ENERGIES                                                      0310
            DO 120 N=1,NEL                                                       0320
            K1=3*(N-1)+1                                                         0330
            K3=K1+2                                                              0340
            ENRGY(N)=(0.0,0.0)                                                   0350
            DO 115 K=K1,K3                                                       0360
        115 ENRGY(N) = ENRGY(N) + T2(K)*T1(K)                                    0370
      C                                                                          0380
        120 CONTINUE                                                             0390
```

```
CARD NO    ****                CONTENTS                                  ****

           C     SELECT LARGEST AND GET AVE AVERAGE E/V                  0490
                 AVGE=0.0                                                0500
                 COUNT = 0.                                              0510
                 EVMX=0.0                                                0520
                 VTOT=0.0
                 DO 142 N=1,NEL
                 IF(Y(N).EQ.0.) GO TO 143
                 V1=Y(N)/3.*(C(N)*(2.*TAU(N,ITER)+TAU(N+1,ITER))+C(N+1)*(TAU(N,ITER
                1)+2.*TAU(N+1,ITER)))
                 V2=Y(N)/3.*(TAU(N,ITER)*(T(N)-2.*TAU(N,ITER))+TAU(N+1,ITER)*(T(N+1
                1)-2.*TAU(N+1,ITER))+(TAU(N,ITER)+TAU(N+1,ITER))*(T(N)-2.*TAU(N,ITE
                2R)+T(N+1)-2.*TAU(N+1,ITER)))
                 VM(N)=V1+V2
                 VTOT=VTOT+VM(N)
                 GO TO 142
             143 VM(N)=0.0
             142 VOLUM(N)=VM(N)
                 DO 145 N=1,NEL                                          0530
                    IF(VM(N) .EQ. 0.0)  GO TO 145                        0540
                                 VM(N)=REAL(ENRGY(N))/VM(N)              0550
                    IF(  VM(N) .GT. EVMX)  EVMX= VM(N)                   0560
                    AVGE = AVGE+VM(N)                                    0570
                 COUNT = COUNT+1                                         0580
             145 CONTINUE                                                0590
                 AVGE = AVGE / COUNT                                     0600
                 IND=0                                                   0601
                 NCOUNT=0
                 AVAVG=0.0
                 DO 180 N=1,NEL                                          0610
                 RATEV(N)= VM(N)/AVGE                                    0611
                 IF(VM(N) .EQ. 0.) GO TO 180                             CRITR525
                 IF(RATEV(N).LT.0.95.OR.RATEV(N).GT.1.05) IND=1          0630
                 IF(VM(N).LT.AVGE) GO TO 180
                 AVAVG=AVAVG+VM(N)
                 NCOUNT=NCOUNT+1
             180 CONTINUE                                                0640
                 AVAVG=AVAVG/NCOUNT
                 WRITE(6,9502)(I,VOLUM(I),VM(I),RATEV(I),I=1,NEL)
                 WRITE(6,9503) VTOT
                 IND=0                                                   0642
                 IF(CP.GE.VREF-0.5) GO TO 195
                 IF(CP.LE.VREF/2.) WRITE(6,9300)
                 IF(CP.LE.VREF/2.) GO TO 200
                 IND=1
             190 IF(IND.EQ.1) GO TO 300                                  0642
             195 WRITE(6,9550)                                           0650
                 GO TO 200                                               0660
             300 IF (ITER.EQ.NITER) GO TO 200
                 RATIO=(1.02*VREF/VFLTR)**2
                 DO 150 N=1,NEL                                          0690
                 FACTOR=1./RATIO
                 IF(VM(N).GE.AVAVG) FACTOR = SQRT(VM(N)/AVAVG)
                 TAUA(N)=.5*(TAU(N,ITER)+TAU(N+1,ITER))*(RATIO*FACTOR-1.)
             150 CONTINUE                                                0710
           C       CALCULATE     TAU 1 PRIME      AND TAU NCP-1 PRIME
                 TAU(1,ITER+1)=TAU(1,ITER)+TAUA(1)/2.
                 TAU(NCP-1,ITER+1)=TAU(NCP-1,ITER)+TAUA(NEL)/2.
                 TAU(NCP,ITER+1)=TAU(NCP,ITER)
                 NEL1=NEL-1
                 DO 160 N=1,NEL1
                 IF(VOLUM(N)+VOLUM(N+1) EQ.0.0) GO TO 155
                 TAU(N+1,ITER+1)=TAU(N+1,ITER)+TAUA(N)*VOLUM(N)/(VOLUM(N)+VOLUM(N+1
                1))+TAUA(N+1)*VOLUM(N+1)/(VOLUM(N)+VOLUM(N+1))
                 GO TO 160
             155 TAU(N+1,ITER+1)=TAU(N+1,ITER)
             160 CONTINUE                                                0770
             199 INOTA=0
                 IDNA=ITER+1
                 DO 198 I=1,NCP
                 IF(TAU(I,ITER+1).LT.0.25*T(I)) GO TO 198
                 WRITE(6,8999) I,TAU(I,IDNA)
```

CARD NO **** CONTENTS ****

```
      INDTA=1
  100 CONTINUE
      IF(INDTA.EQ 1) GO TO 200
      IF(ITER.EQ.1) CALL OUTPUT
      ITER =ITER+1                                                  0010
      RETURN                                                        0020
  200 IF(IND.EQ.1) WRITE(6,9901) ITER
C
C     PUNCH GJ
C
      ICT=346
      IM=1
      IN=NCP/5
      IF(IN*5.LT.NCP)IN=IN+1
      DO 1400 I=1,IN
      IL=IM+4
      PUNCH 1401,ICT,(GJ(J),J=IM,IL)
      ICT=ICT+5
      IM=IM+5
 1400 CONTINUE
 1401 FORMAT(8X,I3,(5E12.5))
      IF(ITER.EQ.1) GO TO 210
      ICASE=-1
  223 CALL VIBRN
      READ(3)((Q(I,J),I=1,NEL3),J=1,NMODE)
      CALL FLTR
      IF(NEWJOB.EQ.1) GO TO 211
  210 CALL OUTPUT
  211 IF(NALT.EQ.0) GO TO 220
      I2S=I2S+1
      IF(I2S.GT.NALT) GO TO 220
      RHO=RHU(I2S)
      ICASE=-2
      GO TO 223
  220 NEWJOB=1
  221 IF(NBUP3.EQ 1) GO TO 216
      IF(IFLX.NE.0) GO TO 500
      DO 20 J=1,NMODE
      DO 10 I=1,NEL
      PX(I)=P(I,J)
      PX(NEL+I)=P(NEL+I,J)
   10 PX(NEL*2+I)=P(2*NEL+I,J)
      DO 11 I=1,NEL
      P(I+1,J)=PX(I)
      P(NEL+I+2,J)=PX(NEL+I)
   11 P(2*NEL+I+3,J)=PX(2*NEL+I)
      P(1,J)=0.0
      P(NEL+2,J)=0.0
   20 P(2*NEL+3,J)=0 0
      NEL=NEL+1
  500 CONTINUE
      DO 222 I=1,5
  222 ZERO(I)=0.0
      DO 30 J=1,NMODE
      DO 31 I=1,NEL
      P(NEL+I,J)=P(NEL+I,J)*12.
   31 P(2*NEL+I,J)=P(2*NEL+I,J)*12.
      ID2=0
      ID1=J
      NXX=NEL/6 +0.999
      NM=NXX*6-NEL
      DO 30 LL=1,3
      L=(LL-1)*NEL
      DO 30 LNXX=1,NXX
      ID2=ID2+1
      M=L+6*(LNXX-1)+1
      N=M+5
   30 CONTINUE
  216 CONTINUE
 9999 FORMAT(1H0,15X,30HTHE SKIN THICKNESS FOR STATION,I3,1H=,E12 4,31H.
     1  THIS IS   0 25%BOX THICKNESS )
```

```
CARD NO   ****                       CONTENTS                          ****
 9000 FORMAT(6E12.5 I2,I3,I3)
 9300 FORMAT(1H0,23X 59HTHE FLUTTER VELOCITY IS LT 5XVREF. EXECUTION IS
     1 TERMINATED  )
 9501 FORMAT(1H0,I9, 89H ITERATIONS HAVE BEEN PERFORMED  THE CRITERION H
     1AS NOT SATISFIED. PLOTS WILL BE OBTAINED  )
 9502 FORMAT(1H0,17X, 12HBEAM ELEMENT, 8X,13HVOLUME(IN**3),5X,10HSTRAIN
     1ENERGY/VOL.,4X,20HRATIO(E/V/AVGE(E/V)) //(I25,4X,F10.4,2X,E20.7,F1
     20.4))
 9503 FORMAT(37X,10H---------- / 29X,F10 4 )
 9505 FORMAT(1H0,20X,29HTOTAL STRUCTURAL WEIGHT     =, E15 7,3H LB/29X,
     129HTOTAL NON-STRUCTURAL WEIGHT =,E15 7,3H LB/29X,12HTOTAL WEIGHT,1
     26X,1H=,E15 7,3H LB )
 9550 FORMAT(1H0//36X,39H******THE CRITERION IS SATISFIED ****** )
      RETURN                                                            1990
      END
      SUBROUTINE FLTR                                                   FDYN0010
      COMMON AN(3,3,15),CE(10,10),OF(45),RT(10),T1(45),T2(45),ENRGY(15),FLTR0003
     *F(10,50),G(10,50),V(10,50),IMIN(50),TAU(16,15),EI(16),GJ(16),     FLTR0004
     *FREQ(45),CP,NCP,NEL,NMODE,ITER,IPNCH,FFLTR                        FLTR0005
      COMMON/BLOCK1/TITLE(7),AK(45,45),Q(45,45),Z(232),VREF,NEL3        FLTR   6
      COMMON/BLOCK2/AMBDA(16),D2(16),CLA(16),CA(16),YA(15),CAY(50),CAM, FLTR0007
     *RHO,VMIN,VMAX,NOK,NEWJOB,NSUP2                                    FLTR0008
      COMPLEX AN,RT,CE,OF,T1,T2,ENRGY                                   FLTR0009
      WRITE(6,9500)
      IF(NOK.EQ.21) WRITE(6,9502)
      IF(NOK.EQ.22) WRITE(6,9505) RHO
      WRITE(6,9501)
      IND=0
      KK1=0
      KOOL=NOK                                                          FDYN0206
      K10=KOOL+10                                                       FDYN0207
      KONE=KOOL+1                                                       FDYN0208
      KK=0                                                              FDYN0210
      DO 50 J=1,50                                                      FDYN0211
      IMIN(J)=0                                                         FDYN0212
      DO 50 I=1,NMODE                                                   FDYN0213
      F(I,J)=0.0                                                        FDYN0214
      G(I,J)=0.0                                                        FDYN0215
      V(I,J)=0.0                                                        FDYN0216
   50 CONTINUE                                                          FDYN0217
      DO 200 K=1,KOOL,2                                                 FDYN0220
      NOK=K                                                             FDYN0230
      CALL EIGN(    CAY(K),     G(1,K),V(1,K),F(1,K),IMIN(K),    0)     FDYN0250
    1 FORMAT(6E17 7)
      IF (IMIN(K).NE.0) GO TO 301                                       FDYN0260
  200 CONTINUE                                                          FDYN0270
      GO TO 302                                                         FDYN0280
  301 KK=NOK                                                            FDYN0290
  302 KUL=NOK                                                           FDYN0299
      IF(NOK.GT.1) KUL=NOK-1                                            FDYN0300
      DO 303 K=KUL,KOOL                                                 FDYN0310
      INND=0
      NOK=K                                                             FDYN0320
      CALL EIGN(    CAY(K),     G(1,K),V(1,K),F(1,K),IMIN(K),    0)     FDYN0330
      IF(K.EQ.KUL AND.IMIN(K) NE.0) KK=NOK                              FDYN0335
      IF(IMIN(K).NE 0.AND.KK EQ 0) KK=NOK                               FDYN0340
      DO 51 I=1,NMODE
      IF(V(I,K) GT.1 75*VREF.OR V(I,K) EQ.0.) GO TO 51
      INND=1
   51 CONTINUE
      IF(INND EQ.0) GO TO 304
  303 CONTINUE                                                          FDYN0350
  304 J1=1                                                              FDYN0275
      NNN=NMODE/2 +0 9999                                               FDYN0276
      IHAH = 5
      DO 212 N=1,NNN                                                    FDYN0277
        J2=J1+1                                                         FDYN0278
      N1=NMODE-J1+1
      N2=NMODE-J2+1
      IHAH = 5 + KOOL + IHAH
      IF (IHAH .LT. 48) GO TO 211
```

CARD NO **** CONTENTS ****

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      WRITE (6,9500)
      IMAN = KOOL
  211 CONTINUE
      IF(N*2.LE.NMODE) WRITE(6,9201) N1,N2
      IF(N*2.GT.NMODE) WRITE(6,9202) N1
      IF(N*2.LE.NMODE)
     1 WRITE (6,9212) (CAY(J),(V(I,J),F(I,J),G(I,J),I=J1,J2),J=1,KOOL) FDYN0282
      IF(N*2.GT.NMODE) WRITE(6,9213)(CAY(J),V(NMODE,J),F(NMODE,J),G(NMOD
     1E,J),J=1,KOOL)
  212 J1=J1+2                                                           FDYN0284
  213 KSRCH=KX                                                          FDYN0290
      IF(KK) 220,220,191
  191 IF(IMIN(KX))220,220,190                                           FDYN0300
  220 WRITE(6,9910)                                                     FDYN0390
      NOX=KOOL
      CP=VREF
      CALL OUTPUT
      NEWJOB=1
      RETURN
  190 KODE=-1                                                           FDYN0291
C     SELECT G OF MIN. V OUT OF THE 20.                                 FDYN0295
      LUK=KX
      IF(KX.LT.KOOL) LUK=KX+1
      IK4=IMIN(KX)
      DO 210 K=LUK,KOOL                                                 FDYN0300
      NOX=K                                                             FDYN0305
      IF(IMIN(K) )210,210,205                                           FDYN0310
  205 IK  =IMIN(K)                                                      FDYN0320
      IKX= IMIN(KX )                                                    FDYN0330
      IK1=1
      IF(NMODE.EQ.1) GO TO 536
      FDIF=ABS(F(IK,K)-F(1,K-1))
      DO 208 J=2,NMODE
      FFDIF=ABS(F(IK,K)-F(J,K-1))
      IF(FFDIF GE.FDIF) GO TO 208
      IK1=J
      FDIF=FFDIF
  208 CONTINUE
  536 CONTINUE
      IF(V(IK,K) .GE. V(IKX,KX).OR. G(IK1,K-1).GE.0.) GO TO 210
      IK4=IK1
      KX=K
  210 CONTINUE                                                          FDYN0350
      KX2=KX                                                            FDYN0360
      IKX=IMIN(KX)                                                      FDYN0370
      KX3=IKX
      IK=IKX                                                            FDYN0380
      GO TO 230
  201 VNEW=50000
      LUK=KSRCH
      IF(KSRCH.EQ.1) LUK=KSRCH+1
      DO 225 K=LUK,KOOL
      DO 225 I=1,NMODE
      IF(KX3 EQ.I AND K EQ.KX2) GO TO 225
      IF(G(I,K).LE.0.) GO TO 225
      IK1=1
      IF(NMODE.EQ.1) GO TO 537
      FDIF=ABS(F(I,K)-F(1,K-1))
      DO 250 J=2,NMODE
      FFDIF=ABS(F(I,K)-F(J,K-1))
      IF(FFDIF.GE.FDIF) GO TO 250
      IK1=J
      FDIF=FFDIF
  250 CONTINUE
  537 CONTINUE
      IF(G(IK1,K-1).GE.0.0) GO TO 225
      IF(V(I,K).GT VNEW) GO TO 225
      VNEW=V(I,K)
      KX=K
      IK=I
      IK4=IK1
```

```
CARD NO   ****                    CONTENTS                          ****
          225 CONTINUE
              IF(VNEW.EQ.50000.)GO TO 840
              IF(V(IKN,KK-1).GE.VKK)) GO TO 840
              IKK=IK
          230 CONTINUE
              IF((G(IKK,KK).LT.0.01.AND.G(IKK,KK).GE.0.0).OR.(K.EQ.1)) GO TO 813 FDYN0430
              IF(KDONE.EQ.-1) GO TO 235
              IND=1
              DO 236 J=KONE,K10
              DO 236 I=1,NMODE
              V(I,J)=0.0
              F(I,J)=0.0
          236 G(I,J)=0.0
          235 CONTINUE
              CAYPG = CAY(KK)                                            FDYN0450
              KPG =KK                                                    FDYN0451
              IKPG =IK
              KMG =KK-1                                                  FDYN0455
              CAYMG = CAY(KK-1)                                          FDYN0460
              IKMG=IKN
          C                                                              FDYN0470
          C   INTERPT. K, UP TO 10 TIMES                                 FDYN0480
              CAY(KONE)=2.0*CAYPG*CAYMG /(CAYPG+CAYMG)                   FDYN0490
              DO 350  K=KONE,K10                                         FDYN0500
          C   CP= PREDICTED FLUTTER SPEED                                FDYN0505
              CP = V(IKPG,KPG)* CAYPG/CAY(K)                             FDYN0507
              NOK=-K                                                     FDYN0508
          300 CALL EIGN(    CAY(K),     G(1,K),V(1,K),F(1,K),IMIN(K),    0)  FDYN0510
              IK = IMIN(K)                                               FDYN0520
              DO 280 NK=1,NMODE
              IF(V(NK,K).LT.V(IKPG,KPG).AND.G(NK,K).GT.0.0             )
             1 IK=NK
          280 CONTINUE
              IF(G(IK,K) .GE. 0.0 .AND. G(IK,K) .LE. 0.01) GO TO 800     FDYN0550
              IF(K.EQ.K10)GO TO 310                                      FDYN0560
              IF (G(IK,K) .LT.  0.0)GO TO 330                            FDYN0570
          310 IF(G(IK,K).GE.G(IKPG,KPG)) GO TO 320                       FDYN0575
              KPG  = K                                                   FDYN0577
                      IKPG=IK                                            FDYN0579
                                    CAYPG=CAY(K)                         FDYN0580
          C   INTERPOLATE AND REPLACE K(+G)                              FDYN0590
          320 IF(K.EQ.K10)GO TO 350                                      FDYN0595
              CAY(K+1)=2.0*CAYMG*CAY(K)/(CAYMG+CAY(K))                   FDYN0600
              GO TO 350                                                  FDYN0620
          330 CAY(K+1) = 2.0*CAYPG*CAY(K)/(CAYPG+CAY(K))                 FDYN0630
              IF ( G(IK,K) .LE. G(IKMG,KMG) ) GO TO 350                  FDYN0635
              KMG  = K                                                   FDYN0637
                      IKMG = IK                                          FDYN0639
                                    CAYMG=CAY(K)                         FDYN0640
          C   GO GET G,F,V BASED ON THIS NEW INTERPOLATED K              FDYN0650
          350 CONTINUE                                                   FDYN0660
              IF (G(IK,K10).GE.0.0 .AND. G(IK,K10).LT.G(IKPG,KPG) ) GO TO 790  FDYN0682
              KK = KPG                                                   FDYN0683
              IK=IKPG
              GO TO 810                                                  FDYN0685
          790 KK =K10                                                    FDYN0686
              GO TO 810                                                  FDYN0688
          800 KK=IABS(NOK)                                               FDYN0690
          810 J1=1
              IF(KDONE.EQ.-1) WRITE(6,9503)
              IF(KDONE.EQ.0) WRITE(6,9504)
              KOLL = KK - KONE
              IHAH = 5
              DO 812 N=1,NNN
                J2=J1+1                                                  FDYN069C
              N1=NMODE-J1+1
              N2=NMODE-J2+1
              IHAH = 5 + KOLL + IHAH
              IF (IHAH .LT. 40) GO TO 811
              WRITE (6,9500)
              IHAH = KOLL
```

CARD NO **** CONTENTS ****

```
 811  CONTINUE
      IF(N*2.LE.NMODE) WRITE(6,9201) N1,N2
      IF(N*2.GT.NMODE) WRITE(6,9202) N1
      IF(N*2.LE.NMODE)
     1  WRITE (6,9212) (CAY(J),(V(I,J),F(I,J),G(I,J),I=J1,J2),J=K  NE,KK)
      IF(N*2 GT NMODE) WRITE(6,9213)(CAY(J),V(NMODE,J),F(NMODE,J),G(NMOD
     1E,J),J=KONE,KK)
  812   J1=J1+2                                                         FDYN0690
  813 IF(KDONE) 815,830,850                                             FDYN0692
  815 KDONE=0                                                           FDYN0694
      VKK1=V(IK,KK)                                                     FDYN0695
      KK1=KK                                                            FDYN0696
      IKSV=IK
      CSAVE=CAY(KK)                                                     FDYN0698
      KK=KSRCH                                                          FDYN0699
      GO TO 201                                                         FDYN0704
  830 IF(IK.EQ.IKSV.AND G(IK,KK).GT 0.0 AND.G(IK,KK).LE.0 01) GO TO 840
      NOK=KK
      IF (V(IK,KK).LT.VKK1.AND.V(IK,KK).GT.0.0.AND.G(IK,KK).GT.-.005)
     1 GO TO 850
  840 KK=KK1                                                            FDYN0706
      IF(IND.EQ.1) NOK=KOOL
      IK=IKSV
      CAY(KK) = CSAVE                                                   FDYN0708
  850 IF(G(IK,KK).GT.0.0.AND.G(IK,KK).LE.0.01) GO TO 851
      KCHCK=KK
      DO 852 K=KONE,KCHCK
      DO 852 J=1,NMODE
      IF(V(J,K).GT.1.1*V(IK,KK).OR.G(J,K).LE.0.0.OR.G(J,K).GT.0.01) GO
     1 TO 852
      KK=K
      IK=J
      GO TO 851
  852 CONTINUE
  851 CALL EIGN(CAY(KK),  G(1,KK), V(1,KK), F(1,KK), IMIN(KK),1)        FDYN0710
      DO 820 I=1,NMODE                                                  FDYN0720
      GF(I) =CE(I,IK )                                                  FDYN0740
  820 CONTINUE                                                          FDYN0750
      IF(IND.EQ.1) GO TO 855
      NOK=KOOL                                                          FDYN0751
      IF(KK1.GT.KOOL) NOK=KK1
  855 CONTINUE
C     IF(NSUP2.EQ 1.OR.ITER.GT.1) GO TO 902
C     WRITE(6,9400)
C     DO 900 K=1,NEL
C     L=K+1
C 900 WRITE(6,9401) L,((A(I,J,K),J=1,3),I=1,3)
C 902 CONTINUE
      FFLTR=F(IK,KK)
C     FLUTTER SPEED                                                     FDYN0751
      CP = V(IK ,KK)                                                    FDYN0752
      WRITE(6,9500)
      IF(KOOL.EQ 21) WRITE(6,9502)
      IF(KOOL.EQ 22) WRITE(6,9505) RHO
      N3=NMODE-IK+1
      WRITE(6,9900) ITER,CAY(KK),N3,CP
      IF(G(IK,KK).LT.0 0.OR G(IK,KK) GT  01) WRITE(6,9905)
      WRITE(6,9906) F(IK,KK),G(IK,KK)
 9201 FORMAT(1H0,30X,4HMODE,I5,45X,4HMODE,I5//8X,1HK,2(14X,1HV,14X,1HF,
     114X,1HG))
 9202 FORMAT(1H0,30X,4HMODE,I5//8X,1HK,14X,1HV,14X,1HF,14X,1HG )
 9212 FORMAT(3X,F10 4,6F15 4)
 9213 FORMAT(3X,F10 4,3F15.4)
 9400 FORMAT(1H1,32X,43HCOMPLEX AERO MATRIX FOR THE FLUTTER K-VALUE )
 9401 FORMAT(1H0,48X,11H  STATION  ,I2//(1X,6E17.7))
 9500 FORMAT(1H1)
 9501 FORMAT(42X,24H****FLUTTER ANALYSIS****)
 9502 FORMAT(27X,54H****FLUTTER CHECK ANALYSIS FOR THE FINAL ITERATION**
     1**//)
 9503 FORMAT(1H1/38X,32H***FIRST CONVERGENCE ANALYSIS***)
 9504 FORMAT(1H1/37X,33H***SECOND CONVERGENCE ANALYSIS***)
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CARD NO **** CONTENTS ****

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 9505 FORMAT(29X,30H****FLUTTER ANALYSIS FOR RHO =,E15 7,4H****//)
 9800 FORMAT(32X,29H******FINAL RESULTS ITERATION,I3,8H******///34X,
     1 7HK-VALUE,11X,1H=,F9 4/34X,18HFLUTTER MODE NO ,2X,1H=,I4/34X,19HF
     2LUTTER VELOCITY  =,F7 2,6H KNOTS)
 9805 FORMAT(1H+,66X,15H(NOT CONVERGED) )
 9806  FORMAT(34X,19HFLUTTER FREQUENCY =,F9 4,4H HZ./34X,19HFLUTTER DAMPI
     1NG   =,F9.4 )
 9810  FORMAT(1H0,10X,88H*****NO INSTABILITIES FOUND----THE STRUCTURE IS
     1STABLE FOR THE K-RANGE CALCULATED***** )
      RETURN                                                            FDYN0780
      END                                                               FDYN0790
      SUBROUTINE MASS                                                       4610
      DIMENSION ZL(16)
      COMMON TCX(2340),TAU(16,15) EI(16),GJ(16),FREQ(45),CP,NCP,NEL,    MASS0004
     *MODE,ITER                                                         MASS0005
      COMMON/BLOCK1/TITLE(7),AK(45,45),AM(45,45),F(3,3,15),VM(15),      MASS0006
     *EIDER(16),GJDER(16),T(16),Y(16),C(16),E,G,VREF,NEL3,NITER         MASS0007
      COMMON/BLOCK3/WTS(15,3),DCG(15),YM(15),RHOM,NI1(16),NI2(16),NO1(16
     *),NO2(16),WST(15,3),SIM,SAM,SOM,DCONS(15),TOTWT,ADM(4,3,3),NMD,
     *LMD(4),WTT(15,3),RHOG(15)                                         MASS0011
C     ZERO MASS MATRIX                                                      4700
      DO 50 J=1,NEL3                                                        4710
      DO 50 I=1,NEL3                                                        4720
   50 AM(I,J) =0 0                                                          4730
      ZL(1)=0.0                                                             4731
      DO 60 I=2,NCP                                                          732
   60 ZL(I)=ZL(I-1)+Y(I-1)                                                  4733
      SIM=0.0                                                               4735
      SAM=0.0                                                               4740
      NS=45
      SOM=0.0                                                               4745
      DO 600 N=1,NEL                                                        4750
      I= 3* (N-1) + 1                                                       4760
      IF(NI1(N+1))900,400,100                                               4770
  100 NR1 = NI1(N+1)                                                        4780
      NR2 = NI2(N+1)                                                        4790
      NT1 = NO1(N+1)                                                        4800
      NT2 = NO2(N+1)                                                        4810
      YM(N)=(ZL(NT2)+ZL(NT1)-ZL(NR2)-ZL(NR1))/2.                            4900
      TR    =0 5*(T(NR1)+T(NR2))                                            4820
      TT    =0.5*(T(NT1)+T(NT2))                                            4830
      CR    =0.5*(C(NR1)+C(NR2))                                            4840
      CT    =0.5*(C(NT1)+C(NT2))                                            4850
      W=(CR+CT)/2                                                           4972
      EL=SQRT(((CR-CT)/2 )**2+YM(N)**2)                                     4974
      TEE=(TR+TT)/2.                                                        4976
      TAUR    =0.5*(TAU(NR1,ITER) + TAU(NR2,ITER))                          4860
      TAUT    =0 5*(TAU(NT1,ITER) + TAU(NT2,ITER))                          4870
      TAM=(TAUR+TAUT)/2                                                     4978
C     VOLUME OF ELEMENT                                                     4970
      V1 = (YM(N)/3 0)* (CR*(2 0*TAUR+TAUT) + CT*(TAUR+2.0*TAUT) )          4980
      V2 = (YM(N)/3 0)*((TR-2.0*TAUR)*TAUR+(TT-2 0*TAUT)*TAUT  + (TR-2.0    4990
     1*TAUR+TT-2 0*TAUT) *(TAUR+TAUT) )                                     5000
      VM(N)=V1+V2                                                           5010
      TP=V1*RHOG(N)*(TEE/2  TAM)**2
C     ROW OF MI,ITHET,IPHI FOR ELEMENT N                                    5020
      AM1=RHOG(N)*VM(N)
      WST(N,1)=AM1                                                          5040
      WST(N,2)=YM(N)**3/(36 *W)*TAM*RHOG(N)*(CR**2+4 *CR*CT+CT**2)+TP+V2
     1*RHOG(N)*YM(N)**2/6
      WST(N,3)=W**3*EL*TAM*RHOG(N)/6 +TP+V2*RHOG(N)*(W/2.-TAM)**2
      IF(ITER GT.1) GO TO 300                                               5084
  251 TEP=WTS(N,1)-WST(N,1)                                                 5080
      DCONS(N)=WTS(N,1)/TEP*DCG(N)                                          5085
      WTS(N,3)=WTS(N,3)+WTS(N,1)*DCG(N)**2-WST(N,3)-TEP*DCONS(N)**2         5090
      WTS(N,1)=TEP                                                          5095
      WTS(N,2)=WTS(N,2)-WST(N,2)                                            5100
  300 DCG(N)=WTS(N,1)/(WTS(N,1)+WST(N,1))*DCONS(N)                          5120
      AM(I,I)=WTS(N,1)+WST(N,1)                                             5125
      AM(I+1,I+1)=WTS(N,2)+WST(N,2)                                         5130
      AM(I+2,I+2)=WTS(N,3)+WTS(N,1)*DCONS(N)**2+WST(N,3)                    5135
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CARD NO **** CONTENTS ****

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      AM(I,I+2)=AM(I,I)*DCO(N)                                    5140
      AM(I+2,I)=AM(I,I+2)                                         5145
      SAM=SAM+AM(I,I)                                             5147
      SOM=SOM+MTS(N,1)                                            5148
      SIM=SIM+WST(N,1)                                            5149
      GO TO 800                                                   5150
  400 VM(N)=0.0                                                   5160
      YM(N)=0.0                                                   5170
      DO 510 J=1,3
  510 WST(N,J)=0.0                                                5170
      IF(ITER.EQ.1.AND.MTS(N,1).NE.0.0)          GO TO 251
      IF(ITER.GT.1.AND.MTS(N,1).NE.0.0) GO TO 300
      DCONS(N)=0.0                                                5171
      DCO(N)=0.0                                                  5172
      DO 500 J=1,3                                                5173
  500 MTS(N,J)=0.0                                                5175
  600 CONTINUE                                                    5180
      IF(ITER.GT.1.OR.TOTWT.EQ.0.0) GO TO 800
      SUM=TOTWT/SAM                                               5184
      SAM=TOTWT
      SOM=SAM-SIM
      DO 700 I=1,NEL                                              5186
      N=3*(I-1)+1                                                 5188
      AM(N  ,N  )=AM(N  ,N  )*SUM                                 5190
      AM(N+1,N+1)=AM(N+1,N+1)*SUM                                 5192
      AM(N+2,N+2)=AM(N+2,N+2)*SUM                                 5194
      MTS(I,1)=AM(N  ,N  )-WST(I,1)                               5196
      MTS(I,2)=AM(N+1,N+1)-WST(I,2)                               5198
  700 MTS(I,3)=AM(N+2,N+2)-WST(I,3)                               5200
  800 IF(NMD.EQ.0) GO TO 890
      DO 810 N=1,NEL
      I=3*(N-1)+1
      DO 810 JJ=1,NMD
      JJJ=LMD(JJ)-1
      IF(JJJ.NE.N) GO TO 810
      SAM=SAM+ADM(JJ,1,1)
      DO 812 K=1,3
      MM=I+K-1
      DO 812 L=1,3
      NN=I+L-1
  812 AM(NN,MM)=AM(NN,MM)+ADM(JJ,L,K)
  810 CONTINUE
  890 DO 891 I=1,3
      DO 891 N=1,NEL
      J=3*(N-1)
  891 WTT(N,I)=AM(J+I,J+I)
C-----MASS MATRIX ON TAPE
      REWIND 4
      WRITE(4)((AM(I,J),I=1,NEL3),J=1,NEL3)
      REWIND 4
      RETURN                                                      5210
  900 WRITE (6,9099) N                                            5220
 9099 FORMAT( 42H0***ERROR*** CHECK BOX BOUNDARY INDICATOR ,I3,5H CARD)
      STOP                                                        5240
      END                                                         5250
      SUBROUTINE MMULT (A,B,C,NI,NK,NJ,MA,MB,MC,IGO)
C
C-----IGO=1
C     CALLING PROGRAM  A(MA,X)  B(MB,X)  C(MC,X)
C     OPERATION          C(NI,NJ)=A(NI,NK)*B(NK,NJ)
C-----IGO=2
C     CALLING PROGRAM  A(MA,X)  B(MB,X)  C(MC,X)
C     OPERATION          C(NI,NJ)=(A(NK,NI)-TRANSPOSE)*B(NK,NJ)
C
      DIMENSION A(1),B(1),C(1)
      IF (IGO.LE.0.OR.IGO.GT.2) GO TO 70
      DO 40 I = 1,NI                                          23007580
      DO 40 J = 1,NJ                                          23007590
      IC = MC *(J-1) + I                                      23007600
      C(IC)=0.0
      DO 40 K=1,NK
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CARD NO **** CONTENTS ****

```
      IB  = MB *(J-1) + K                                               23007630
      GO TO (10,20),100
   10 IA = MA * (K-1) + I                                               23007650
      GO TO 30                                                          23007660
   20 IA = MA * (I-1) + K                                               23007670
   30 C(IC)=C(IC)+A(IA)*B(IB)
   40 CONTINUE                                                          23007690
      RETURN                                                            23007710
   70 WRITE       (6,80)      100                                       23007720
   80 FORMAT (30H0 ERROR CODE FROM MULT =              I8  )            23007730
      CALL EXIT                                                         23007740
      STOP                                                              23007750
      END                                                               23007760
      SUBROUTINE NPRINT(A,M,N,MD,NWORD,TITLE)                               3450
      DIMENSION A(MD,N),TITLE(8)
      DATA HDO/8H COLUMN /
   77 FORMAT(1H1)
   12 FORMAT(8A10)
    2 FORMAT(1H0,9X,6(A8,I4,5X))
    3 FORMAT     (I5,6E17.7   )                                             3510
      WRITE(6,77)                                                           3520
      J1=1                                                                  3530
   50 WRITE (6,12) (TITLE(I),I=1,NWORD)                                     3540
      J2 = J1+5                                                             3550
      IF(J2 .GT. N) J2 =N                                                   3560
      WRITE(6,2) (HDO,J,J=J1,J2)                                            3570
      DO 60 I=1,M                                                           3580
   60 WRITE (6,3)  I,(A(I,J),J=J1,J2)                                       3590
      IF(J2 .GE.  N)RETURN                                                  3600
      J1=J1+6                                                               3610
      GO TO 50                                                              3620
      END                                                                   3630
      SUBROUTINE OUTPUT
      COMMON Z1(790 ),F(10,50),G(10,50),V(10,50),IMIN(50),TAU(16,15),   OUTPUT05
     *EI(16),GJ(16),FREQ(45),VFLTR,NCP,NEL,NMODE,ITER,IPNCH,FFLTR,      OUTPUT06
     *RMDO(2,2),MA,XMD(2,2),QD(2,10),ISYT,DO(45,2),DELY                 OUTPUT07
      COMMON/BLOCK1/TITL(7),Z3(2025),Z2(2025),Z4(198),Y(16),Z5(10),VREF,OUTPUT 9
     *NEL3,NITER,Z6(9),IFLX                                             OUTPUT10
      COMMON/BLOCK2/Z7(129),IZS,RHO,VMIN,VMAX,ICASE,NEWJOB,NSUP2,NSUP3, OUTPUT11
     *GAMA(100),P(45,10),PMAX(10)                                       OUTPUT12
      COMMON/BLOCK3/WTS(15,3),DCG(15),Z8(80 ),WST(15,3),SIM,SAM,SOM,    OUTPUT13
     *DCGNS(15),TOTWT,ADM(4,3,3),NMD,LMD(4),WTT(15,3)                   OUTPUT14
      IF(IZS GT 0) RETURN
      IF(ISYT LT 0) GO TO 4
      DO 2 J=1,NMODE
      DO 2 I=1,MA
    2 QD(I,J)=QD(I,J)/PMAX(J)
    4 CONTINUE
      IF(                NSUP3 EQ 1) GO TO 26
      CALL NPRINT(GAMA,NMODE,NMODE,NMODE,7,70H0
     1                   GENERALIZED MASS MATRIX        )
      IF(ISYT LT 0) GO TO 9876
      CALL NPRINT(QD,MA,NMODE,2,8,80H0
     1  NORMALIZED RIGID BODY VIBRATION MODES          )
      WRITE(6,9006)
      DO 3 I=1,MA
    3 WRITE(6,9007)(RMDO(I,J),J=1,MA)
 9876 CONTINUE
      WRITE(6,9908) NMODE
      IF(NMODE LE 0) GO TO 27
      DO 20 I=1,NEL3
      IF(I EQ 1) WRITE(6,9004)(PMAX(J),J=1,NMODE)
      L=I+1
      IF(I GT NEL AND I LE 2*NEL) L=I-NEL+1
      IF(I GT NEL*2) L=I-2*NEL+1
      IF(I EQ 1) WRITE(6,9001)
      IF(I.EQ NEL+1) WRITE(6,9002)
      IF(I.EQ NEL*2+1) WRITE(6,9003)
   20 WRITE(6,9909)L,(P(I,J),J=1,NMODE)
      GO TO 26
   27 DO 25 I=1,NEL3
```

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CARD NO   ****                    CONTENTS                              ****
                IF(I.EQ.1) WRITE(6,9005)(PMAX(J),J=1,NMODE)
                L=I+1
                IF(I.GT.NEL .AND.I.LE.2*NEL) L=I-NEL+1
                IF(I.GT.NEL*2) L=I-2*NEL+1
                IF(I.EQ.1) WRITE(6,9001)
                IF(I.EQ.NEL+1) WRITE(6,9002)
                IF(I.EQ.NEL*2+1) WRITE(6,9003)
             25 WRITE(6,9011)L,(P(I,J),J=1,NMODE)
             26 CONTINUE
                RETURN
          C     WRITE(6,9196)                                           4082
          C     DO 42 I=1,NEL
          C     L=I+1
          C  42 WRITE(6,9194) L,(WGT(I,N),N=1,3)
          C     WRITE(6,9190) SIM                                       4086
          C     WRITE(6,9198)                                           4040
          C     DO 43 I=1,NEL
          C     L=I+1
          C  43 WRITE(6,9201) L,(WTS(I,N),N=1,3),DCONS(I)
          C     WRITE(6,9191) SOM                                       4044
          C     WRITE(6,9193)                                           4020
          C     WRITE(6,9195)                                           4022
          C     DO 300 I=1,NEL                                          4024
          C     L=I+1
          C 300 WRITE(6,9201) L,(W T(I,N),N=1,3),DCG(I)
          C     WRITE(6,9191) SAM                                       4030
           9001 FORMAT(5H0 STA,39X,17HH (DEFLECTION-IN) / )
           9002 FORMAT(5H0 STA,39X,18HHPRIME (SLOPE-RAD) / )
           9003 FORMAT(5H0 STA,39X,17HALPHA (TWIST-RAD) / )
           9004 FORMAT(3X,10E11.3)
           9005 FORMAT(4X,8E13 4)
           9006 FORMAT(1H0,///42X,22HRIGID BODY MASS MATRIX/)
           9007 FORMAT(39X,2E17.7)
          C9190 FORMAT(30X,14H--------------,/27X,E17.7)
          C9191 FORMAT(12X,14H--------------,/8X,E20.7)
          C9193 FORMAT(1H1,27X,35HTOTAL WEIGHT DATA AND MASS ADDITION )
          C9194 FORMAT(24X,I3,3E17.7)
          C9195 FORMAT(1H0,8H STATION,5X,10HWEIGHT(LB),7X,15HIROLL(LB-IN**2),4X,
          C     118HIPITCHEA(LB-IN**2),4X,13HDEA(IN)(-FWD) /)
          C9196 FORMAT(1H1,37X,22HSTRUCTURAL WEIGHT DATA //23X,7HSTATION,3X,8HWT(L
          C     1B),8X,15HIROLL(LB-IN**2),1X,18HIPITCHCG(LB-IN**2) )
          C9198 FORMAT(1H1,35X,26HNON-STRUCTURAL WEIGHT DATA//9H  STATION,5X,8HWT(
          C     1LB),11X,15HIROLL(LB-IN**2),4X,18HIPITCHCG(LB-IN**2),4X,14HDEA(IN)
          C     2(-FWD) / )
          C9201 FORMAT(1H ,I5,4E20.7)
           9908 FORMAT(1H1,30X,44HMASS SCALE FACTORS - VIBRATION MODE PRINTOUT //
               141X,23HMODE NUMBERS |---------, I2/ )
           9909 FORMAT(1H ,I2,10E11.3)
           9911 FORMAT(1H ,I3,8E13.4)
          C     RETURN
                END
                SUBROUTINE RMULC (A,B,C,NI,NK,NJ,MA,MB,MC,IOD)
                DIMENSION A(1),B(1),C(1)
                COMPLEX B,C
                IF (IOD.LE.0.OR IOD GT.2) GO TO 70
                DO 40 I = 1,NI                                      23007580
                DO 40 J = 1,NJ                                      23007590
                IC = MC *(J-1) + I                                  23007600
                C(IC)=(0.0,0.0)
                DO 40 K=1,NK
                IB  = MB *(J-1) + K                                 23007630
                GO TO (10,20),IOD
             10 IA = MA * (K-1) + I                                 23007650
                GO TO 30                                            23007660
             20 IA = MA * (I-1) + K                                 23007670
             30 C(IC)=C(IC)+A(IA)*B(IB)
             40 CONTINUE                                            23007690
                RETURN                                              23007710
             70 WRITE      (6,80)     IOD                           23007720
             80 FORMAT (30H0 ERROR CODE FROM RMULT =          I8  )  23007730
                CALL EXIT                                           23007740
```

```
CARD NO  ****                    CONTENTS                              ****
              STOP                                                      23007750
              END                                                       23007760
              SUBROUTINE ROOTS(A ,ROOT,D ,NMT ,MAX ,NC ,NERR )          EIGN0720
        C                                                               EIGN0730
              DIMENSION  A(NC,MAX,NMT) ,D(NC,NMT,NMT) ,ROOT(NC,NMT),    EIGN0740
             1           X(2,20) ,Y(2,20) ,Z(2,20)                      EIGN0750
        C                                                               EIGN0760
              DOUBLE PR ..SION XOR, XOI, QR, QI, RR, RI, SS, TT, TEST, XIR, XII,EIGN0770
             1           REST, CONV        , X, Y, Z, A, D              EIGN0780
        C     A    =     COMPLEX CHARACTERISTIC MATRIX                  EIGN0790
        C     ROOT=      EIGENVALUES                                    EIGN0800
        C     D    =     TEMPORARY STORAGE                              EIGN0810
        C     NMT =      ORDER OF CHARACTERISTIC MATRIX                 EIGN0820
        C     MAX =      NUMBER OF ROWS IN THE DIMENSION OF (A)         EIGN0830
        C     NC    = 2                                                 EIGN0840
        C     NERR =0    NO ERRORS                                      EIGN0850
        C          =-1  =NO ROOTS CALCULATED (PIVOT =0 )                EIGN0860
        C          =+   =NO OF ROOTS CALCULATED (ONLY WHEN .LT. NMT )   EIGN0870
        C                                                               EIGN0880
        C                COMPUTE COEF OF CHARACTERISTIC POLYNOMIAL      EIGN0890
        C                                                               EIGN0900
              NERR = 0                                                  EIGN0910
              K =NMT                                                    EIGN0920
              L =NMT -1                                                 EIGN0930
          810 TEST =A(1,K,L)**2 + A(2,K,L) ** 2                         EIGN0940
              IF (TEST)  820 , 1010 , 820                               EIGN0950
         1010 DO  1020 I =1,NMT                                         EIGN0960
              DO  1020 J =1,NMT                                         EIGN0970
              D (1,I,J) =A(1,I,J)                                       EIGN0980
         1020 D (2,I,J) =A(2,I,J)                                       EIGN0990
              DO  1040 JL= 1,L                                          EIGN1000
                J=L-JL+1                                                EIGN1010
              TEST =A(1,K,J) ** 2                  +A(2,K,J) ** 2       EIGN1020
              IF (TEST) 1030, 1040, 1030                                EIGN1030
         1030 LPVT = .'                                                 EIGN1040
              GO TO 1100                                                EIGN1050
         1040 CONTINUE                                                  EIGN1060
              GO TO 990                                                 EIGN1070
         1100 DO 1390  I = 1,NMT                                        EIGN1080
              IF (I-L) 1120 ,1110,1120                                  EIGN1090
         1110 IPV = LPVT                                                EIGN1100
              GO TO 1150                                                EIGN1110
         1120 IF(I-LPVT) 1140,1130, 1140                                EIGN1120
         1130 IPV = L                                                   EIGN1130
              GO TO 1150                                                EIGN1140
         1140 IPV = I                                                   EIGN1150
         1150 CONTINUE                                                  EIGN1160
        C                                                               EIGN1170
         1225 FORMAT (35H1 REARRANGED CHARACTERISTIC MATRIX          )  EIGN1180
         1235 FORMAT(1H0 / (8E17.8))                                    EIGN1190
        C                                                               EIGN1200
              DO 1390  J = 1,NMT                                        EIGN1210
              IF(J -L)   1320,1310, 1320                                EIGN1220
         1310 JPV  = LPVT                                               EIGN1230
              GO TO 1350                                                EIGN1240
         1320 IF(J -LPVT)1340,1330, 1340                                EIGN1250
         1330 JPV  = L                                                  EIGN1260
              GO TO 1350                                                EIGN1270
         1340 JPV = J                                                   EIGN1280
         1350 CONTINUE                                                  EIGN1290
              A(1,I,J)  =D (1,IPV,JPV)                                  EIGN1300
         1390 A(2,I,J)  =D (2,IPV,JPV)                                  EIGN1310
              WRITE          ( 6,1225)                                  EIGN1320
              DO 1395I=1,NMT                                            EIGN1330
         1395 WRITE          ( 6,1235)(A(1,I,J),A(2,I,J),J =1,NMT )     EIGN1340
              GO TO 810                                                 EIGN1350
        C                                                               EIGN1360
          820 DO890 J =1,NMT                                            EIGN1370
              Y(1,J) = A (1,K,J)                                        EIGN1380
              Y(2,J) = A (2,K,J)                                        EIGN1390
              IF (J-L)830 , 860 , 830                                   EIGN1400
```

```
CARD NO    ****                     CONTENTS                                  ****

        830 X(1,J) = -( A(1,K,J) * A(1,K,L)  + A( 2,K,J) * A( 2,K,L) )/TEST   E10N1410
            X(2,J) =  ( A(1,K,J) * A(2,K,L)  - A( 2,K,J) * A( 1,K,L) )/TEST   E10N1420
            DO840 I =1,K                                                      E10N1430
            D(1,I,J) = A(1,I,J) + A (1,I,L) * X(1,J) -A(2,I,L) * X (2,J)       E10N1440
        840 D(2,I,J) = A(2,I,J) + A (1,I,L) * X(2,J) +A(2,I,L) * X (1,J )      E10N1450
            GO TO890                                                          E10N1460
        860 X(1,L) = A(1,K,L) / TEST                                          E10N1470
            X(2,L) =-A(2,K,L) / TEST                                          E10N1480
            DO870 I =1,K                                                      E10N1490
            D(1,I,L) = A(1,I,L) * X(1,L)                  - A(2,I,L) * X(2,L)  E10N1500
        870 D(2,I,L) = A(1,I,L) * X(2,L)                  + A(2,I,L) * X(1,L)  E10N1510
        890 CONTINUE                                                          E10N1520
            DO 900 J =1,NMT                                                   E10N1530
            A(1,L,J) = 0.0                                                    E10N1540
        900 A(2,L,J) = 0.0                                                    E10N1550
            DO 940 J =1,NMT                                                   E10N1560
            DO 910 I =1,NMT                                                   E10N1570
            A(1,L,J) =A(1,L,J) + Y(1,I) *    D(1,I,J) -Y(2,I)* D(2,I,J)       E10N1580
        910 A(2,L,J) =A(2,L,J) + Y(1,I) *    D(2,I,J) +Y(2,I)* D(1,I,J)       E10N1590
            DO 940  I= 1,K                                                    E10N1600
            IF (I-L) 920, 940 , 920                                           E10N1610
        920 A(1,I,J) = D (1,I,J)                                              E10N1620
            A(2,I,J) = D (2,I,J)                                              E10N1630
        940 CONTINUE                                                          E10N1640
            L = L-1                                                           E10N1650
            K = K-1                                                           E10N1660
            IF (L) 950 ,950 , 810                                             E10N1670
        950 NERR = 0                                                          E10N1680
            Z(1,1) =1.0                                                       E10N1690
            Z(2,1) =0.0                                                       E10N1700
            DO 960 I =1,NMT                                                   E10N1710
            J= I+1                                                            E10N1720
            Z(1,J) =-A(1,1,I)                                                 E10N1730
        960 Z(2,J) =-A(2,1,I)                                                 E10N1740
      C                                                                       E10N1770
      C                 SOLVE FOR THE ROOTS OF THE POLYNOMIAL                 E10N1780
            ITLIM =100                                                        E10N1800
            CONV = .0000001                                                   E10N1810
            NP1 =NMT     + 1                                                  E10N1820
            DO 6300JJ=1,NMT                                                   E10N1830
            NO =1                                                             E10N1840
       6020 XOR =0.0                                                          E10N1850
            XOI =0 0                                                          E10N1860
       6030 QR =0.0                                                           E10N1870
            QI =0.0                                                           E10N1880
            RR =0.0                                                           E10N1890
            RI =0.0                                                           E10N1900
            JIM =NP1 -1                                                       E10N1910
            DO 6100 KK = 1, JIM                                               E10N1920
            X (1,KK)=QR *  XOR  -QI * XOI           + Z(1,KK)                 E10N1930
            X (2,KK)=QR *  XOI  +QI * XOR           + Z(2,KK)                 E10N19.0
            QR =X (1,KK)                                                      E10N1950
            QI =X (2,KK)                                                      E10N1960
            Y (1,KK) =RR * XOR  -RI * XOI           + QR                      E10N1970
            Y (2,KK) =RR * XOI  +RI * XOR           + QI                      E10N1980
            RR = Y (1,KK)                                                     E10N1990
       6100 RI = Y (2,KK)                                                     E10N2000
            X (1,NP1) =QR * XOR - QI * XOI           + Z(1,NP1)               E10N2010
            X (2,NP1) =QR * XOI + QI * XOR           + Z(2,NP1)               E10N2020
            QR = X (1,NP1)                                                    E10N2030
            QI = X (2,NP1)                                                    E10N2040
            TEST =  RR **2  +RI **2                                           E10N2050
            IF (TEST)6120,6170,6120                                           E10N2060
       6120 XIR =XOR - (QR * RR + QI * RI)           / TEST                   E10N2070
            XII =XOI - (QI * RR - QR * RI)          /  TEST                   E10N2080
            TEST =XOR -XIR                                                    E10N2090
            REST=CONV*DABS(XIR)-DABS(TEST)                                    E10N2100
            IF(REST)6150,6122,6122                                            E10N2110
       6122 TEST =XOI- XII                                                    E10N2120
            REST=CONV*DABS(XII)-DABS(TEST)                                    E10N2130
            IF(REST)6150,6200,6200                                            E10N2140
```

```
CARD NO   ****                      CONTENTS                                ****
      6150 NO  = NO +1                                                  EION2150
           IF (ITLIM -NO) 6290,6160,6160                                EION2160
      6160 XOR  =XIR                                                    EION2170
           XOI =XII                                                     EION2180
           GO TO  6030                                                  EION2190
      6170 ROOT(1,JJ) = XOR                                             EION2200
           ROOT(2,JJ) = X                                               EION2210
           WRITE          ( 6 ,6175)JJ,CR, QI                           EION2220
      6175 FORMAT(66H1  DIVISOR = 0.0  LOOK AT REMAINDER TERM  IF NEAR 0.0 EION2230
          1 ALL O.K.        / (I 6,2E17.8))                             EION2240
           GO TO 6205                                                   EION2250
      6200 ROOT(1,JJ) = XIR                                             EION2260
           ROOT(2,JJ) = XII                                             EION2270
      6205 NPI =NPI     - 1                                             EION2280
           DO 6210  KK =1,NPI                                           EION2290
           Z(1,KK) =X (1,KK)                                            EION2300
      6210 Z(2,KK) =X (2,KK)                                            EION2310
           GO TO  6300                                                  EION2320
      6290 LOOK = JJ                                                    EION2330
           GO TO 6350                                                   EION2340
      6300 CONTINUE                                                     EION2350
      6400 CONTINUE                                                     EION2380
           GO TO  4000                                                  EION2400
      6350 WRITE      (6,6355)   (JJ, ROOT(1,JJ) ,ROOT(2,JJ) , JJ=1,LOOK) EION2410
           NERR = JJ                                                    EION2420
      6355 FORMAT(45H1EIGENVALUES SOME MISSING--MAX ITER. EXCEDED       EION2430
          1    / (I6,2E 17.8))                                          EION2440
           GO TO 4000                                                   EION2450
       990 NERR =-1                                                     EION2460
           WRITE          ( 6 ,992)NERR,K, L                            EION2470
       992 FORMAT(22H1 PIVOT EQUALS ZERO        / (3I12 ))              EION2480
      4000 RETURN                                                       EION2490
           END                                                          EION2500
           SUBROUTINE SEES (T,N,M,V,RT,K1)
     C-----T=SQUARE MATRIX OF SIZE N TO BE SOLVED FOR M ROOTS AND VECTORS 00010012
     C-----      BY MATRIX ITERATION AND DEFLATION (QUADRATIC INTERP.)  00010013
     C-----DLT=CONVERGENCE CRITERION FACTOR                             00010014
           DIMENSION T(K1,1),U(45,5),V(K1,1),RT(1)                      SEES0006
     C-----SELECT INITIAL VECTOR. COLUMN WITH LARGEST DIAGONAL          00010030
           WRITE (6,4)
         4 FORMAT(1H1)
           IT=20
           NV= 0
           DLT=1.E-4                                                    00010032
           DO 202 IM=1,M                                                00010040
           IF(NV EQ 1)DLT= 1.E-4
            BIGD=0                                                      00010041
            DO 100 I=1,N                                                00010050
              IF (ABS(T(I,I)).LT ABS(BIGD)) GO TO 100                      10051
              BIGD = T(I,I)                                             00010052
              ID=I                                                      00010053
       100   CONTINUE                                                   00010054
     C-----NORMALIZE INITIAL VECTOR                                     00010070
            DO 101 I=1,N                                                00010075
       101     U(I,5)=T(I,ID)/BIGD                                      00010076
           NIT=0                                                        00010080
     C-----ITERATE                                                      00010081
      205  DO 200 L=1,IT
                 DO 106 KK=1,4                                             10095
                    K=KK                                                   10096
                 KL=K-1                                                 00010100
                 NIT=NIT+1                                              00010101
     C-----MATRIX TIMES VECTOR                                          00010102
                 DO 102 I=1,N                                           00010110
                   U(I,K)=0.                                            00010111
                 DO 102 J=1,N                                           00010112
       102         U(I,K)=T(I,J)*U(J,5)+U(I,K)                          00010113
     C-----DO NOT CHECK FIRST ITERATE                                   00010120
                 IF (K.EQ.1) GO TO 112                                  00010121
     C-----CHECK FOR CONVERGENCE                                        00010129
                 DO 116 I=1,N                                           00010130
```

```
CARD NO   ****                    CONTENTS                          ****
                        UD=-U(ID,K)
                         IF (UD.NE.U(I,K)) UD=-UD
                    R=ABS(1.-(U(I,KL)+UD)/(U(I,K)+UD))                  10131
                    IR=I
                      IF (R.GT.DLT) GO TO 104                        00010132
      110 CONTINUE
            GO TO 300                                                00010140
C-----NORMALIZE VECTOR                                               00010151
C-----SKIP FIRST 4 ITERATES FOR CONV. ACCEL.                         00010180
      104       IF (K.EQ.4.AND.L.EQ.1) GO TO 107                     00010159
                  IF (L.EQ.IT) GO TO 203
                IF (K.EQ.4) GO TO 111                                00010160
      112         DO 103 I=1,N                                       00010161
      103           U(I,5)=U(I,K)/U(ID,K)                            00010162
      106     CONTINUE                                               00010163
C-----CHECK NORMALIZING ROW FOR LARGEST ELEMENT                      00010172
      107 BIGV=0.                                                    00010173
              DO 108 I=1,N                                           00010174
                IF (ABS(U(I,4)).LT.ABS(BIGV)) GO TO 108              00010175
                BIGV=U(I,4)                                          00010176
                ID=I                                                 00010177
      108     CONTINUE                                               00010178
              DO 110 I=1,N                                           00010179
      110       U(I,5)=U(I,4)/BIGV                                   00010180
              GO TO 200                                              00010181
C-----CONVERGENCE ACCELERATION                                       00010170
C-----INTERPOLATION--QUADRATIC APPROACH                              00010190
      111       DO 105 I=1,N                                         00010200
              IF (I.LE.IR) GO TO 117
                    R=ABS(1.-(U(I, 3)+U(ID,4))/(U(I,4)+U(ID,4)))
              IF (R.LE.DLT) GO TO 118
      117         C=U(I,3)-U(I,4)                                    00010202
                  E=U(I,2)-U(I,3)                                    00010204
                  H=U(I,2)-U(I,1)
                  P=U(I,1)-U(I,3)
           IF (ABS(1.0-U(I,1)/U(I,2)).LE.DLT) GO TO 118
           IF (ABS(1.0-U(I,3)/U(I,2)).LE.DLT) GO TO 118
           IF (ABS(1.0-U(I,3)/U(I,1)).LE.DLT) GO TO 118
                  G=C/E                                              00010206
                  A=(G-((U(I,2)-U(I,4))/P))/H                        00010208
                  B=G-A*E                                            0001[illegible]10
                  D=(1.-B)/(A+A)                                     00010212
                  F=D*D+C/A                                          00010214
                    IF (F.GE.0.0) GO TO 113                             10219
                    IF (F.LT.0.0) U(I,5)=U(I,4)                      00010216
                    GO TO 105                                        00010218
      113         F=SQRT(F)                                          00010220
                  H1=D+F+U(I,3)                                      00010222
                  H2=D-F+U(I,3)                                      00010224
                  D1=ABS(H1-U(I,4))                                  00010226
                  D2=ABS(H2-U(I,4))                                  00010228
                    IF (D1.LT.D2) U(I,5)=H1                          00010230
                    IF (D2.LT.D1) U(I,5)=H2                          00010232
                   GO TO 105
      118   U(I,5)=U(I,4)
      105       CONTINUE                                             00010234
C-----NORMALIZE INTERPOLATED VECTOR                                  00010250
                RN = U(ID,5)
                DO 109 I=1,N                                         00010251
      109         U(I,5)=U(I,5)/RN                                   00010252
      200   CONTINUE                                                 00010260
      300             DO 121 I=1,N
      121               V(I,IM)=U(I,K)
                    RT(IM)=U(ID,K)
           IF (IM.EQ M) GO TO 418
C-----SWEEP OUT CONVERGED MODE                                       00010290
              A=0.                                                   00010291
                DO 119 I=1,N                                         00010292
      119         A=A+U(I,K)**2                                      00010293
                B=U(ID,K)/A                                          00010294
                DO 120 I=1,N                                         00010295
```

```
CARD NO  ****                        CONTENTS                               ****
              C=B*U(I,K)                                                00010296
            DO 120 J=1,N                                                00010297
   120        T(I,J)=T(I,J)-C*U(J,K)                                    00010298
      GO TO 202
  203 IF (NIT.EQ.312) WRITE (6,5) NIT
    5 FORMAT(40H NOT CONVERGED FOR MAXIMUM OF ITERATIONS, I4)
      IF (NIT.EQ.312) STOP
         IF (NIT.EQ.78) DLT=.001
         IF (NIT.EQ.156) DLT=.01
         IF (NIT.EQ.234) DLT=.1
      NV=1
      DO 204 KR=1,N
  204 U(KR,5)=U(KR,4)/U(ID,4)
      GO TO 205
  202 CONTINUE                                                          00010310
  410 RETURN                                                            00010400
      END                                                               00010410
      SUBROUTINE STIFN
      DIMENSION RK(3,3,15),DI(45,45),B(45,45),UNIT(3,3)
      COMMON TCX(2340),TAU(16,15),RI(16),RJ(16),FREQ(45),CP,NCP,NDS,    STIFN004
     *NMODE,ITER                                                        STIFN005
      COMMON/BLOCK1/TITLE(7),D(45,45),R(45,45),F(3,3,15),VM(15),
     *EIDER(16),GJDER(16),T(16),Y(16),C(16),E,G,VREF,ND3,NITER,ROOTK(3,3STIFN007
     *),IFLX,ADK(4,3,3),NKD,LKD(4),EX(16),GX(16)                        STIFN008
      COMMON /BLOCK2/ AMBDA(21)
      EQUIVALENCE(B(1),TCX(1)),(NEL,NDS),(NEL3,ND3)                     STIFN012
      EQUIVALENCE (DI(1,1),R(1,1))
      DATA UNIT/1.0,3*0.0,1.0,3*0.0,1.0/                                    4090
      NS=45
      DO 20 J=1,ND3                                                         4100
      DO 20 I=1,ND3                                                         4110
      DI(I,J) =0.0                                                          4120
   20 R(I,J) =0.0                                                           4130
      IF(ITER.EQ.1)   GO TO 120
   80 DO 100 I=1,NCP                                                        4150
      CMT=C(I)-TAU(I,ITER)                                                  4160
      TMT=T(I)-TAU(I,ITER)                                                  4170
      RJ(I)=GX(I)* 2.0*CMT*CMT *TMT*TMT *TAU(I,ITER) / (CMT+TMT)
      RI(I)=EX(I)*(C(I)*T(I)**3 - (CMT-TAU(I,ITER)
     1                                  )* (TMT-TAU(I,ITER))**3) /12.0      4200
      RJ(I) = RJ(I)*GJDER(I)
  100 CONTINUE                                                              4210
  120 L=1                                                                   4214
      IF(IFLX.NE.0) L=2                                                     4216
      DO 200 I=L,NDS                                                        4220
      IF(Y(I).EQ.0.) GO TO 200
      D=6./(Y(I)*(4.+RI(I+1)/RI(I)+RI(I)/RI(I+1)))                          4230
      RK(1,1,I)=D*6./Y(I)**2*(RI(I+1)+RI(I))                                4240
      RK(2,2,I)=D*(3*RI(I+1)+RI(I))                                         4250
      RK(1,2,I)=-D*2./Y(I)*(2.*RI(I+1)+RI(I))                               4260
      RK(3,1,I)=0.0                                                         4290
      RK(2,1,I) = RK(1,2,I)                                                 4310
      RK(3,2,I)=0.0                                                         4320
      RK(1,3,I)=0.0                                                         4330
      RK(2,3,I)=0.0                                                         4340
      RK(3,3,I) = 2.0   / ( Y(I)*(1.0/RJ(I+1)+1.0/RJ(I) ) )                 4350
  200 CONTINUE                                                              4360
C     FILL DI(60,60) AND KR(60,60) FOR STRAIN ENERGY COMPUTATIONS           4380
      JD = 1                                                                4390
      DO 5 N=1,NDS                                                          4400
      IF(NKD.EQ.0) GO TO 240
      DO 220 JJ=1,NKD
      JJJ=LKD(JJ)-1
      IF(JJJ.NE.N) GO TO 220
      DO 230 J=1,3
      DO 230 I=1,3
  230 RK(I,J,N)=ADK(JJ,I,J)
  220 CONTINUE
  240 ION= 3*(N-1) +1                                                       4410
      DO 10 J=1,3                                                           4420
      IO=ION                                                                4430
```

CARD NO **** CONTENTS ****

```
      DO 15 I=1,3                                                    4440
      DI(ID,JD)=UNIT(I,J)                                            4450
      DI(ID+3,JD)=F(I,J,N+1)                                         4460
      R  (ID,JD)=RK(I,J,N)                                           4470
      ID=ID+1                                                        4480
   15 CONTINUE                                                       4490
      JD=JD+1                                                        4500
   10 CONTINUE                                                       4510
    5 CONTINUE                                                       4520
      IF(IFLX.EQ.0) GO TO 250
      DO 300 J=1,3                                                   4560
      DO 300 I=1,3                                                   4570
  300 R(I,J)=ROOTK(I,J)                                              4580
C     PUT DI AND R ON SCRATCH TAPE
      REWIND 1
      WRITE(1)((DI(I,J),I=1,NEL3),J=1,NEL3)
      REWIND 1
      REWIND 2
      WRITE(2)((R(I,J),I=1,NEL3),J=1,NEL3)
      REWIND 2
C-----FORM DI INVERSE IN DI
  250 L=3
      DO 23 J=1,ND3
      DO 22 I=1,ND3
22    DI(I,J)=0.0
23    DI(J,J)=1.0
      M=0
      IB=2
403   DO 402 IK=IB,NEL
      L1=L+1
      L2=L+2
      L3=L+3
      M1=M+1
      M2=M+2
      M3=M+3
      DI(L1,M1)=1.0
      SWANGL=0.0
      DO 401 K=IB,IK
      SWANGL=AMBDA(K+1) + SWANGL
      ALPHA=COSD(SWANGL)
      BETA=SIND(SWANGL)
      DI(L1,M2)=Y(K)*ALPHA+DI(L1,M2)
      DI(L1,M3)=Y(K)*BETA+DI(L1,M3)
      DI(L2,M2)=ALPHA
      DI(L2,M3)=BETA
      DI(L3,M2)=-BETA
      DI(L3,M3)=ALPHA
401   CONTINUE
      L=L+3
402   CONTINUE
      L=L-(NEL-IB)*3
      IB=IB+1
      M=M+3
      IF(IB.LE.NEL)GO TO 403
C-----FORM D2 INVERSE*GAMA**(-1/2)
      READ(2)((DI(I,J),I=1,NEL3),J=1,NEL3)
      REWIND 2
      DO 407 I=1,ND3
      DO 407 J=1,ND3
407   B   (I,J)=0.0
      L=1
      DO 406 K=1,NEL
      L1=L+1
      L2=L+2
      B(L,L)=1.0/SQRT(DI(L,L))
      B(L2,L2)=1.0/SQRT(DI(L2,L2))
      B(L1,L1)=1.0/SQRT(DI(L1,L1)-(DI(L,L1)/DI(L,L))*DI(L,L1))
      B(L,L1)=(-DI(L,L1)/DI(L,L))*B(L1,L1)
406   L=L+3
      CALL MMULT(DI,B,DI,NEL3,NEL3,NEL3,NS,NS,NS,1)
C     DECOMPOSED STIFFNESS MATRIX ON TAPE
```

CARD NO **** CONTENTS ****

```
      REWIND 3
      WRITE(3)((D(I,J),I=1,NEL3),J=1,NEL3)
      REWIND 3
      RETURN                                                          4590
      END                                                             4600
      SUBROUTINE STRNTH                                           STRN0010
      COMMON TCX(2340),TAU(16,15),EI(16),GJ(16),FREQ(45),CP,NCP,NEL,   STRNTH03
     *NMODE,ITER                                                  STRNTH04
      COMMON/BLOCK1/TITLE(7),AK(45,45),AM(45,45),F(3,3,15),VM(15),    STRNTH05
     *EIDER(16),GJDER(16),T(16),B(16),C(16),E,G,VREF,NEL3,NITER ,Z(15)),STRNTH06
     *EX(16),GX(16)                                               STRNTH07
      IND=0                                                       STRN0037
      DO 10 I=1,NCP                                               STRN0040
      IF(T(I).EQ.0.0.OR.C(I).EQ.0.0) GO TO 100
      X=T(I)*(T(I)+3.*C(I))/(12.*(T(I)+C(I)))                     STRN0050
      Y=EI(I)/EX(I)/(T(I)*(T(I)+C(I)))
      IF(X**2-Y.LT.0.0) GO TO 100                                 STRN0070
      TAU(I,1)=X-SQRT(X**2-Y)                                     STRN0080
      IF(TAU(I,1).LT.0.0) GO TO 101                               STRN0090
      EIDER(I)=EX(I)*(C(I)*T(I)**3/12.-((C(I)-2.*TAU(I,1))/12.0*(T(I)-2.
     1*TAU(I,1))**3))
      GJDER(I)=2.0*TAU(I,1)*((T(I)-TAU(I,1))*(C(I)-TAU(I,1)))**2/(T(I)-2STRN0095
     1.*TAU(I,1)+C(I))*GX(I)
      GO TO 10                                                    STRN0150
  100 WRITE(6,200) I                                              STRN0120
      IND=1                                                       STRN0125
      GO TO 10                                                    STRN0130
  101 WRITE(6,201) I                                              STRN0140
      IND=1                                                       STRN0145
   10 CONTINUE                                                    STRN0100
      IF(IND.EQ.0) RETURN
      IF(NITER.GT.1) NITER=100
      DO 20 I=1,NCP
      TAU(I,1)=0.1
      EIDER(I)=1.0
   20 GJDER(I)=1.0
      IF(NITER.EQ.100) RETURN
      WRITE(6,202)
      RETURN                                                      STRN0110
  200 FORMAT(1H0,13X,18HTHE EI FOR STATION, I3,60H GIVES AN IMAGINARY RE
     1SULT FOR TAU  EXECUTION IS TERMINATED  /31X,46HEITHER DECREASE EI,
     2 INCREASE C, OR INCREASE T  )
  201 FORMAT(1H0,14X,18HTHE EI FOR STATION,I3,58H GIVES A NEGATIVE RESU
     1T FOR TAU  EXECUTION IS TERMINATED  /31X,46HEITHER INCREASE EI, DE
     2CREASE C, OR DECREASE T  )
  202 FORMAT(1H0/23X,63HSINCE NO ITERATION WAS REQUESTED, EXECUTION WILL
     1 NOT TERMINATE. )
      END                                                         STRN0180
      SUBROUTINE VIBRN
      DIMENSION VEL(50),TEMP(45,45)                               VIBRN003
      DIMENSION XM(2,2),DOTM(2,60),SAVE(2,60),        DOTMO(10,10),
     *DATMO(10,10),DENM(10,10),DA(45,10)                          VIBRN005
      COMMON TCX(2340),TAU(16,15),EI(16),GJ(16),FREQ(45),CP,NCP,NEL,   VIBRN006
     *NMODE,ITER,IPNCH,FFLTR,XMDO(2,2),MA,XMO(2,2),DD(2,10),ISYM,     VIB?N007
     *DB(45,2),DELY
      COMMON/BLOCK1/TITLE(7),AK(45,45),AM(45,45),F(3,3,15),VM(15),    VIBRN009
     *EIDER(16),GJDER(16),T(16),Y(16),C(16),E,G,VREF,NEL3,NITER       VIBRN010
      COMMON/BLOCK2/AMBDA(16),D2(16),CLA(16),CA(16),YA(15),CAY(50),CAM, VIBRN012
     *RHO,VMIN,VMAX,ICASE,NEWJOB,NSUP2,NSUP3,GAMA(100),P(45,10),PMAX(10)VIBRN013
      EQUIVALENCE  (CAY(1),VEL(1)),(TEMP(1),TCX(1))
      NS=45
      COEF=SQRT(386.4)/6.2832                                     VIBR0140
      VMIN=.25*VREF
      VMAX=1.5*VREF
      IF(ICASE.GE.0) GO TO 251
      FMAX=FREQ(NMODE)
      FMIN=FREQ(1)
      IF(NMODE.EQ.1) FMAX=3.*FMIN
      GO TO 250
C-----CANTILEVER                ISYM = -1   (WITH OR WITHOUT ROOT FLEX)
C-----SYMMETRIC FREE-FREE       ISYM =0
```

```
CARD NO   ****                    CONTENTS                              ****
C-----ANTISYMMETRIC FREE-FREE  ISYM = 1
  251 IF(ITER.GT.1.OR.ISYM.LT.0)GO TO 1333
      NCOL=1
      IF(ISYM.EQ 0)NCOL=2
      DO 810 MN=1,NEL3
      DO 810 MM=1,NCOL
810   DD(MN,MM)=0.0
      SUMANG=0 0
      SUM=0 0
      MM=0
      IF(ISYM)1333,800,801
800   DO 802 MN=1,NEL3,3
      MM=MM+1
      SUMANG=SUMANG+AMBDA(MM+1)
      SUM=SUM+Y(MM)*SIND(SUMANG)
      MN1=MN+1
      MN2=MN+2
      DD(MN,1)=1.0
      DD(MN,2)=SUM
      DD(MN1,2)=SIND(SUMANG)
802   DD(MN2,2)=COSD(SUMANG)
      GO TO 1333
801   DO 803 MN=1,NEL3,3
      MM=MM+1
      SUMANG=SUMANG+AMBDA(MM+1)
      SUM=SUM+Y(MM)*COSD(SUMANG)
      MN1=MN+1
      MN2=MN+2
      DD(MN,1)=DELY+SUM
      DD(MN1,1)=COSD(SUMANG)
  803 DD(MN2,1)=-SIND(SUMANG)
1333  CONTINUE
      READ(4)((AM(I,J),I=1,NEL3),J=1,NEL3)
      IF(ISYM.LT.0) GO TO 902
      IF(ITER.EQ.1.AND.NSUP3.EQ 0)
     1CALL MPRINT(DD,NEL3,MA,NS,7,70H
     2          RIGID BODY MODE SHAPES                    )
      CALL DTSD(AM,AM,XM00,XM00,DD,NEL3,MA 1,NS,2)                    VIBRN 63
      DO 905 I=1,MA
      DO 905 J=1,MA
905   XM00(I,J)=XM00(I,J)+XMD(I,J)
      IF(MA.EQ 1)GO TO 906
      DEN=XM00(1,1)*XM00(2,2)-XM00(1,2)**2
      XM(1,1)=XM00(2,2)/DEN
      XM(1,2)=-XM00(1,2)/DEN
      XM(2,1)=XM(1,2)
      XM(2,2)=XM00(1,1)/DEN
      GO TO 907
906   XM(1,1)=1.0/XM00(1,1)
C-----XM=(DDT*M*DD+MD)**(-1)
907   CALL MMULT(DD,AM,DDTM,MA,NEL3,NEL3,NS,NS,2,2)                   VIBRN 76
      CALL DTSD(XM,XM,TEMP,TEMP,DDTM,MA,NEL3,1,2,NS)                  VIBRN 77
      DO 908 I=1,NEL3
      DO 908 J=1,NEL3
908   AM(I,J)=AM(I,J)-TEMP(I,J)                                       VIBRN 80
902   READ(3)((AK(I,J),I=1,NEL3),J=1,NEL3)
      CALL DTSD(AM,AM,TEMP,TEMP,AK,NEL3,NEL3,1,NS,NS)                 VIBRN 81
      REWIND 7
      WRITE(7)((AK(I,J),I=1,NEL3),J=1,NEL3)
      REWIND 7
  909 DO 430 J=1,NEL3
      DO 430 I=1,NEL3
  430       AM(I,J)=TEMP(I,J)
      CALL SEES(TEMP,NEL3,NMODE,AK,VEL,NS)                            VIBRN 85
C-----FREQ FROM LAMBDAS (RT=VEL)                                          1501
            DO 530 J=1,NMODE                                              1502
               IF(VEL(J)) 510,510,515                                     1503
  510                    FREQ(J)=0 0                                      1504
                         GO TO 530                                        1505
  515          FREQ(J) = COEF/SQRT(VEL(J))                                1506
  530 CONTINUE                                                            1507
```

```
CARD NO    ****                        CONTENTS                          ****

           C-----SCALE MODE SHAPES
                 CALL DTSD(AM,AM,GAMA,GAMA,AK,NEL3,NMODE,1,NS,NMODE)     VIBRN 98
                 DO 762 J=1,NMODE
                 JJ = NMODE*(J-1) + J                                    VIBR0721
                 SCALE= 1.0/ SQRT(GAMA(JJ))                              VIBR0723
                 DO 760 I=1,NEL3                                         VIBR0722
           760   AK(I,J)=AK(I,J)*SCALE                                   VIBRN103
           762   CONTINUE
                 CALL DTSD(AM,AM,GAMA,GAMA,AK,NEL3,NMODE,1,NS,NMODE)     VIBRN105
           C-----CALCULATE QRQ=U*GAMA**(-1/2)*P*Q
                 READ(7)((TEMP(I,J),I=1,NEL3),J=1,NEL3)
                 CALL MMULT(TEMP,AK,AM,NEL3,NEL3,NMODE,NS,NS,NS,1)       VIBRN107
                 IF (ISYM) 789 ,911 ,911
             789 DO 788 I = 1,NEL3
                 DO 788 J = 1,NMODE
           788   AM(I,J+10)=AM(I,J)                                      VIBRN111
                 REWIND 3
                 WRITE(3)((AM(I,J),I=1,NEL3),J=1,NMODE)
                 REWIND 3
           C-----SCALED VIBRATION MODES NOW IN AM
           787   DO 786 J=1,NMODE
                 DO 786 I=1,NEL3
                 IF(I.LE.NEL) L=3*I-2
                 IF(I.GT.NEL.AND.I.LE.2*NEL) L=3*(I-NEL)-1
                 IF(I.GT 2*NEL.AND.I.LE.NEL3) L=3*(I-2*NEL)
           786   P(I,J)=AM(L,J)                                          VIBRN117
                 DO 780 J=1,NMODE
                 PMAX(J)=P(NEL,J)
                 DO 770 I=1,NEL3
             770 P(I,J)=P(I,J)/PMAX(J)
             780 CONTINUE
                 WRITE(6,9500) ITER                                      FDYN0205
                 WRITE(6,9504)(I,TAU(I,ITER),EI(I),GJ(I),I=1,NCP)
                 WRITE(6,9907)(I,FREQ(I),I=1,NMODE)
                 IF(NITER.GT.0) GO TO 781
                 CALL OUTPUT
                 CALL ENERGY
                 NEWJOB=1
                 RETURN
             781 CONTINUE
                 FRAT=FREQ(NMODE)/FREQ(1)                                VIBR0731
                 IF(FRAT.LE.12.)ICASE=20                                 VIBR0732
                 IF(FRAT.GT.12..AND FRAT.LE.30 ) ICASE=30                VIBR0733
                 IF(FRAT.GT.30.) ICASE=40                                VIBR0734
                 FMIN=FREQ(1)
                 FMAX=FREQ(NMODE)
                 IF (NMODE.EQ.1) FMAX = 3. * FMIN
                 IF(ITER.EQ.1) GO TO 250
                 FMAX=1 5*FFLTR
                 FMIN=.5*FMAX
                 VMIN=.9*CP
                 VMAX=1.1*VREF
                 ICASE=7
             250 IF(ICASE.EQ -1) ICASE=21
                 IF(ICASE EQ -2) ICASE=22
                 TI=3.1416*CA(2)*661.0/(1117.0*12 0)                     VIBR0740
                 ICAS1=ICASE-1                                           VIBR0735
                 CMAX=TI*FMAX       /VMIN
                 CMIN=TI*FMIN    /VMAX
                 AAA =(VMAX-VMIN)/(ALOG(CMAX)-ALOG(CMIN) )               VIBR0770
                 BBB = VMIN- AAA*ALOG(CMIN)                              VIBR0780
                 VEL(1)=VMAX                                             VIBR0790
                 TI=(VMAX-VMIN)/ICAS1                                    VIBR0800
                 DO 300 I=2,ICAS1                                        VIBR0810
                 VEL(I)= VEL(I-1)- TI                                    VIBR0820
             300 CONTINUE                                                VIBR0830
                 VEL(ICASE)=VMIN                                         VIBR0840
                 DO 320 I=1,ICASE                                        VIBR0860
                 CAY(I) = EXP( (VEL(I)-BBB)/AAA)                         VIBR0870
             320 CONTINUE                                                VIBR0880
                 RETURN
```

```
CARD NO   ****                    CONTENTS                           ****
          C*****QA = (I - DOMOOINVDOTM)*QRO
          911   CALL MMULT(XM,DOTM,SAVE,MA,MA,NEL3,2,2,2,1)
                CALL MMULT(SAVE,AM,OO,MA,NEL3,NMODE,2,MS,2,1)         VIBRN165
                DO 913 I = 1,MA
                DO 913 J = 1,NMODE
            913 OO(I,J) = -OO(I,J)
                CALL MMULT(DO,OO,AK,NEL3,MA,NMODE,MS,2,MS,1)          VIBRN169
                DO 924 I = 1,NEL3
                DO 924 J = 1,NMODE
          924   QA(I,J)=AK(I,J)+AM(I,J)                               VIBRN172
                DO 923 I=1,NEL3
                DO 923 J=1,NMODE
                AM(I,J+10)=AM(I,J)
          923   AM(I,J)=QA(I,J)
                REWIND 3
                WRITE(3)((AM(I,J),I=1,NEL3),J 1,NMODE)
                REWIND 3
                GO TO 787
          9500  FORMAT(1H ,36X,25H*******COMMENCE ITERATION,I3,7H******* )
           9504 FORMAT(1H6//21X,7HSTATION,12X, 7H  TAU  ,10X,12HEI(LB-IN**2), 8X,
               1(12HGJ(LB-IN**2) //(I25,4X,3E20.7))
           9507 FORMAT(1H0/40X,28H*****VIBRATION ANALYSIS***** //43X, 21HMODE  FRE
               1QUENCY (HZ.) //(43X,I3,F12.3))
                END
                FUNCTION SIND(X)
                SIND=SIN(.01745329*X)
                RETURN
                END
                FUNCTION COSD(X)
                COSD=COS(.01745329*X)
                RETURN
                END
```

PROGRAM TABLE OF CONTENTS AND REFERENCES

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CARD ID   PAGE/BOX    NAME                              REFERENCES  (SOURCE SEQUENCE NO. AND PAGE/BOX)


FORTRAN MODULE   ' SWEEP              '


CHART TITLE - INTRODUCTORY COMMENTS


CHART TITLE - PROCEDURES

(000030)    2.07  500        (000033)   2.09     (000035)   2.11     (000037)   2.14     (000039)   2.16
MAIN0200    2.10  300        (000042)   2.19

CHART TITLE - NON-PROCEDURAL STATEMENTS


CHART TITLE - SUBROUTINE  AERO(VBAR)

FLUT1340    4.01  AERO       EIGN0090  27.02-X
FLUT 460    4.04             FLUT1610   4.16
FLUT1370    4.06  20
FLUT1380    4.07             FLUT1390   4.10
FLUT1390    4.08  25
FLUT1390    4.08             FLUT1390   4.09
FLUT1410    4.11  30         FLUT1360   4.05
FLUT1610    4.16  100        FLUT1400   4.10

CHART TITLE - NON-PROCEDURAL STATEMENTS


CHART TITLE - SUBROUTINE  AERO1(NST,BR,B,XLH,XLA,XMH,XMA,VBAR)

18985006    8.01  AERO1      FLUT1340   4.01-X
18985030    8.02  0401
18985030    8.02             18985030   8.03
18985050    8.05  0402
18985490    8.06  264        18985140   8.22     18985210    7.02
18985510    8.08             18985520   8.10
18985520    8.09  265
18985530    8.11  1230
18985610    8.13  1240       18985340   8.35     18985480    7.06
18985650    8.14  280
18985070    8.16  0404       18985040   8.04
18985080    8.17  0406       18985060   8.05
18985100    8.19             18985790   8.32
18985120    8.21  261
18985150    8.23  262
18985160    8.24             18985170   8.26
18985170    8.25  263
18985180    8.27  266
18985710    8.29  290        18985110   8.20
18985760    8.31  295        18985700   8.15
18985790    8.32  300
18985230    8.34  1210       18985190   8.28
18985200    7.01  267
18985360    7.03  1220       18985190   8.28     18985210    7.02

CHART TITLE - NON-PROCEDURAL STATEMENTS


CHART TITLE - SUBROUTINE  CEIGN(A,R,T,N,NR,MAXA,NC,NERR,100)

EIGN0060    9.01  CEIGN      (000698)  29.05-X
EIGN0230    9.03  100
EIGN0230    9.03             EIGN0230   9.04
EIGN0260    9.07             EIGN0290   9.13
EIGN0270    9.08             EIGN0290   9.12
EIGN0280    9.09             EIGN0290   9.11
EIGN0290    9.10  110
EIGN0330    9.16  120
EIGN0340    9.17  130
EIGN0380    9.18  150        EIGN0320   9.15     EIGN0330    9.16
EIGN0410    9.20             EIGN0440   9.26
EIGN0420    9.21             EIGN0440   9.25
EIGN0430    9.22             EIGN0440   9.24
EIGN0440    9.23  160
EIGN0510   10.01  200        EIGN0485   9.28
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CARD ID   PAGE/BOX   NAME                  REFERENCES  (SOURCE SEQUENCE NO. AND PAGE/BOX)

E10N0530   10.03                  E10N0600  10 19
E10N0550   10 05                  E10N0820  10.14
E10N0560   10.06                  E10N0620  10.13
E10N0570   10.07                  E10N0620  10.12
E10N0610   10.10                  E10N0600  10 08
E10N0620   10.12  220
E10N0620   10.12                  E10N0610  10 10
E10N0680   10.18  290
E10N0680   10.20  300             E10N0320   9.15    E10N0405   9.20

CHART TITLE - NON-PROCEDURAL STATEMENTS


CHART TITLE - SUBROUTINE  COLSO(A,X,IL,N,M,MD,ALPHA,E1,E2,MAXA,MAXX)

E10N2570   12.01  COLSO           E10N0660  10.16-X
E10N2710   12.03  10
E10N2710   12.03                  E10N2710  12.04
E10N2740   12.07                  E10N2990  12.25
E10N2750   12.08  20
E10N2760   12.09  30              E10N2740  12.07
E10N2780   12.11  35
E10N2790   12.12                  E10N2940  12.21
E10N2800   12.13  40
E10N2840   12.15  50
E10N2880   12.16  60              E10N2830  12.14
E10N2890   12.17                  E10N2920  12.19
E10N2920   12.18  70
E10N2930   12.20  75              E10N2870  12.15
E10N2940   12.21  80              E10N2790  12.12
E10N2960   12.23  85
E10N2970   12.24  90
E10N2990   12.25  100             E10N2950  12.22    E10N2960  12.23
E10N3000   12.26  105             E10N2770  12.10
E10N3030   13.02  110
E10N3070   13.05  120             E10N3020  13 01
E10N3080   13.06                  E10N3300  13.24
E10N3110   13.08  130
E10N3110   13.08                  E10N3110  13.09
E10N3130   13.11                  E10N3230  13.19
E10N3140   13.12  140
E10N3180   13.14  150
E10N3190   13.15  160
E10N3190   13.15                  E10N3190  13.16
E10N3200   13 17  170             E10N3170  13.13
E10N3230   13.18  180             E10N3130  13 11
E10N3240   13 20  190
E10N3260   13.22  192
E10N3280   13 23  194             E10N3250  13.21
E10N3300   13.24  200             E10N3270  13 22

CHART TITLE - NON-PROCEDURAL STATEMENTS


CHART TITLE - SUBROUTINE  CMULC(A,B,C,NI,NK,NJ,MA,MB,MC,100)

(000317)   15.01  CMULC           (000686)  28.30-X   (000687)  28 31-X
23007590   15.03                  23007690  15.16
23007600   15.04                  23007690  15 15
23007630   15 06                  23007690  15.14
23007650   15.08  10              (000324)  15.07
23007720   15.09  70              (000317)  15.01
23007670   15.12  20              (000324)  15 07
(000320)   15 13  30              23007660  15.08
23007690   15.14  40

CHART TITLE - NON-PROCEDURAL STATEMENTS


CHART TITLE - SUBROUTINE  CMULR(A,B,C,NI,NK,NJ,MA,MB,MC,100)

(000330)   17.01  CMULR           (000655)  27.43-X   (000658)  27.46-X   (000771)  32 25-X
23007590   17.03                  23007690  17.16
23007600   17.04                  23007690  17.15
23007630   17.06                  23007690  17.14
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CARD ID	PAGE/BOX	NAME	REFERENCES (SOURCE SEQUENCE NO. AND PAGE/BOX)		
23007650	17.00	10	(000346) 17.07		
23007720	17.00	70	(000339) 17.01		
23007670	17.12	20	(000346) 17.07		
(000350)	17.13	30	23007660 17 00		
23007690	17.14	40			

CHART TITLE - NON-PROCEDURAL STATEMENTS

CHART TITLE - SUBROUTINE DATAN

CARD ID	PAGE/BOX	NAME	REFERENCES		
(000371)	19.01	DATAN	(000032) 2.00-X		
(000377)	19.05	1			
(000380)	19.09		(000379) 19.07		
(000381)	19.11		(000380) 19.09		
(000571)	19.12	2000	(000376) 19.04		
9422	19.15		(000381) 19.11		
(000391)	19.22	920	(000388) 19 21		
(000393)	19.27		(000392) 19.24		
(000394)	19.30		(000393) 19.27		
(000395)	19.31	901			
(000400)	20.01	903	(000394) 19.30		
(000401)	20.02	902	(000394) 19 30	(000399) 19.32	
(000402)	20.03	904	(000380) 19.21		
(000405)	20.05	10			
(000405)	20.05		(000405) 20.06		
(000411)	20.09		(000412) 20.13		
(000412)	20.11	940			
(000412)	20.13		(000412) 20 11		
(000415)	20.16		(000416) 20 19		
(000416)	20 17	700			
(000417)	20.20	210			
(000420)	20.22		(000422) 20.27		
(000422)	20.25	160			
(000423)	20.28	170	(000417) 20 20		
(000424)	20.29		5700 20 38		
(000426)	20.33		(000425) 20.31		
(000427)	20.35		(000426) 20.33		
5650	20 36	212			
5680	20.37	214	(000427) 20 35		
5700	20 38	220	5670 20 36		
5720	20.40		5810 20 43		
5810	20.43	50			
5830	21.01		5825 20.44		
5854	21.07	250	5830 21.01		
5858	21 09		5860 21.12		
5860	21 10	251			
5860	21 10		5860 21.11		
5862	21.13	252	5854 21.07		
5865	21.16		(000464) 21.14		
(000466)	21.19		5865 21.16		
(000468)	21 22		(000467) 21 20		
(000469)	21 23		(000471) 21 28		
(000471)	21 26	260			
(000472)	21 29	270	(000466) 21.19		
(000478)	21 35		(000479) 21 39		
(000479)	21.37	982			
(000479)	21.37		(000478) 21 35		
(000479)	21 38		(000479) 21 37		
6060	22 03	515			
6070	22 04	520			
6070	22.04		6070 22 06		
6120	22 08		6130 22 11		
6130	22.10	934			
(000495)	22 16		(000494) 22 14		
(000498)	22 18	999	(000493) 22 13		
(000498)	22 18		(000495) 22 16		
(000499)	22 23		6167 22 21		
6170	22 31	800	(000483) 22 02	(000499) 22 23	(000502) 22 28
(000507)	22 34		(000506) 22 32		
6180	22 36		(000507) 22.34		
6182	22 37	610			
6182	22 37		6182 22.38		

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CARD ID   PAGE/BOX   NAME          REFERENCES  (SOURCE SEQUENCE NO. AND PAGE/BOX)

(000510)  22.39  620
(000512)  22.41  630               (000510)  22.39

CHART TITLE - NON-PROCEDURAL STATEMENTS


CHART TITLE - SUBROUTINE  DTSD(S,SC,R,RC,D,M,N,NRC,MD,ND)

DTSD0200  25.01  DTSD              EI7N0290  27.34-X   (000656)  27.44-X   VIBRN 83  78.13-X   VIBRN 77  78.24-X   VIBRN 81  78.32-X
                                   VIBRN 98  78.03-X   VIBRN105  78.10-X
DTSD0900  25.03                    DTSD1000  25.06
DTSD1000  25.04  20
DTSD1000  25.04                    DTSD1000  25.05
DTSD1200  25.08                    (000589)  25.17
DTSD1300  25.09                    (000589)  25.16
(000587)  25.11  30
(000587)  25.11                    (000587)  25.12
(000589)  25.14  40
(000589)  25.14                    (000589)  25.15
DTSD1900  25.18  100               DTSD0700  25.01
DTSD2000  25.19                    DTSD2100  25.22
DTSD2100  25.20  120
DTSD2100  25.20                    DTSD2100  25.21
DTSD2300  25.24                    (000600)  25.33
DTSD2400  25.25                    (000600)  25.32
(000598)  25.27  130
(000598)  25.27                    (000598)  25.28
(000600)  25.30  140
(000600)  25.30                    (000600)  25.31
DTSD2900  25.34  200               DTSD1800  25.17

CHART TITLE - NON-PROCEDURAL STATEMENTS


CHART TITLE - SUBROUTINE  EIGN(CAY,G,V,F,IMIN,IVECT)

EIGN0080  27.01  EIGN              FDYN0250  38.18-X   FDYN0330  38.27-X   FDYN0510  40.42-X   FDYN0710  43.20-X
EIGN0130  27.05                    EIGN0140  27.08
EIGN0140  27.08  100
EIGN0140  27.08                    EIGN0140  27.07
(000629)  27.11                    (000630)  27.14
(000630)  27.12  101
(000630)  27.12                    (000630)  27.13
(000632)  27.16                    (000634)  27.20
(000633)  27.17                    (000634)  27.19
(000634)  27.18  102
EIGN0170  27.21  103               (000627)  27.09
EIGN0171  27 22                    EIGN0360  28 16
EIGN0255  27.25                    EIGN0280  27.33
EIGN0270  27 26  110
EIGN0270  27.26                    EIGN0270  27 27
(000648)  27.30  111
(000648)  27.30                    (000646)  27 31
EIGN0280  27.32  120               (000644)  27.28
EIGN0310  27.37                    EIGN0320  27 40
EIGN0320  27.38  140
EIGN0320  27 38                    EIGN0320  27 39
(000654)  27.42  8001
(000660)  28 02                    (000661)  28 05
(000661)  28 03  3000
(000661)  28 03                    (000661)  28 04
(000663)  28 07                    (000664)  28 10
(000664)  28 08  3001
(000664)  28 08                    (000664)  28 09
(000666)  28.12                    (000667)  28 15
(000667)  28.13  3002
(000667)  28 13                    (000667)  28.14
EIGN0360  28 16  200               EIGN0171  27 22      (000653)  27.41
EIGN0400  28 18  210
EIGN0400  28 18                    EIGN0400  28 19
(000674)  28 21  8501
(000675)  28 22                    (000676)  28 25
(000676)  28 23  3005
(000676)  28 23                    (000676)  28 24
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CARD ID   PAGE/BOX   NAME          REFERENCES  (SOURCE SEQUENCE NO. AND PAGE/BOX)

(000680)   28.28  3007     (000677)  28.26
(000686)   28.30  3008     (000678)  28.27
(000688)   28.33           (000690)  28.36
(000690)   28.34  3009
(000690)   28.34           (000690)  28.35
(000691)   28 37  9500     (000673)  28.20
(000692)   28.38           EIGN0440  29.02
EIGN0430   28.39  220
EIGN0430   28.39           EIGN0430  29.01
EIGN0440   29.02  230
(000698)   29.05  300
(000700)   29.06  20       (000695)  29.03
(000703)   29.10  21       (000700)  29.06
(000703)   29.10           (000702)  29 08
EIGN0506   29.13           EIGN0540  29.15
EIGN0540   29.15  350      EIGN0506  29.13
EIGN0550   29.18           EIGN0545  29.16
EIGN0590   29.22  385      EIGN0550  29.18
EIGN0595   29.23           EIGN0605  29.25
EIGN0605   29.25  370
FDYN0552   29.28           (000715)  29.20
FDYN0554   29.28           FDYN0558  29.30
FDYN0558   29.30  360      FDYN0554  29.28
EIGN0610   30.01  380      EIGN0600  29.24
EIGN0630   30.03           EIGN0640  30.05
EIGN0640   30.05  39
EIGN0640   30.05           EIGN0630  30.03
EIGN0660   30.08  400      EIGN0606  29.25    FDYN0559  29.30

CHART TITLE - NON-PROCEDURAL STATEMENTS


CHART TITLE - SUBROUTINE  ENERGY

(000751)   32.01  ENERGY   (000038)   2.15-X   (002095)  80.17-X
    0230   32.15           ENERGY24  32.18
ENERGY24   32.18  100
ENERGY24   32.18           ENERGY24  32.17
    0280   32.23  110
    0280   32.23               0280  32.24
    0330   32.27               0390  32.31
    0370   32 29  115
    0370   32.28               0370  32.30
    0390   32.31  120
(000787)   32.34           (000797)  33 03
(000798)   33 01  143      (000787)  32.34
(000797)   33 02  142      (000795)  32 37
    0540   33 05               0590  33.10
    0570   33.09               0560  33.07
    0590   33.10  145          0540  33 05
    0611   33.13               0840  33.20
(000813)   33.18               0630  33.16
    0840   33.20  180      CRITR525  33 14    (000813)  33 18
(000823)   33 30           (000822)  33 28
    0842   33.32  190
    0850   33 33  195      (000821)  33.27
(000828)   34.01  300          0842  33 32
(000831)   34 04               0710  34.08
(000833)   34 07           (000832)  34 05
    0710   34.08  150
(000841)   34 12               0770  34.15
(000845)   34 14  195      (000841)  34 12
    0770   34.15  160      (000844)  34.13
(000847)   34 16  199
(000850)   34.18           (000853)  34 22
(000853)   34.22  198      (000850)  34.18
    0910   34 26           (000855)  34 24
(000858)   35.01  200      (000823)  33 30       0860  33.33    (000828)  34.01    (000854)  34 23
(000860)   35 04           (000858)  35 01
(000866)   35.07           (000865)  35 05
(000867)   35 08           (000871)  35 12
(000871)   35 12  1400
(000875)   35.15  223      (000885)  35 24
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(000879)	35.20	210	(000873)	35.13						
(000880)	35.21	211	(000878)	35.18						
(000886)	35.25	220	(000880)	35.21	(000882)	35.23				
(000887)	35.26	221	(000753)	32.02						
(000890)	35.29		(000900)	36.03						
(000891)	35.30		(000893)	35.32						
(000893)	35.31	10								
(000895)	35.34		(000897)	35.36						
(000897)	35.35	11								
(000900)	36.02	20								
(000902)	36.05	500	(000888)	35.27						
(000904)	36.07	222								
(000904)	36.07		(000904)	36.08						
(000906)	36.10		(000919)	36.21						
(000907)	36.11		(000908)	36.13						
(000908)	36.12	31								
(000914)	36.16		(000919)	36.20						
(000916)	36.18		(000919)	36.19						
(000919)	36.19	30								
(000920)	36.22	216	(000887)	35.26						

CHART TITLE - NON-PROCEDURAL STATEMENTS

CHART TITLE - SUBROUTINE FLTR

CARD ID	PAGE/BOX	NAME	REFERENCES							
(000946)	38.01	FLTR	(000036)	2.12-X	(000877)	35.18-X				
(000948)	38.04		(000947)	38.02						
(000949)	38.07		(000948)	38.04						
FDYN0212	38.11		FDYN0217	38.15						
FDYN0214	38.13		FDYN0217	38.14						
FDYN0217	38.14	50								
FDYN0230	38.17		FDYN0270	38.20						
FDYN0270	38.20	200								
FDYN0290	38.21	301	FDYN0260	38.19						
FDYN0299	38.22	302	FDYN0280	38.20						
FDYN0310	38.25		FDYN0300	38.23						
(000974)	38.26		FDYN0350	38.37						
FDYN0340	38.30		FDYN0335	38.28						
(000979)	38.32		FDYN0340	38.30						
(000980)	38.33		(000982)	38.35						
(000982)	38.35	51	(000980)	38.33						
FDYN0350	38.37	303								
FDYN0275	38.38	304	(000983)	38.36						
FDYN0279	38.40		FDYN0284	39.14						
(000996)	38.44	211	(000993)	38.41						
(000998)	39.04		(000997)	39.01						
(000999)	39.07		(000998)	39.04						
(001001)	39.10		(000999)	39.07						
FDYN0284	39.13	212								
FDYN0284	39.13		(001001)	39.10						
FDYN0290	39.15	213								
FDYN0380	39.17	191								
FDYN0390	39.18	220	(001005)	39.16						
FDYN0291	39.23	190	FDYN0380	39.17						
(001017)	39.27		(001018)	39.25						
FDYN0305	39.29		FDYN0350	39.43						
FDYN0320	39.31	205								
(001027)	39.35		(001031)	39.38						
(001031)	39.38	208	(001028)	39.36						
(001032)	39.39	538	(001024)	39.32						
FDYN0350	39.43	210	FDYN0310	39.30	(001033)	39.41				
(001042)	40.01	201	FDYN0704	42.30						
(001045)	40.04		(001044)	40.02						
(001046)	40.05		(001065)	40.21						
(001047)	40.08		(001065)	40.20						
(001053)	40.12		(001057)	40.15						
(001057)	40.15	250	(001054)	40.13						
(001058)	40.16	537	(001050)	40.09						
(001065)	40.20	225	(001047)	40.06	(001048)	40.07	(001059)	40.17	(001060)	40.18
(001069)	40.25	230	(001041)	38.44						
(001074)	40.31		(001077)	40.35						
(001075)	40.32		(001077)	40.34						

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(001077)	40.33	236			
(001078)	40.36	235	(001071) 40 28		
FDYN0506	40 41		FDYN0660 41.16		
FDYN0510	40.42	300			
FDYN0595	41 01	320	FDYN0575 41.10		
(001095)	41.03		(001097) 41 06		
(001097)	41.06	280			
(001097)	41.06		(001095) 41.04		
FDYN0575	41.10	310	FDYN0560 41 08		
FDYN0630	41.13	330	FDYN0570 41.09		
FDYN0660	41.16	350	FDYN0595 41.01	FDYN0620 41.02	FDYN0635 41.14
FDYN0686	41 20	790	FDYN0682 41.18		
FDYN0690	42.01	800	FDYN0550 41.07		
(001123)	42 02	810	FDYN0685 41.19	FDYN0688 41.20	
(001125)	42.05		(001124) 42.03		
(001126)	42.07		(001125) 42.05		
FDYN069C	42.09		FDYN069G 42.27		
(001136)	42.13	811	(001133) 42 10		
(001138)	42.17		(001137) 42.14		
(001139)	42.20		(001138) 42.17		
(001141)	42.23		(001139) 42.20		
FDYN069G	42 26	812			
FDYN069G	42.26		(001141) 42.23		
FDYN0692	42.28	813	FDYN0430 40.27		
FDYN0694	42.29	815			
(001152)	43.01	830	FDYN0692 42 28		
FDYN0706	43.06	840	(001066) 40 22	(001067) 40.23	(001152) 43.02
(001158)	43.09		(001157) 43.07		
(001160)	43.10	850	FDYN0692 42.28	(001154) 43.05	
(001163)	43.14		(001169) 43.19		
(001164)	43.15		(001169) 43.18		
(001169)	43.18	852	(001164) 43.16		
FDYN0710	43.20	851	(001160) 43.11	(001168) 43.17	
FDYN0740	43.22		FDYN0750 43.23		
FDYN0750	43.23	820			
(001177)	43.28	855	(001174) 43.24		
(001177)	43.28		(001176) 43.26		
(001189)	44.06		(001188) 44.04		
(001190)	44.09		(001189) 44.06		
(001193)	44.15		(001192) 44.13		

CHART TITLE - NON PROCEDURAL STATEMENTS

CHART TITLE - SUBROUTINE MASS

4700	46 01	MASS	(000041) 2 18-X	6090 22 01-X
4720	46 02		4730 46 05	
4730	46 03	50		
4730	46 03		4730 46 04	
4733	46 08	60		
4733	46.08		4733 46 09	
4760	46 12		5180 47 25	
4780	46.14	100		
5220	46 21	900	4770 46 13	
5080	47.08	251	(001288) 47 18	
5120	47.09	300	5064 47 05	(001289) 47 20
5160	47.13	400	4770 46 13	
5170	47.15	510		
5170	47.15		5170 47.16	
5175	47.23	500		
5175	47 23		5175 47 24	
5180	47.25	600	5150 47 12	
5188	47 29		5200 47.33	
5200	47.32	700		
(001307)	47 34	800	(001295) 47 26	
(001309)	48 02		(001319) 48 15	
(001311)	48 04		(001319) 48 14	
(001315)	48 08		(001318) 48 13	
(001317)	48 10		(001318) 48 12	
(001318)	48 11	812		
(001319)	48 14	810	(001312) 48 05	
(001320)	48 16	890	(001307) 47 34	

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CARD ID   PAGE/BOX   NAME                REFERENCES (SOURCE SEQUENCE NO. AND PAGE/BOX)

(001321)  40 17                (001323)  40 21
(001322)  40.18                (001323)  40.20
(001323)  40.19  891

CHART TITLE - NON-PROCEDURAL STATEMENTS


CHART TITLE - SUBROUTINE  MMULT(A,B,C,NI,NK,NJ,MA,MB,MC,IGO)

(001335)  50 01  MMULT         ENERGY25  32.21-X   (001915)  73 18-X   VIBRN 76  78 23-X   VIBRN107  79 14-X   (002131)  81 18-X
                               VIBRN165  81.18-X   VIBRN169  81.25-X
23007590  50 03                23007690  50 16
23007600  50 04                23007690  50 15
23007630  50 06                23007690  50.14
23007650  50.08  10            (001350)  50 07
23007720  50.09  70            (001343)  50.01
23007670  50.12  20            (001350)  50.07
(001354)  50 13  30            23007660  50.08
23007690  50.14  40

CHART TITLE - NON-PROCEDURAL STATEMENTS


CHART TITLE - SUBROUTINE  NPRINT(A,M,N,MD,NWORD,TITLE)

    3520  52.01  NPRINT        (000511)  22.40-X   (001398)  94.11-X   (001401)  94.13-X   (002022)  78.11-X
    3540  52.03  50                3620  52.18
    3570  52.08                    3560  52.06
    3590  52.11  80
    3590  52.11                    3590  52.13
    36'0  52.18                    3600  52.14

CHART TITLE - NON-PROCEDURAL STATEMENTS


CHART TITLE - SUBROUTINE  OUTPUT

(001391)  94.01  OUTPUT        (000855)  34.25-X   (000879)  35.20-X   (001010)  39.20-X   (002094)  80.18-X
(001392)  94.03                (001391)  94.01
(001394)  94.05                (001395)  94.08
(001395)  94.08  2
(001395)  94.08                (001395)  94 07
(001396)  94 09  4             (001392)  94.03
(001405)  94.16  3
(001405)  94.16                (001405)  94.18
(001406)  94.19  9878          (001400)  94.12
(001410)  94 24                (001417)  95 16
(001411)  95 03                (001410)  94.24
(001413)  95 06                (001412)  95 04
(001414)  95 08                (001413)  95 06
(001415)  95 10                (001414)  95 08
(001416)  95 12                (001415)  95 10
(001417)  95.14  28
(001417)  95 14                (001416)  95 12
(001419)  95.17  27            (001408)  94.22
(001420)  95 18                (001427)  95 34
(001421)  95 21                (001420)  95 18
(001423)  95 24                (001422)  95 22
(001424)  95.26                (001423)  95 24
(001425)  95 28                (001424)  95 26
(001426)  95 30                (001425)  95 28
(001427)  95 32  25
(001427)  95 32                (001426)  95 30
(001428)  95 35  26            (001397)  94 10     (001418)  95 16

CHART TITLE - NON-PROCEDURAL STATEMENTS


CHART TITLE - SUBROUTINE  RMULC(A,B,C,NI,NK,NJ,MA,MB,MC,IGO)

(001474)  58 01  RMULC         (000654)  27 42 X   (000657)  27 45-X   ENERGY18  32 03 X   ENERGY19  32 10-X   ENERGY20  32 13 X
23007590  58.03                23007690  58 16
23007600  58 04                23007690  58 15
23007630  58 06                23007690  58 14
23007650  58 08  10            (001481)  58 07
23007720  58 09  70            (001474)  58 01
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CARD ID   PAGE/BOX   NAME                 REFERENCES (SOURCE SEQUENCE NO AND PAGE/BOX)

23007670  58 12  20          (0014011  58.07
(0014051  58 13  30          23007660  58 08
23007690  58 14  40

CHART TITLE - NON-PROCEDURAL STATEMENTS


CHART TITLE - SUBROUTINE  ROOTS(A,ROOT,D,NMT,MAX,NC,NERR)

EIGN1060  60 01  1040        EIGN1030  60.04
EIGN1010  60.03              EIGN1060  60.01
EIGN1040  60.05  1030
EIGN0790  60.06  ROOTS       EIGN0300   9.14-X
EIGN0940  60.07  810         EIGN1350  62.11     EIGN1670  62.33
EIGN0960  60.09  1010
EIGN0970  60.10              EIGN0990  60.14
EIGN0980  60.11              EIGN0990  60.13
EIGN0990  60.12  1020
EIGN1370  60.15  820         EIGN0950  60.08
EIGN1380  60.16              EIGN1520  62.17
EIGN1410  60.18  830
EIGN1440  60.20              EIGN1450  60.22
EIGN1450  60.21  840
EIGN1080  61.01  1100        EIGN1050  60.05
EIGN1090  61.02              EIGN1310  62.06
EIGN1100  61.03  1110
EIGN1120  61.04  1120        EIGN1090  61.02
EIGN1130  61 05  1130
EIGN1150  61.06  1140        EIGN1120  61.04
EIGN1160  61.07  1150        EIGN1110  61.03     EIGN1140  61.05
EIGN1220  61.09              EIGN1310  62.05
EIGN1230  61.10  1310
EIGN1250  61.11  1320        EIGN1220  61.09
EIGN1260  61.12  1330
EIGN1280  62.01  1340        EIGN1250  61.11
EIGN1290  62.02  1350        EIGN1240  61.10     EIGN1270  61.12
EIGN1310  62.04  1390
EIGN1340  62.09  1395
EIGN1340  62.09              EIGN1340  62.11
EIGN1470  62 12  860         EIGN1400  60.17
EIGN1500  62.14              EIGN1510  62.16
EIGN1510  62.15  870
EIGN1520  62.17  890         EIGN1460  60 22
EIGN1540  62 19              EIGN1550  62.21
EIGN1550  62.20  900
EIGN1570  62 23              EIGN1640  62 31
EIGN1580  62 24              EIGN1590  62 26
EIGN1590  62 25  910
EIGN1610  62 28              EIGN1640  62 30
EIGN1620  62 29  920
EIGN1640  62.30  940         EIGN1610  62 28
EIGN1680  62.34  950
EIGN1720  62 36              EIGN1740  62 38
EIGN1740  62.37  960
EIGN1840  62 41              EIGN2350  64 01
EIGN1850  62 42  6020
EIGN1870  62 43  6030        EIGN2190  63 04
EIGN1930  62 45              EIGN2000  63 06
EIGN2330  63 01  6290        EIGN2160  63 03
EIGN2150  63 02  6150        EIGN2110  63 12
EIGN2170  63 04  6160
EIGN2000  63 05  6100
EIGN2070  63 10  6120
EIGN2120  63 13  6122
EIGN2200  63 15  6170        EIGN2060  63 09
EIGN2260  63 18  6200        EIGN2140  63 14
EIGN2280  63 19  6205        EIGN2250  63 17
EIGN2300  63.21              EIGN2310  63 23
EIGN2310  63 22  6210
EIGN2350  64.01  6300        EIGN2320  63 23
EIGN2380  64 02  6400
EIGN2410  64 03  6350        EIGN2340  63 01
EIGN2460  64.06  990         EIGN1070  60.01
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CARD ID   PAGE/BOX   NAME                        REFERENCES  (SOURCE SEQUENCE NO  AND PAGE/BOX)

E10N2490   04.09  4000        E10N2400  04.02    E10N2450  04 05

CHART TITLE - NON-PROCEDURAL STATEMENTS


CHART TITLE - SUBROUTINE  SEES(T,N,M,V,RT,K1)

00010012   66 01  SEES        VIBRN 05   70 42-X
(0016780)  66 04              00010310  69 24
00010041   66 06              (0016780) 66 04
   10051   66.08              00010094  66 10
00010094   66.10  100            10051  66 08
00010076   66.13  101
00010076   66 13              00010076  66 14
(0016890)  66.16  205         (0017880) 67 30
   10095   66.17              00010260  69.07
   10098   66 18              00010183  67 13
00010111   66.20              00010113  66 24
00010113   66.22  102
00010113   66.22              00010113  66 23
(0017041)  66.27              (0017091) 66 32
   10131   66.30              (0017051) 66 28
(0017091)  66.32  116
00010175   67.01              00010178  67.03
00010178   67.03  108         00010175  67 01
00010180   67.05  110
00010180   67.05              00010180  67.06
00010159   67.07  104         00010132  66.31
00010161   67.10  112         00010121  66 25
00010162   67.11  103
00010162   67.11              00010162  67.12
00010163   67.13  106
00010173   67.14  107         00010159  67 07
(0017779)  67.16  203         (0017141) 67.08
(0017811)  67.19              (0017791) 67.16
(0017821)  67.21              (0017811) 67.19
(0017831)  67.23              (0017821) 67.21
(0017841)  67.25              (0017831) 67.23
(0017851)  67.27              (0017841) 67.25
(0017871)  67.29  204
(0017871)  67 29              (0017871) 67.30
00010200   68 01  111         00010160  67 09
(0017321)  68 02              00010234  69 02
00010202   68 05  117         (0017321) 68 02
00010218   68 14              00010216  68 12
00010220   68 15  113            10219  68 11
00010232   68 19              00010230  68 17
(0017571)  68 21              00010232  68 19
(0017581)  69 01  118         (0017341) 68 04    (0017391)  68 06    (0017401)  68 07    (0017411)  68 08
00010234   69.02  105         00010218  68 14    (0017571)  68 21
00010252   69 05  109
00010252   69 05              00010252  69 06
00010260   69 07  200         00010181  67 06
(0017851)  69 08  300         00010140  66 32
(0017661)  69 09  121
(0017861)  69 09              (0017661) 69 10
00010293   69 15  119
00010293   69 15              00010293  69 16
00010296   69 19              00010298  69 23
00010298   69 21  120
00010298   69 21              00010298  69 22
00010310   69 24  202         (0017781) 69 23
00010400   69 25  410         (0017681) 69 12

CHART TITLE - NON-PROCEDURAL STATEMENTS


CHART TITLE - SUBROUTINE  STIFN

(0018003)  71 01  STIFN       (0000401)   2 17-X       8080  21 30-X
    4110   71.03                  4130  71 07
    4120   71.04                  4130  71 06
    4130   71.05  20
    4150   71.09  80
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CARD ID   PAGE/BOX   NAME                    REFERENCES (SOURCE SEQUENCE NO AND PAGE/BOX)

    4160   71.10                 4210  71.12
    4210   71.12  100
    4214   71.13  120         (001808)  71.08
    4220   71.16                 4216  71.14
(001820)   71.17                 4380  71 22
    4380   71.22  200         (001820)  71.17
(001835)   71 25                 4520  72.01
(001837)   71.27              (001842)  71.34
(001840)   71.30              (001841)  71.33
(001841)   71.31  230
(001841)   71.31              (001841)  71.32
(001842)   71.34  220         (001838)  71 28
    4410   71.35  240         (001835)  71.25
    4430   71.37                 4510  71.42
    4450   71.39                 4480  71.40
    4490   71.40  15
    4510   71.42  10
    4520   72.01  5
    4570   72.04                 4580  72.07
    4580   72.05  300
    4580   72.05                 4580  72 06
(001867)   72 16  250         (001855)  72.02
(001869)   72.18              (001871)  72 22
(001870)   72.19  22
(001870)   72.19              (001870)  72.20
(001871)   72.21  23
(001874)   72.24  403         (001899)  73.01
(001875)   72.25              (001895)  72.33
(001884)   72.28              (001893)  72.31
(001893)   72.31  401
(001895)   72.33  402
(001904)   73.06              (001905)  73.09
(001905)   73.07  407
(001905)   73.07              (001905)  73.08
(001908)   73 12              (001914)  73.15
(001914)   73.14  406

CHART TITLE - NON-PROCEDURAL STATEMENTS


CHART TITLE - SUBROUTINE  STRNTH

STRN0037   75.01  STRNTH      (000476)  21 33-X
(001930)   75.03              STRN0100  75.16
STRN0120   75.10  100         (001930)  75 03    STRN0070  75.05
STRN0140   75 13  101         STRN0090  75 07
STRN0100   75 16  10          STRN0150  75 09    STRN0130  75.12
(001948)   75 19              (001947)  75 17
(001949)   75 21              (001948)  75.19
(001950)   75 22              (001952)  75 24
(001952)   75.23  20
(001954)   75.27              (001953)  75 25

CHART TITLE - NON-PROCEDURAL STATEMENTS


CHART TITLE - SUBROUTINE  VIBRN

(001977)   77.01  VIBRN       MAIN0280   2 10-X  (000875)  35 15-X
(001985)   77.06              (001984)  77 04
(001989)   77 07  251         (001901)  77 02
(001992)   77.11              (001991)  77.09
(001993)   77.12              (001994)  77 15
(001994)   77.13  810
(001994)   77.13              (001994)  77.14
(001999)   77.18  800
(002000)   77.19              (002008)  77 22
(002008)   77.21  802
(002010)   78 01  801         (001998)  77 17
(002011)   78 02              (002018)  78 05
(002018)   78.04  803
(002019)   78 06  1333        (001989)  77 07    (001998)  77.17    (002009)  77 22
VIBRN 63   78.13              (002022)  78 10
(002027)   78 15              (002028)  78 18
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CARD ID	PAGE/BOX	NAME	REFERENCES (SOURCE SEQUENCE NO. AND PAGE/BOX)		
(002028)	78.16	905			
(002028)	78.18		(002028) 78.17		
(002036)	78.22	906	(002029) 78.19		
VIBRN 76	78.23	907	(002035) 78.21		
(002041)	78.26		VIBRN 80 78.29		
VIBRN 80	78.27	908			
VIBRN 80	78.27		VIBRN 80 78.28		
(002043)	78.30	902	(002021) 78.09		
(002048)	78.37	903			
(002049)	78.38		(002050) 78.41		
(002050)	78.39	430			
(002050)	78.39		(002050) 78.40		
1503	78.44		1507 79.02		
1504	78.45	510			
1506	79.01	518	1503 78.44		
1507	79.02	530	1505 78.45		
VIBR0721	79.05		(002066) 79.09		
VIBRN103	79.07	760			
VIBRN103	79.07		VIBRN103 79.08		
(002066)	79.09	762			
(002072)	79.16	769			
(002073)	79.17		VIBRN111 79.20		
VIBRN111	79.18	768			
VIBRN111	79.18		VIBRN111 79.19		
(002079)	79.25	767	(002147) 81.40		
(002080)	79.26		VIBRN117 80.02		
(002081)	79.27		VIBRN117 80.01		
(002082)	79.29		(002081) 79.27		
(002083)	79.31		(002082) 79.29		
VIBRN117	79.33	766			
VIBRN117	79.33		(002083) 79.31		
(002086)	80.04		(002089) 80.08		
(002088)	80.06	770			
(002088)	80.06		(002088) 80.07		
(002089)	80.08	780			
(002098)	80.20	781	(002093) 80.15		
VIBR0733	80.24		VIBR0732 80.22		
VIBR0734	80.26		VIBR0733 80.24		
(002103)	80.28		VIBR0734 80.26		
(002106)	81.01		(002105) 80.29		
(002112)	81.03	250	(001985) 77.06	(002106) 81.01	
(002113)	81.05		(002112) 81.03		
VIBR0740	81.07		(002113) 81.05		
VIBR0820	81.11		VIBR0830 81.12		
VIBR0830	81.12	300			
VIBR0870	81.15		VIBR0880 81.16		
VIBR0880	81.16	320			
(002131)	81.18	911	(002071) 79.15		
(002134)	81.21		(002135) 81.24		
(002135)	81.22	913			
(002135)	81.22		(002135) 81.23		
(002138)	81.27		VIBRN172 81.30		
VIBRN172	81.28	924			
VIBRN172	81.28		VIBRN172 81.29		
(002141)	81.32		(002143) 81.36		
(002142)	81.33		(002143) 81.35		
(002143)	81.34	923			

CHART TITLE - NON-PROCEDURAL STATEMENTS

CHART TITLE - FUNCTION SIND(X)

CHART TITLE - FUNCTION COSD(X)

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08/19/73       TABLE OF DIAGNOSTICS              AUTOFLOW CHART SET - SWEEP I                PAGE   1
         LOCATION                DIAGNOSTIC
    CARD ID   PAGE/BOX
    (000378)      19.04      MISSING DESTINATION
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CHART TITLE - INTRODUCTORY COMMENTS

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                    ***MASTER CONTROL PROGRAM***

          STRUCTURAL OPTIMIZATION BY STRAIN ENERGY METHODS

           AUTHORS   S. SIEGEL, W. H. MILLS, A. LIU
           DATE      FEBRUARY 5, 1970
           FUNCTION  COMPLETE VIBRATION AND FLUTTER ANALYSIS
                     OF A GIVEN AIR VEHICLE COMPONENT WITH
                     AN OPTIMIZATION FEATURE TO ATTAIN
                     ANY REQUIRED FLUTTER VELOCITY.
```

PROGRAM FLOW CHARTS

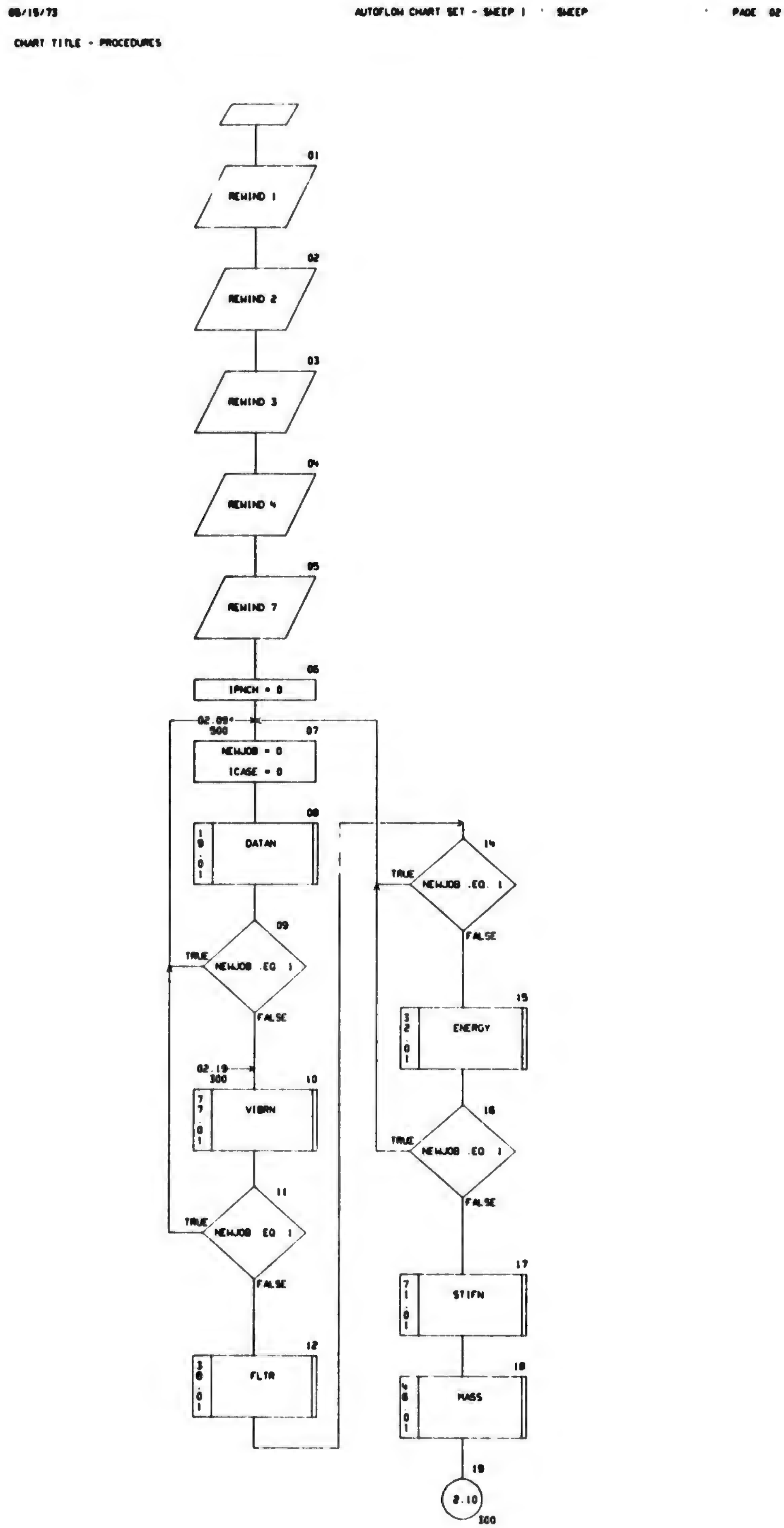

CHART TITLE - NON-PROCEDURAL STATEMENTS

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COMMON TCX(2340 ),TAU(16,15),EI(16),GJ(16),FREQ(45),CP,NCP,NEL,
NMODE,ITER,IPNCH,FFLTR,XMOO(2,2),MA,XMO(2,2),OO(2,10),ISYM,
DO(45,2),DELY
COMMON/BLOCK1/TITLE(7),AK(45,45),AM(45,45),F(3,3,15),VM(15),
EIDER(16),GJDER(16),T(16),Y(16), C(16),E,G,VRGF,NEL3,NITER,
ROOTK(3,3),IFLX,ADK(4,3,3),NKD,  LKD(4),EX(16),GX(16)
COMMON/BLOCK2/AMBDA(16),D2(16),  CLA(16),CA(16),YA(15),CAY(50),
CAM,RHO,VMIN,VMAX,ICASE,NEWJOB,NSUP2,NSUP3,GAMA(100),P(45,10),
PMAX(10),RHU(6),NALT
COMMON/BLOCK3/WTS(15,3),DCG(15),YM(15),RHOM,NI1(16),NI2(16),
NO1(16),NO2(16),WST(15,3),SIM,SAM,SOM,DCONS(15),TOTWT,ADM(4,3,3),
NMD,LMD(4),WTT(15,3),RHOO(15)
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CHART TITLE - SUBROUTINE AERO(VBWR)

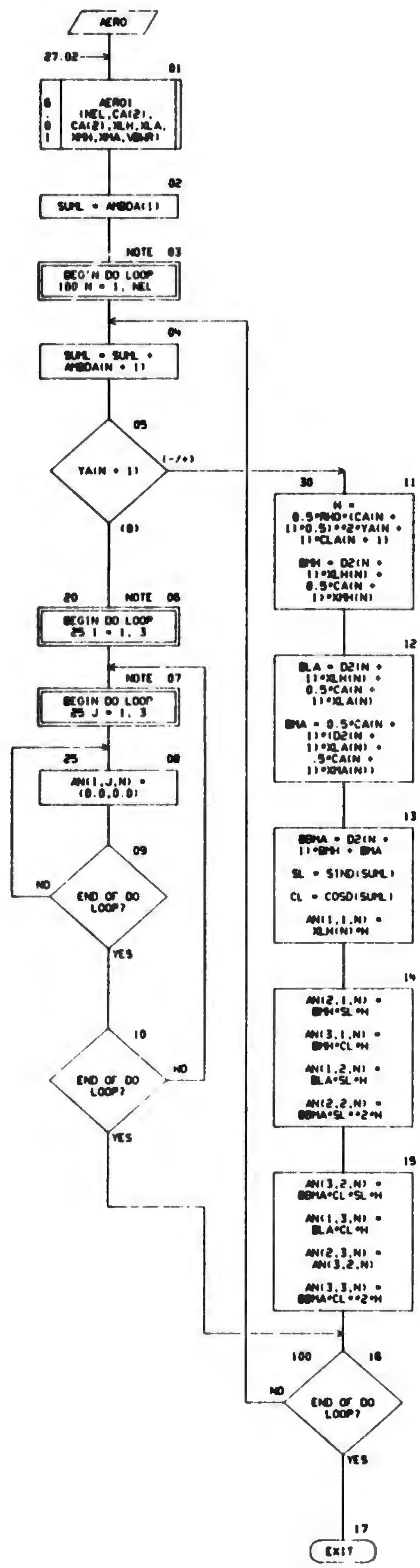

CHART TITLE - NON-PROCEDURAL STATEMENTS

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COMMON AN(3,3,15),XLM(15),XLA(15),XMM(15),XMA(15),BMM,BLA,BMA,BBMA
,TCX(19*2),TAU(16,15),EI(16),GJ(16),FREQ(45),CP,NCP,NEL,NMODE,ITER
COMMON/BLOCK2/AMBDA(16),D2(16),CLA(16),CA(16),YA(15),CAY(50),CAM,
RHO,VMIN,VMAX,ICASE
COMPLEX AN,XLM,XLA,XMM,XMA,BMM,BLA,BMA,BBMA
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CHART TITLE - SUBROUTINE AERO1(NST,BR,B,XLH,XLA,XMH,XMA,VBWR)

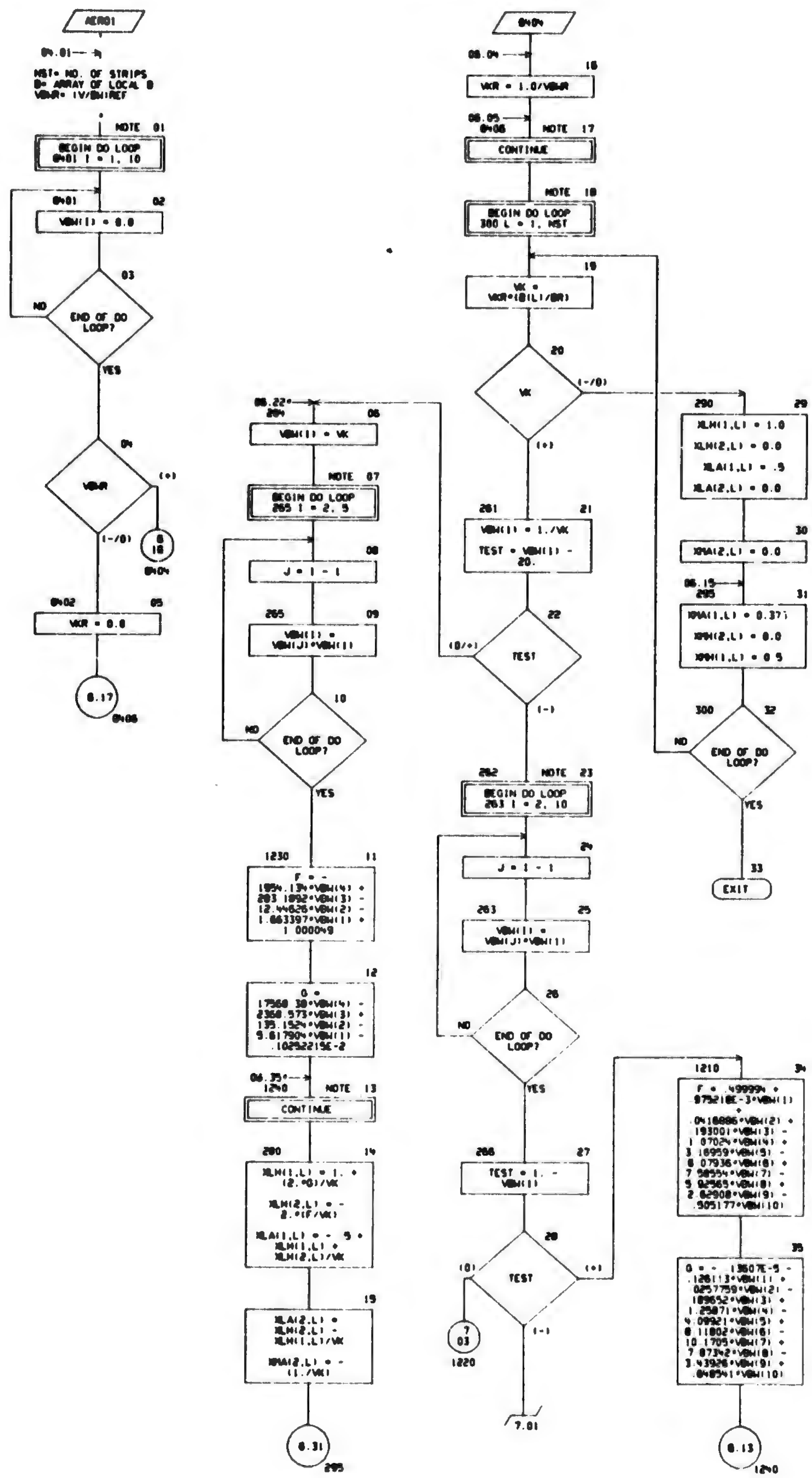

CHART TITLE - SUBROUTINE AERO1(NST,BR,B,XLH,XLA,XMH,XMA,VBWR)

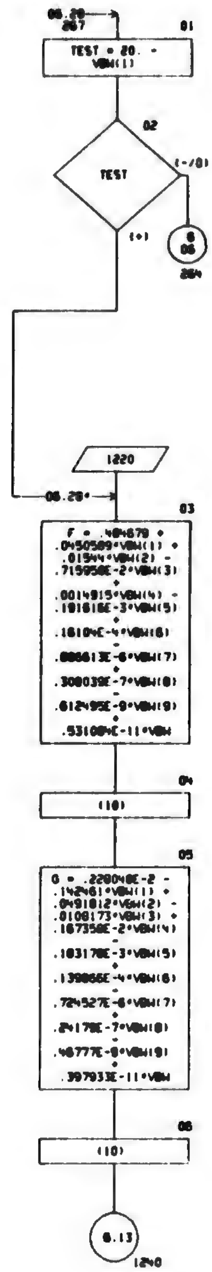

CHART TITLE - NON-PROCEDURAL STATEMENTS

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      DIMENSION B(NST)      ,XLH(2,1)  ,XLA(2,1)  ,XMH(2,1)  ,XMA(2,1)
                 ,VBH(10)
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CHART TITLE - SUBROUTINE CEION(A,R,T,N,NR,MAXA,NC,NERR,IOO)

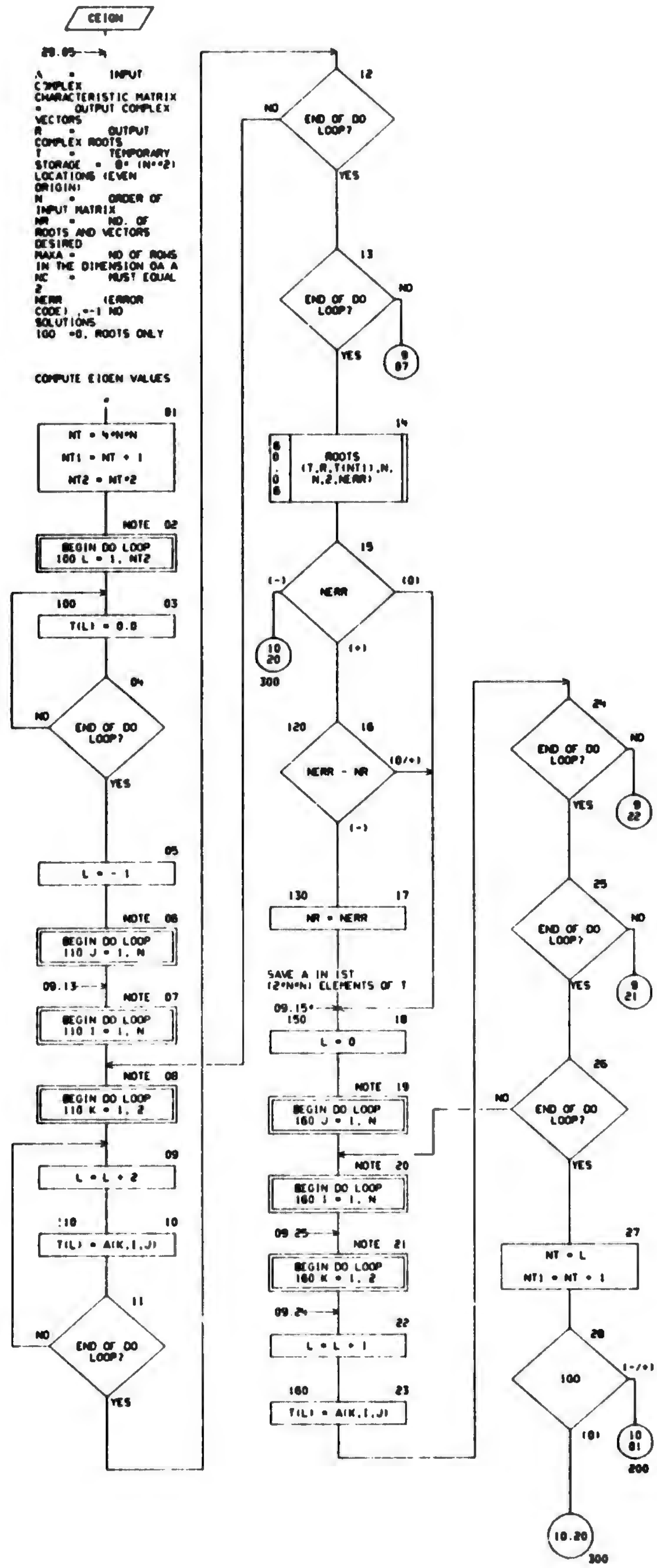

CHART TITLE - SUBROUTINE CEIGN(A,R,T,N,NR,MAXA,NC,NERR,IOO)

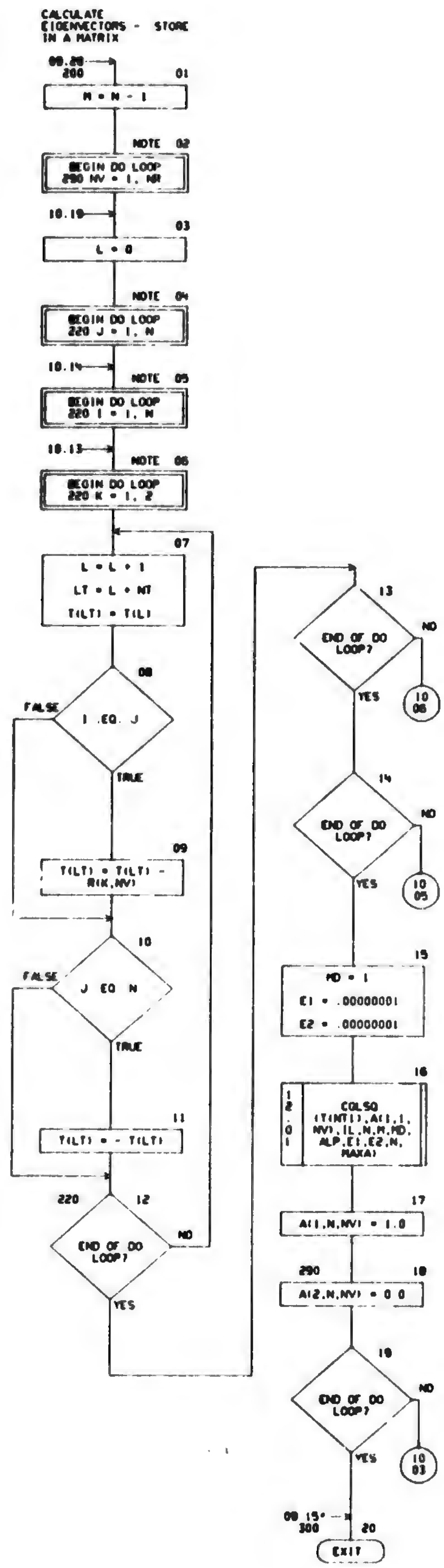

CHART TITLE - NON-PROCEDURAL STATEMENTS

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DIMENSION A(NC,MAXA,N),B(NC,N),T(1),IL(15)
COMPLEX   ALP
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CHART TITLE - SUBROUTINE COLSO(A,X,IL,N,M,MD,ALPHA,E1,E2,MAXA,MAXX)

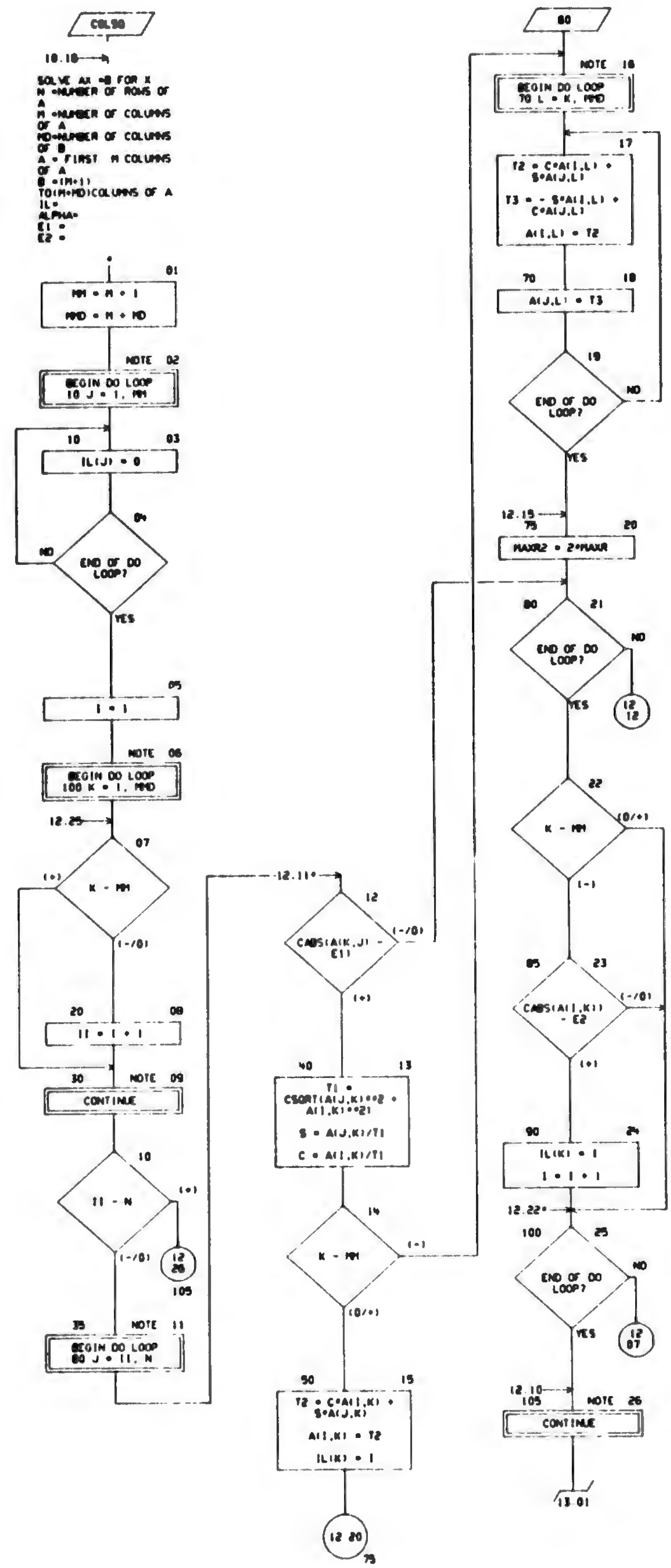

CHART TITLE - SUBROUTINE COLSO(A,X,IL,N,M,MD,ALPHA,E1,E2,MAXA,MAXX)

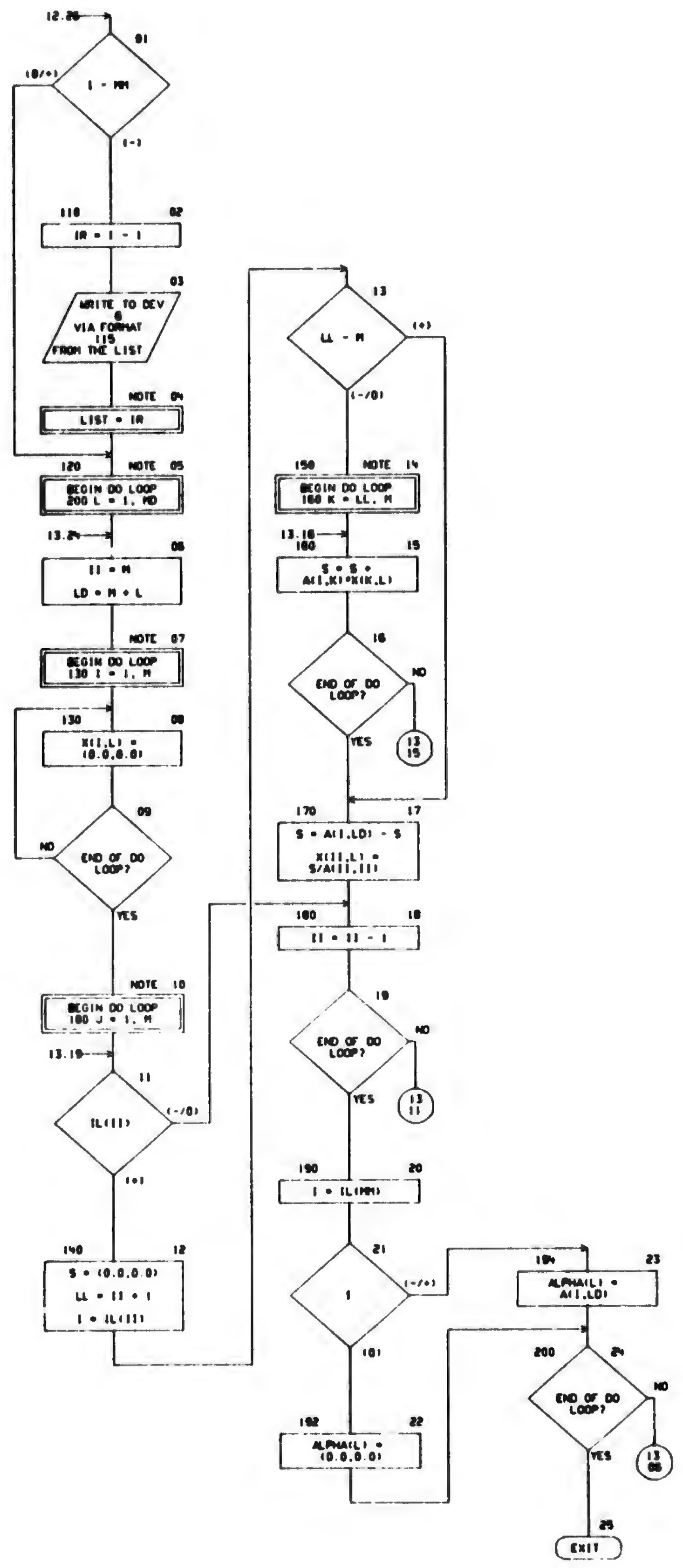

CHART TITLE - NON-PROCEDURAL STATEMENTS

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          COMPLEX    A(MAXA,1) ,X(MAXX,1) ,ALPHA(1)  ,S  ,T1 ,C  ,T2 ,T3
          DIMENSION  IL(1)
    115   FORMAT (30H- THE RANK OF THE A MATRIX IS    I15    )
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CHART TITLE - SUBROUTINE CMULC(A,B,C,NI,NK,NJ,MA,MB,MC,IOO)

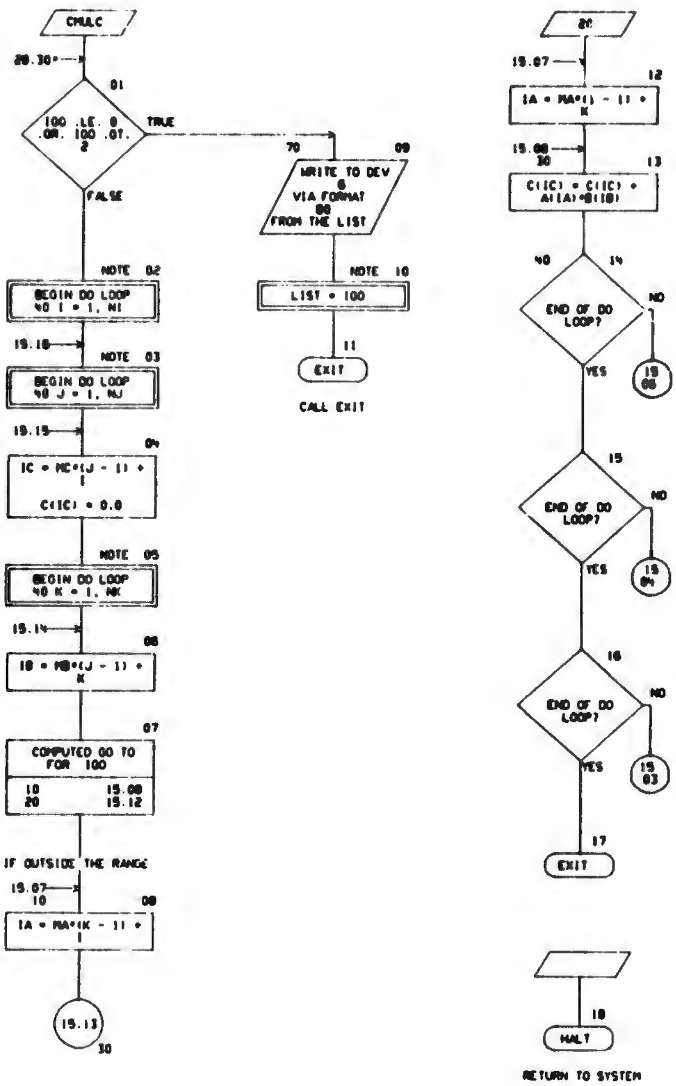

CHART TITLE - NON-PROCEDURAL STATEMENTS

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          DIMENSION A(1),B(1),C(1)
          COMPLEX A,B,C
    80    FORMAT (30H0 ERROR CODE FROM MMULT =            I8 )
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CHART TITLE - SUBROUTINE CMULR(A,B,C,NI,NK,NJ,MA,MB,MC,IOO)

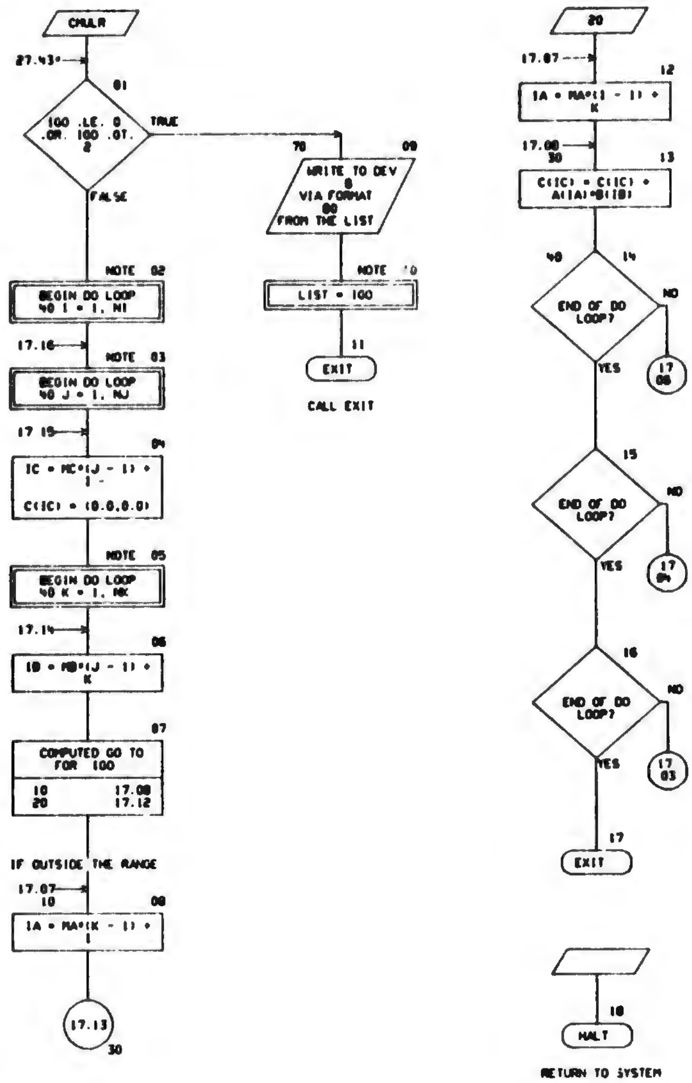

CHART TITLE - NON-PROCEDURAL STATEMENTS

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      DIMENSION A(1),B(1),C(1)
      COMPLEX A,C
80    FORMAT (30H0 ERROR CODE FROM MMULT =            I8 )
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CHART TITLE - SUBROUTINE DATAN

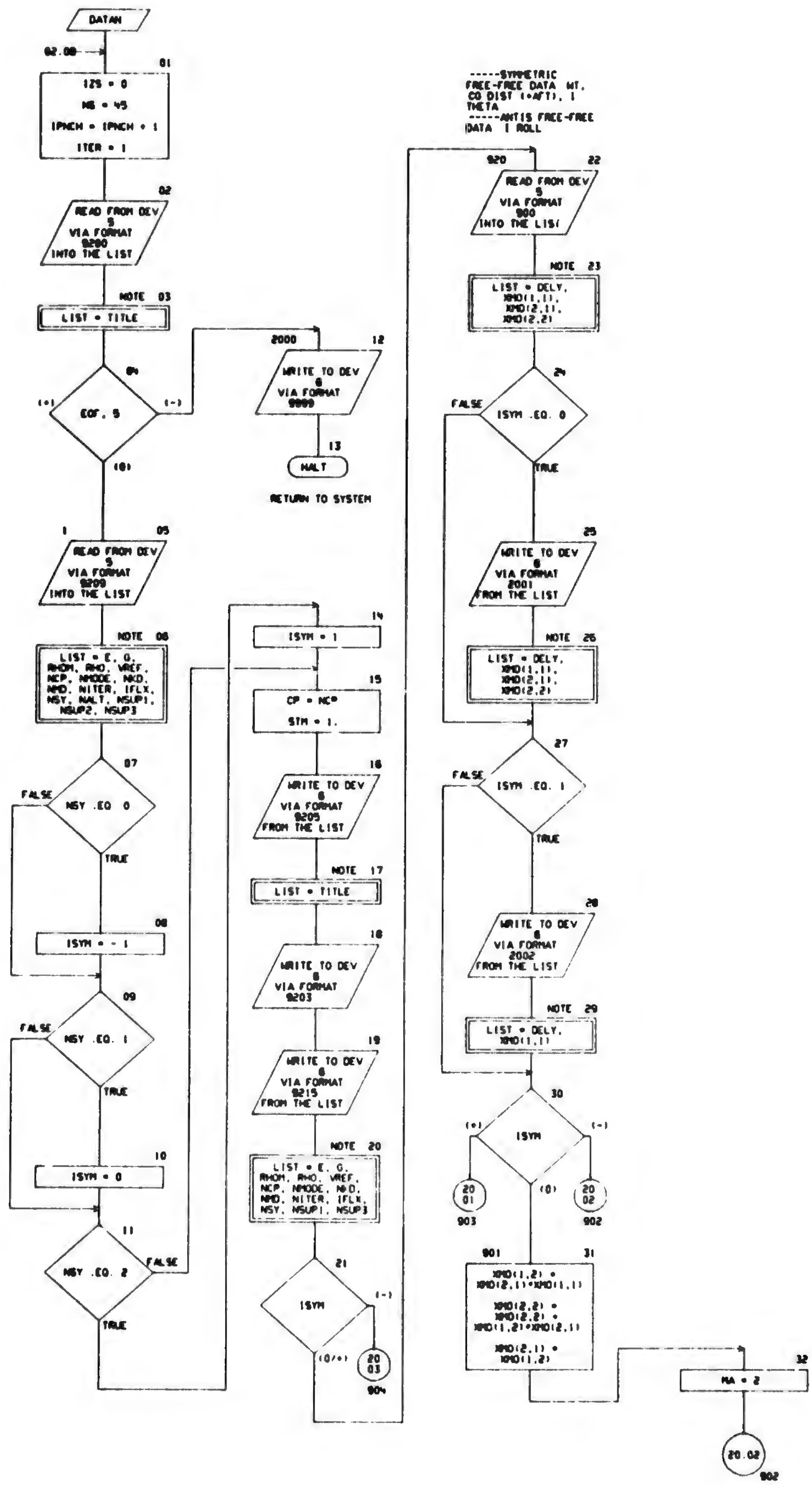


CHART TITLE - SUBROUTINE DATAN

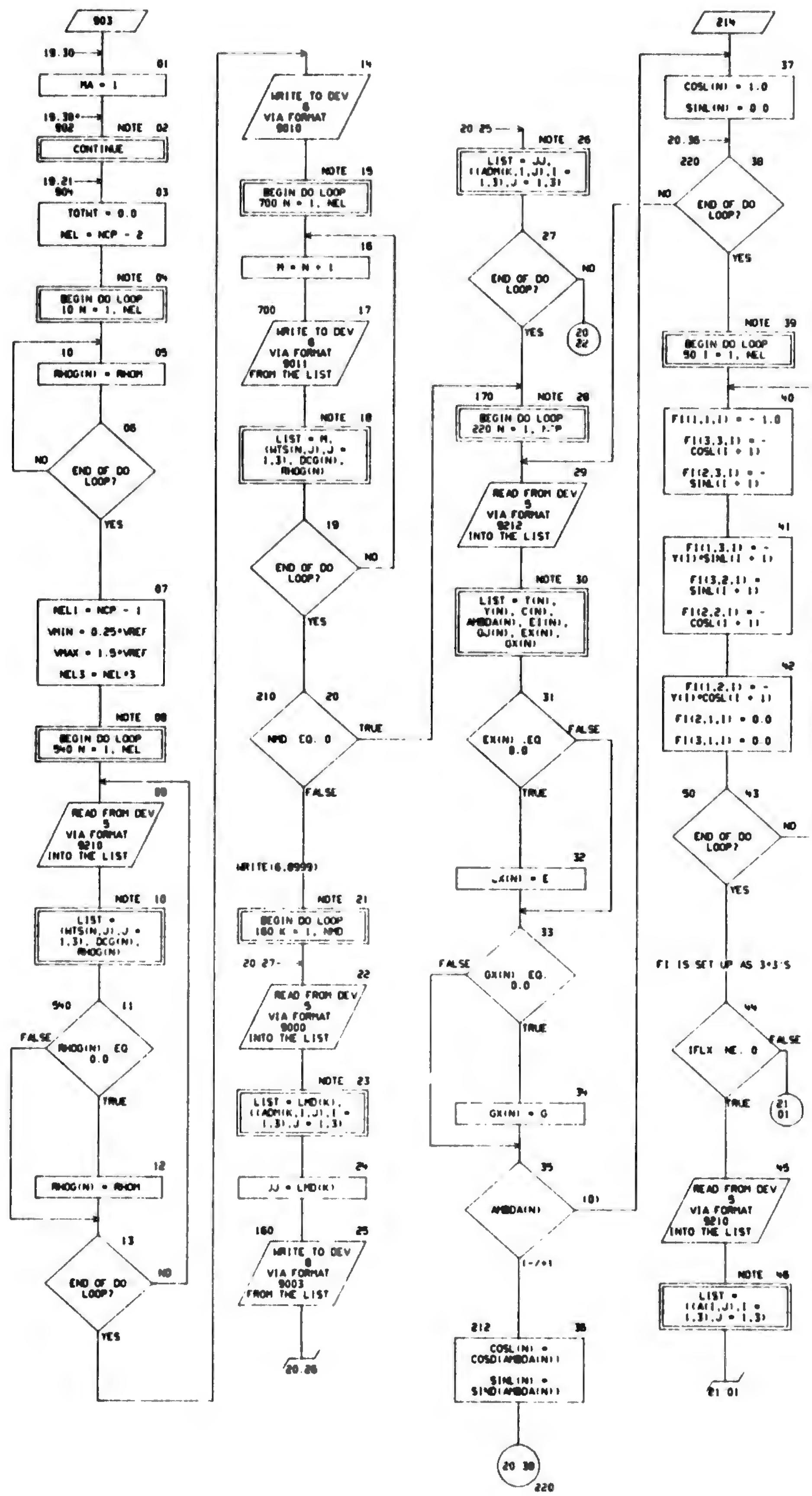
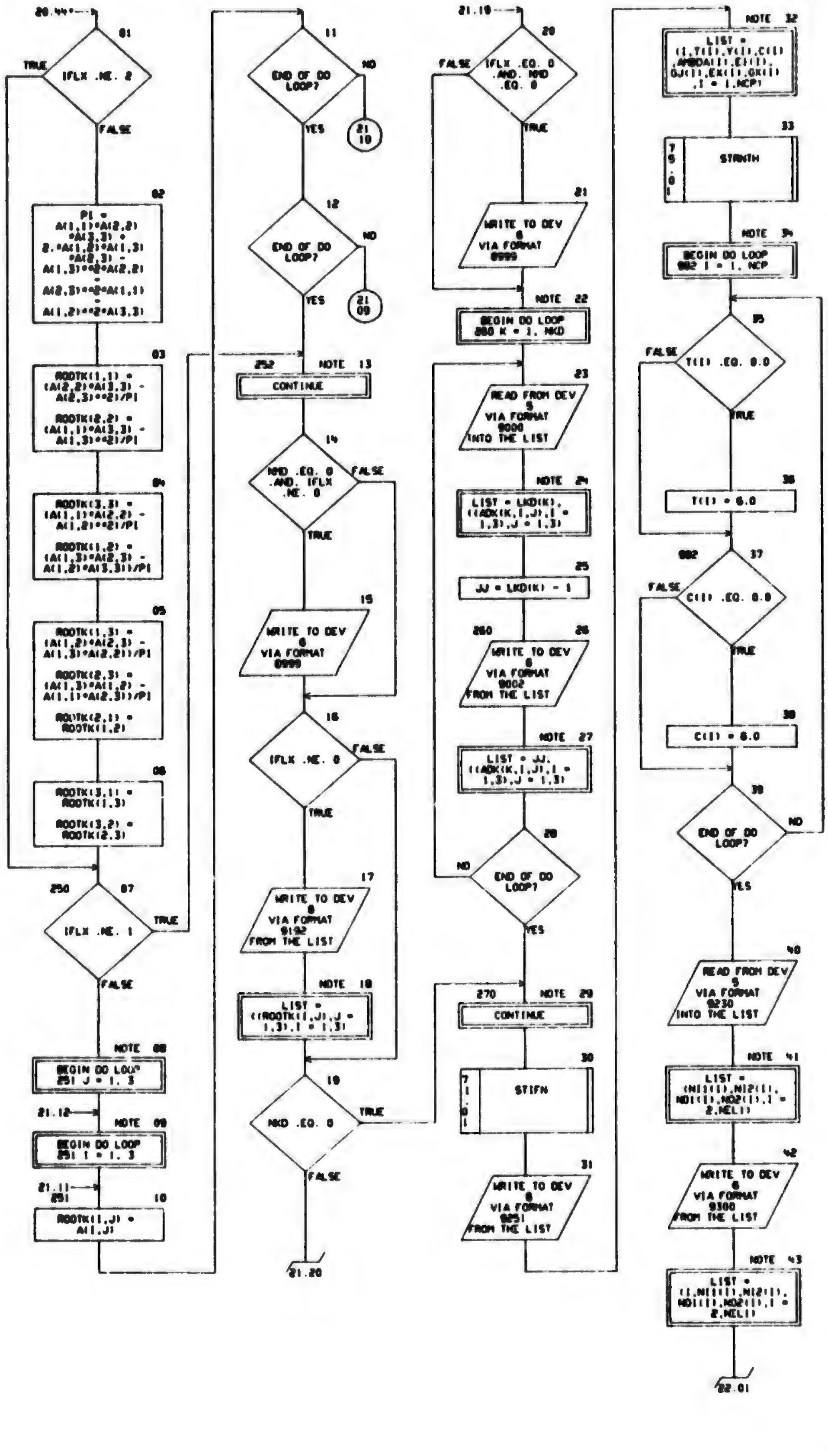


CHART TITLE - SUBROUTINE DATAN



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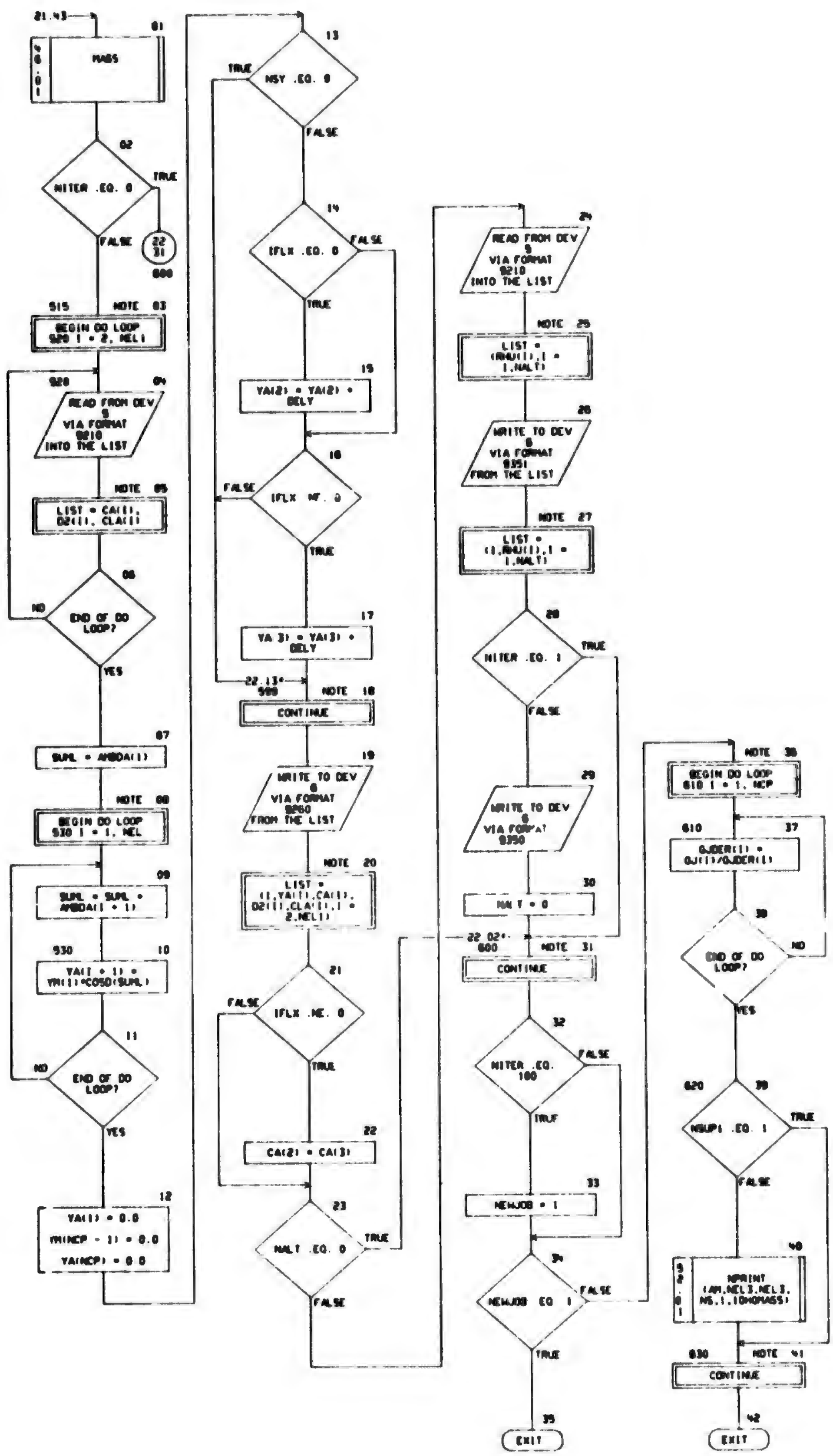

CHART TITLE - NON-PROCEDURAL STATEMENTS

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      DIMENSION SINL(16),COSL(16),A(3,3)
      COMMON TCX(2340 ),TAU(16,15),EI(16),GJ(16),FREQ(45),CP,NCP,NEL,
     NMODE,ITER,IPNCH,FFLTR,XMOO(2,2),MA,XMO(2,2),OO(2,10),ISYM,DO(45,2
     ),DELY
      COMMON/BLOCK1/TITLE(7),AK(45,45),AM(45,45),F(3,3,15),WH(15),
     EIDER(16),GJDER(16),T(16),Y(16),C(16),E,G,VREF,NEL3,NITER,
     ROOTK(3,3),IFLX,ADK(4,3,3),NKD,LKD(4),EX(16),GX(16)
      COMMON/BLOCK2/AMBDA(16),D2(16),CLA(16),CA(16),YA(15),CAY(50),I25,
     RHO,VMIN,VMAX,ICASE,NEWJOB,NSUP2,NSUP3,Z(560),RHU(6),NALT
      COMMON/BLOCK3/WTS(15,3),DCO(15),YM(15),RHOM,NI1(16),NI2(16),NO1(16
     ),NO2(16),WST(15,3),SIM,SAM,SOM,DCONS(15),TOTWT,ADM(4,3,3),NMD,LMD
     (4),WTT(15,3),RHOO(15)
900   FORMAT(8E12.0)
2001  FORMAT(1H1,42X,24HFREE-FREE SYMMETRIC DATA//28X, 4HDELY,13X,10HWEI
     GHT(LB), 8X,13HDEA(IN)(-FWD), 5X,18HIPITCHCG(LB-IN**2)//14X,4E20.7
     )
2002  FORMAT(1H1,39X,29HFREE-FREE ANTI-SYMMETRIC DATA//47X,4HDELY,11X,16
     HI-ROLL(LB-IN**2)//34X,2E20.7)
8999  FORMAT(1H1)
9000  FORMAT(I12,5E12.0/4E12.0)
9002  FORMAT(1H0,38X,32HSTIFFNESS INSERTION BEAM ELEMENT,I3//(28X,3E17 7
     ))
9003  FORMAT(1H0,37X,21HMASS ADDED TO STATION,I3//(29X,3E17.7))
9010  FORMAT(1H0,40X,28HINPUT DISTRIBUTED WEIGHT DATA//105H STATION
      WT(LB)            IROLLCG(LB-IN**2)  IPITCHCG(LB-IN**2)    DEA(IN)
     (-FWD)      RHOG(LB/IN**2) / )
9011  FORMAT(4X, I2,5E20.7)
9192  FORMAT(1H0,43X,20HINPUT ROOT STIFFNESS/(28X,3E17.7))
9198  FORMAT(38X,I5,E15.7)
9200  FORMAT(7A10)
9203  FORMAT(1H0,///10X,72(1H*)/10X,72H* STRENGTH CRITERION----  THE EI-
     GJ CURVE IS INPUT AND INCREASED UNTIL */10X,72H* THE FLUTTER VELOC
     ITY IS GREATER  THAN THE INPUT  REFERENCE VELOCITY  */10X,72(1H*))
9205  FORMAT(1H1///10X,7A10)
9209  FORMAT(5E12.0/8I6,4I1)
9210  FORMAT(8E12.0)
9211  FORMAT(4F8 2,E12 0,12X,2E12.0)
9212  FORMAT(4F8 2,4E12.0)
9215  FORMAT(1H0,44X,10H*** INPUT DATA ***///19X,23HMODULUS OF ELASTICIT
     Y,E,17X,1H=,E15.7, 9H LB/IN**2/19X 21HMODULUS OF SHEAR,G   ,19X,1H
     =,E15.7, 9H LB/IN**2/19X,30HDENSITY OF STRUCTURAL MATERIAL,10X,1H=
     ,E15.7,10H LBF/IN**3/19X,14HDENSITY OF AIR,26X,1H=,E15.7,10H LBF/I
     N**3/19X,24HFLUTTER VELOCITY DESIRED,16X,1H=,E15 7,6H KNOTS/19X,
     26HNUMBER OF CONTROL STATIONS,14X,1H=,I3/19X,
     15HNUMBER OF MODES,25X,1H=,I3/19X,
     30HNUMBER OF STIFFNES  INSERTIONS,10X,1H=,I3/19X,
     24HNUMBER OF MASS ADDITIONS,16X,1H=,I3/19X,28HMAXIMUM NUMBER OF IT
     ERATIONS,12X,1H=,I3/19X,26HROOT FLEXIBILITY INDICATOR,14X,1H=,I3/
     19X,26HFREE-FREE OPTION INDICATOR,14X,1H=,I3/
     19X,28H M        PRINTOUT INDICATOR,12
     X,1H=,I3/19X,33HVIBRATION MODE PRINTOUT INDICATOR,7X,1H=,I3)
9230  FORMAT(4I12)
9250  FORMAT(1H1,37X,23HSTRUCTURAL BOX GEOMETRY//1X,3HSTA,3X, 9HDEPTH(IN
     ),8X,10HLENGTH(IN),5X, 9HWIDTH(IN),7X,10HANGLE(DEG),4X, 7HTAU(IN),
     10X,12HEI(LB-IN**2),3X,12HGJ(LB-IN**2)//(1H ,I2,7E15 6))
9251  FORMAT(1H1,24X,49HSTRUCTURAL BOX GEOMETRY AND CONTROL STATION DATA
     //78H STA DEPTH(IN)  LENGTH(IN) WIDTH(IN)  ANGLE(DEG)   EI(LB-IN**
     2)   GJ(LB-IN**2),4X,25HE(LB/IN**2)   G(LB/IN**2)//(1H ,I2,1X,4(F8
     .3,2X),4E15.6))
9260  FORMAT(1H1,42X,15HAERO STRIP DATA//2X, 7HSTATION, 8X,  9HWIDTH(IN)
     7X, 13HAVG CHORD(IN),5X,19HAC TO EA(IN) (-FWD),8X, 7HCLALPHA
     //(1H ,I4,4E20 7))
9300  FORMAT(1H0,25X,49HSTRUCTURAL BOX AND AERO STRIP BOUNDARY INDICATOR
```

CHART TITLE - NON-PROCEDURAL STATEMENTS

```
      $ // 27X, 7HSTATION,5X,3HN11,7X,3HN12,7X,3HND1,7X,3HND2//
      (21X,5I10))
9350  FORMAT(1H0,2X,103H***ERROR*** EXTRA ALTITUDES MAY BE SPECIFIED ONL
      Y IF NITER=1. THIS CASE RUN FOR ORIGIONAL DENSITY ONLY.  )
9351  FORMAT(1H1,41X, 23HEXTRA ALTITUDEDENSITIES  //(45X,I3,E17.7))
9999  FORMAT(1H1,41X, 18H*****END OF PROGRAM  )
```

CHART TITLE - SUBROUTINE DTSD(S,SC,R,RC,D,M,N,NRC,MD,ND)

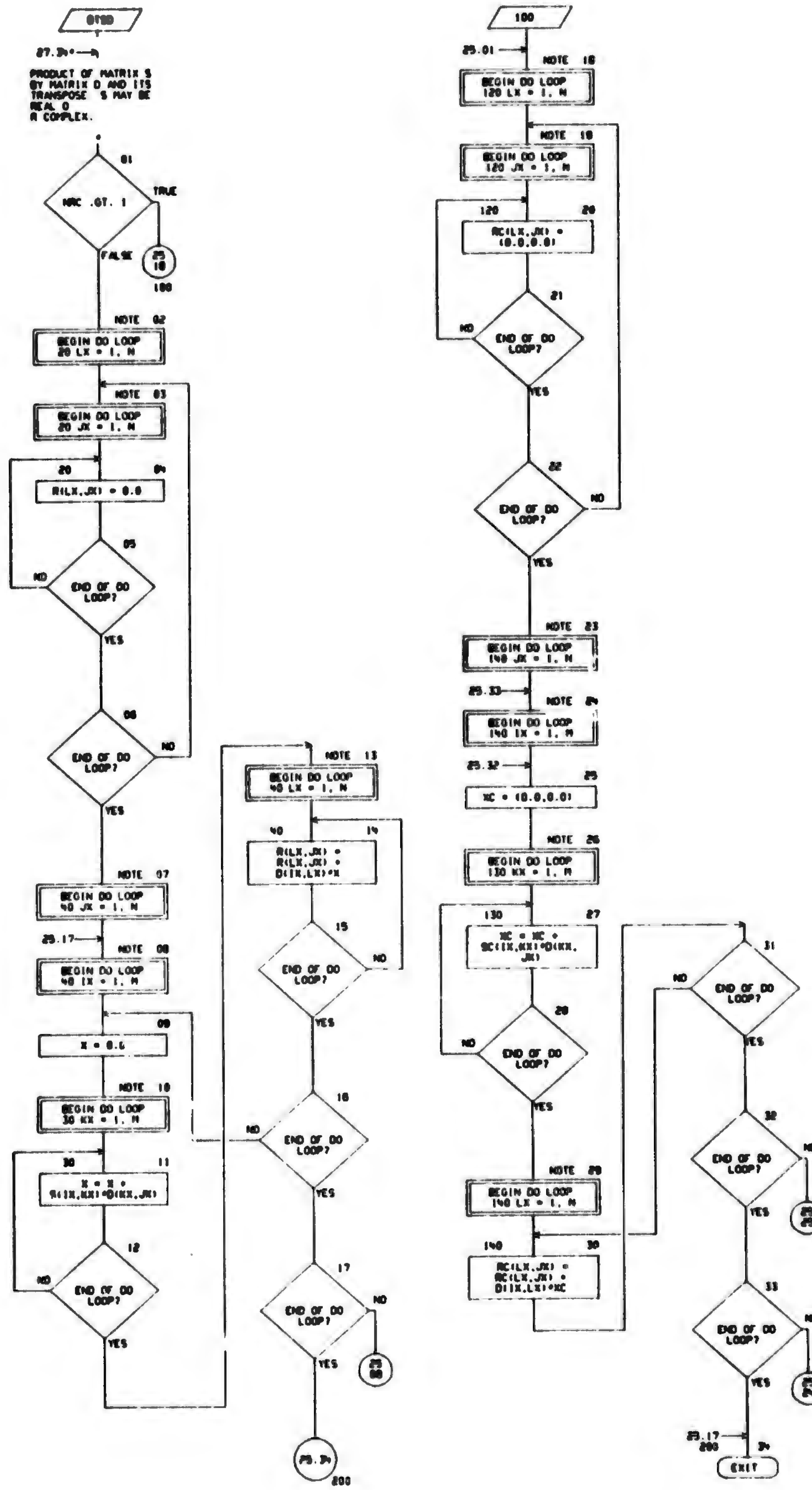


CHART TITLE - NON-PROCEDURAL STATEMENTS

```
DIMENSION S(ND,ND),D(ND,ND),R(ND,ND),SC(ND,ND),RC(ND,ND)
COMPLEX SC,RC,XC
```

CHART TITLE - SUBROUTINE EIGN(CAY,Q,V,F,IMIN,IVECT)

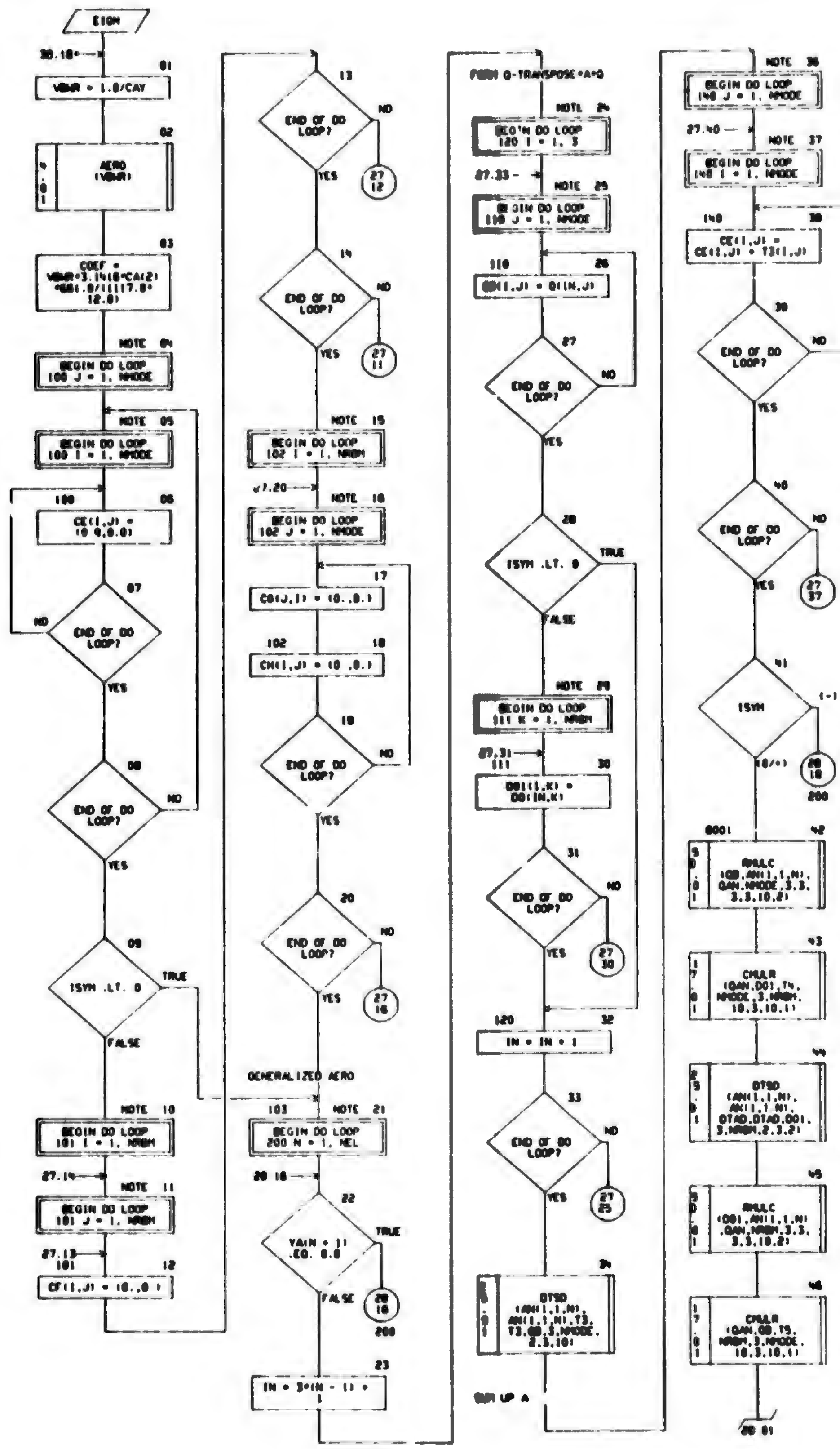


CHART TITLE - SUBROUTINE EIGN(CAY,G,V,F,DIN,IVECT)

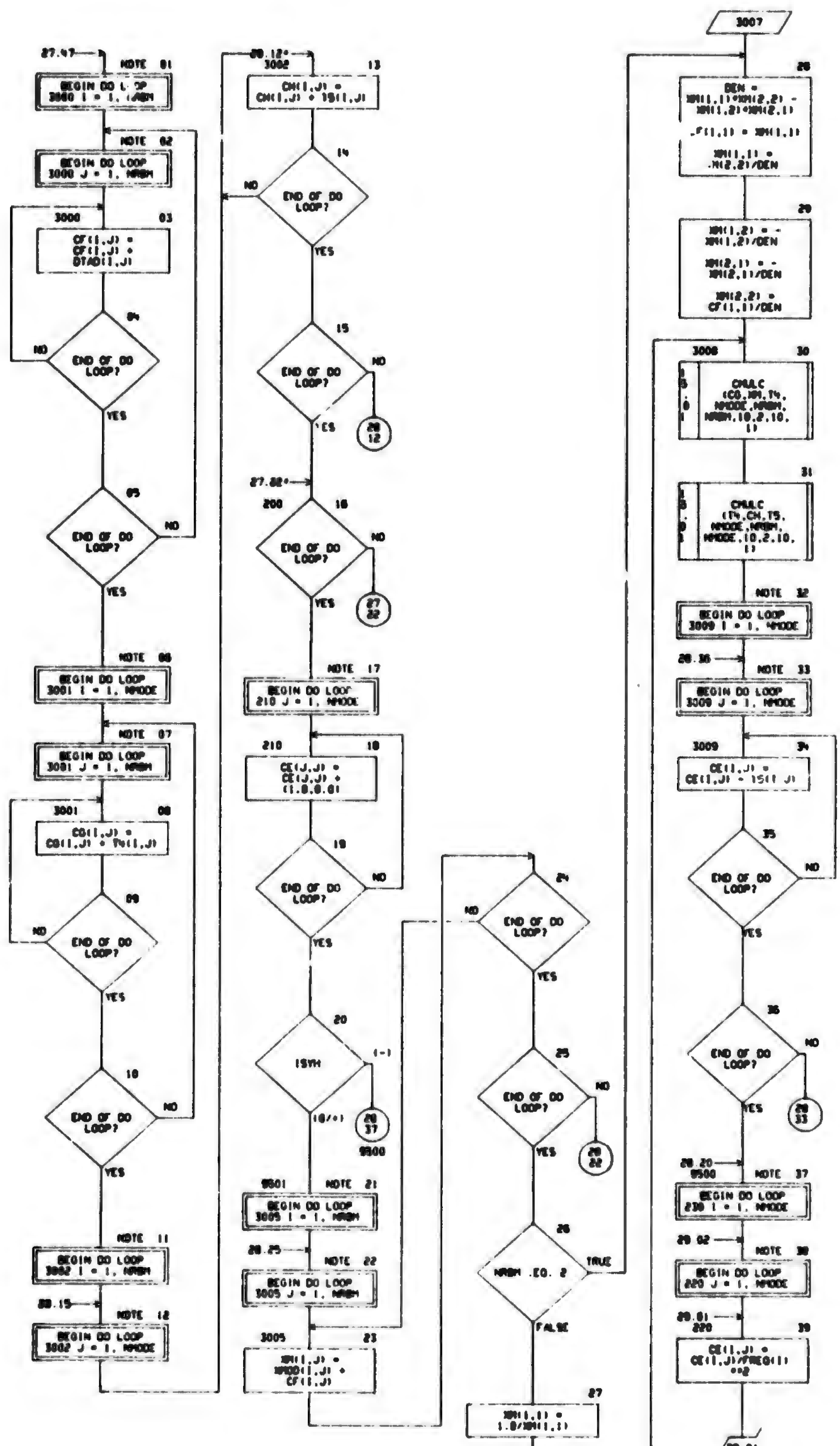


CHART TITLE - SUBROUTINE EIGN(CAY,G,V,F,IMIN,IVECT)

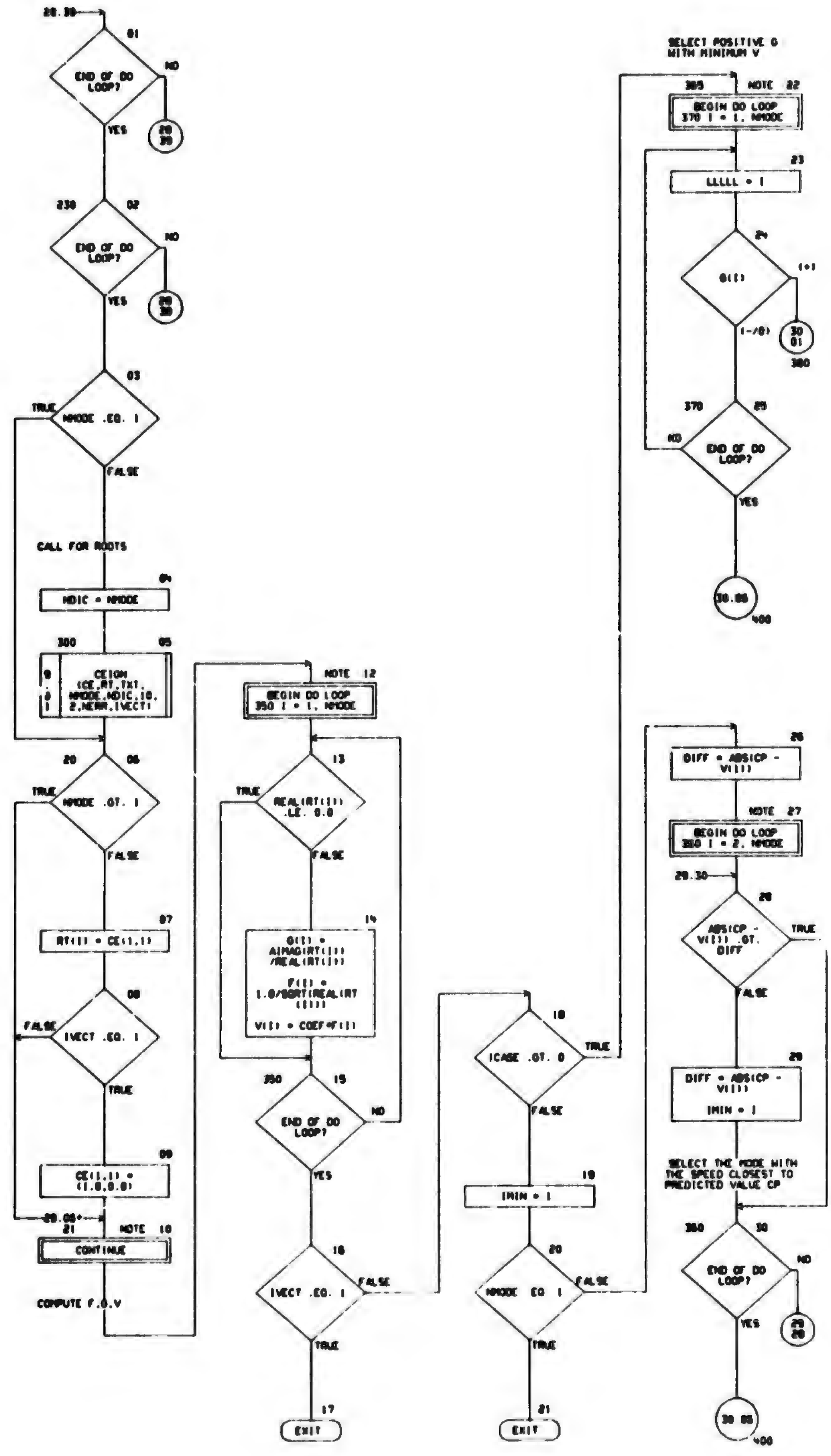


CHART TITLE - SUBROUTINE EIGN(CAY,G,V,F,IMIN,IVECT)

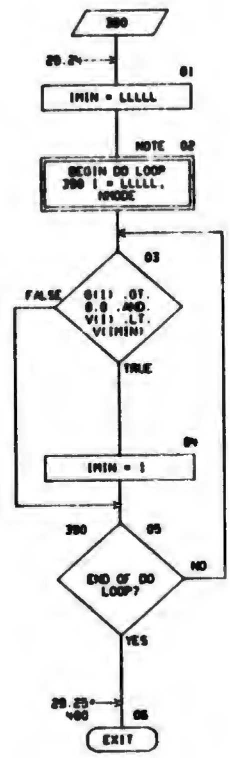


CHART TITLE - NON-PROCEDURAL STATEMENTS

```
        DIMENSION   OB(3,10),G(10),V(10),F(10),T3(10,10)
        DIMENSION GAN(10,3),T4(10,2),DTAD(2,2),T5(10,10),
         DD(3,2),CF(2,2),CO(10,2),CH(2,10),XM(2,2),XMOVOT(10,2),
        XMOVO(2,10)
        DIMENSION TXT(800)
        COMMON AN(3,3,15),CE(10,10),OF(45),RT(10),T1(45),T2(45),ENRGY(15),
        TXTT(1950),TAU(10,15),EI(16),OJ(16),FREQ(45),CP,NCP,NEL,NMODE,ITER
        ,
        IPNCH,FFLTR,XMDO(2,2),NREM,XMD(2,2),OD(2,10),ISYM,DD(45,2),DELY
        COMMON/BLOCK1/TITLE(7),AK(45,45),Q(45,45),F(3,3,15),VM(15),
        EIGER(16),OJDER(16),T(16),Y(16),C(16),E,OGO,VROF,NEL3,NITER,
        ROOTK(3,3),IFLX,ADK(4,3,3),NKD,LKD(4)
        COMMON/BLOCK2/AMBDA(16),D2(16),CLA(16),CA(16),YA(15),GAY(50),
        CAM,RHO,VMIN,VMAX,ICASE
        COMPLEX AN,RT,CE,OF,T1,T2,ENRGY,T3
        COMPLEX GAN,T4,DTAD,T5,CF,CO,CH,XM,DEN
        EQUIVALENCE (OB(1),Q(1,45)),(T1(1),T3(1))
1       FORMAT(8E17.7)
```

CHART TITLE - SUBROUTINE ENERGY

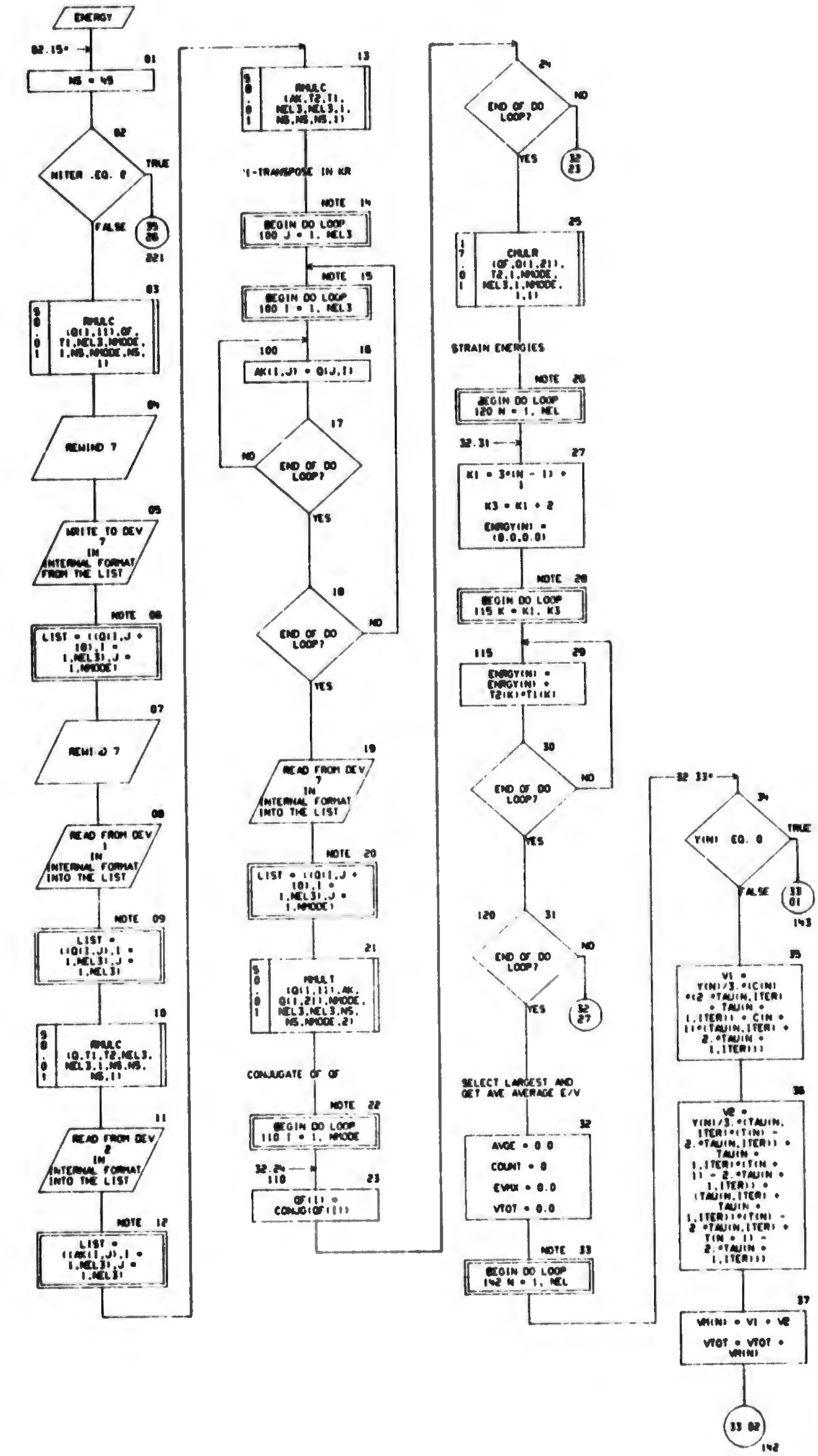


CHART TITLE - SUBROUTINE ENERGY

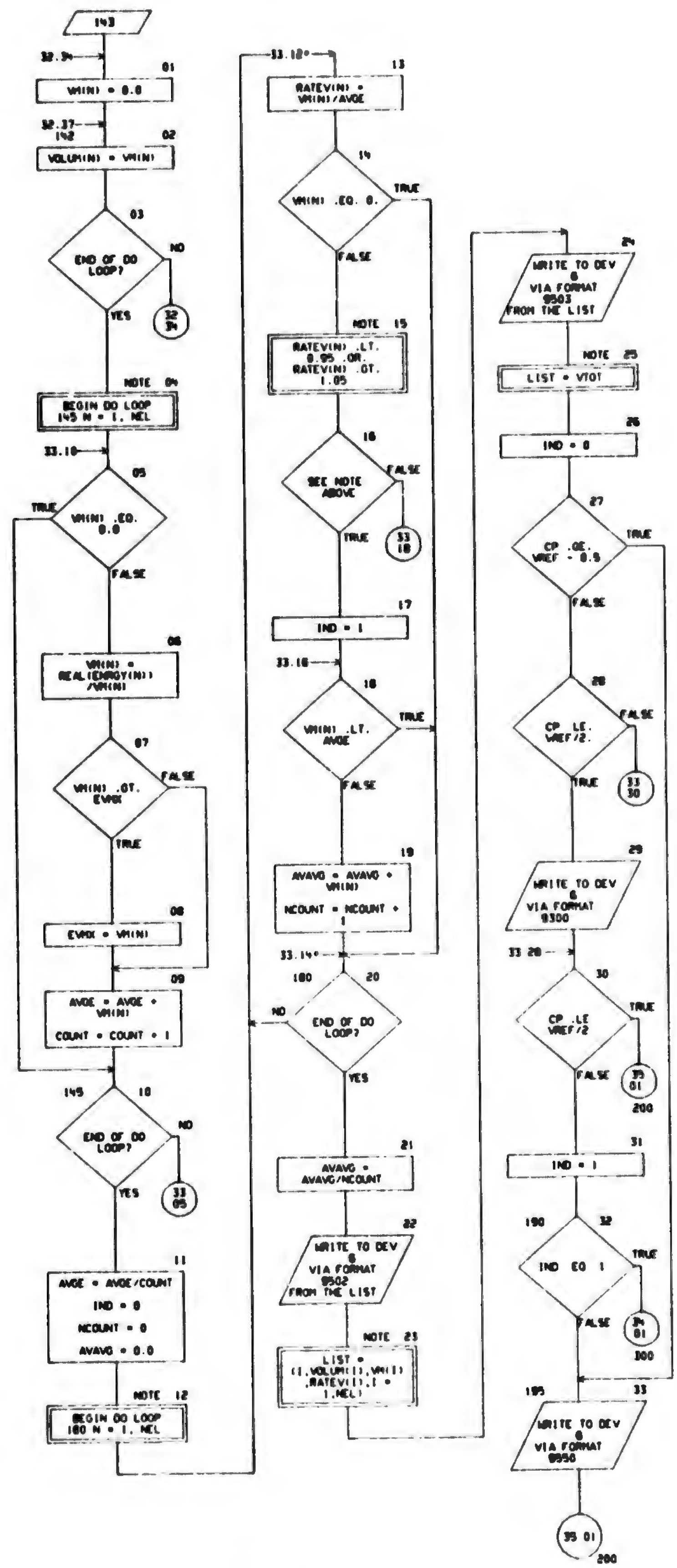


CHART TITLE - SUBROUTINE ENERGY

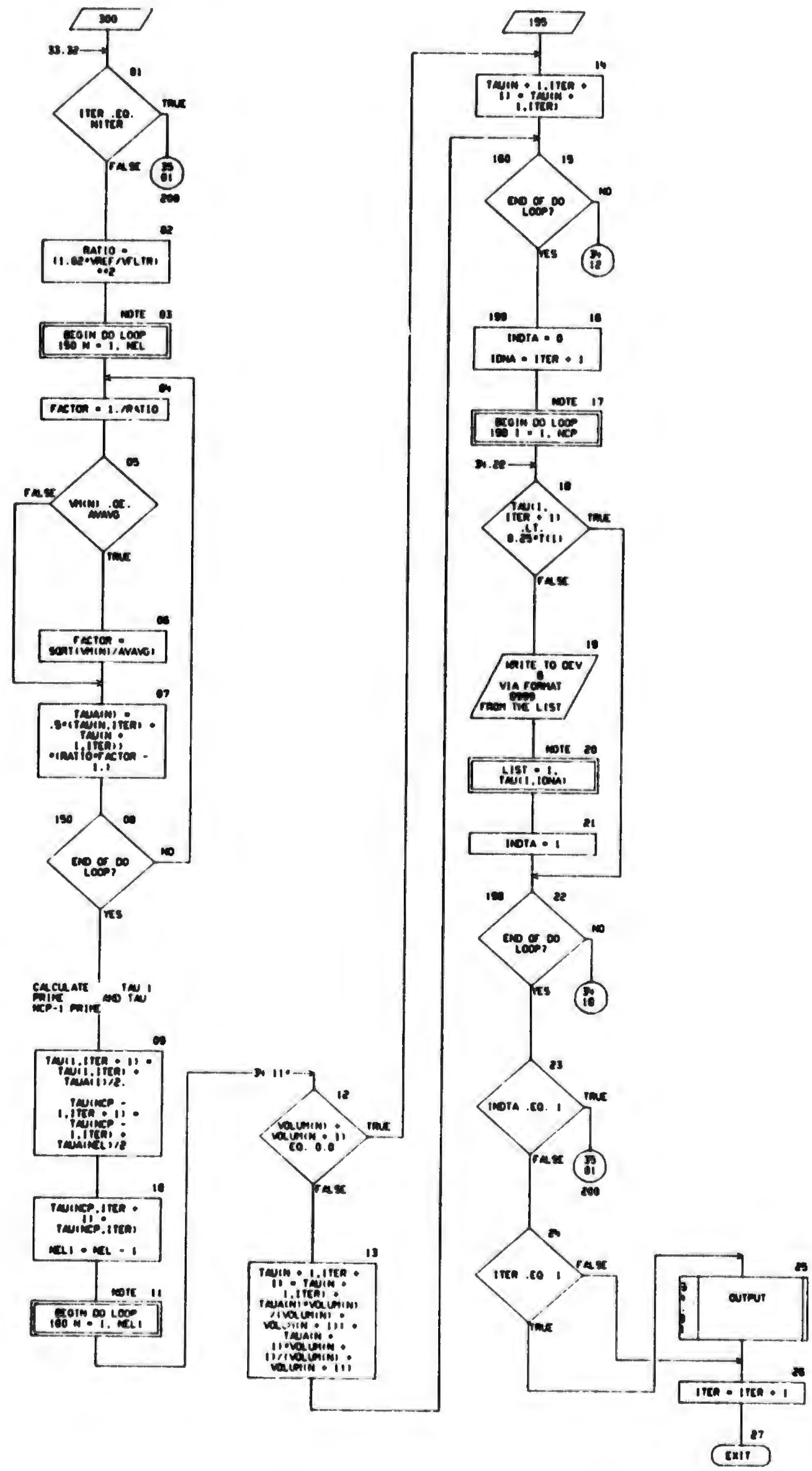


CHART TITLE - SUBROUTINE ENERGY

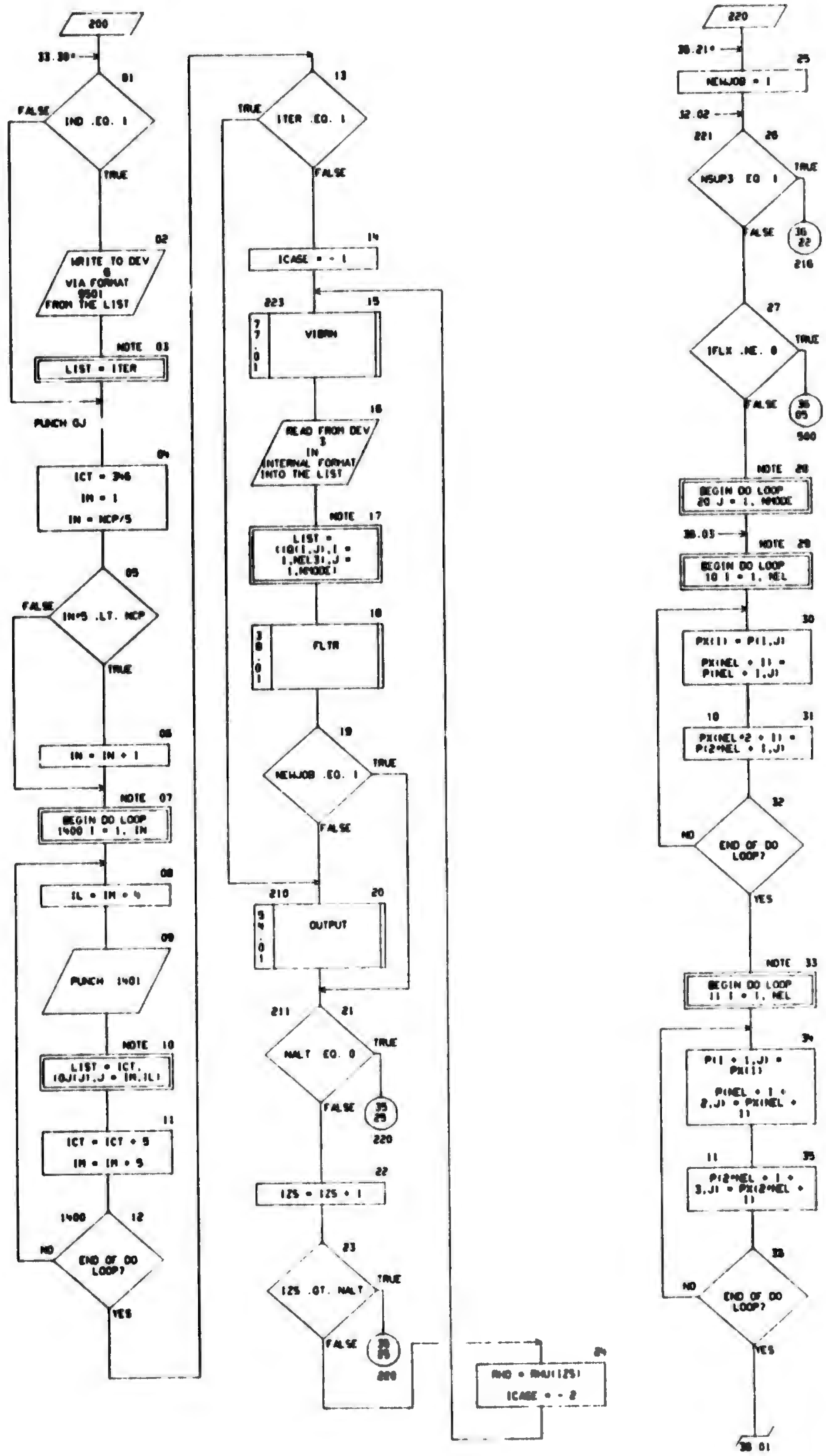


CHART TITLE - SUBROUTINE ENERGY

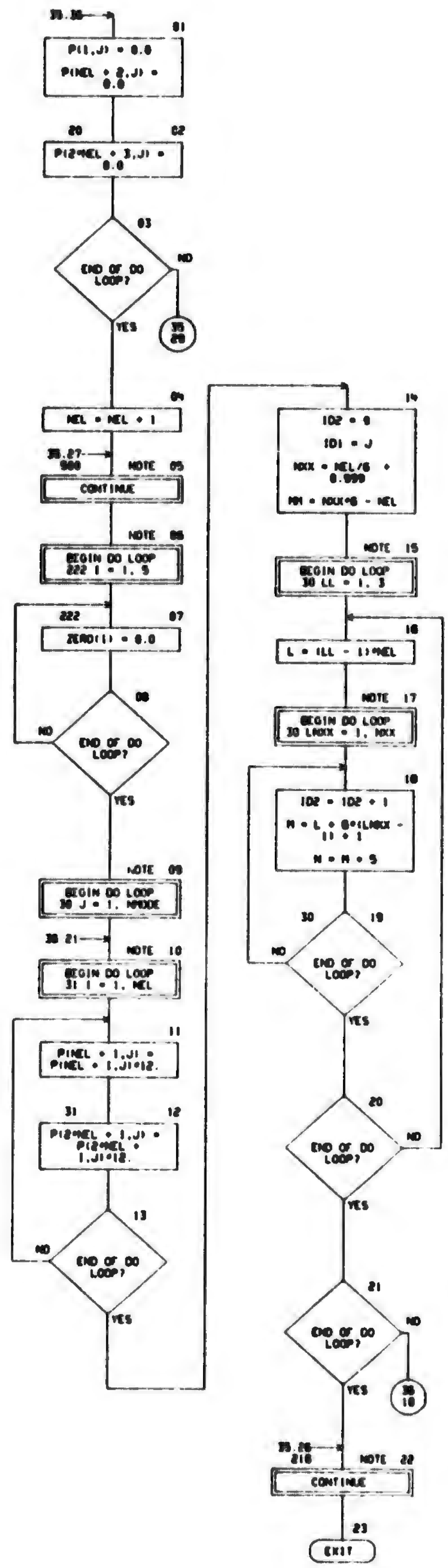


CHART TITLE - NON-PROCEDURAL STATEMENTS

```
            DIMENSION ZERO(5),RATEV(15),VOLUM(15),TAUA(15),PX(45)
            COMMON AN(3,3,15),CE(10,10),OF(45),RT(10),T1(45),T2(45),ENROY(15),
            F(10,50),O(10,50),V(10,50),IMIN(50),TAU(6,15),EI(16),
            GJ(16),FREQ(45),CP,NCP,NEL,NMODE,ITER,IPNCH,FFLTR
            COMMON/BLOCK1/TITL(7),AK(45,45),Q(45,45),F1(3,3,15),VM(15),
            EIDER(16),GJDER(16),T(16),Y(16),C(16),E,GEE,VREF,NEL3,NITER,
            ROOTK(3,3),IFLX
            COMMON/BLOCK2/A(129),I25,RHO,VMIN,VMAX,ICASE,NFWJ08,NSUP2,NSUP3,
            GAMA(180),P(45,10),PMAX(10),RHU(6),NALT
            COMMON/BLOCK3/NTS(15,3),DCG(15),YM(15),RHOM,NI1(16),NI2(16),NO1(16
           ),NO2(16),NST(15,3),SIM,SAM,SOM,DCGNS(15)
            EQUIVALENCE (VFLTR,CP)
            COMPLEX AN,RT,CE,OF,T1,T2,ENROY
1           FORMAT(8E17.7)
1401        FORMAT(8X,13,(5E12.5))
8999        FORMAT(1H0,15X,30HTHE SKIN THICKNESS FOR STATION,13,1H=,E12.4,31H
              THIS IS   0.25XBOX THICKNESS )
9000        FORMAT(8E12.5,12,13,13)
9300        FORMAT(1H0,23X, 59HTHE FLUTTER VELOCITY IS LT 5XVREF. EXECUTION IS
             TERMINATED  )
9501        FORMAT(1H0,19, 89H ITERATIONS HAVE BEEN PERFORMED  THE CRITERION W
            AS NOT SATISFIED  PLOTS WILL BE OBTAINED  )
9502        FORMAT(1H0,17X, 12HBEAM ELEMENT, 8X,13HVOLUME(IN**3),5X,18HSTRAIN
            ENERGY/VOL ,4X,20HRATIO(E/V/AVGE(E/V)) //(125,4X,F10.4,2X,E20.7,F1
            0.4))
9503        FORMAT(37X,10H---------- / 29X,F10.4 )
9505        FORMAT(1H0,20X,29HTOTAL STRUCTURAL WEIGHT     =, E15.7,3H LB/29X,
            29HTOTAL NON STRUCTURAL WEIGHT =,E15.7,3H LB/29X,12HTOTAL WEIGHT,1
            0X,1H=,E15.7,3H LB )
9550        FORMAT(1H0//38X,39H******THE CRITERION IS SATISFIED ****** )
```

CHART TITLE - SUBROUTINE FLTR

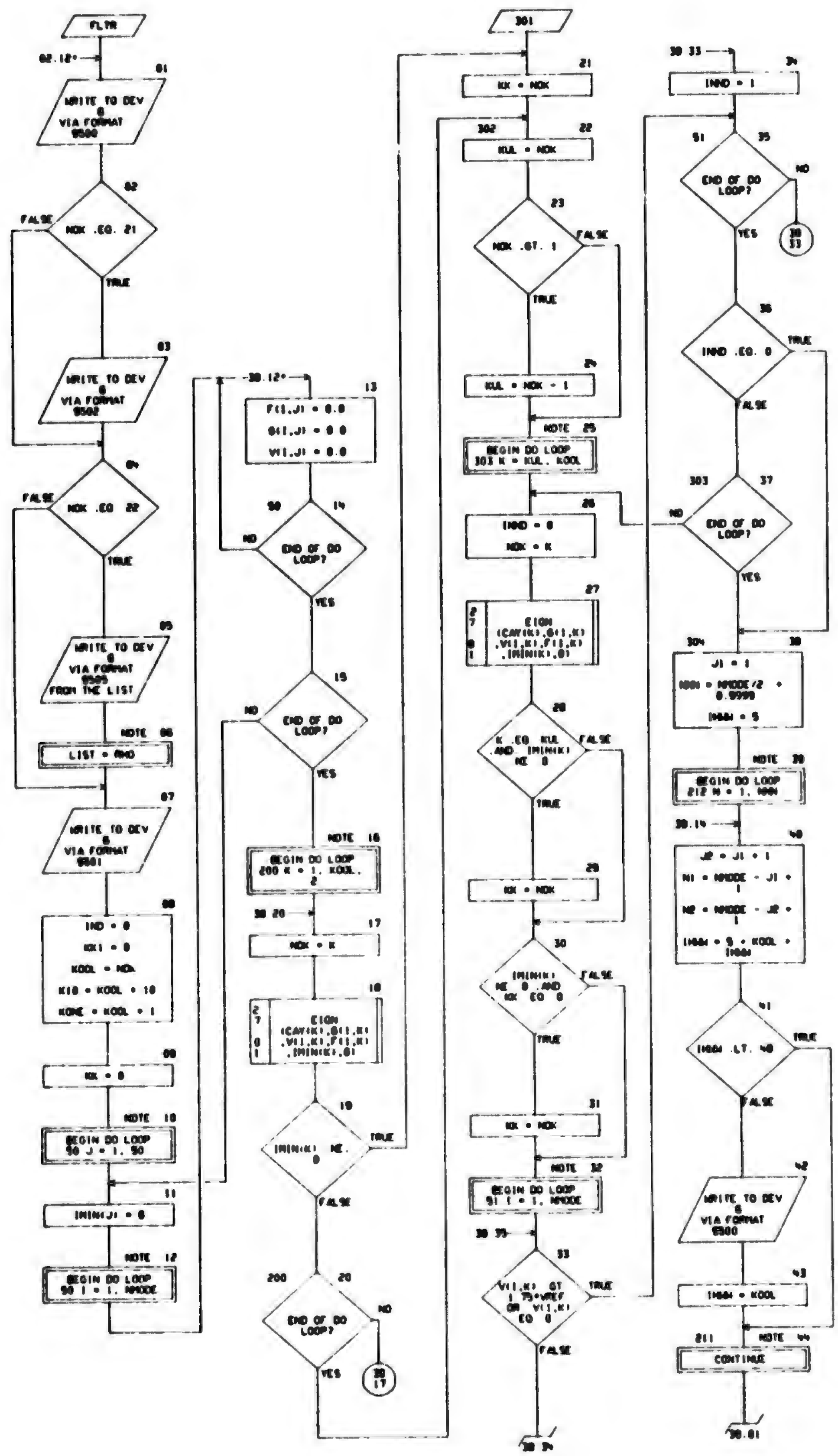


CHART TITLE - SUBROUTINE FLTR

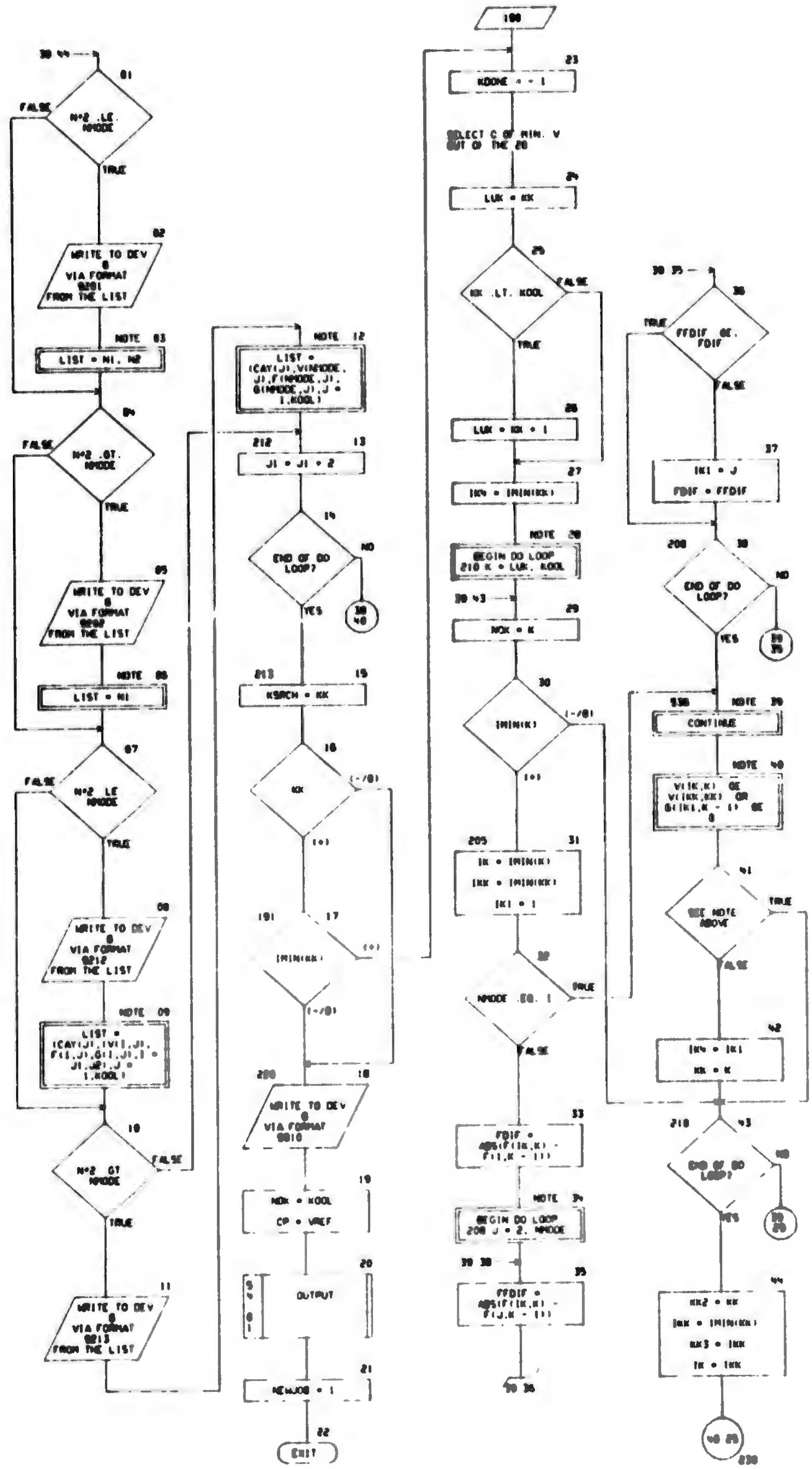


CHART TITLE - SUBROUTINE FLTR

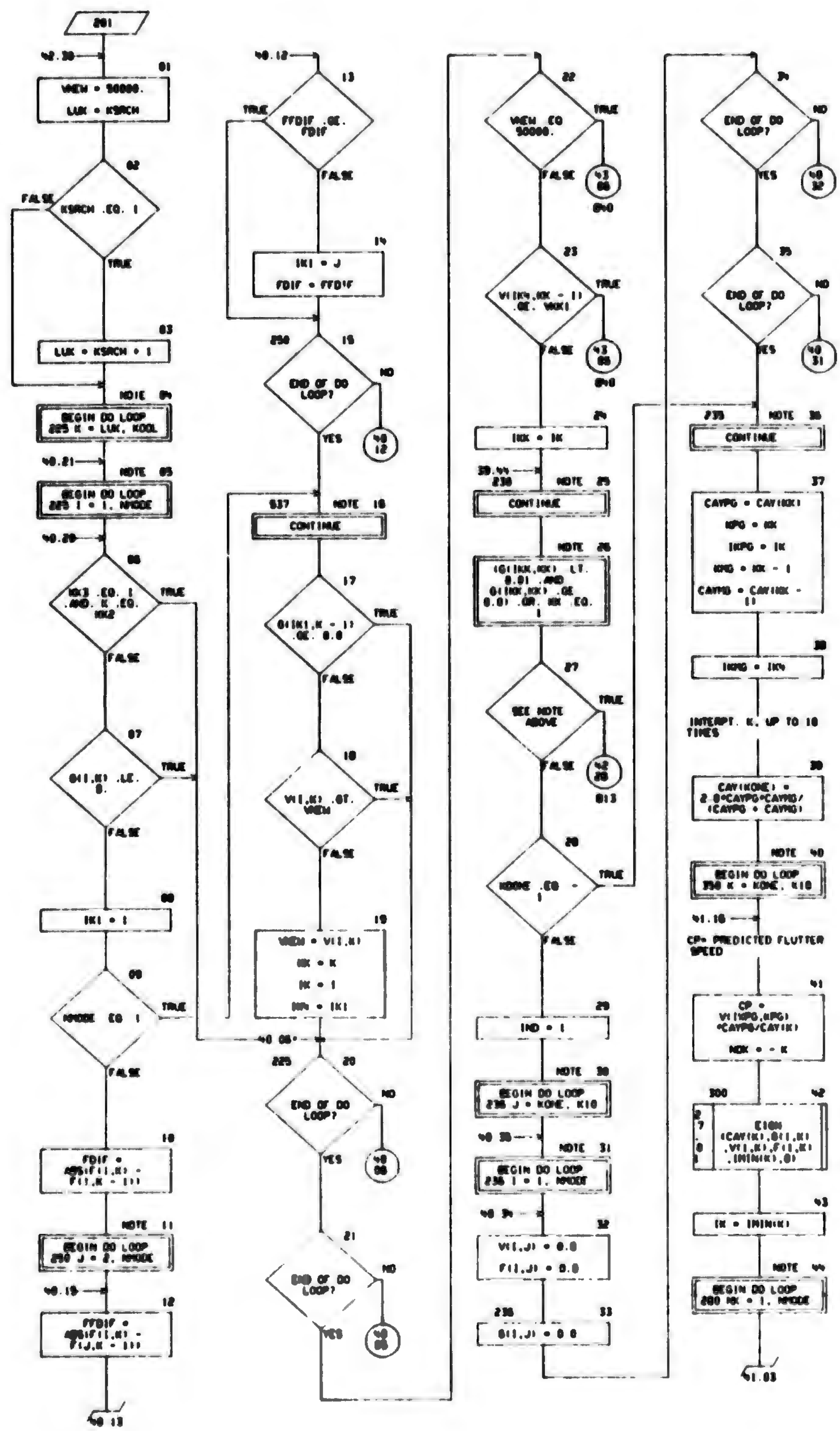


CHART TITLE - SUBROUTINE FLTR

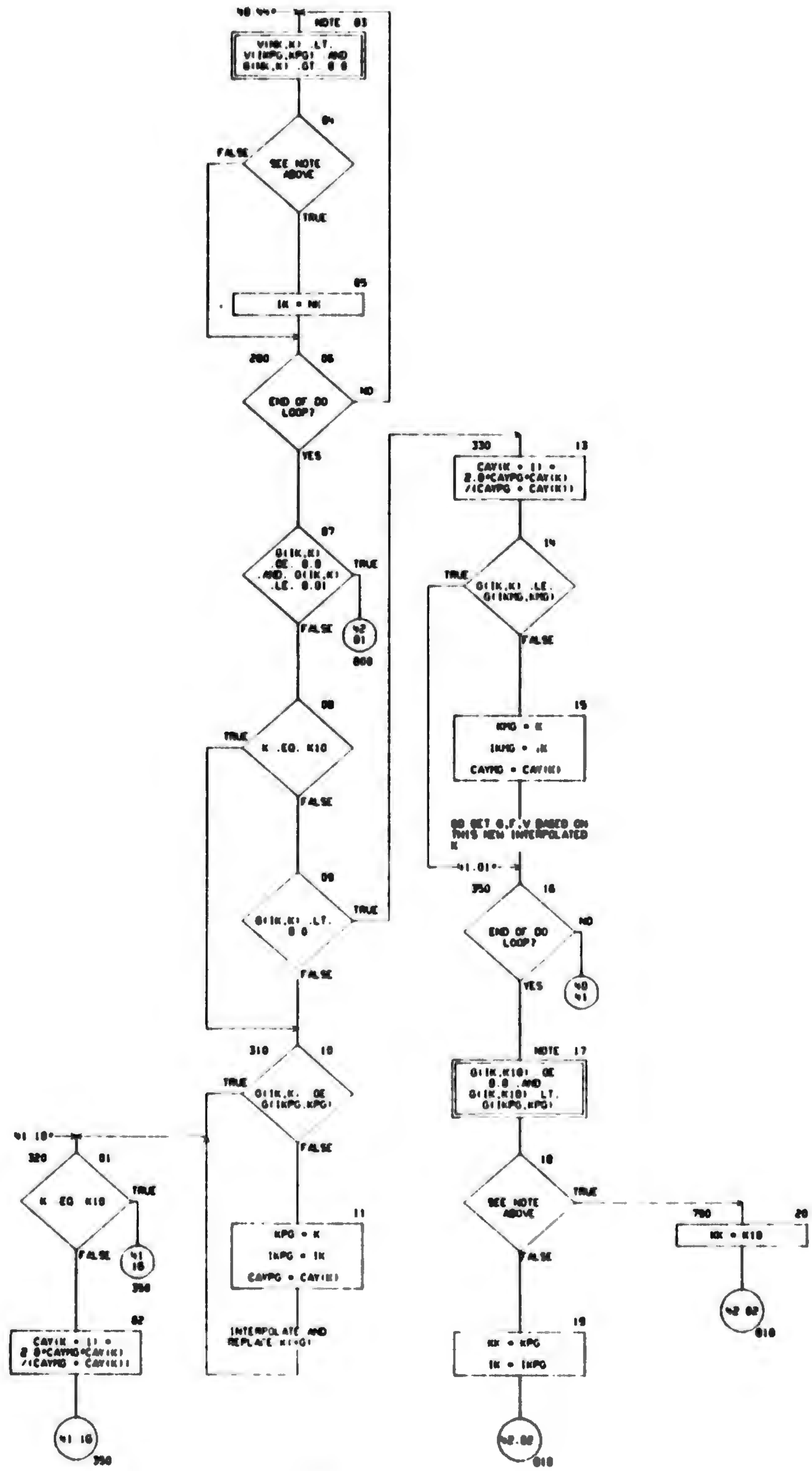


CHART TITLE - SUBROUTINE FLTR

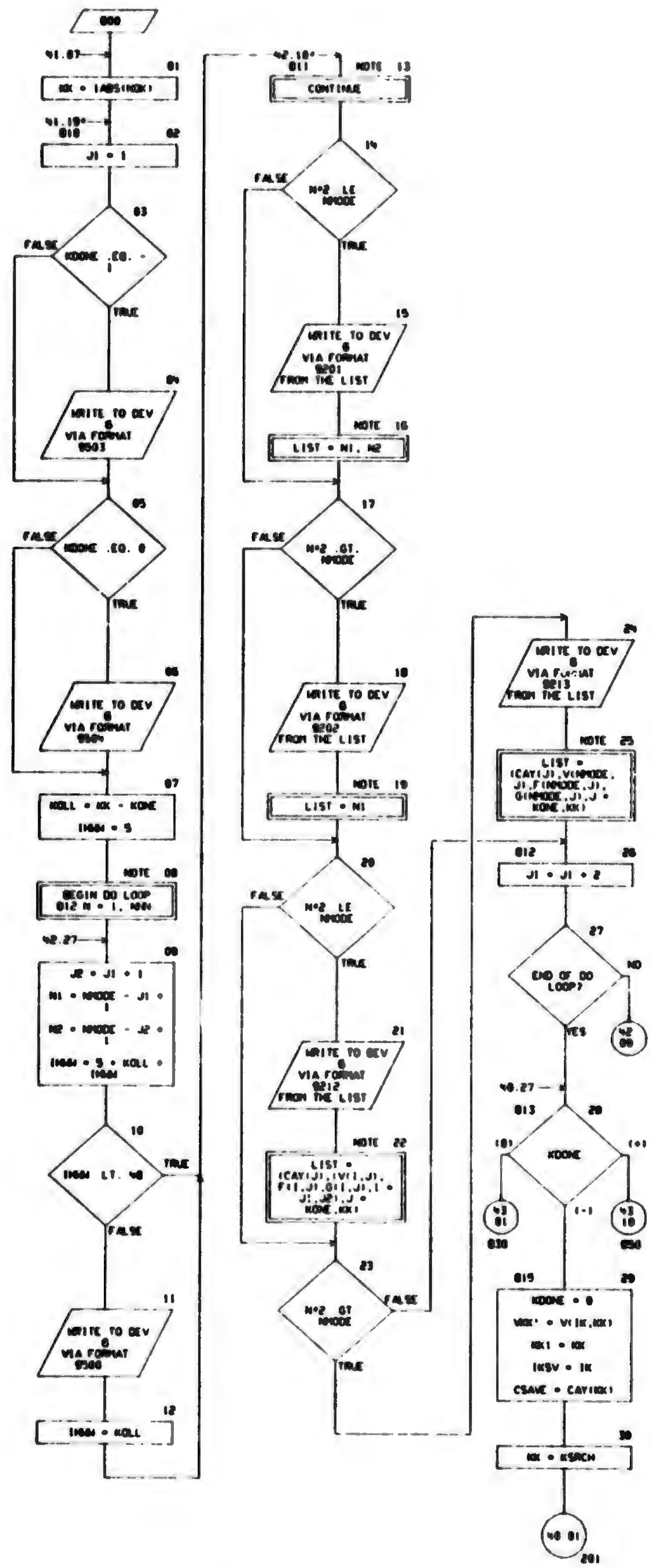
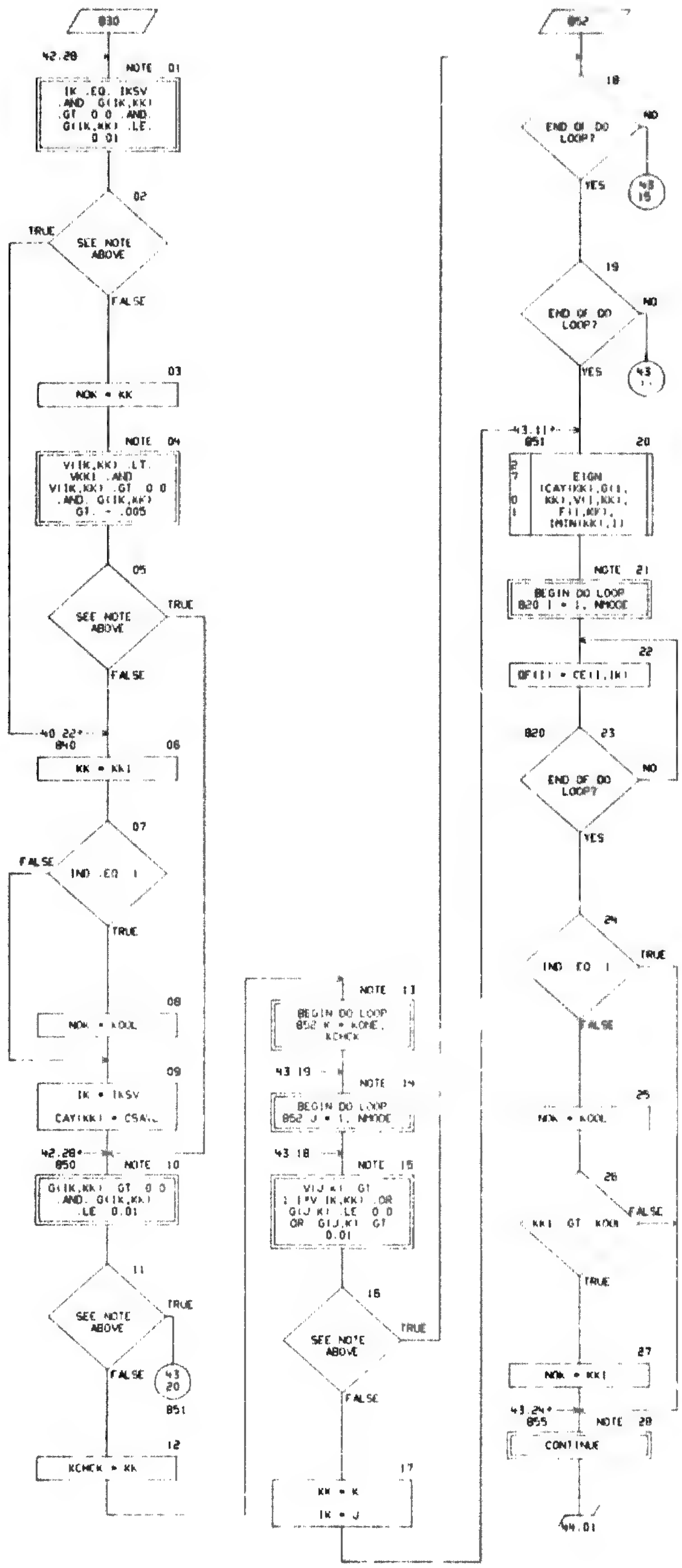


CHART TITLE - SUBROUTINE FLTR



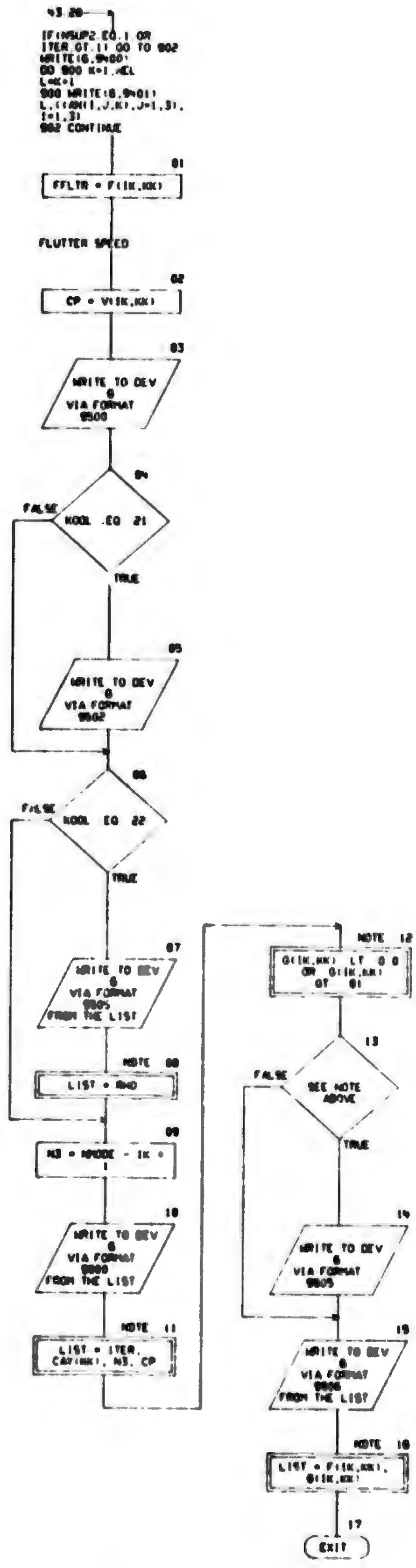

43 20
IF(NSUP2 EQ.1 OR ITER GT.1) GO TO 902
WRITE(6,9400)
DO 900 K=1,KEL
L=K+1
900 WRITE(6,9401) L,((AN(I,J,K),J=1,3),I=1,3)
902 CONTINUE
FFLTR = F(IK,KK)
FLUTTER SPEED
CP = V(IK,KK)
WRITE TO DEV 6 VIA FORMAT 9500
FALSE
KOOL .EQ 21
TRUE
WRITE TO DEV 6 VIA FORMAT 9502
KOOL EQ 22
WRITE TO DEV 6 VIA FORMAT 9505 FROM THE LIST
NOTE
LIST = RHO
N3 = NMODE - IK + 1
WRITE TO DEV 6 VIA FORMAT 9800 FROM THE LIST
LIST = ITER, CAY(KK), N3, CP
NOTE 12
G(IK,KK) LT 0 0 OR G(IK,KK) GT 01
SEE NOTE ABOVE
WRITE TO DEV 6 VIA FORMAT 9805
WRITE TO DEV 6 VIA FORMAT 9806 FROM THE LIST
LIST = F(IK,KK), G(IK,KK)
EXIT

CHART TITLE - NON-PROCEDURAL STATEMENTS

```
      COMMON AN(3,3,15),CE(10,10),OF(45),RT(10),T1(45),T2(45),ENRGY(15),
      F(10,90),G(10,90),V(10,90),IMIN(90),TAU(10,15),E1(10),GJ(10),
      FREQ(45),CP,NCP,NEL,NMODE,ITER,IPNCH,FFLTR
      COMMON/BLOCK1/TITLE(7),AK(45,45),Q(45,45),Z1(232),VREF,NEL3
      COMMON/BLOCK2/AMBDA(10),D2(10),CLA(10),CA(10),YA(15),CAY(50),CAM,
      RHO,VMIN,VMAX,NOK,NEWJOB,NSUP2
      COMPLEX AN,RT,CE,OF,T1,T2,ENRGY
1     FORMAT(8E17.7)
9201  FORMA (1H0,30X,4HMODE,I5,45X,4HMODE,I5//8X,1HK,2(14X,1HV,14X,1HF,
      14X, G))
9202  FORMAT 1H0,30X,4HMODE,I5//8X,1HK,14X,1HV,14X,1HF,14X,1HG )
9212  FORMAT(3X,F10.4,8F15.4)
9213  FORMAT(3X,F10.4,3F15.4)
9400  FORMAT(1H1,32X,43HCOMPLEX AERO MATRIX FOR THE FLUTTER K-VALUE )
9401  FORMAT(1H0,46X,11H  STATION  ,I2//(1X,8E17.7))
9500  FORMAT(1H1)
9501  FORMAT(42X,24H****FLUTTER ANALYSIS****)
9502  FORMAT(27X,54H****FLUTTER CHECK ANALYSIS FOR THE FINAL ITERATION**
      **//)
9503  FORMAT(1H1/38X,32H***FIRST CONVERGENCE ANALYSIS***)
9504  FORMAT(1H1/37X,33H***SECOND CONVERGENCE ANALYSIS***)
9505  FORMAT(29X,30H****FLUTTER ANALYSIS FOR RHO =,E15.7,4H****//)
9800  FORMAT(32X,28H*****FINAL RESULTS ITERATION,I3,8H******///34X,
       7HK-VALUE,11X,1H=,F8.4/34X,18HFLUTTER MODE NO.,2X,1H=,I4/34X,18HF
      LUTTER VELOCITY  =,F7.2,6H KNOTS)
9805  FORMAT(1H+,68X,15H(NOT CONVERGED) )
9806  FORMAT(34X,18HFLUTTER FREQUENCY =,F8.4,4H HZ./34X,18HFLUTTER DAMPI
      NG   =,F8.4 )
9810  FORMAT(1H0,10X,86H*****NO INSTABILITIES FOUND----THE STRUCTURE IS
      STABLE FOR THE K-RANGE CALCULATED***** )
```

CHART TITLE - SUBROUTINE MASS

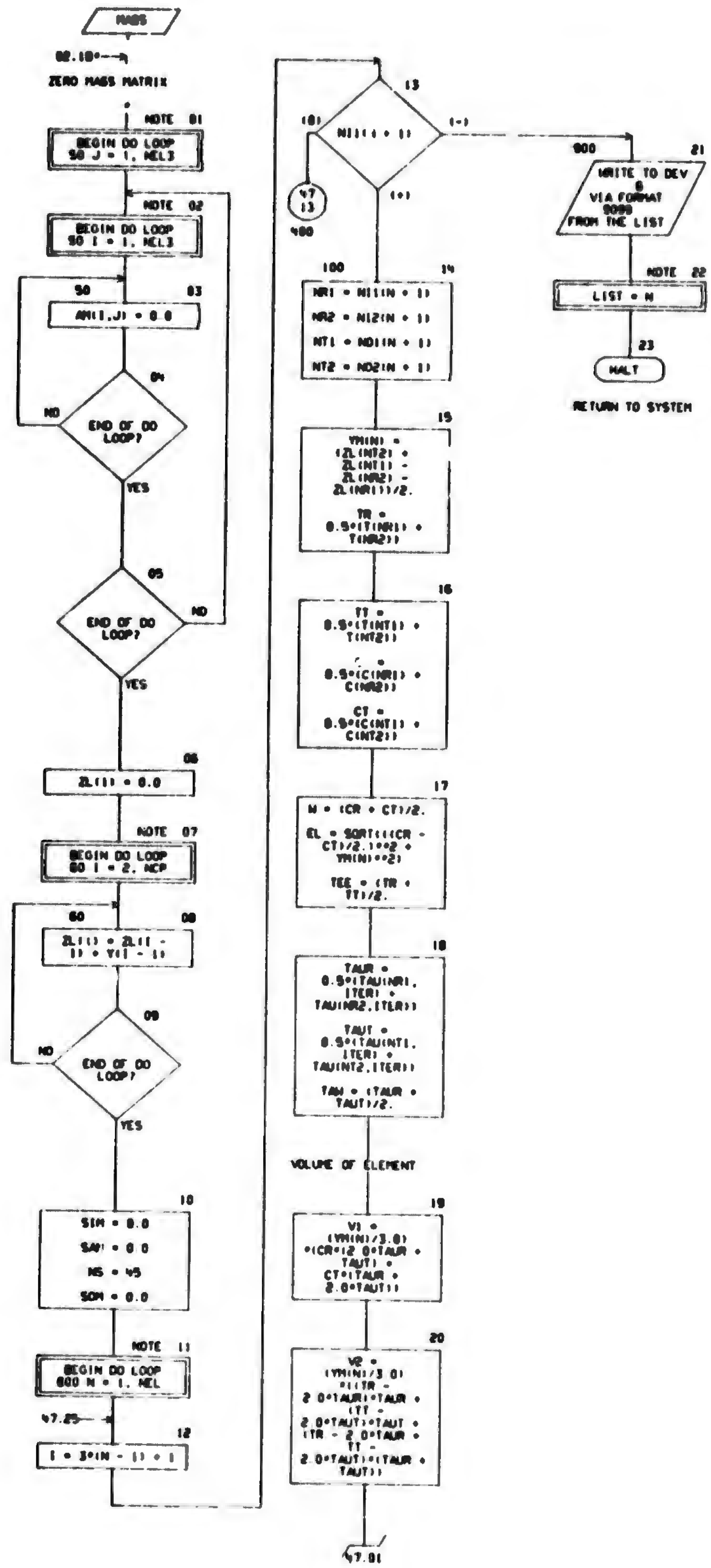


CHART TITLE - SUBROUTINE MASS

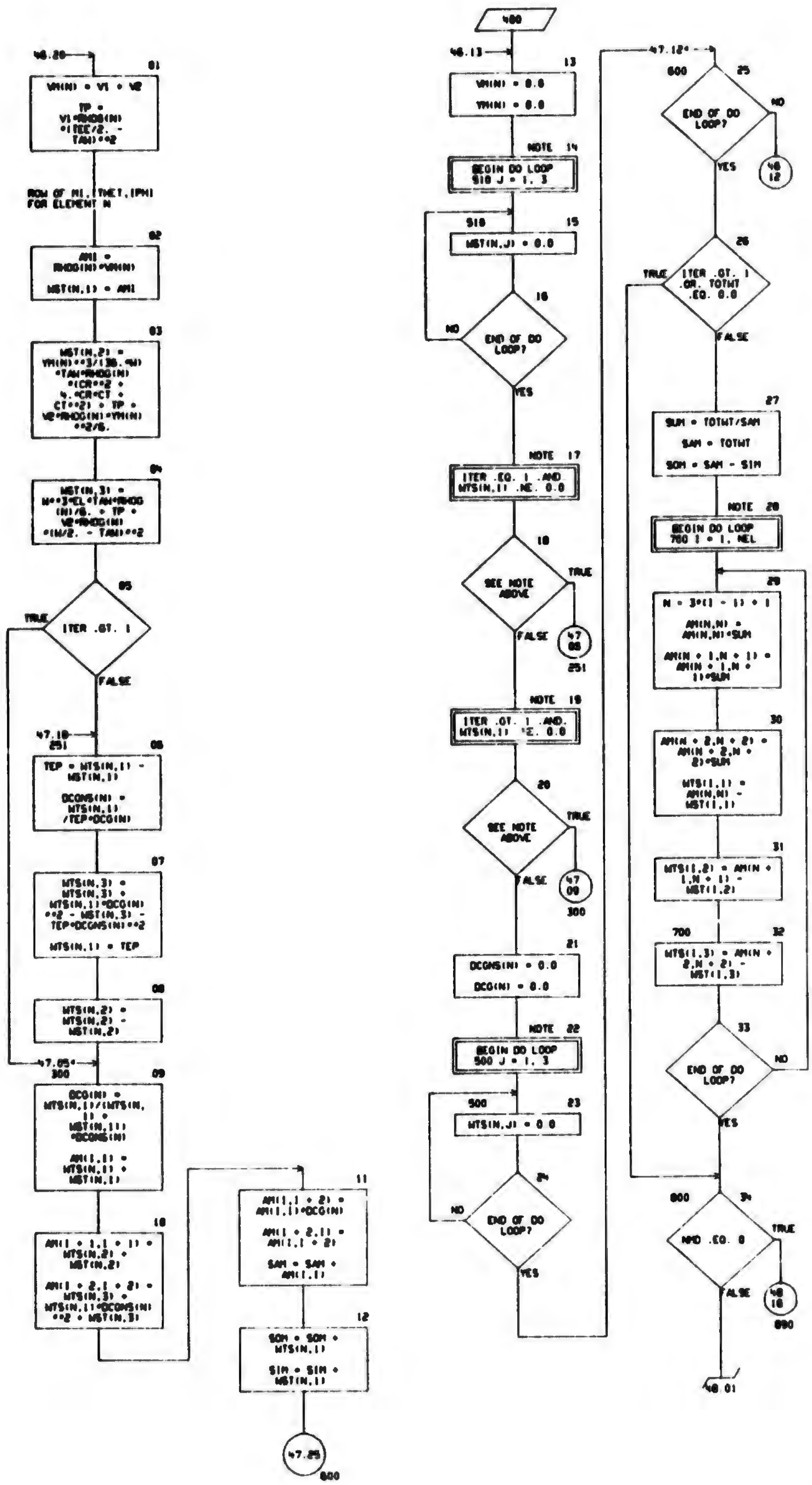


CHART TITLE - SUBROUTINE MASS

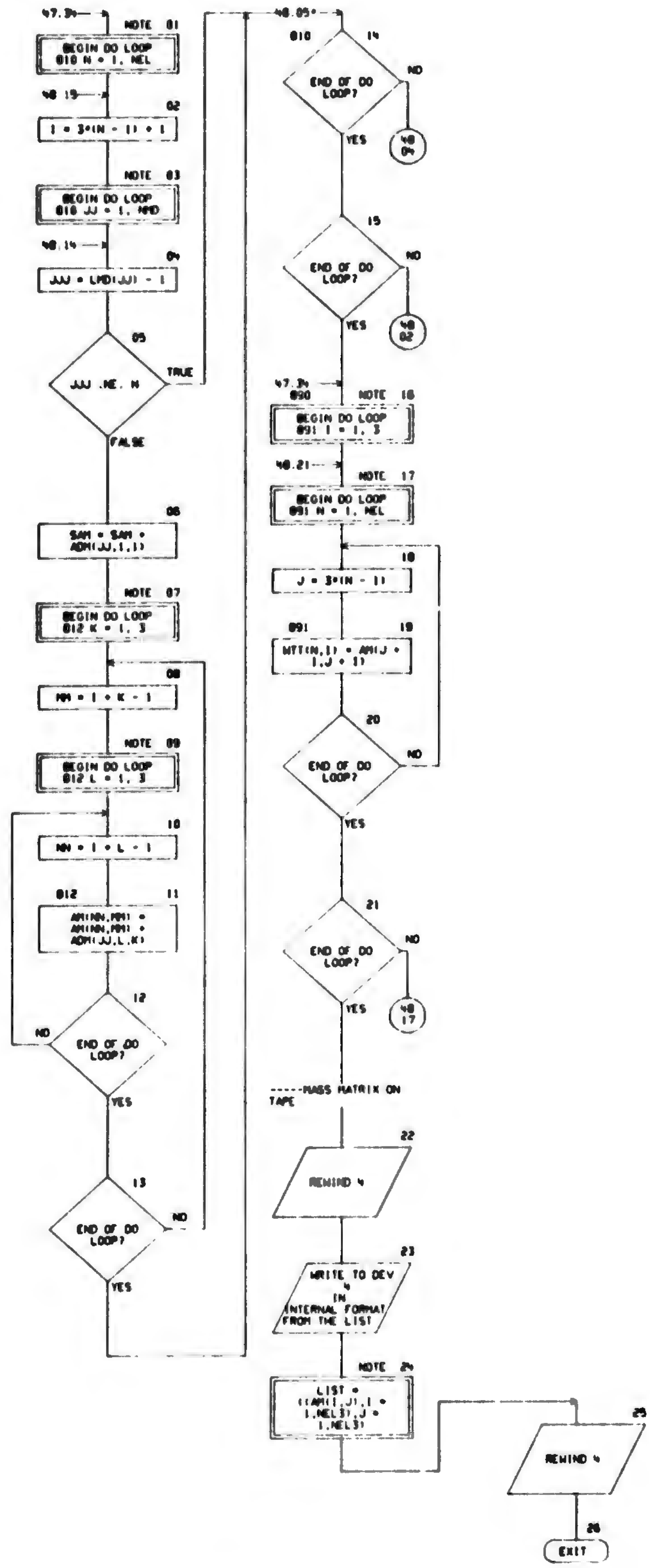


CHART TITLE - NON-PROCEDURAL STATEMENTS

```
          DIMENSION ZL(16)
          COMMON TCX(2940),TAU(16,15),E1(16),GJ(16),FREQ(45),CP,NCP,NEL,
          NMODE,ITER
          COMMON/BLOCK1/TITLE(7) AK(45,45),AM(45,45),F1(3,3,15),VM(15),
          EIDER(16),GJDER(16),T(16),Y(16),C(16),E,G,VRCF,NEL3,NITER
          COMMON/BLOCK3/WTS(15,3),DCO(15),YM(15),RHOM,NI1(16),NI2(16),ND1(16
          ),ND2(16),WST(15,3),SIM,SAM,SOM,DCONS(15),TOTWT,ADM(4,3,3),NMD,
          LMD(4),WTT(15,3),RHOO(15)
 9099     FORMAT( 42H0***ERROR*** CHECK BOX BOUNDARY INDICATOR ,I3,5H CARD)
```

CHART TITLE - SUBROUTINE MMULT(A,B,C,NI,NK,NJ,MA,MB,MC,IOO)

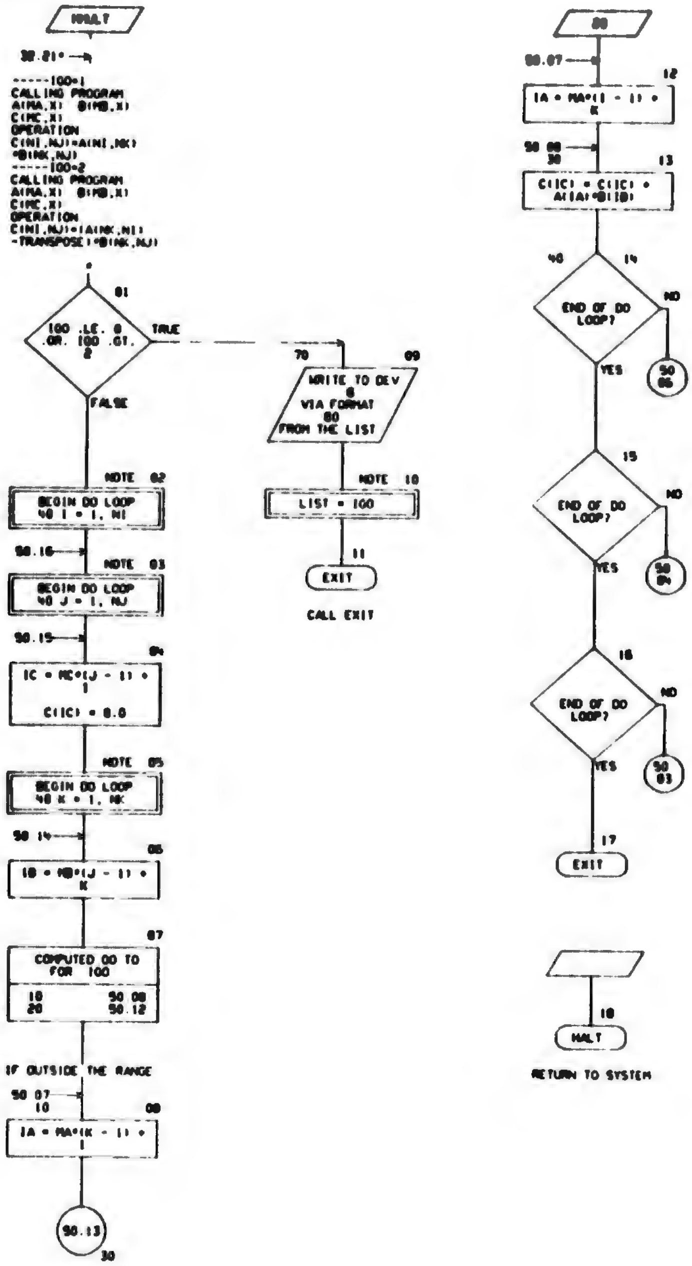


CHART TITLE - NON-PROCEDURAL STATEMENTS

```
          DIMENSION A(1),B(1),C(1)
    80    FORMAT (30H0 ERROR CODE FROM MMULT =          I0 )
```

CHART TITLE - SUBROUTINE WPRINT(A,M,N,MD,NWORD,TITLE)

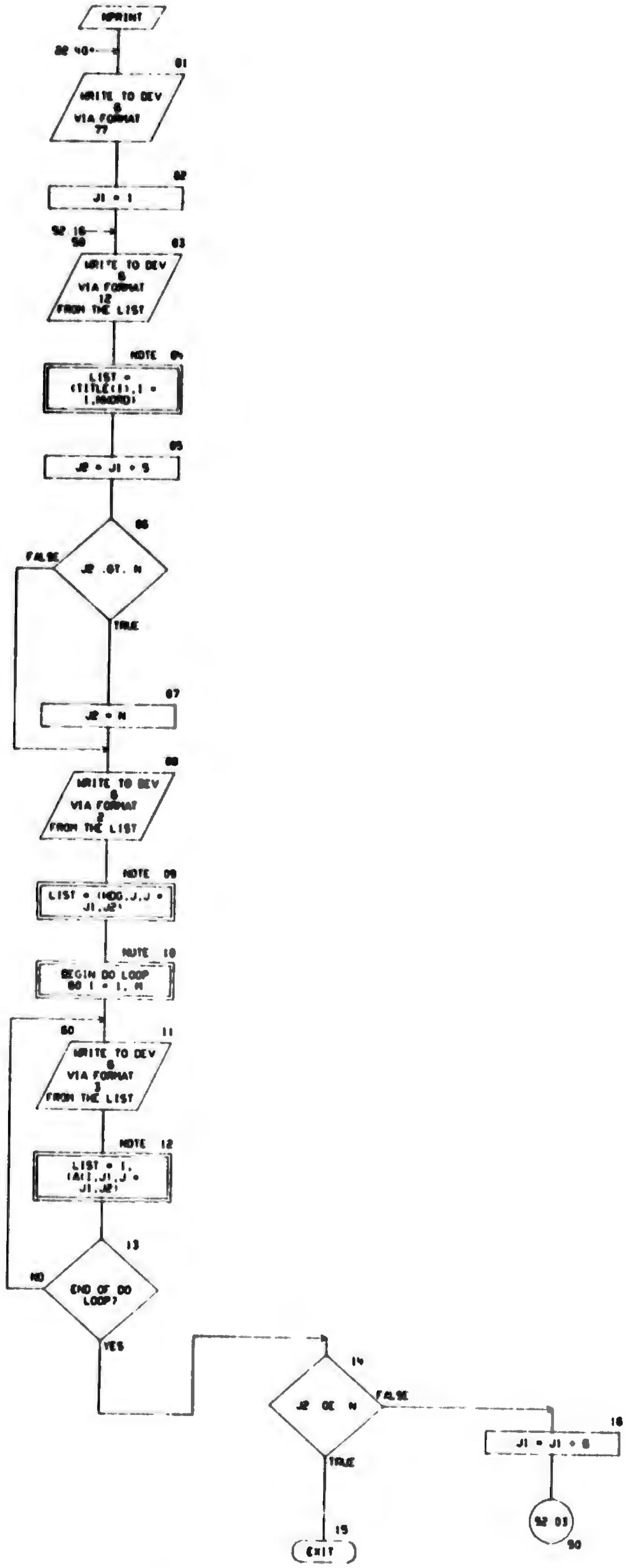


CHART TITLE - NON-PROCEDURAL STATEMENTS

```
          DIMENSION A(ND,N),TITLE(8)
          DATA HDG/8H COLUMN /
77        FORMAT(1H1)
12        FORMAT(8A10)
2         FORMAT(1H0,9X,6(A8,I4,5X))
3         FORMAT     (I5,8E17.7    )
```

CHART TITLE - SUBROUTINE OUTPUT

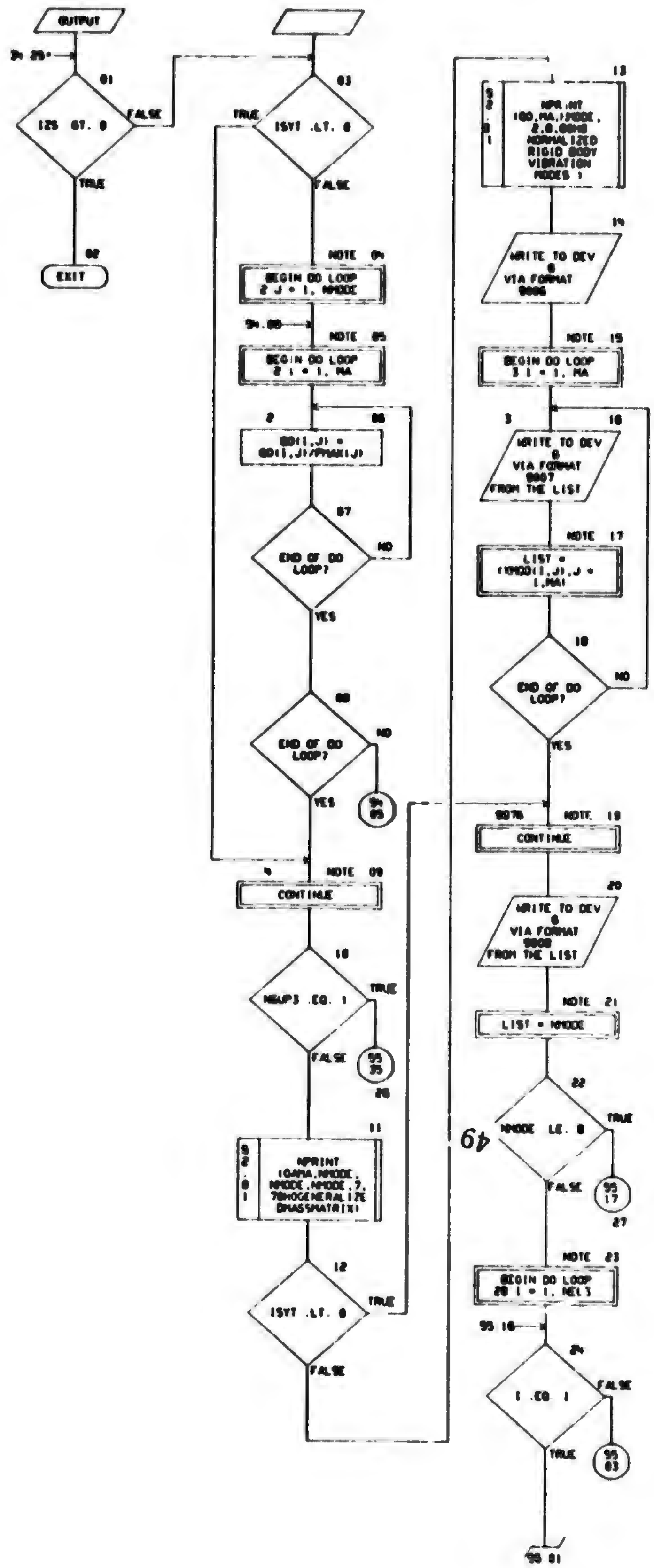


CHART TITLE - SUBROUTINE OUTPUT

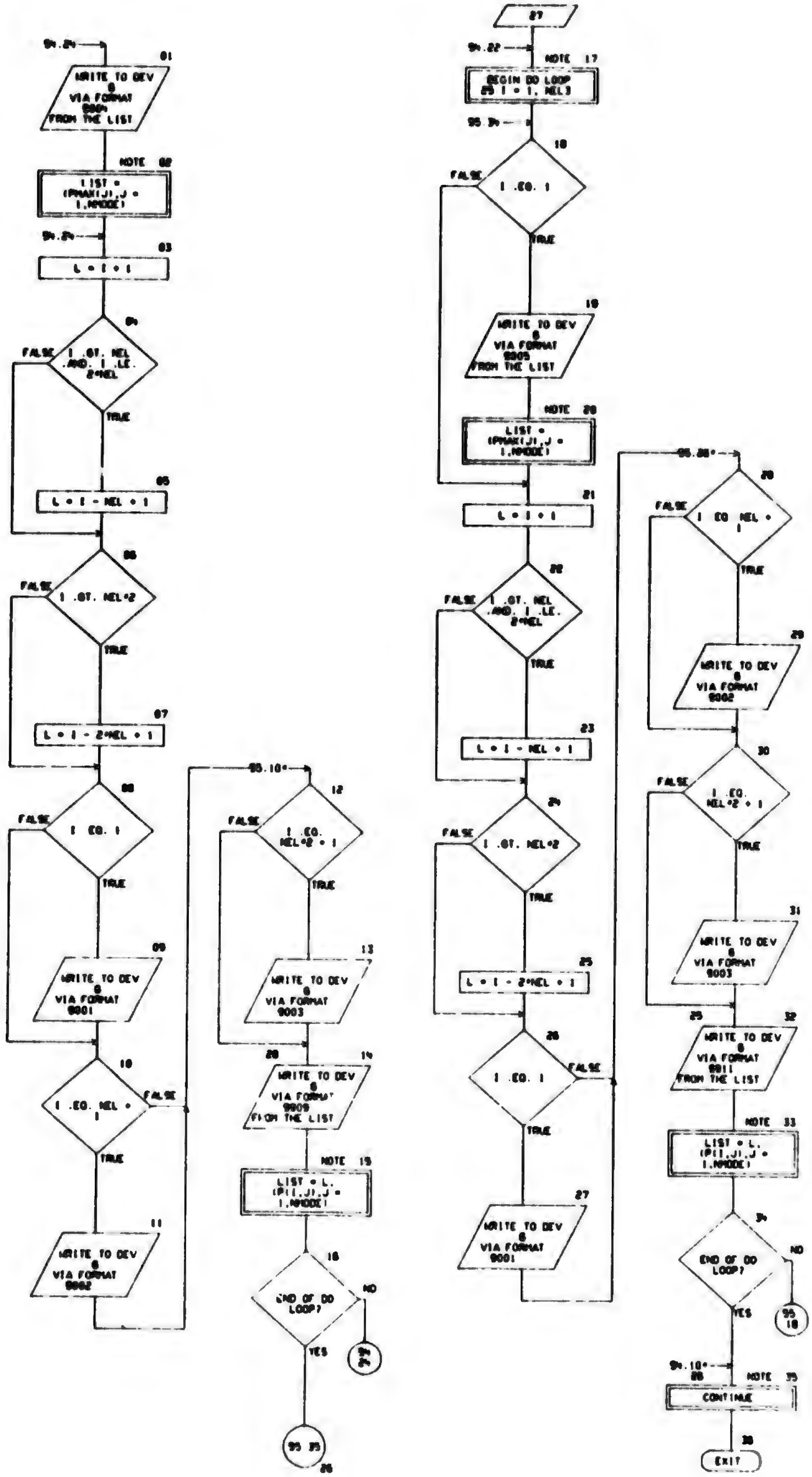


CHART TITLE - SUBROUTINE OUTPUT

```
WRITE(6,9198)
DO 42 I=1,NEL
L=I+1
42 WRITE(6,9194)
L,(WST(I,N),N=1,3)
WRITE(6,9190) SIM
WRITE(6,9198)
DO 43 I=1,NEL
L=I+1
43 WRITE(6,9201)
L,(WTS(I,N),N=1,3),
DCONS(I)
WRITE(6,9191) SOM
WRITE(6,9193)
WRITE(6,9195)
DO 300 I=1,NEL
L=I+1
300 WRITE(6,9201)
L,(WTT(I,N),N=1,3),
DCO(I)
WRITE(6,9191) SAM
9190
FORMAT(30X,
1H----------------,
/27X,E17.7)
9191
FORMAT(12X,
1H----------------,
/8X,E20.7)
9193
FORMAT(1H1,27X,
35HTOTAL WEIGHT DATA
AND MASS ADDITION )
9194
FORMAT(24X,I3,3E17.7)
9195 FORMAT(1H0,8H
STATION,5X,
10HWEIGHT(LB),7X,
15HIROLL(LB-IN**2),
4X,
16HIPITCHEA(LB-IN**
2),4X,13HDEA(IN)
(-FWD) /)
9196
FORMAT(1H1,37X,
22HSTRUCTURAL WEIGHT
DATA
//23X,7HSTATION,3X,
6HWT(L
B),8X,
15HIROLL(LB-IN**2),
1X,
16HIPITCHCO(LB-IN**2)
)
9198
FORMAT(1H1,35X,
26HNON-STRUCTURAL
WEIGHT DATA//9H
STATION,5X,6HWT(
(LB),11X,
15HIROLL(LB-IN**2),
4X,
16HIPITCHCO(LB-IN**2)
,4X,14HDEA(IN)
2(-FWD) / )
9201 FORMAT(1H
,I9,4E20.7)
RETURN
```

CHART TITLE - NON-PROCEDURAL STATEMENTS

```
      COMMON Z1(700 ),F(10,50),Q(10,50),V(10,50),IMIN(50),TAU(10,15),
     E1(10),GJ(10),FREQ(45),VFLTR,NCP,NEL,NMODE,ITER,IPNCH,FFLTR,
     XMOD(2,2),MA,XMO(2,2),QQ(2,10),ISYT,DD(45,2),DELY
      COMMON/BLOCK1/TITL(7),Z3(2025),Z2(2025),Z4(100),Y(10),Z5(10),VREF,
     NEL3,NITER,Z6(9),IFLX
      COMMON/BLOCK2/Z7(120),IZS,RHO,VMIN,VMAX,ICASE,NEWJOB,NSUP2,NSUP3,
     GAMA(100),P(45,10),PMAX(10)
      COMMON/BLOCK3/WTS(15,3),DCG(15),Z8(80 ),WST(15,3),SIM,SAM,SOM,
     DCONS(15),TOTWT,ADM(4,3,3),NMD,LMD(4),WTT(15,3)
9001  FORMAT(5H0 STA,30X,17HH (DEFLECTION-IN) / )
9002  FORMAT(5H0 STA,30X,18HHPRIME (SLOPE-RAD) / )
9003  FORMAT(5H0 STA,30X,17HALPHA (TWIST-RAD) / )
9004  FORMAT(3X,10E11.3)
9005  FORMAT(4X,8E13.4)
9006  FORMAT(1H0,///42X,22HRIGID BODY MASS MATRIX/)
9007  FORMAT(30X,2E17.7)
9008  FORMAT(1H1,30X,44HMASS SCALE FACTORS - VIBRATION MODE PRINTOUT //
     41X,23HMODE NUMBERS I---------, I2/ )
9009  FORMAT(1H ,I2,10E11.3)
9011  FORMAT(1H ,I3,8E13.4)
```

CHART TITLE - SUBROUTINE RMULC(A,B,C,NI,NK,NJ,MA,MB,MC,IOO)

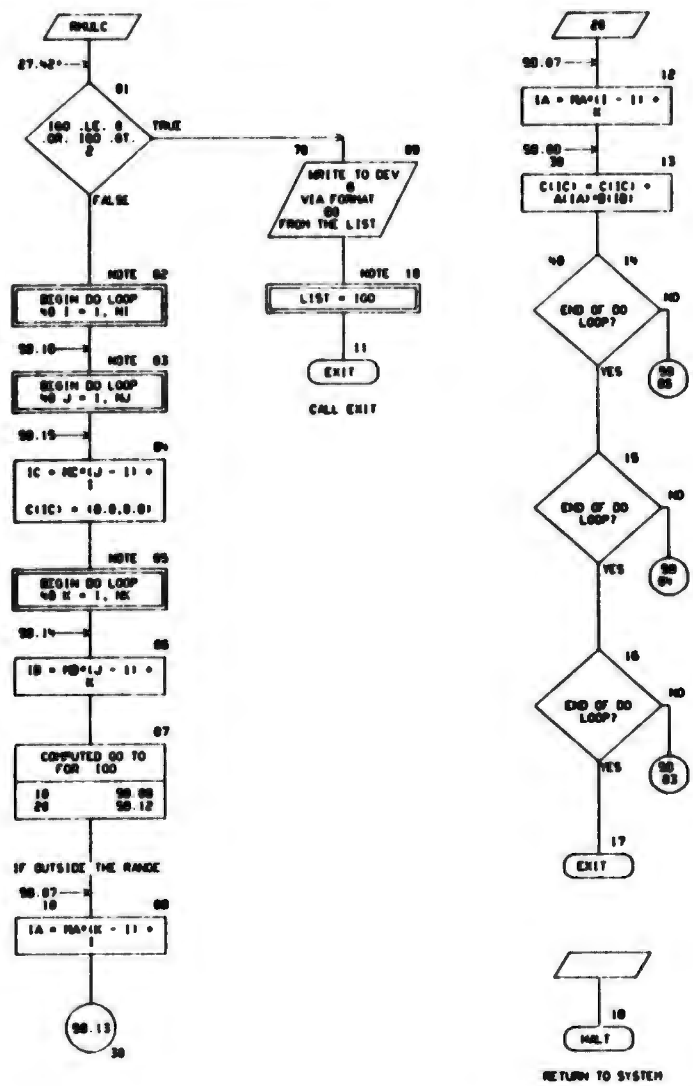


CHART TITLE - NON-PROCEDURAL STATEMENTS

```
          DIMENSION A(1),B(1),C(1)
          COMPLEX B,C
   80     FORMAT (30H0 ERROR CODE FROM MULT =          I8 )
```

CHART TITLE - SUBROUTINE ROOTS(A,ROOT,D,NMT,MAX,NC,NERR)

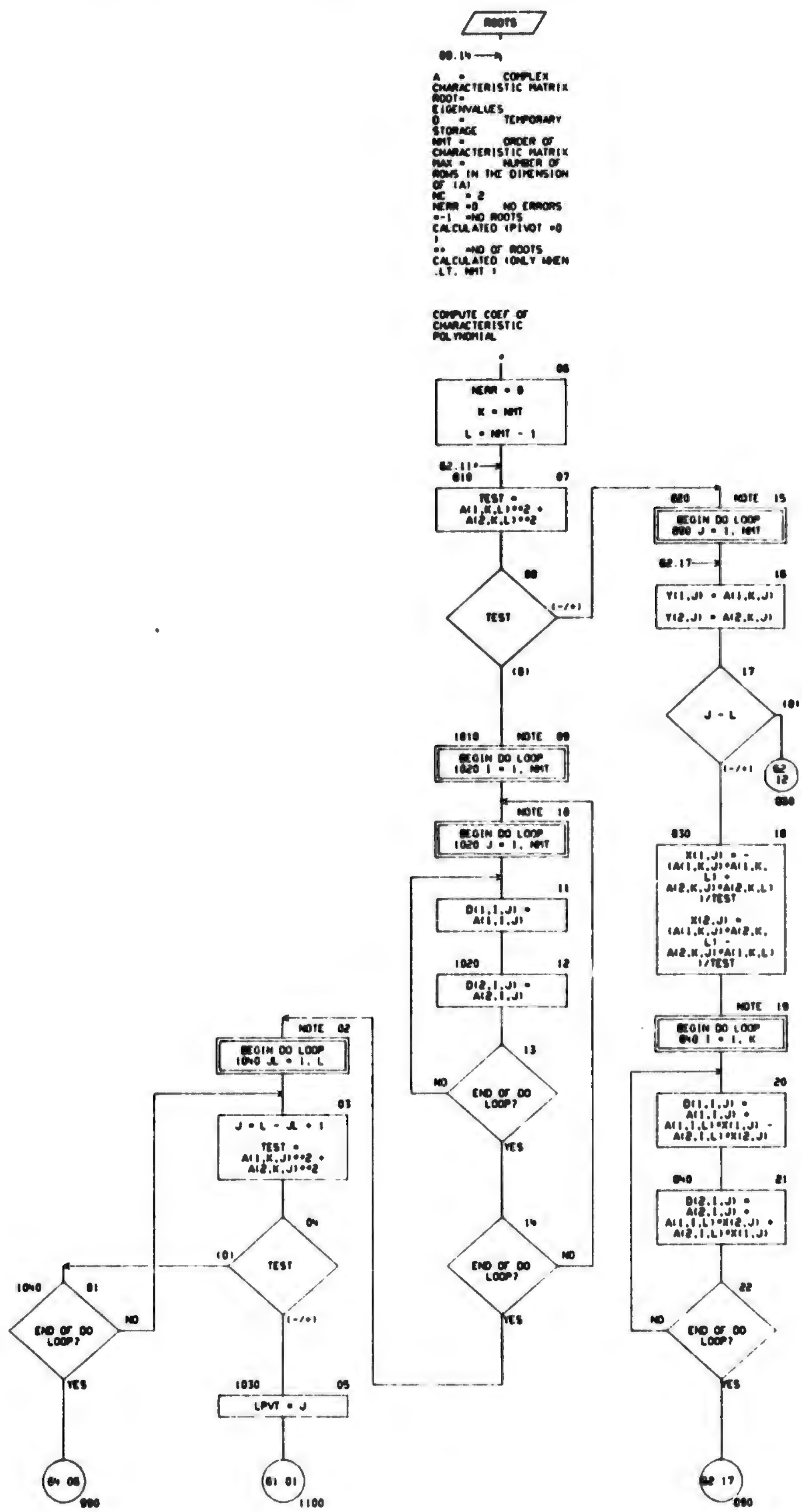


CHART TITLE - SUBROUTINE ROOTS(A,ROOT,D,NMT,MAX,NC,NERR)

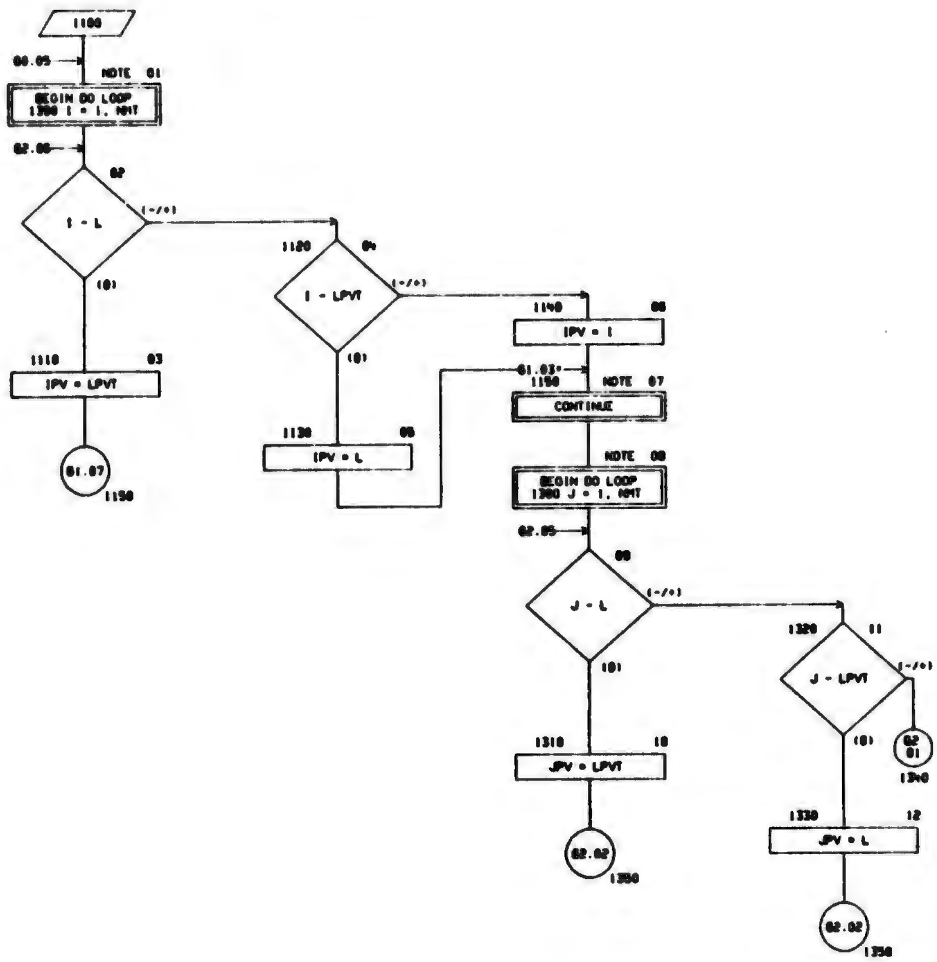


CHART TITLE - SUBROUTINE ROOTS(A,ROOT,D,NMT,MAX,NC,NERR)

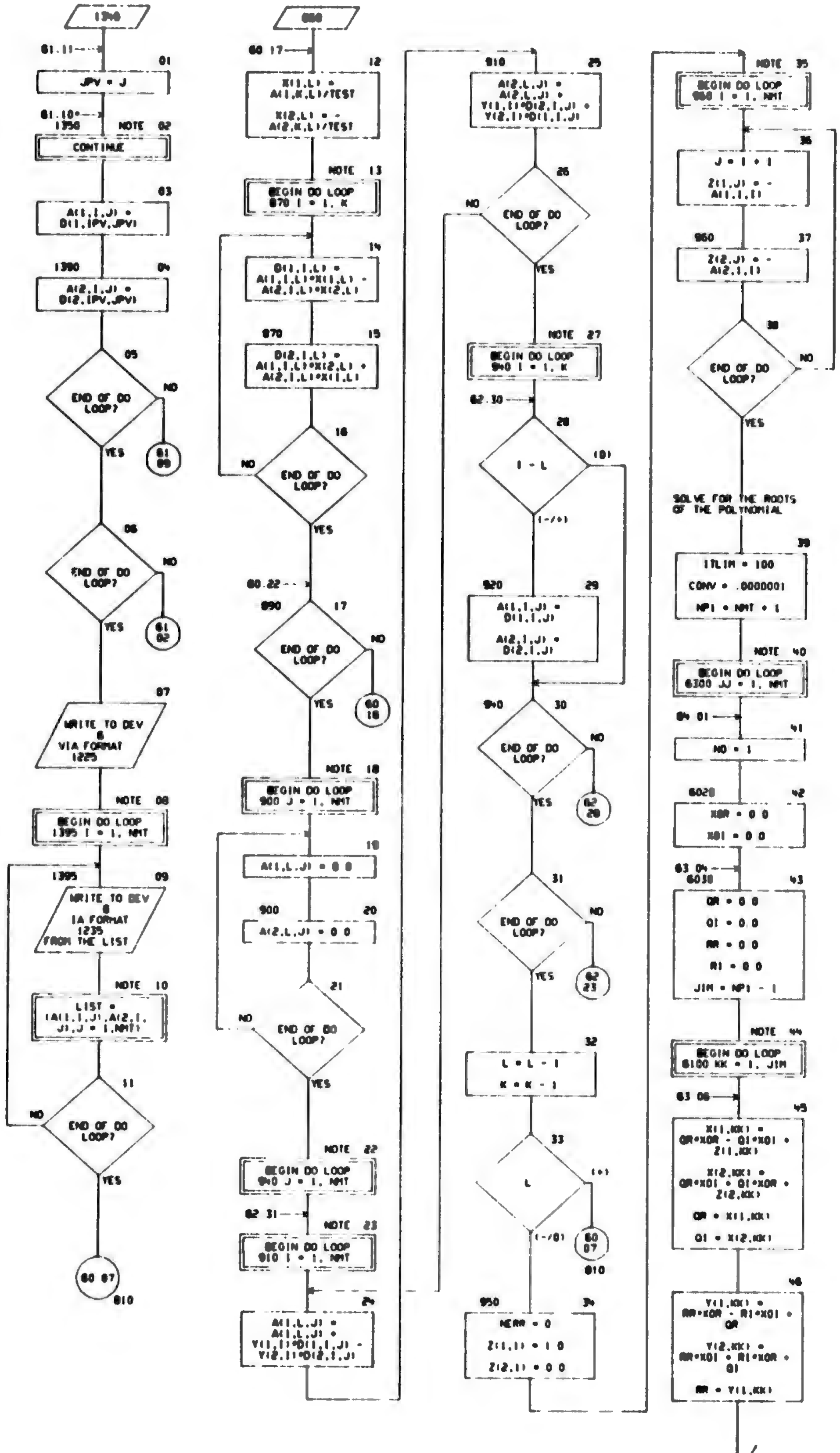


CHART TITLE - SUBROUTINE ROOTS(A,ROOT,D,NMT,MAX,NC,NERR)

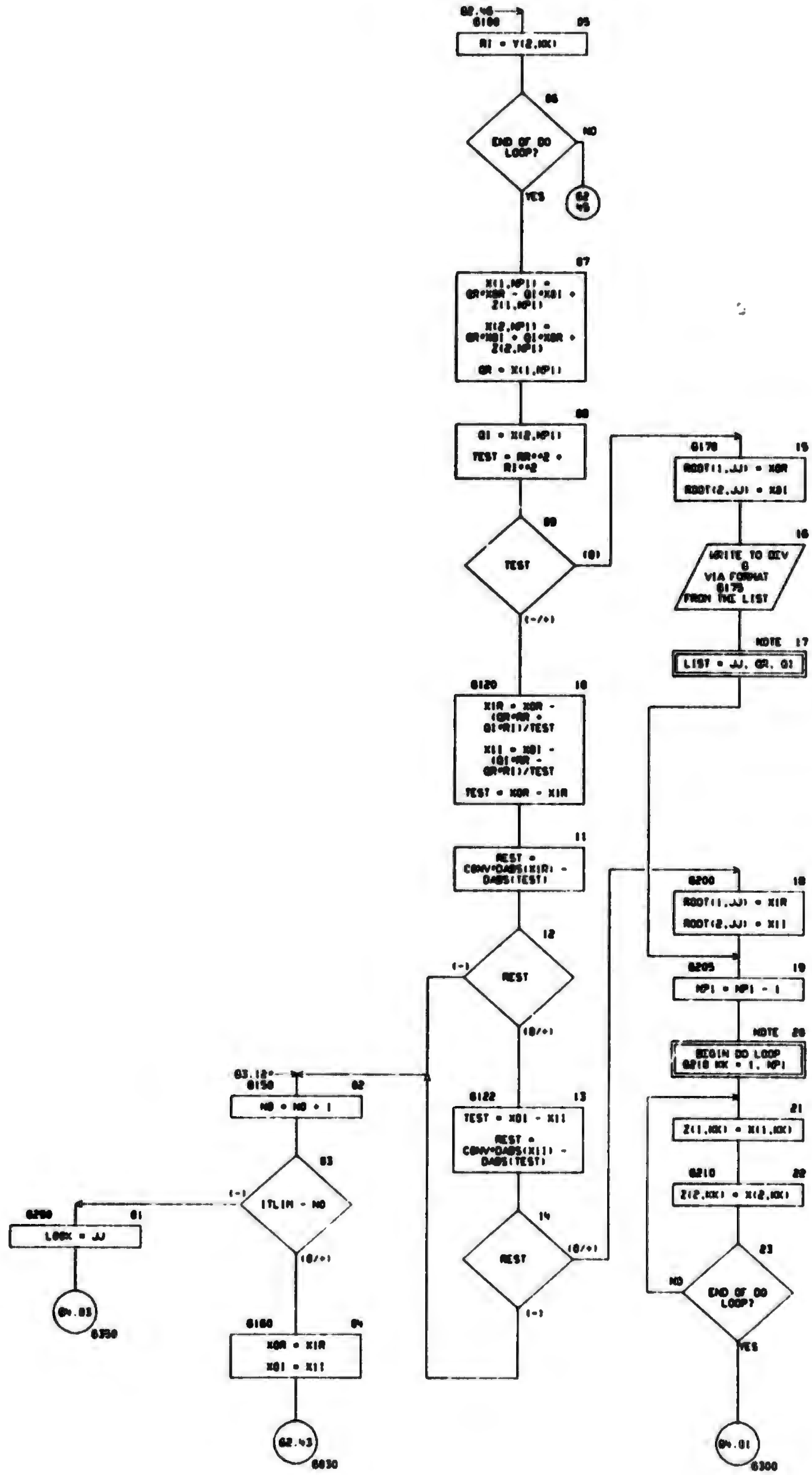


CHART TITLE - SUBROUTINE ROOTS(A,ROOT,D,NMT,MAX,NC,NERR)

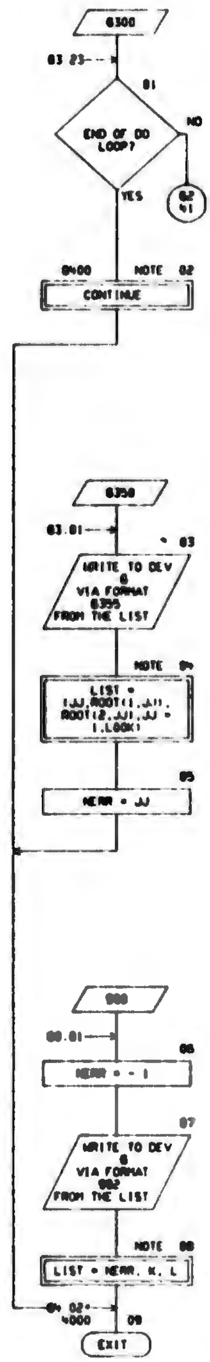


CHART TITLE - NON-PROCEDURAL STATEMENTS

```
          DIMENSION  A(NC,MAX,NMT) ,D(NC,NMT,NMT)  ROOT(NC,NMT),
                   X(2,20) ,Y(2,20) ,Z(2,20)
          DOUBLE PRECISION XOR, XOI, QR, QI, RR, RI, SS, TT, TEST, XIR, XII,
                   REST, CONV        , X, Y, Z, A, D
 1205     FORMAT (30H) REARRANGED CHARACTERISTIC MATRIX          )
 1235     FORMAT(1H0 / 10E17.8))
 6175     FORMAT(60H1  DIVISOR = 0 0  LOOK AT REMAINDER TERM  IF NEAR 0 0
           ALL O.K.        / (1 6.2E17 8))
 6395     FORMAT(45H1EIGENVALUES SOME MISSING--MAX ITER  EXCEDED
             / (16.2E 17.8))
 902      FORMAT(22H) PIVOT EQUALS ZERO        / (3I12 ))
```

CHART TITLE - SUBROUTINE SEES(T,N,M,V,RT,K1)

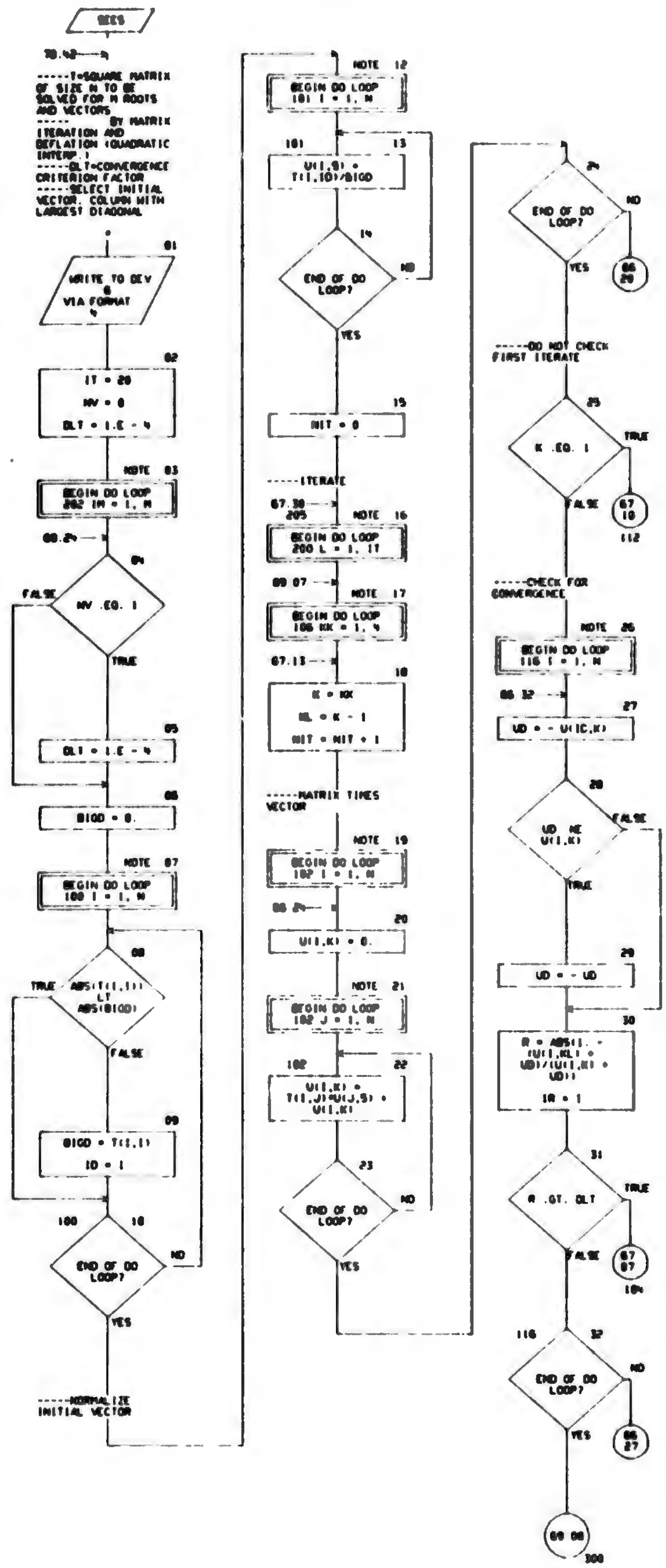


CHART TITLE - SUBROUTINE SEESIT,N,M,V,RT,K)

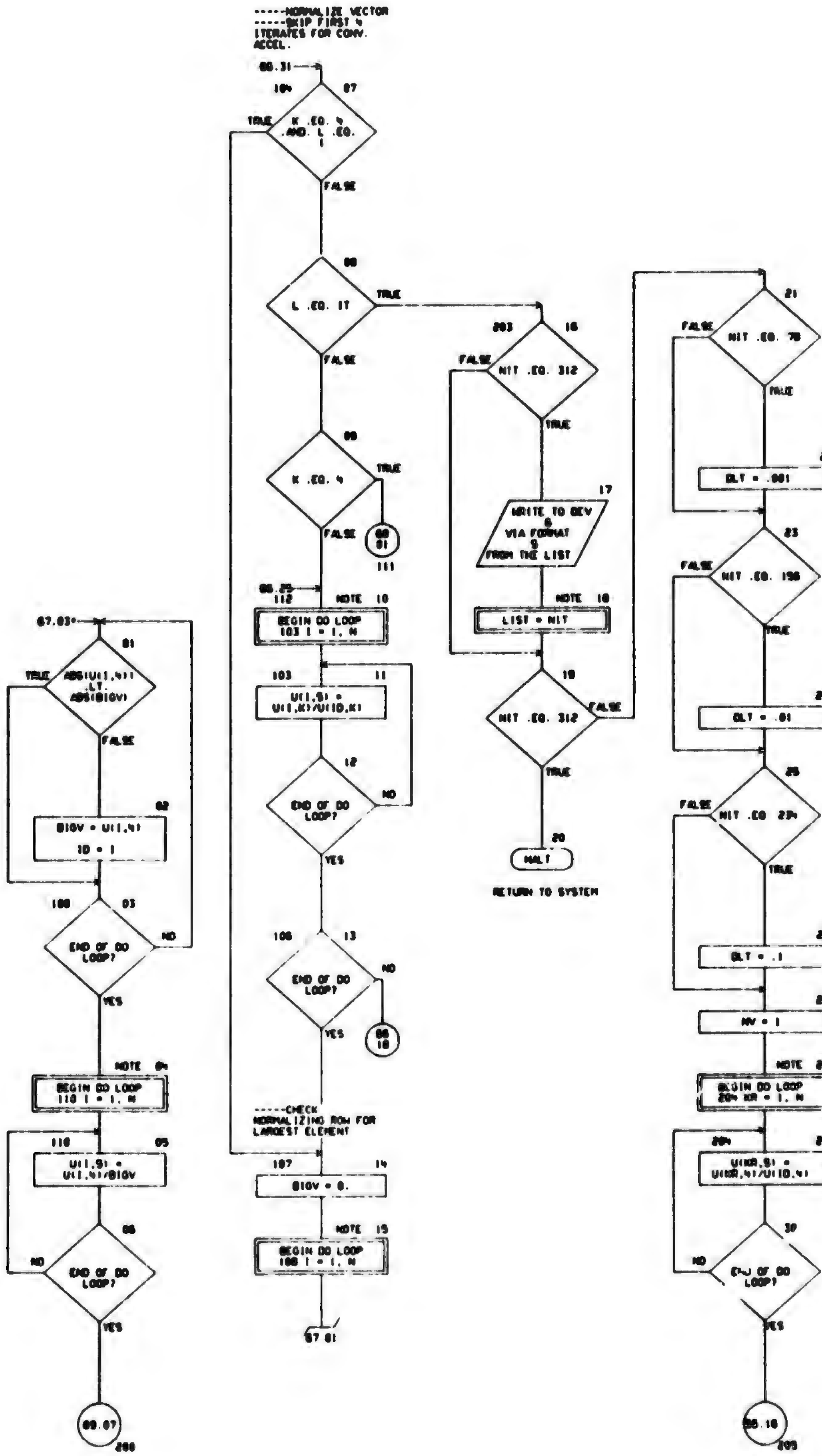


CHART TITLE - SUBROUTINE SEES(T,N,M,V,RT,K1)

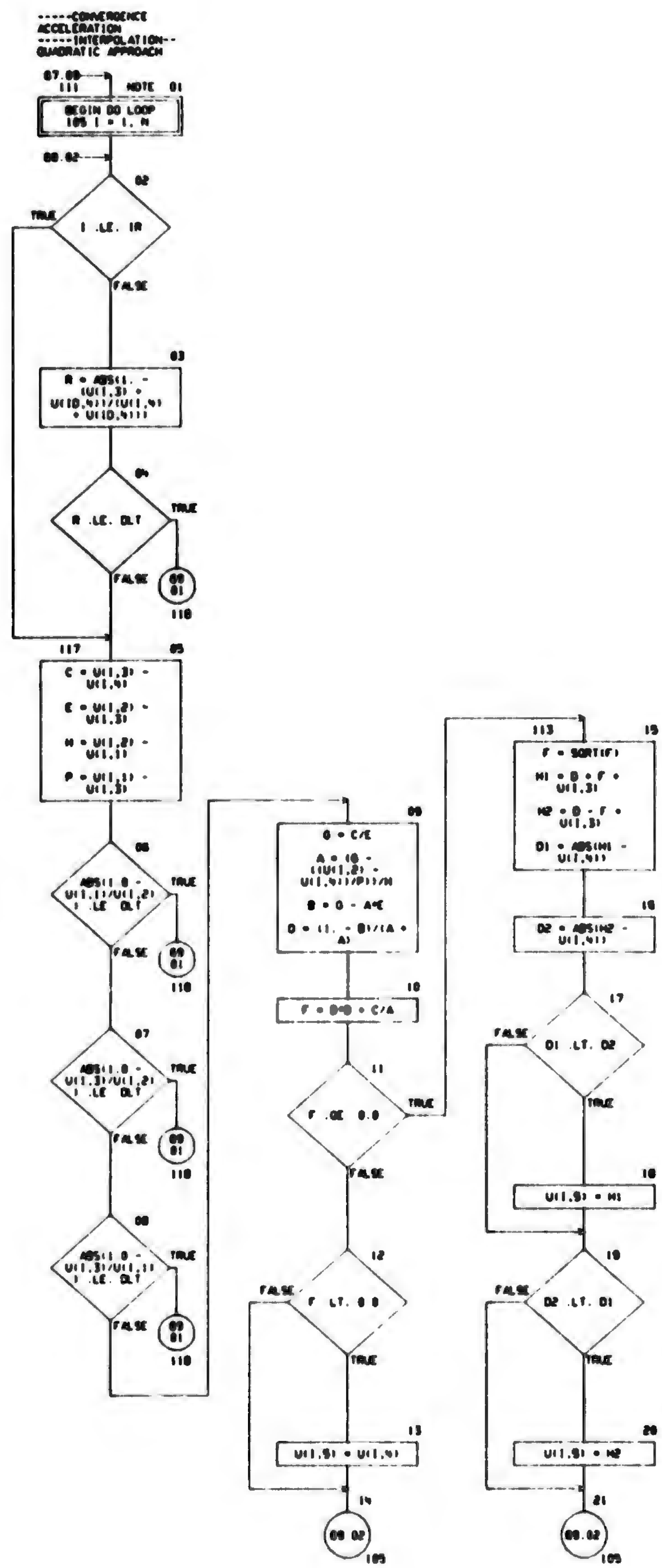


CHART TITLE - SUBROUTINE SEES(T,N,M,V,RT,K))

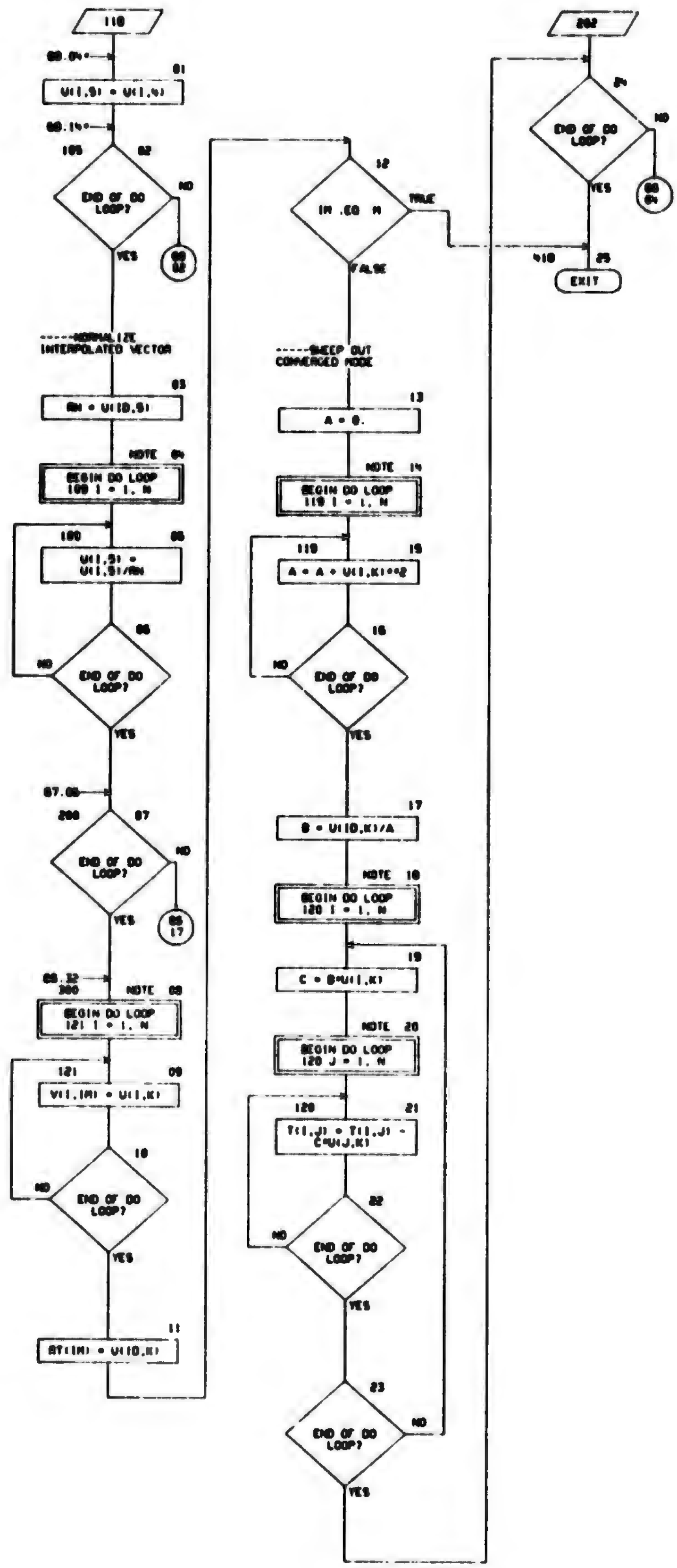
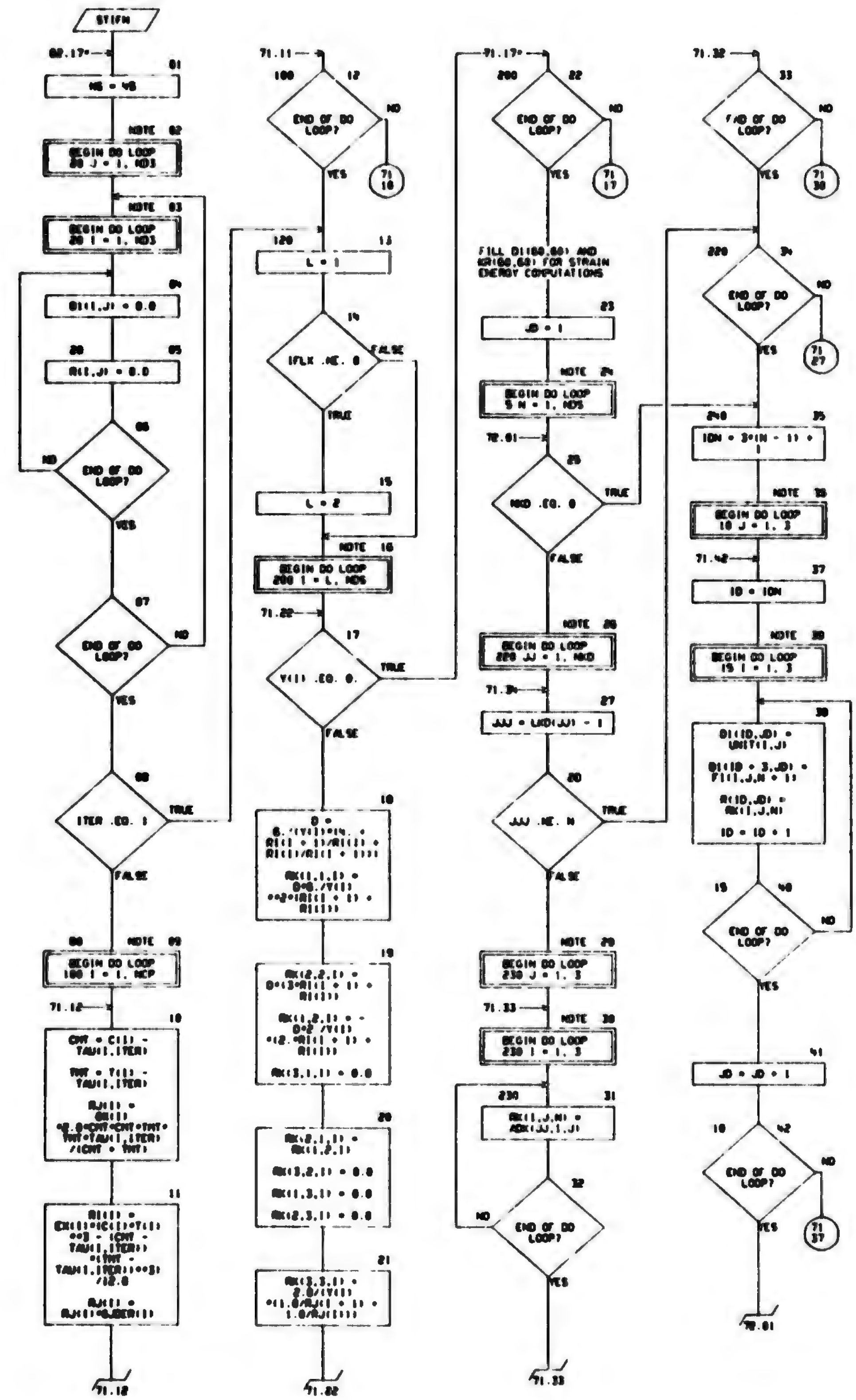


CHART TITLE - NON-PROCEDURAL STATEMENTS

```
      DIMENSION T(K1,1),U(45,5),V(K1,1),RT(1)
4     FORMAT(1H1)
5     FORMAT(40H NOT CONVERGED FOR MAXIMUM OF ITERATIONS, 14)
```

CHART TITLE - SUBROUTINE STIFN



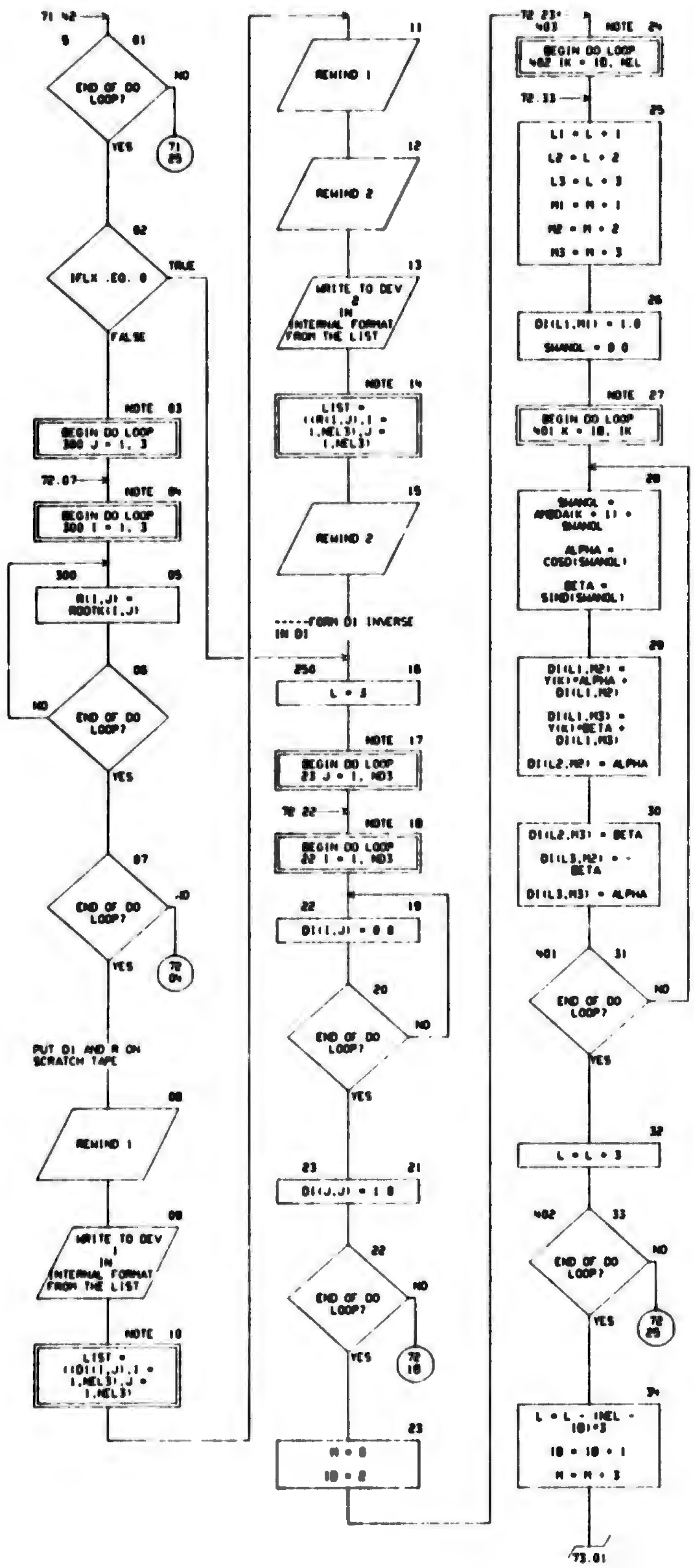


CHART TITLE - SUBROUTINE STIFN

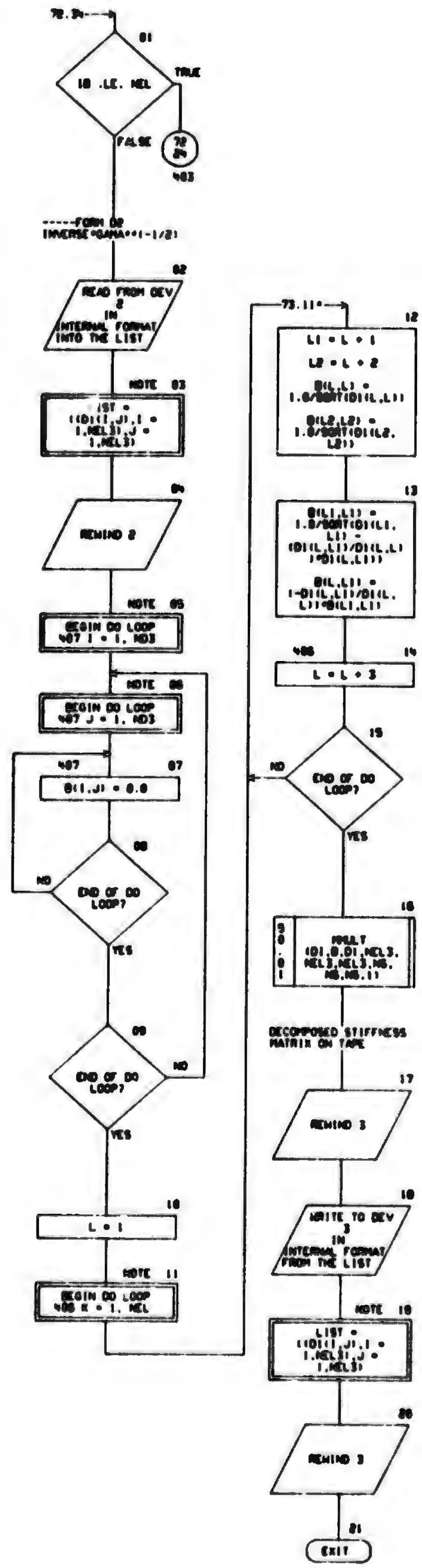


CHART TITLE - NON-PROCEDURAL STATEMENTS

```
DIMENSION RK(3,3,15),DI(45,45),B(45,45),UNIT(3,3)
COMMON TCX(2340),TAU(16,15),RI(16),RJ(16),FREQ(45),CP,NCP,NDS,
NMODE,ITER
COMMON/BLOCK1/TITLE(7),DI(45,45),R(45,45),F(3,3,15),VM(15),
EIDER(16),GJDER(16),T(16),Y(16),C(16),E,G,VREF,ND3,NITER,ROOTK(3,3
),IFLX,ADK(4,3,3),NKD,LKD(4),EX(16),GX(16)
COMMON /BLOCK2/ AMBDA(21)
EQUIVALENCE(B(1),TCX(1)),(NEL,NDS),(NEL3,ND3)
EQUIVALENCE (DI(1,1),R(1,1))
DATA UNIT/1.0,3*0.0,1.0,3*0.0,1.0/
```

CHART TITLE - SUBROUTINE STRNTH

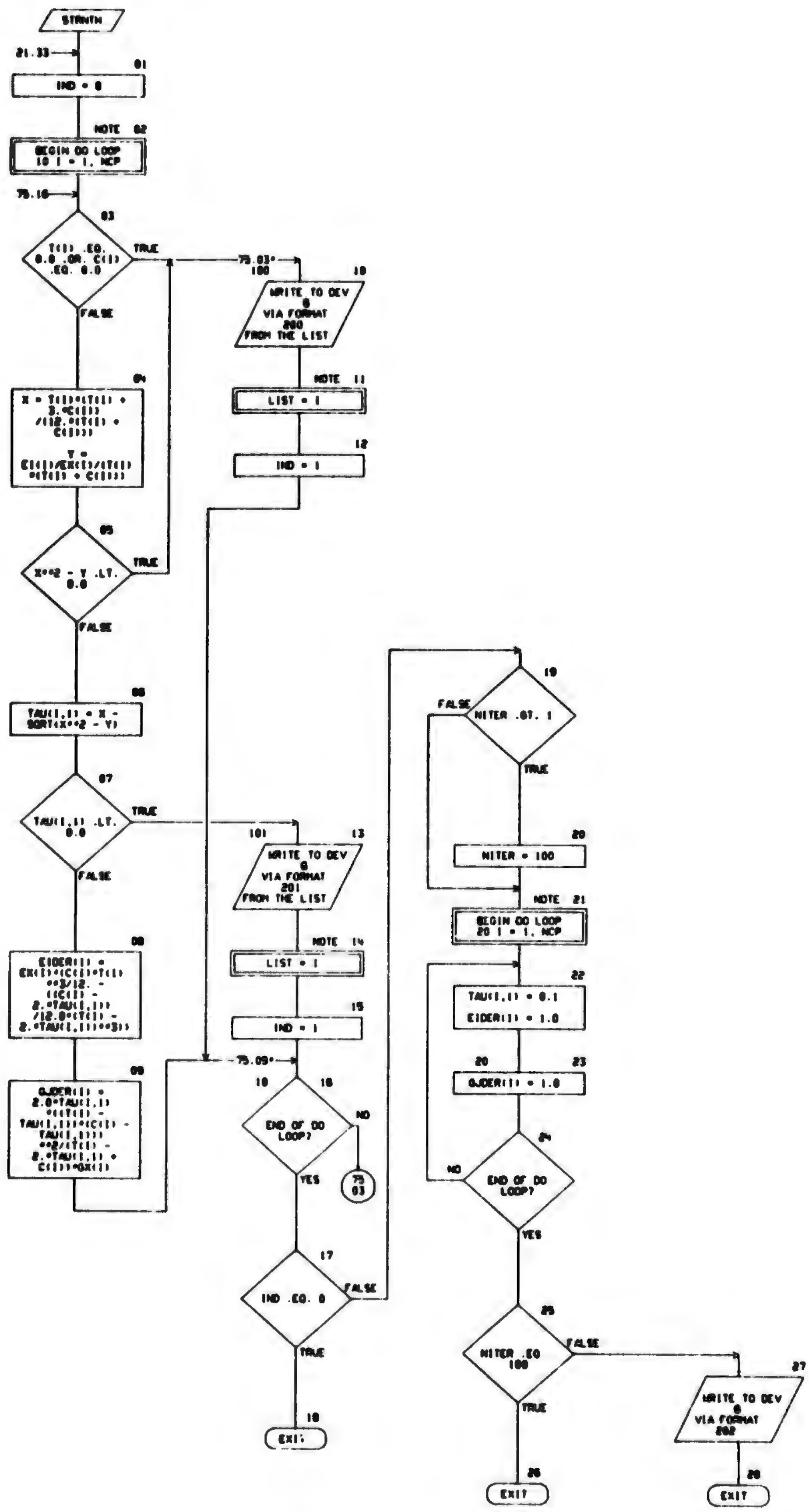


CHART TITLE - NON-PROCEDURAL STATEMENTS

```
      COMMON TCX(2340),TAU(16,15),EI(16),GJ(16),FREQ(45),CP,NCP,NEL,
      NMODE,ITER
      COMMON/BLOCK1/TITLE(7),AK(45,45),AM(45,45),F(3,3,15),WM(15),
      EIDER(16),GJDER(16),T(16),B(16),C(16),E,G,VREF,NEL3,NITER ,Z(15)),
      EX(16),GX(16)
200   FORMAT(1H0,13   8HTHE EI FOR STATION, 13,60H GIVES AN IMAGINARY RE
      SULT FOR TAU. EXECUTION IS TERMINATED. /31X,46HEITHER DECREASE EI,
       INCREASE C, OR INCREASE T. )
201   FORMAT(1H0,14X,18HTHE EI FOR STATION,13,58H GIVES A NEGATIVE RESUL
      T FOR TAU. EXECUTION IS TERMINATED. /31X,46HEITHER INCREASE EI, DE
      CREASE C, OR DECREASE T. )
202   FORMAT(1H0/23X,63HSINCE NO ITERATION HAS REQUESTED, EXECUTION WILL
       NOT TERMINATE. )
```

CHART TITLE - SUBROUTINE VIBRN

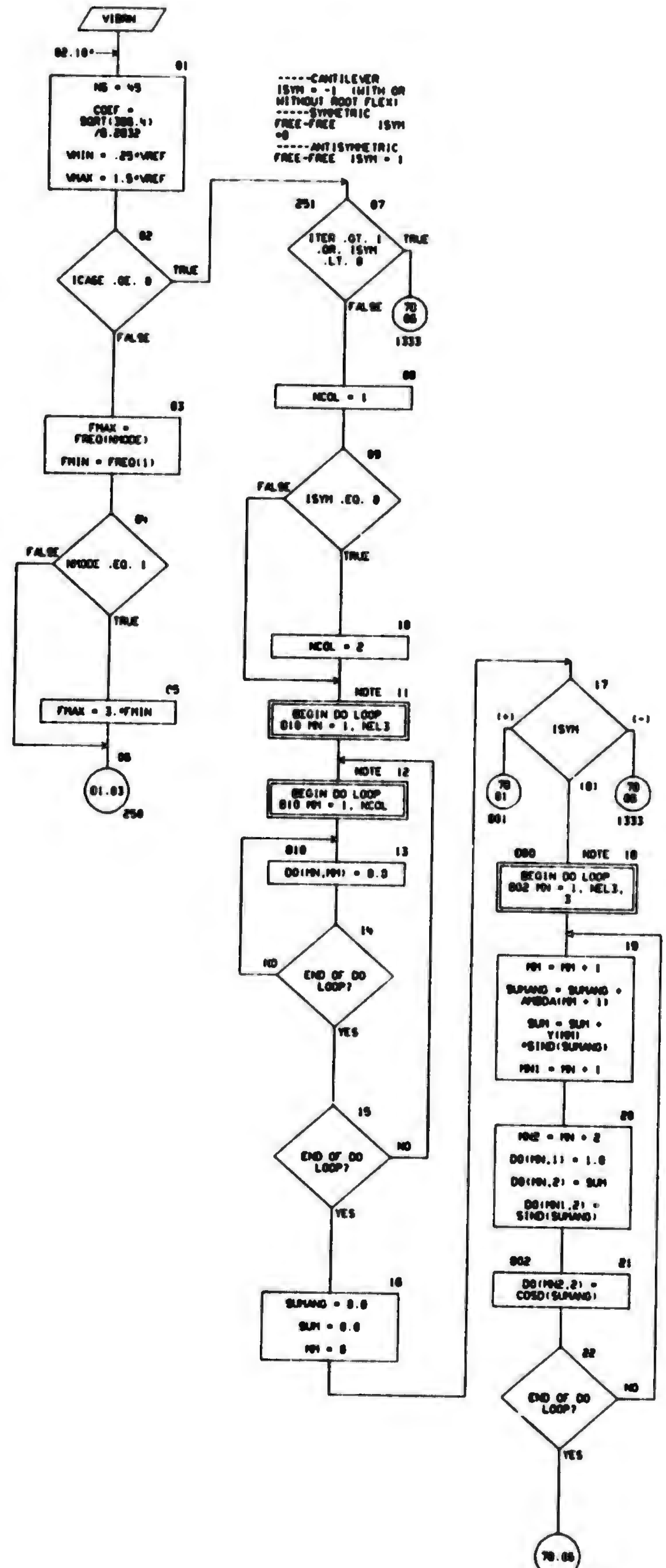


CHART TITLE - SUBROUTINE VIBRN

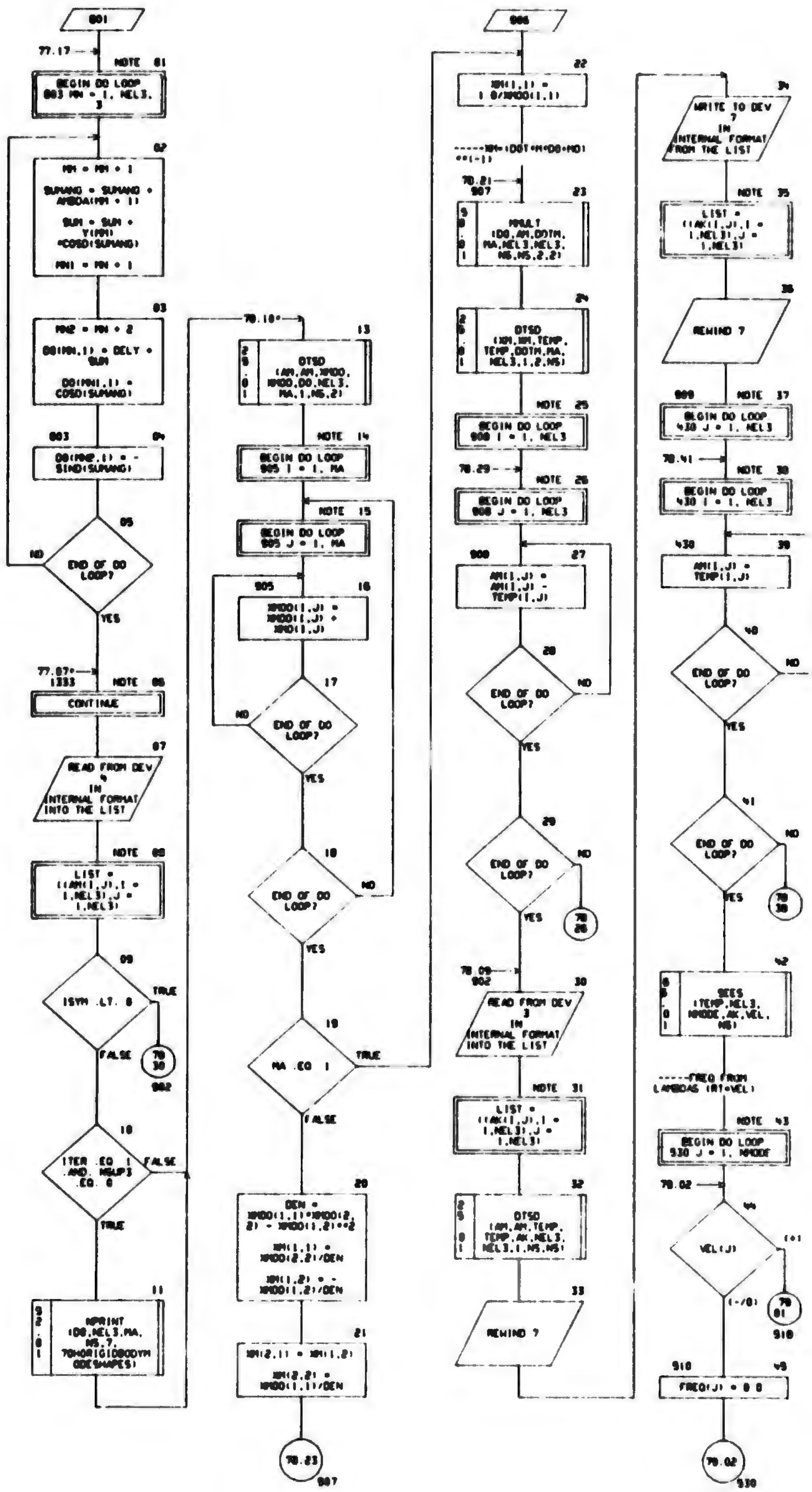


CHART TITLE - SUBROUTINE VIBRN

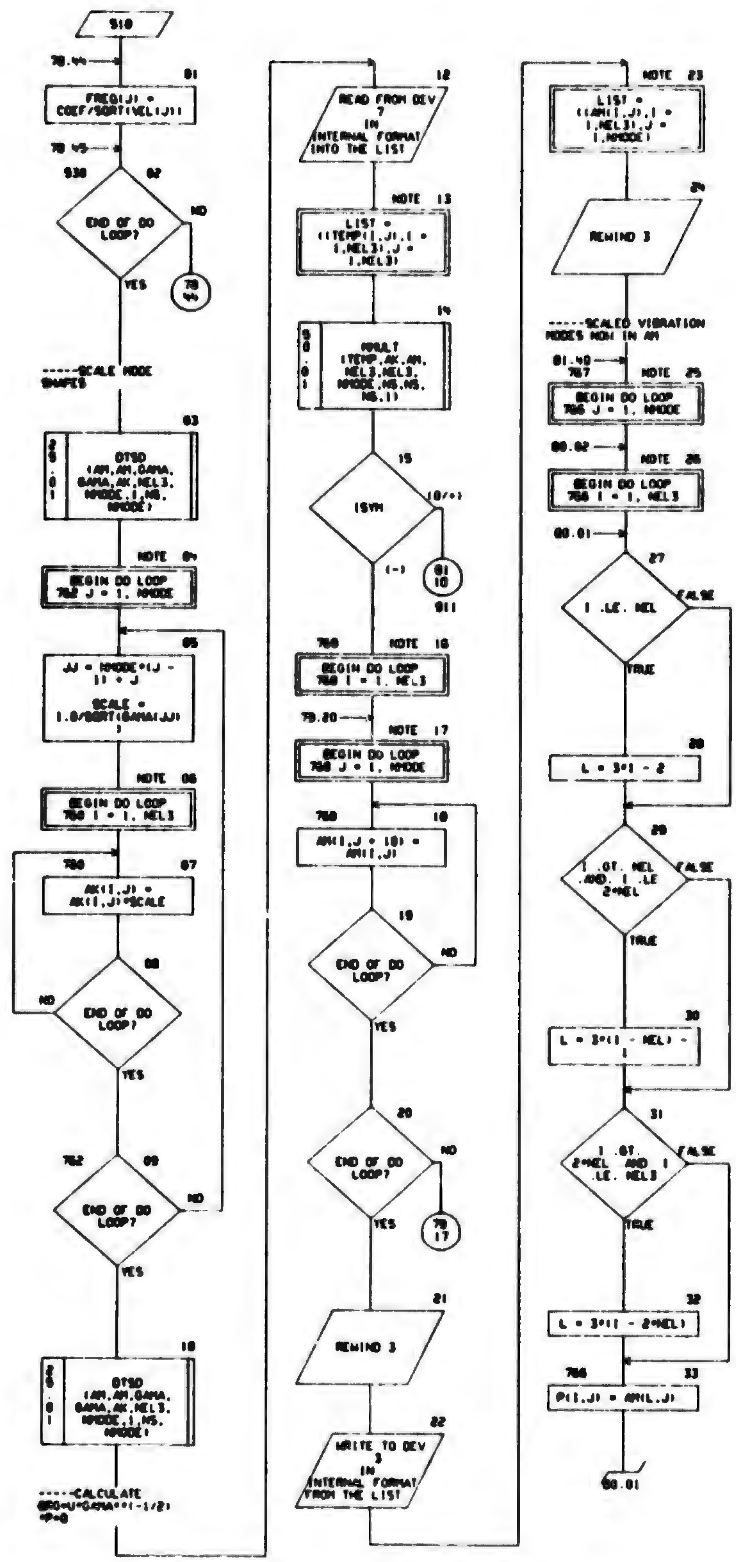


CHART TITLE - SUBROUTINE VIBRN

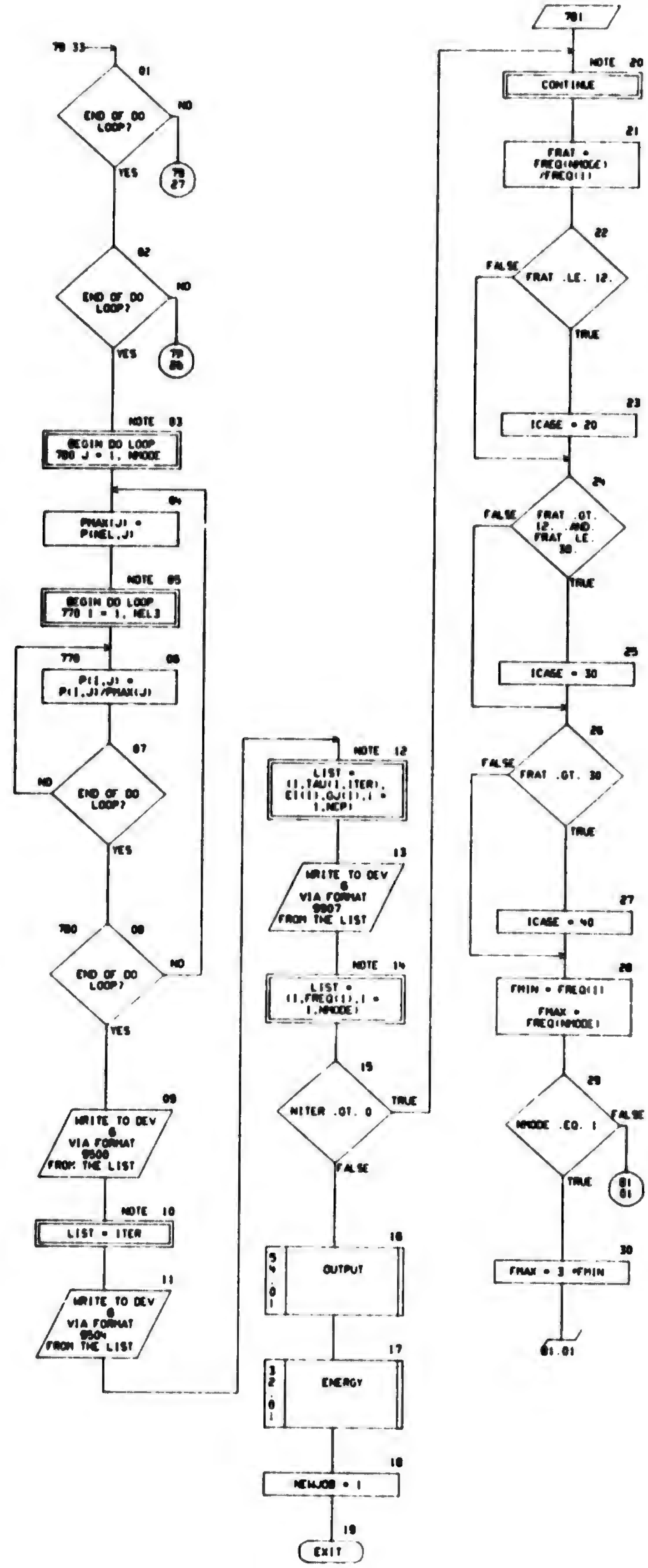


CHART TITLE - SUBROUTINE VIBRN

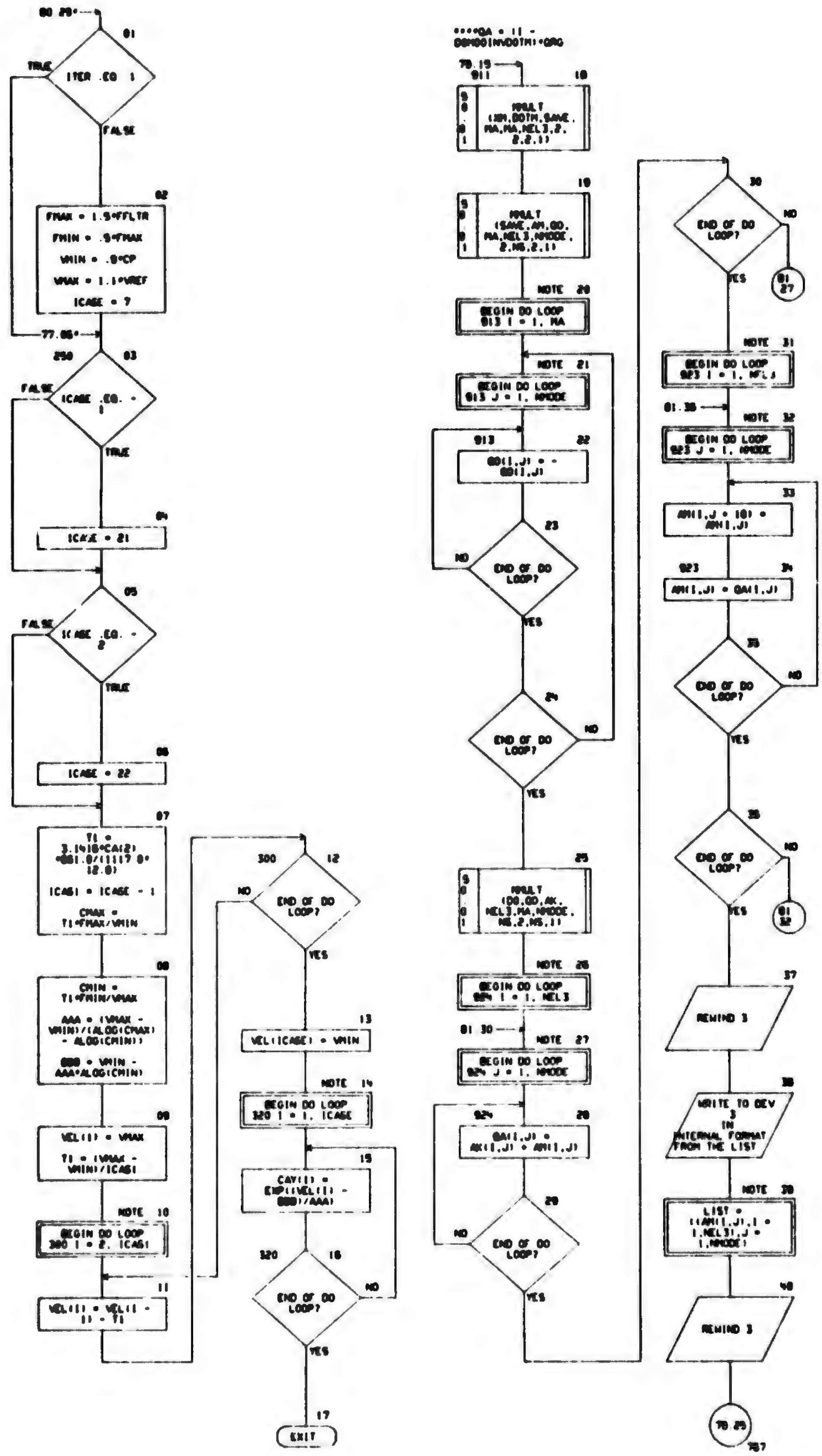


CHART TITLE - NON-PROCEDURAL STATEMENTS

```
          DIMENSION VEL(50),TEMP(45,45)
          DIMENSION XM(2,2),DOTM(2,60),SAVE(2,60),         QOTMD(10,10),
          QATMD(10,10),QENM(10,10),QA(45,10)
          COMMON TCX(2340),TAU(16,15),EI(16),GJ(16),FREQ(45),CP,NCP,NEL,
          NMODE,ITER,IPNCH,FFLTR,NMOD(2,2),MA,NMD(2,2),QD(2,10),ISYM,
          QD(45,2),DELT
          COMMON/BLOCK1/TITLE(7),AK(45,45),AM(45,45),F(3,3,15),VM(15),
          EIDER(16),GJDER(16),T(16),Y(16),C(16),E,G,VREF,NEL3,NITER
          COMMON/BLOCK2/AMBDA(16),D2(16),CLA(16),CA(16),YA(15),CAY(50),CAM,
          RHO,VMIN,VMAX,ICASE,NEWJOB,NSUP2,NSUP3,GAMA(100),P(45,10),PMAX(10)
          EQUIVALENCE  (CAY(1),VEL(1)),(TEMP(1),TCX(1))
9500      FORMAT(1H ,38X,25H*******COMMENCE ITERATION,I3,7H******* )
9504      FORMAT(1H0//21X,7HSTATION,12X, 7H  TAU  ,10X,12HEI(LB-IN**2), 8X,
          12HGJ(LB-IN**2) //(I25,4X,3E20.7))
9507      FORMAT(1H0/40X,28H*****VIBRATION ANALYSIS***** //43X, 21HMODE  FRE
          QUENCY (HZ.) //(43X,I3,F12.3))
```

CHART TITLE - FUNCTION SIND(X)

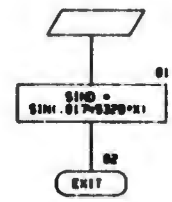
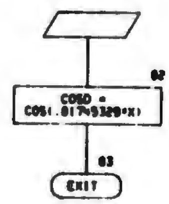


CHART TITLE - FUNCTION COSD(X)



END OF AUTOFLOW CHART SET   8,161 INPUT STATEMENTS PROCESSED   EXECUTION TIME -   3 MIN 55 SEC

Section IV

PROGRAM USAGE

INPUT DATA

The required input data for the structural optimization program (STROP) is described in detail in Table 2. The input data cards are itemized in terms of sequence, occurrence, quantity, format, description, and applicable units. Section II provides definitions of the terminology used in the chart and also contains explanations to guide the user.

Punched output cards from SWEEP can be used for input card types 2, 4, 5, 6, 7, 8, 11, and 12. These card types may also be provided manually. The remaining card types 1, 3, 9, and 10 must be provided manually.

OUTPUT DATA

Data from the input cards are printed on the output computer sheets. The particular format of the output can be seen from the printed output of the sample problems. The printed input data and the output results are outlined in Table 3. The required torsional stiffness at each control station, which is to be used for further analysis in SWEEP, is punched on output data cards and is part of the printed output results identified as sequence 12 of Table 3 for the final iteration.

PROGRAM OPTIONS AND ERROR STOPS

VIBRATION ANALYSIS

The user can select the boundary condition for the analysis, whether cantilever, free-free symmetric, or free-free antisymmetric. If cantilever, card types (CT) 4 and 5 must be deleted; if free-free symmetric, CT 5 must be deleted; if free-free antisymmetric, CT 4 must be deleted.

Rigid attached stores, such as fuel tanks or engine pods, and masses, such as balance weights or booms, may be added to the basic airfoil structure. The data for these added masses will normally be punched by SWEEP; however, the user may manually insert his own data for CT 7 and appropriately modify CT 3. Root flexibility and stiffness inserts must be supplied by the user for CT 9 and 10. If desired, the mass and/or the normalized vibration modes may be printed for the first and last iterations by supplying the necessary information on CT 3.

TABLE 2. STROP INPUT DATA

Card Type	Occurrence	Qty	Format	Field	Description	Units
1*	Always	1	18A4		Title to occupy first 71 columns	
2	Always	1	5E12.8	1	E, modulus of elasticity	$lb/in.^2$
				2	G, shear modulus	$lb/in.^2$
				3	RHOM, density of structural material	$lb/in.^3$
				4	Density of air ρ	$lb/in.^3$
				5	Required velocity, v_{req}	knots
3*	Always	1	8I6	1	NCP ≤15, number of control stations	
				2	Number of modes for flutter analysis ≤10	
				3	NKD ≤4, number of stiffness insertions	
				4	NMD ≤4, number of mass additions	
				5	Maximum number of iterations allowed for the case to be analyzed ≤20	
				6	IFLX = 0, cantilevered case	
				6	IFLX = 1, root stiffness	
				6	IFLX = 2, root flexibility	
				7	NSY = 0, non-free-free analysis	
				7	NSY = 1, free-free symmetric analysis	
				7	NSY = 2, free-free antisymmetric analysis	
			3I1	1	0 = print mass matrix	
				1	1 = suppress printing of mass matrix	
				3	0 = print normalized vibration modes	
				3	1 = suppress printing of vibration modes	

TABLE 2. STROP INPUT DATA (CONT)

Card Type	Occurrence	Qty	Format	Field	Description	Units
4	NSY=1	1	6E12.8	1	Blank	
				2	Aircraft weight less airfoil weight (WTF)	lb/side
				3	Fore-and-aft distance from CG of WTF to root station. Distance is positive if CG is aft of root station	in.
				4	Pitch moment of inertia of WTF about CG	lb in.^{2}/side
5	NSY=2	1	6E12.8	1	Lateral distance from aircraft centerline to root station	in.
				2	Roll moment of inertia of aircraft less airfoil about aircraft centerline	lb in.^{2}/side
6	Always	1 per section	6E12.8	1	Section weight, m	lb
				2	Section roll moment of inertia about CG (axis perpendicular to EA), I_ϕ	lb in.^{2}
				3	Section pitch moment of inertia about CG (axis parallel to EA), I_θ	lb in.^{2}
				4	Distance from section CG to EA Positive for CG aft of EA, d	in.
				5	Density of section structural material if different from RHOM	lb/in.^{3}

NOTE: One card type 6 is required for each section starting with control station 2 and ending with the penultimate control station

7	NMD>0	2 per added mass	I12	1	Control station at which to add mass (3x3 matrix)	
			5E12.8	1 (Card 1)	1, 1 element of added mass matrix	lb
				2 (Card 1)	2, 1 element of added mass matrix	in. lb
				3 (Card 1)	3, 1 element of added mass matrix	in. lb
				4 (Card 1)	1, 2 element of added mass matrix	in. lb

TABLE 2. STROP INPUT DATA (CONT)

Card Type	Occurrence	Qty	Format	Field	Description	Units
				5	2, 2 element of added mass matrix	lb in.^{2}
			5E12.8	1 (Card 2)	3, 2 element of added mass matrix	lb in.^{2}
				2 (Card 2)	1, 3 element of added mass matrix	in. lb
				3 (Card 2)	2, 3 element of added mass matrix	lb in.^{2}
				4 (Card 2)	3, 3 element of added mass matrix	lb in.^{2}
NOTE: Card Type 7 is repeated for each added mass						
8	Always	1 per control station	4F6.2	1	Structural box depth, t	in.
				2	Distance to next station	in.
				3	Structural box chord, c	in.
				4	Change in EA sweep angle with respect to prior station, λ	degrees
			4E12.8	1	EI, bending stiffness	lb in.^{2}
				2	GJ, torsion stiffness	lb in.^{2}
				3	Modulus of elasticity if $\neq$ E	lb/in.^{2}
				4	Shear modulus if $\neq$ G	lb/in.^{2}
NOTE: One card type 8 is required for each control station. The distances to the next control station for the first (with root flex) and last control stations are zero. Number of card type 8 equals two more than number of card type 6.						
9*	IFLX>0	2	6E12.8	1 (Card 1)	1, 1 element of root flex or stiffness matrix	in./lb,lb/in.
				2 (Card 1)	2, 1 element of root flex or stiffness matrix	rad/lb,lb/rad
				3 (Card 1)	3, 1 element of root flex or stiffness matrix	rad/lb,lb/rad
				4 (Card 1)	1, 2 element of root flex or stiffness matrix	in./in.lb,in. lb/in.
				5 (Card 1)	2, 2 element of root flex or stiffness matrix	rad/in.lb,in. lb/rad
				6 (Card 1)	3, 2 element of root flex or stiffness matrix	rad/in.lb,in. lb/rad
				1	1, 3 element of root flex or stiffness matrix	in./in.lb,in. lb/rad

TABLE 2. STROP INPUT DATA (CONT)

Card Type	Occurrence	Qty	Format	Field	Description	Units
				2 Card 2	2, 3 element of root flex or stiffness matrix	rad/in.lb, in. lb/rad
				3	3, 3 element of root flex or stiffness matrix	rad/in.lb, in. lb/rad
10*	NKD>0	2 per stiffness insert	I12	1	Control Station of outboard end of stiffness insertion (3x3 matrix)	
			5E12.8	1 Card 1	1, 1 element of stiffness insert matrix	lb/in.
				2	2, 1 element of stiffness insert matrix	lb/rad
				3	3, 1 element of stiffness insert matrix	lb/rad
				4	1, 2 element of stiffness insert matrix	in./in.lb
				5	2, 2 element of stiffness insert matrix	in.lb/rad
				1 Card 2	3, 2 element of stiffness insert matrix	in.lb/rad
				2	1, 3 element of stiffness insert matrix	lb/rad
				3	2, 3 element of stiffness insert matrix	in.lb/rad
				4	3, 3 element of stiffness insert matrix	in.lb/rad

NOTE: Card type 10 is required for each stiffness insert

Card Type	Occurrence	Qty	Format	Field	Description	Units
11	Always	1 per section	4I12	1	First inboard boundary control station	
				2	Second inboard boundary control station	
				3	First outboard boundary control station	
				4	Second outboard boundary control station	

NOTE: One card of type 11 is required for each control station except for the first and the last. Same number of cards as card type 6.

TABLE 2. STROP INPUT DATA (CONT)

Card Type	Occurrence	Qty	Format	Field	Description	Units
12	Always	1 per section	6E12.8	1	Section streamwise chord	in.
				2	Section distance from EA to AC, positive for AC aft of EA, d_A	in.
				3	Local $dC_\ell/d\alpha$	rad^{-1}

NOTE: One card of type 12 is required for each control station except for the first (with root flex) and last.

* These cards to be punched by user. All other cards to be punched by SWEEP

TABLE 3. PRINTED OUTPUT DATA

Sequence	Description
1	Title
2	Basic constants and control parameters
3	Rigid body weight data for free-free cases
4	Input distributed weight data
5	Added mass matrices
6	Input root stiffness or flexibility matrix
7	Stiffness insertion matrices
8	Control station structural box geometry and stiffness data
9	Structural box and aerodynamic strip boundary indicators
10	Aerodynamic strip data (includes calculated strip widths)
11	Rigid body modes for free-free cases
12	Control station skin gages (τ) and bending (EI) and torsional stiffness (GJ)
13	Vibration frequencies (Hz)
14	Flutter analysis results in terms of the reduced frequency parameter (k) and the flutter speed in knots (ν), the flutter frequency in hertz (f), and the damping (g) for each mode of the analysis and for each k stipulated by the program. Results are also included for the convergence analyses to find the mode that just goes unstable at the lowest speed.
15	Summary flutter results for the mathematical model using the input data. These results contain the critical k value; mode number; and flutter speed, frequency, and damping.
16	Structural volume, strain energy per structural volume, and the ratio of the strain energy per structural volume to the average strain energy for each beam element.
17	Generalized mass matrix for the vibration modes. This matrix should be an identity matrix to verify the orthogonality of the calculated modes around the mass matrix.
18	Normalized rigid body modes factors and rigid body mass matrix for free-free cases.
19	Normalizing factors per mode to scale the modes to obtain an identity generalized mass matrix.
20	Vibration modes normalized to the largest element in three groups: deflections at the control points on the EA, bending slopes at the control points, and twisting slopes at the control points.
21	Items 12-16 are repeated for each iteration until the required speed is reached or the prescribed number of iterations has been reached.
22	Items 14-20 for the check analysis of the final iteration.

The program will stop if a negative boundary indicator (CT 11) is used. The program will also stop if the bending stiffness is not compatible with the structural box geometry at the local control station as determined by the calculation of an imaginary skin gage. Furthermore, a program stoppage will occur if the eigenvalue solution exceeds a maximum number of 312 iterations probably indicating an ill-conditioned dynamic matrix resulting from inappropriate input data.

FLUTTER ANALYSIS

The spanwise distributions of the lift curve slopes and the distances from the elastic axis to the aerodynamic centers of the airfoil will be punched by SWEEP to supply the data for CT 12. The lift curve slopes will have values of 2π times the cosine of the sweep angle of the quarter chord line. The aerodynamic centers will be assumed at the quarter chord line. If more sophisticated values are desired, the user may substitute them for the SWEEP values on CT 12.

STROP is programmed to terminate when the speed of the mode that goes unstable at the lowest speed equals or exceeds the required speed. This termination can occur during any cycle of iteration, including the first. Program termination will occur when the total number of iterations specified on CT 3 has been reached even though the required speed has not been reached. Termination will also occur when the lowest unstable flutter speed is less than 50 percent of the required speed.

ENERGY CALCULATION AND OPTIMIZATION

In order to raise the flutter speed, structural box skin gages are increased incrementally. If during the optimization, the skin gage at any control station exceeds 25 percent of the box depth, the program will stop.

PROGRAM MAXIMA

The following maxima have been imposed in STROP primarily to stay within 100,000 octal words of core usage and secondarily to minimize computer machine time:

- Number of control stations 15
- Number of vibration and flutter modes 10
- Number of stores or added masses 4
- Number of stiffness inserts including root flexibility 4
- Number of iterations for optimizing 20
- Number of aerodynamic strips 15

RECOMMENDATION

It is highly recommended that STROP be closely monitored by experienced and knowledgeable flutter engineers in order to fully understand and appreciate the appropriate input and resulting outputs.

SAMPLE PROBLEMS

Three sample problems are presented: (1) cantilever, (2) free-free symmetric, and (3) free-free antisymmetric. They are based on the planform and structural box of Figure 1 in Section II. The airfoil is all-movable, rotating about a spindle extending from control station 6 inboard. This airfoil contains 15 control stations described as follows:

Station	Description
1	Root
2	Root stiffness
3	Mass 1
4	Mass 2
5	Stiffness insert
6	Stiffness insert
7	Mass 3
8	Sweep angle change
9	Mass 4
10	Mass 5
11	Mass 6
12	Mass 7
13	Mass 8
14	Mass 9 (added mass for problem 3)
15	Tip

Note that, for free-free antisymmetric, an added mass is included in the analysis. Also, since the stiffness from control station CS 2 to CS 5 is included in the stiffness insert at CS 6, high stiffness values were used between CS 2 and CS 5 to maintain structural continuity.

The computer printouts for each of these three problems are shown on pages 172 through 270, and the required flutter speed for these cases is specified as 750 knots. The third iteration structure for the cantilever case calculated the lowest flutter speed to be 748 knots which, although close to the required value, was not high enough. A fourth iteration produced a speed of 770 knots, which caused the program to proceed through the termination process. Note that, as the program cycled through the optimization process, the strain energy per structural volume approached a constant level throughout the structural span.

A flutter speed of 770 knots was also calculated for the free-free symmetric case indicating that the free boundary had an insignificant effect on the flutter of this airfoil.

The flutter speed for the free-free antisymmetric case was slightly lower than that for the previous two cases. This reduction in speed may be due to the effect of the added mass.

SAMPLE 1

CANTILEVER CASE

SAMPLE CASE NUMBER 1 CANTILEVER CASE

```
************************************************************************
* STRENGTH CRITERION----  THE EI-GJ CURVE IS INPUT AND INCREASED UNTIL *
* THE FLOTTER VELOCITY IS GREATER  THAN THE INPUT  REFERENCE VELOCITY. *
************************************************************************
```

*** INPUT DATA ***

MODULUS OF ELASTICITY,E	=	1.0300000E+07 LB/IN**2
MODULUS OF SHEAR,G	=	3.9000000E+06 LB/IN**2
DENSITY OF STRUCTURAL MATERIAL	=	1.0100000E-01 LBF/IN**3
DENSITY OF AIR	=	4.4294000E-05 LBF/IN**3
FLUTTER VELOCITY DESIRED	=	7.5000000E+02 KNOTS
NUMBER OF CONTROL STATIONS	=	15
NUMBER OF MODES	=	6
NUMBER OF STIFFNESS INSERTIONS	=	1
NUMBER OF MASS ADDITIONS	=	0
MAXIMUM NUMBER OF ITERATIONS	=	4
ROOT FLEXIBILITY INDICATOR	=	1
FREE-FREE OPTION INDICATOR	=	0
<M> PRINTOUT INDICATOR	=	1
VIBRATION MODE PRINTOUT INDICATOR	=	0

INPUT DISTRIBUTED WEIGHT DATA

STATION	WT(LB)	IROLLCG(LB-IN**2)	IPITCHCG(LB-IN**2)	DEA(IN) (-FWD)	RHOG(LB/IN**2)
2	0.	0.	0.	0.	1.0100000E-01
3	3.2710000E+02	6.3529000E+04	8.7674000E+04	-1.6500000E+01	1.0100000E-01
4	5.3360000E+02	1.3518600E+05	1.7053700E+05	1.2500000E+00	1.0100000E-01
5	0.	0.	0.	0.	1.0100000E-01
6	0.	0.	0.	0.	1.0100000E-01
7	1.7790000E+02	2.8129000E+04	1.4098800E+05	7.7500000E+00	1.0100000E-01
8	0.	0.	0.	0.	1.0100000E-01
9	1.4720000E+02	1.5898000E+04	1.3794700E+05	4.2500000E+00	1.0100000E-01
10	1.2260000E+02	1.3241000E+04	9.6051000E+04	4.5000000E+00	1.0100000E-01
11	1.9340000E+02	1.1167000E+04	6.5603000E+04	4.7500000E+00	1.0100000E-01
12	9.2700000E+01	1.0011000E+04	4.4444000E+04	3.5000000E+00	1.0100000E-01
13	8.8500000E+01	9.5580000E+03	2.9389000E+04	2.0000000E+00	1.0100000E-01
14	7.6800000E+01	3.3950000E+03	1.1907000E+04	7.5000000E-01	1.0100000E-01

INPUT ROOT STIFFNESS

1.0000000E+10	0.	0.
0.	1.0000000E+13	0.
0.	0.	1.6611296E+08

STIFFNESS INSERTION BEAM ELEMENT 5

4.0570000E+05	-8.8190000E+06	0.
-8.8190000E+06	3.8892000E+08	0.
0.	0.	1.4925000E+08

STRUCTURAL BOX GEOMETRY AND CONTROL STATION DATA

STA	DEPTH(IN)	LENGTH(IN)	WIDTH(IN)	ANGLE(DEG)	EI(LB-IN**2)	GJ(LB-IN**2)	E(LB/IN**2)	G(LB/IN**2)
1	15.000	0.000	120.000	0.000	2.000000E+11	2.000000E+11	1.030000E+07	3.900000E+06
2	15.000	14.750	120.000	0.000	2.000000E+11	2.000000E+11	1.030000E+07	3.900000E+06
3	15.000	10.000	120.000	0.000	2.000000E+11	2.000000E+11	1.030000E+07	3.900000E+06
4	15.000	11.500	120.000	0.000	2.000000E+11	2.000000E+11	1.030000E+07	3.900000E+06
5	15.000	0.000	120.000	0.000	2.000000E+11	2.000000E+11	1.030000E+07	3.900000E+06
6	11.849	38.250	88.000	0.000	1.565000E+10	2.080000E+10	1.030000E+07	3.900000E+06
7	1[illegible].510	21.500	79.500	49.000	9.600000E+09	1.210000E+10	1.030000E+07	3.900000E+06
8	9.784	13.750	73.750	0.000	7.100000E+09	8.850000E+09	1.030000E+07	3.900000E+06
9	9.190	35.500	70.000	-15.000	5.400000E+09	6.750000E+09	1.030000E+07	3.900000E+06
10	7.784	36.250	62.500	0.000	2.930000E+09	3.630000E+09	1.030000E+07	3.900000E+06
11	6.445	36.000	55.500	0.000	1.570000E+09	1.950000E+09	1.030000E+07	3.900000E+06
12	5.268	36.000	48.000	0.000	8.250000E+08	1.030000E+09	1.030000E+07	3.900000E+06
13	4.182	31.000	40.500	0.000	4.200000E+08	5.200000E+08	1.030000E+07	3.900000E+06
14	3.306	24.000	34.500	0.000	2.000000E+08	2.300000E+08	1.030000E+07	3.900000E+06
15	2.686	8.750	29.500	0.000	8.000000E+07	1.200000E+08	1.030000E+07	3.900000E+06

STRUCTURAL BOX AND AERO STRIP BOUNDARY INDICATORS

STATION	NI1	NI2	NO1	NO2
2	0	0	0	0
3	2	2	3	4
4	3	4	5	5
5	0	0	0	0
6	0	0	0	0
7	6	6	8	8
8	0	0	0	0
9	8	8	9	10
10	9	10	10	11
11	10	11	11	12
12	11	12	12	13
13	12	13	13	14
14	13	14	15	15

AERO STRIP DATA

STATION	WIDTH(IN)	AVG CHORD(IN)	AC TO EA(IN) (-FWD)	CLALPHA
2	0.	1.9400000E+02	-7.5000000E+00	3.9970000E+00
3	1.9750000E+01	1.8900000E+02	-5.5000000E+00	4.1020000E+00
4	1.0500000E+01	1.8650000E+02	-4.0000000E+00	4.1570000E+00
5	0.	1.8275000E+02	0.	4.2330000E+00
6	0.	1.8275000E+02	0.	4.4160000E+00
7	3.4194533E+01	1.6950000E+02	-1.2750000E+01	4.7210000E+00
8	0.	1.6225000E+02	-2.0800000E+01	4.8860000E+00
9	2.6114685E+01	1.5550000E+02	-2.0800000E+01	5.0450000E+00
10	2.9741725E+01	1.3950000E+02	-2.0000000E+01	5.4140000E+00
11	2.9944984E+01	1.2300000E+02	-1.9750000E+01	5.7250000E+00
12	2.0845354E+01	1.0750000E+02	-1.9500000E+01	5.9840000E+00
13	2.7772760E+01	9.1500000E+01	-2.0000000E+01	6.1140000E+00
14	3.2746986E+01	7.7250000E+01	-2.0500000E+01	5.7400000E+00

*******COMMENCE ITERATION 1*******

STATION	TAU	EI(LB-IN**2)	GJ(LB-IN**2)
1	1.9014102E+00	2.0000000E+11	2.0000000E+11
2	1.9014102E+00	2.0000000E+11	2.0000000E+11
3	1.9014102E+00	2.0000000E+11	2.0000000E+11
4	1.9014102E+00	2.0000000E+11	2.0000000E+11
5	1.9014102E+00	2.0000000E+11	2.0000000E+11
6	2.4694389E-01	1.5650000E+10	2.0800000E+10
7	2.1264293E-01	9.6000000E+09	1.2100000E+10
8	1.9548248E-01	7.1000000E+09	8.8500000E+09
9	1.7734296E-01	5.4000000E+09	6.7500000E+09
10	1.5053435E-01	2.9300000E+09	3.6300000E+09
11	1.3322777E-01	1.5700000E+09	1.9500000E+09
12	1.2207038E-01	8.2500000E+08	1.0300000E+09
13	1.1846520E-01	4.2000000E+08	5.2000000E+08
14	1.0718293E-01	2.0000000E+08	2.3000000E+08
15	7.5309400E-02	8.0000000E+07	1.2000000E+08

*****VIBRATION ANALYSIS*****

MODE	FREQUENCY (HZ.)
1	5.418
2	19.239
3	30.867
4	47.200
5	56.769
6	79.437

****FLUTTER ANALYSIS****

	MODE 6			MODE 5		
K	V	F	G	V	F	G
12.4051	175.1397	74.2004	-.0296	128.3456	54.3754	-.0179
10.6305	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
9.1098	238.3623	74.1596	-.0403	174.3944	54.2578	-.0243
7.8066	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
6.6899	324.2565	74.0843	-.0547	236.5303	54.0411	-.0328
5.7329	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.9128	440.7299	73.9466	-.0741	319.7272	53.6445	-.0440
4.2100	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3.6077	598.1341	73.6974	-.1000	429.5676	52.9279	-.0584
3.0916	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2.6494	809.6175	73.2557	-.1339	571.0342	51.6682	-.0759
2.2704	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.9456	1091.0796	72.4980	-.1763	745.8657	49.5599	-.0980
1.6673	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.4288	1460.3678	71.2590	-.2251	949.4263	46.3275	-.2043
1.2244	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.0492	1936.6712	69.3971	-.2700	1336.2580	47.8824	-.3755
.8991	2224.3095	68.3022	-.2837	1596.1043	49.0118	-.4748
.7705	2559.4914	67.3515	-.2882	1920.5575	50.5383	-.6056
.6603	2968.9826	66.9507	-.2884	2327.3331	52.4815	-.7785
.5658	3492.3196	67.4863	-.2987	2840.9924	54.8999	-1.0001
.4849	4182.9492	69.2689	-.3385	3503.3834	58.0154	-1.2807
.4155	5134.3202	72.8605	-.4400	4383.5925	62.2071	-1.6393
.3561	6565.5109	79.8421	-.6860	5580.7278	67.8663	-2.0895
.3051	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.2615	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.2241	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1920	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1646	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1410	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

	MODE 4			MODE 3		
K	V	F	G	V	F	G
12.4051	104.3997	44.2304	-.0277	70.2803	29.7752	-.0173
10.6305	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
9.1098	142.2027	44.2423	-.0377	95.5090	29.7149	-.0235
7.8066	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
6.6899	193.7369	44.2639	-.0514	129.5687	29.6031	-.0318
5.7329	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.9128	264.0499	44.3028	-.0701	175.2069	29.3966	-.0429
4.2100	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3.6077	360.1172	44.3708	-.0956	235.4982	29.0162	-.0572
3.0916	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2.6494	491.5103	44.4818	-.1299	313.0162	28.3223	-.0745
2.2764	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.9456	671.7952	44.6382	-.1717	407.5905	27.0828	-.0922
1.6673	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.4288	917.2280	44.7564	-.1367	511.6739	24.9673	-.1002
1.2244	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.0492	1115.3693	39.6089	-.0406	603.8076	21.6364	-.0688
.8991	1196.2909	36.7347	.0249	638.2333	19.5983	-.0126
.7705	1292.6005	34.0161	.1257	794.0221	20.8942	-.6751
.6603	1416.6426	31.9318	.2635	969.8951	21.8712	-.9321
.5658	1583.9182	30.6079	.4271	1192.8085	23.0501	-1.2955
.4849	1801.3635	29.8302	.6119	1485.1203	24.5933	-1.8209
.4155	2073.1149	29.4193	.8269	1898.0553	26.9351	-2.6650
.3561	2412.6353	29.3397	1.0943	2568.6251	31.2366	-4.3364
.3051	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.2615	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.2241	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1920	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1646	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1410	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

	MODE 2			MODE 1		
K	V	F	G	V	F	G
12.4051	42.4618	17.9895	-.0248	12.1402	5.1472	-.0201
10.6305	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
9.1098	57.8463	17.9972	-.0339	16.5518	5.1496	-.0274
7.8066	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
6.6899	78.8333	18.0114	-.0463	22.5589	5.1541	-.0375
5.7329	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.9128	107.5066	18.0377	-.0633	30.7688	5.1624	-.0514
4.2100	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3.6077	146.7909	18.0864	-.0870	42.0225	5.1777	-.0707
3.0916	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2.6494	200.8951	18.1774	-.1205	57.5329	5.2057	-.0982
2.2704	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.9456	276.1632	18.3500	-.1689	79.1255	5.2576	-.1380
1.6673	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.4288	383.0584	18.6915	-.2428	109.7650	5.3560	-.1983
1.2244	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.0492	542.8957	19.4537	-.3740	154.9452	5.5522	-.2971
.8991	654.7827	20.1065	-.4969	186.3674	5.7228	-.3750
.7705	665.5669	17.5145	.0751	227.4028	5.9840	-.4914
.6603	687.7808	15.5095	.2152	283.8039	6.3998	-.6847
.5658	725.0780	14.0231	.4449	366.1267	7.0751	-1.0419
.4849	815.8375	13.5101	.8006	495.6011	8.2071	-1.7579
.4155	994.5436	14.1135	1.3637	747.4833	10.6074	-3.6231
.3561	1345.3351	16.3604	2.4956	2158.9219	26.2543	-26.7830
.3051	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.2615	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.2241	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1920	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1646	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1410	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FIRST CONVERGENCE ANALYSIS

MODE 6

K	V	F	G
.8299	2391.1013	67.7676	-.2872
.8631	2307.6321	68.0220	-.2858

MODE 5

V	F	G
1755.4695	49.7528	-.5380
1675.0647	49.3758	-.5059

MODE 4

K	V	F	G
.8299	1244.5025	35.2712	.0723
.8631	122[illegible].5764	35.9789	.0478

MODE 3

V	F	G
723.0780	20.4932	-.5814
688.6243	20.2986	-.5381

MODE 2

K	V	F	G
.8299	653.5104	18.5215	.0285
.8631	646.3024	19.0510	.0073

MODE 1

V	F	G
206.1962	5.8439	-.4290
196.1248	5.7812	-.4011

******FINAL RESULTS ITERATION 1******

```
K-VALUE              =    .8631
FLUTTER MODE NO.     =   2
FLUTTER VELOCITY     = 646.30 KNOTS
FLUTTER FREQUENCY    =  19.0510 HZ.
FLUTTER DAMPING      =    .0073
```

BEAM ELEMENT	VOLUME(IN**3)	STRAIN ENERGY/VOL.	RATIO(E/V/AVGE(F/V))
1	0.0000	0.	0.0000
2	7359.0600	2.5657096E-01	.0015
3	4989.1932	2.2422342E-01	.0013
4	5737.5722	1.9943234E-01	.0012
5	0.0000	0.	0.0000
6	1662.7605	2.8448732E+01	.1712
7	758.2129	4.6469451E+01	.2796
8	415.3579	7.4756721E+01	.4498
9	867.4999	1.2998470E+02	.7821
10	678.0281	2.8418546E+02	1.7099
11	527.6790	5.1672781E+02	3.1092
12	422.1910	5.6405756E+02	3.3939
13	287.3266	1.8284174E+02	1.1002

	2370..88 3		

GENERALIZED MASS MATRIX

	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
1	1.0000000E+00	7.1660621E-05	-5.2960792E-06	-8.6588157E-10	-7.2019145E-08	3.5454673E-09
2	7.1660621E-05	1.0000000E+00	2.0122584E-05	-6.0070639E-06	-5.2582345E-06	3.1851398E-06
3	-5.2960792E-06	2.0122584E-05	1.0000000E+00	3.1311919E-06	1.0086883E-06	-1.6824426E-06
4	-8.6588585E-10	-6.0070639E-06	3.1311919E-06	1.0000000E+00	-7.0014413E-07	-6.0642602E-12
5	-7.2019154E-08	-5.2582345E-06	1.0086883E-06	-7.0014413E-07	1.0000000E+00	-6.8487946E-06
6	3.5454213E-09	3.1851398E-06	-1.6824426E-06	-6.0589311E-12	-6.8487946E-06	1.0000000E+00

MASS SCALE FACTORS - VIBRATION MODE PRINTOUT

MODE NUMBERS 1--------- 6

7.0748E-02	6.[illegible]233E-02	-1.3328E-02	-3.9955E-02	1.9658E-02	-1.5834E-02

H (DEFLECTION-IN)

STA						
2	9.50[illegible]E-08	-7.8568E-07	-3.1144E-06	2.3039E-06	1.1127E-05	2.0513E-05
3	8.71[illegible]E-05	-2.1808E-04	-2.7302E-03	1.2787E-04	3.6674E-03	2.3214E-03
4	2.3943E-04	-5.7126E-04	-7.5201E-03	2.2812E-04	9.7449E-03	5.6382E-03
5	5.0226E-04	-1.1212E-03	-1.5776E-02	1.2361E-04	1.9632E-02	1.0971E-02
6	1.[illegible]442E-02	-5.7140E-02	-5.9159E-01	8.1069E-02	8.4985E-01	2.6554E-01
7	6.9327E-02	-2.6159E-01	-4.2975E-01	4.8432E-01	1.0609E+00	-3.0368E-01
8	1.365[illegible]E-01	-4.1601E-01	-3.6660E-01	6.4869E-01	1.1176E+00	-3.1449E-01
9	1.6931E-01	-4.5565E-01	-5.4034E-01	6.5573E-01	1.2492E+00	-1.2165E-01
10	2.7123E-01	-6.2769E-01	-1.0553E+00	3.9652E-01	1.1282E+00	5.3973E-01
11	4.[illegible]836E-01	-6.3680E-01	-1.4996E+00	-3.0004E-01	8.7656E-02	6.8433E-01
12	5.6324E-01	-3.8521E-01	-1.4742E+00	-9.8706E-01	-1.3326E+00	-5.1642E-01
13	7.401[illegible]E-01	2.2593E-01	-5.4439E-01	-6.3209E-01	-1.2994E+00	-1.3458E+00
14	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00

HPRIME (SLOPE-RAD)

STA						
2	1.[illegible]19E-08	-4.3695E-08	-5.1531E-07	3.4321E-08	7.2496E-07	5.2247E-07
3	1.16[illegible]9E-05	-2.7946E-05	-3.6362E-04	1.2815E-05	4.7486E-04	2.7427E-04
4	1.4077E-05	-4.1938E-05	-5.9244E-04	4.3638E-06	7.3358E-04	3.9183E-04
5	2.6041E-05	-5.2770E-05	-8.4069E-04	-2.6176E-05	9.7631E-04	5.3621E-04
6	7.8912E-04	-1.6852E-03	-2.4649E-02	-4.4230E-05	2.9360E-02	1.2842E-02
7	2.0665E-03	-6.2018E-03	3.1578E-03	9.2376E-03	4.8571E-03	-6.3260E-03
8	2.3845E-03	-6.2458E-03	2.9170E-03	5.7921E-03	-2.5281E-04	5.3406E-03
9	2.4[illegible]E-03	-4.9135E-03	-1.3379E-02	-1.3300E-03	6.8774E-03	1.6347E-02
10	3.2875E-03	-2.5688E-03	-1.4764E-02	-1.3718E-02	-1.5558E-02	1.6835E-02
11	4.3048E-03	2.7601E-03	-7.9549E-03	-2.2829E-02	-3.9828E-02	-1.4225E-02
12	5.4114E-03	1.1731E-02	1.1600E-02	-1.0170E-02	-3.0188E-02	-4.5341E-02
13	6.3408E-03	2.1988E-02	4.0404E-02	3.3805E-02	4.0583E-02	2.1850E-02
14	6.7171E-03	2.6898E-02	5.6160E-02	6.5795E-02	9.8249E-02	1.1691E-01

ALPHA (TWIST-RAD)

STA						
2	6.6559E-04	-2.7403E-03	1.5100E-02	9.1809E-03	-1.4501E-02	-6.7388E-02
3	6.7374E-04	-2.8234E-03	1.5285E-02	9.2934E-03	-1.4679E-02	-6.8214E-02
4	6.7925E-04	-2.8456E-03	1.5397E-02	9.3510E-03	-1.4756E-02	-6.8385E-02
5	6.8557E-04	-2.8701E-03	1.5511E-02	9.3902E-03	-1.4798E-02	-6.8147E-02
6	1.4218E-03	-5.7247E-03	2.8828E-02	1.4667E-02	-1.9610E-02	-4.0412E-02
7	2.7293E-04	-2.9177E-03	4.8666E-02	1.2306E-02	-4.3245E-02	-3.4211E-02
8	2.1784E-04	-3.2164E-03	5.6655E-02	1.3322E-02	-4.6620E-02	-2.4029E-02
9	9.3403E-04	-4.9470E-03	6.2133E-02	1.4553E-02	-4.8990E-02	-1.3271E-02
10	8.5581E-04	-5.0026E-03	8.3853E-02	1.1123E-02	-5.0179E-02	3.5627E-02
11	9.8713E-04	-6.3616E-03	1.1444E-01	3.3170E-04	-3.2113E-02	9.3457E-02
12	3.2479E-04	-7.0240E-03	1.5332E-01	-1.9081E-02	2.0455E-02	8.6443E-02
13	3.6211E-04	-7.4506E-03	1.9614E-01	-4.2836E-02	1.1442E-01	-5.3936E-02
14	9.8232E-04	-7.5714E-03	2.2176E-01	-5.6500E-02	1.8822E-01	-2.0042E-01

*******COMMENCE ITERATION 2*******

STATION	TAU	EI(LB-IN**2)	GJ(LB-IN**2)
1	1.9014102E+00	2.0760906E+11	2.0000000E+11
2	1.9014102E+00	2.0760906E+11	2.0000000E+11
3	1.9014102E+00	2.0760906E+11	2.0000000E+11
4	1.9014102E+00	2.0760906E+11	2.0000000E+11
5	1.9014102E+00	2.0760906E+11	2.0000000E+11
6	2.4694389E-01	1.5662721E+10	2.0800000E+10
7	2.1264293E-01	9.6073025E+09	1.2100000E+10
8	1.9548248E-01	7.1052685E+09	8.8500000E+09
9	1.7734296E-01	5.4037233E+09	6.7500000E+09
10	1.5053435E-01	2.9320039E+09	3.6300000E+09
11	1.6780997E-01	1.9560818E+09	2.4290145E+09
12	2.0293401E-01	1.3277162E+09	1.6583749E+09
13	1.6795507E-01	5.8117558E+08	7.1922582E+08
14	1.0718293E-01	2.0037375E+08	2.3000000E+08
15	7.5309400E-02	8.0109711E+07	1.2000000E+08

*****VIBRATION ANALYSIS*****

MODE	FREQUENCY (HZ.)
1	5.222
2	20.317
3	31.180
4	50.043
5	60.647
6	81.791

****FLUTTER ANALYSIS****

	MODE 6			MODE 5		
K	V	F	G	V	F	G
1.4385	1430.2258	72.7210	-.2359	993.5492	48.8114	-.1131
1.2090	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.0162	2030.1033	70.4555	-.2936	1452.4824	50.4089	-.3800
.8541	2371.5753	69.1776	-.3115	1773.8926	51.7435	-.4925
.7179	2744.7170	68.2719	-.3196	2182.3932	53.5050	-.6471
.6034	3317.9959	68.3706	-.3327	2699.2605	55.6210	-.8496
.5071	4039.9200	69.9506	-.3781	3357.2541	58.1447	-1.0986

	MODE 4			MODE 3		
K	V	F	G	V	F	G
1.4385	984.5044	48.3670	-.2193	528.0055	25.9400	-.1035
1.2090	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.0162	1218.0778	41.9268	-.0317	648.5206	22.5071	-.0895
.8541	1310.4047	38.2238	.0487	729.2315	21.2713	-.4969
.7179	1425.5230	34.9491	.1797	911.6831	22.3514	-.7186
.6034	1590.1341	32.7663	.3546	1144.8308	23.5904	-1.0509
.5071	1820.5220	31.5299	.5557	1447.2005	25.0643	-1.5276

	MODE 2			MODE 1		
K	V	F	G	V	F	G
1.4385	400.9688	19.6989	-.2327	104.9983	5.1584	-.1750
1.2090	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.0162	539.4335	20.4565	-.3677	154.1173	5.3487	-.2727
.8541	690.1749	20.1321	-.0462	189.3762	5.5240	-.3521
.7179	718.5471	17.6188	.0470	236.8598	5.8070	-.4756
.6034	739.7805	15.2439	.2102	305.3052	6.2911	-.6964
.5071	737.2774	13.6350	.4973	412.8585	7.1503	-1.1555

FIRST CONVERGENCE ANALYSIS

K	MODE 6 V	MODE 6 F	MODE 6 G	MODE 5 V	MODE 5 F	MODE 5 G
.7801	2575.6122	68.6180	-.3165	1974.8743	52.6135	-.5672
.7477	2679.3218	68.4163	-.3181	2077.8656	53.0581	-.6066
.7635	2627.2803	68.5102	-.3173	2026.1721	52.8354	-.5868

K	MODE 4 V	MODE 4 F	MODE 4 G	MODE 3 V	MODE 3 F	MODE 3 G
.7801	1360.5120	36.4059	.1104	818.7194	21.8119	-.6000
.7477	1395.4003	35.6314	.1443	864.7926	22.0824	-.6575
.7635	1380.8270	36.0071	.1271	841.6502	21.9473	-.6283

K	MODE 2 V	MODE 2 F	MODE 2 G	MODE 1 V	MODE 1 F	MODE 1 G
.7801	706.5398	18.8232	-.0040	212.2187	5.6538	-.4089
.7477	713.0577	18.2079	.0204	224.2902	5.7272	-.4408
.7635	709.9252	18.5123	.0079	218.1954	5.6898	-.4245

******FINAL RESULTS ITERATION 2******

K-VALUE	=	.7635
FLUTTER MODE NO.	=	2
FLUTTER VELOCITY	=	709.93 KNOTS
FLUTTER FREQUENCY	=	18.5123 HZ.
FLUTTER DAMPING	=	.0079

BEAM ELEMENT	VOLUME(IN**3)	STRAIN ENERGY/VOL.	RATIO(E/V/AVGE(E/V))
1	0.0000	0.	0.0000
2	7359.0600	1.0834705E-01	.0026
3	4989.1932	9.4187759E-02	.0022
4	5737.5722	8.3541323E-02	.0020
5	0.0000	0.	0.0000
6	1662.7605	1.2729439E+01	.3005
7	758.2129	2.1685901E+01	.5120
8	415.3579	3.5498398E+01	.8381
9	867.4999	6.2536933E+01	1.4764
10	758.4125	1.0114778E+02	2.3880
11	762.0698	9.9133598E+01	2.3404
12	650.7497	8.8242670E+01	2.0833
13	351.5556	4.4668653E+01	1.0546

	24312.4443		

*******COMMENCE ITERATION 3*******

STATION	TAU	EI(LB-IN**2)	GJ(LB-IN**2)
1	1.9014102E+00	2.0760906E+11	2.0000000E+11
2	1.9014102E+00	2.0760906E+11	2.0000000E+11
3	1.9014102E+00	2.0760906E+11	2.0000000E+11
4	1.9014102E+00	2.0760906E+11	2.0000000E+11
5	1.9014102E+00	2.0760906E+11	2.0000000E+11
6	2.4694389E-01	1.5662721E+10	2.0800000E+10
7	2.1264293E-01	9.6073025E+09	1.2100000E+10
8	1.9548248E-01	7.1052685E+09	8.8500000E+09
9	1.7734296E-01	5.4037233E+09	6.7500000E+09
10	1.7375031E-01	3.3622246E+09	4.1640474E+09
11	2.2046682E-01	2.5244380E+09	3.1372897E+09
12	2.5219782E-01	1.6165702E+09	2.0206650E+09
13	1.9517650E-01	6.6583986E+08	8.2439683E+08
14	1.0718293E-01	2.0037375E+08	2.3000000E+08
15	7.5309400E-02	8.0109711E+07	1.2000000E+08

*****VIBRATION ANALYSIS*****

MODE	FREQUENCY (HZ.)
1	5.117
2	20.925
3	31.273
4	51.462
5	62.775
6	82.937

****FLUTTER ANALYSIS****

	MODE 6			MODE 5		
K	V	F	G	V	F	G
1.2726	1674.2027	72.7621	-.2711	1161.2235	50.4677	-.2662
1.0864	1932.0851	71.6889	-.3015	1379.7239	51.1939	-.3309
.9275	2224.8347	70.4778	-.3266	1648.2601	52.2132	-.4132
.7919	2562.7902	69.3100	-.3419	1982.1294	53.6062	-.5256
.6761	2973.6891	68.6605	-.3503	2395.3708	55.3075	-.6774
.5772	3503.7268	69.0669	-.3699	2901.2860	57.1914	-.8663
.4928	4211.6214	70.8790	-.4258	3522.4279	59.2803	-1.0858

	MODE 4			MODE 3		
K	V	F	G	V	F	G
1.2726	1163.6907	47.9672	-.0841	586.5252	25.4908	-.1086
1.0864	1205.5590	44.7316	-.0525	647.0706	24.0092	-.1068
.9275	1298.9909	41.1491	.0016	698.2571	22.1191	-.0990
.7919	1389.9935	37.5920	.0941	824.7127	22.3041	-.5408
.6761	1504.9746	34.7489	.2324	1013.4221	23.3992	-.7746
.5772	1671.6807	32.9529	.4010	1245.1963	24.5458	-1.0990
.4928	1894.7064	31.8868	.5868	1535.9323	25.8488	-1.5377

	MODE 2			MODE 1		
K	V	F	G	V	F	G
1.2726	471.6346	20.4976	-.2609	117.3615	5.1006	-.1875
1.0864	563.4438	20.8135	-.3198	139.6259	5.1807	-.2288
.9275	673.6927	21.3411	-.3968	167.2150	5.2970	-.2837
.7919	731.7817	19.7909	-.0527	202.2951	5.4710	-.3603
.6761	755.1394	17.4357	.0384	248.7366	5.7432	-.4767
.5772	771.7529	15.2131	.1892	314.1127	6.1919	-.6773
.4928	809.0883	13.6165	.4444	413.5019	6.9590	-1.0739

FIRST CONVERGENCE ANALYSIS

		MODE 6			MODE 5	
K	V	F	G	V	F	G
.7294	2764.5951	68.8688	-.3463	2186.2570	54.4619	-.5995
.7017	2868.0512	68.7346	-.3482	2290.2529	54.8873	-.6380
.7153	2816.0696	68.7942	-.3473	2238.1081	54.6751	-.6186

		MODE 4			MODE 3	
K	V	F	G	V	F	G
.7294	1444.4957	35.9838	.1608	917.9061	22.8660	-.6514
.7017	1473.8710	35.3222	.1962	965.3997	23.1364	-.7116
.7153	1458.9743	35.6415	.1784	941.5838	23.0021	-.6811

		MODE 2			MODE 1	
K	V	F	G	V	F	G
.7294	745.2589	18.5651	-.0108	224.6582	5.5965	-.4140
.7017	750.5957	17.9885	.0128	236.4610	5.6669	-.4440
.7153	748.0352	18.2739	.0008	230.5034	5.6310	-.4287

******FINAL RESULTS ITERATION 3******

K-VALUE = .7153
FLUTTER MODE NO. = 2
FLUTTER VELOCITY = 748.04 KNOTS
FLUTTER FREQUENCY = 18.2739 HZ.
FLUTTER DAMPING = .0008

BEAM ELEMENT	VOLUME(IN**3)	STRAIN ENERGY/VOL.	RATIO(E/V/AVGE(E/V))
1	0.0000	0.	0.0000
2	7359.0600	1.0904299E-01	.0036
3	4989.1932	9.5795468E-02	.0032
4	5737.5722	8.5878758E-02	.0028
5	0.0000	0.	0.0000
6	1662.7605	1.3466848E+01	.4447
7	758.2129	2.3077645E+01	.7621
8	415.3579	3.7630094E+01	1.2426
9	927.3211	5.5368159E+01	1.8283
10	936.7872	6.4445473E+01	2.1281
11	970.5211	5.5331977E+01	1.8271
12	784.4590	5.1580155E+01	1.7032
13	386.7979	3.1927113E+01	1.0543

	24928.0430		

*******COMMENCE ITERATION 4********

STATION	TAU	EI(LB-IN**2)	GJ(LB-IN**2)
1	1.9014102E+00	2.0760906E+11	2.0000000E+11
2	1.9014102E+00	2.0760906E+11	2.0000000E+11
3	1.9014102E+00	2.0760906E+11	2.0000000E+11
4	1.9014102E+00	2.0760906E+11	2.0000000E+11
5	1.9014102E+00	2.0760906E+11	2.0000000E+11
6	2.4694389E-01	1.5662721E+10	2.0800000E+10
7	2.1264293E-01	9.6073025E+09	1.2100000E+10
8	1.9548248E-01	7.1052685E+09	8.8500000E+09
9	1.9037249E-01	5.7827534E+09	7.2246840E+09
10	2.0243163E-01	3.8857960E+09	4.8144348E+09
11	2.5220631E-01	2.8568773E+09	3.5520299E+09
12	2.7308626E-01	1.7352727E+09	2.1696613E+09
13	2.0550080E-01	6.9728363E+08	8.6347560E+08
14	1.0719293E-01	2.0037375E+08	2.3000000E+08
15	7.5309400E-02	8.0109711E+07	1.2000000E+08

*****VIBRATION ANALYSIS*****

MODE	FREQUENCY (HZ.)
1	5.088
2	21.207
3	31.338
4	52.211
5	63.734
6	83.534

****FLUTTER ANALYSIS****

	MODE 6			MODE 5		
K	V	F	G	V	F	G
1.1922	1791.5650	72.9033	-.2964	1263.2785	51.4347	-.2820
1.0207	2049.1768	71.8539	-.3273	1488.2331	52.1845	-.3427
.8842	2340.4648	70.6783	-.3523	1763.7625	53.2628	-.4236
.7615	2675.2291	69.5759	-.3671	2103.3150	54.7018	-.5351
.6558	3082.8863	69.0508	-.3761	2517.7115	56.3919	-.6842
.5048	3609.2050	69.6215	-.3991	3016.0033	58.1777	-.8653
.4864	4310.1522	71.6029	-.4610	3615.7314	60.0667	-1.0696

	MODE 4			MODE 3		
K	V	F	G	V	F	G
1.1922	1159.9552	47.2279	-.0721	620.1341	25.2489	-.1124
1.0267	1252.5769	43.9213	-.0385	678.4593	23.7900	-.1118
.8842	1336.5069	40.3604	.0213	724.5665	21.8808	-.1052
.7615	1422.4038	36.9931	.1205	879.9438	22.8851	-.5691
.6558	1538.1452	34.4515	.2603	1069.0476	23.9446	-.8057
.5648	1703.9656	32.8689	.4228	1296.6295	25.0115	-1.1201
.4864	1919.8982	31.8945	.5983	1576.9695	26.1976	-1.5320

	MODE 2			MODE 1		
K	V	F	G	V	F	G
1.1922	513.8484	20.9215	-.2756	125.2101	5.0980	-.1953
1.0267	606.1102	21.2531	-.3342	147.7386	5.1804	-.2364
.8842	724.1346	21.8677	-.4127	175.4494	5.2983	-.2906
.7615	754.6235	19.6258	-.0539	210.3994	5.4719	-.3656
.6558	775.8603	17.3778	.0351	256.2089	5.7386	-.4781
.5048	790.4800	15.2481	.1787	319.8017	6.1689	-.6677
.4864	822.8745	13.6701	.4162	414.5998	6.8876	-1.0315

FIRST CONVERGENCE ANALYSIS

K	MODE 6 V	MODE 6 F	MODE 6 G	MODE 5 V	MODE 5 F	MODE 5 G
.7047	2874.8342	69.1921	-.3715	2308.4330	55.5598	-.6079
.6794	2977.6302	69.0904	-.3736	2412.6234	55.9804	-.6457
.6918	2925.9427	69.1334	-.3725	2360.4088	55.7712	-.6267
.6856	2951.7116	69.1100	-.3731	2386.4872	55.8761	-.6362

K	MODE 4 V	MODE 4 F	MODE 4 G	MODE 3 V	MODE 3 F	MODE 3 G
.7047	1476.6046	35.5440	.1889	973.6650	23.4344	-.6822
.6794	1506.5767	34.9573	.2245	1021.1603	23.6943	-.7429
.6918	1491.4635	35.2399	.2066	997.3686	23.5656	-.7122
.6856	1498.9633	35.0960	.2155	1009.2571	23.6303	-.7275

K	MODE 2 V	MODE 2 F	MODE 2 G	MODE 1 V	MODE 1 F	MODE 1 G
.7047	766.9384	18.4588	-.0127	232.4736	5.5952	-.4176
.6794	771.7701	17.9075	.0103	244.1130	5.6642	-.4466
.6918	769.4554	18.1805	-.0014	238.2389	5.6291	-.4318
.6856	770.6371	18.0433	.0044	241.1621	5.6465	-.4391

******FINAL RESULTS ITERATION 4*******

```
K-VALUE             =     .6856
FLUTTER MODE NO.    =    2
FLUTTER VELOCITY    =  770.64 KNOTS
FLUTTER FREQUENCY   =   18.0433 HZ.
FLUTTER DAMPING     =     .0044
```

BEAM ELEMENT	VOLUME(IN**3)	STRAIN ENERGY/VOL.	RATIO(E/V/AVGE(E/V))
1	0.0000	0.	0.0000
2	7359.0600	1.2895612E-01	.0044
3	4989.1932	1.1487492E-01	.0039
4	5737.5722	1.0433594E-01	.0035
5	0.0000	0.	0.0000
6	1662.7605	1.6627748E+01	.5649
7	758.2129	2.8283456E+01	.9609
8	429.6702	4.2535669E+01	1.4451
9	1036.0589	5.2229252E+01	1.7745
10	1079.5779	5.5186422E+01	1.8749
11	1078.3437	4.8735181E+01	1.6558
12	838.9781	4.7639248E+01	1.6185
13	400.1482	3.2184784E+01	1.0935

	25369.5759		

******THE CRITERION IS SATISFIED.******

****FLUTTER CHECK ANALYSIS FOR THE FINAL ITERATION****

****FLUTTER ANALYSIS****

	MODE 6			MODE 5		
K	V	F	G	V	F	G
13.0449	173.9206	77.4838	-.0298	137.3134	61.1749	-.0186
10.3697	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
8.2431	274.9034	77.3915	-.0471	216.5500	60.9637	-.0292
6.5527	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5.2089	433.7783	77.1673	-.0745	339.7235	60.4354	-.0454
4.1407	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3.2915	681.8353	76.6475	-.1176	525.9502	59.1239	-.0682
2.6165	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2.0799	1063.5443	75.5487	-.1836	788.0593	55.9797	-.0935
1.6534	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.3143	1637.5920	73.5032	-.2752	1137.9627	51.0801	-.2485
1.0448	2017.3804	71.9844	-.3239	1459.5906	52.0813	-.3348
.8305	2474.3853	70.1850	-.3598	1897.5896	53.8244	-.4660
.6602	3062.5472	69.0536	-.3756	2497.5420	56.3140	-.6768
.5248	3927.4574	70.3949	-.4230	3296.7248	59.0898	-.9633
.4172	5321.5496	75.8218	-.6050	4358.6307	62.1021	-1.2913
.3316	9276.2935	93.7386	-1.3120	5654.4493	64.0432	-1.5423
.2636	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.2096	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1666	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1324	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

		MODE 4			MODE 3	
K	J	F	G	V	F	G
13.0449	110.5624	49.2570	-.0223	69.1154	30.3463	-.0157
10.3697	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
8.2431	175.0498	49.2804	-.0354	107.5379	30.2743	-.0247
6.5527	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5.2089	277.3444	49.3391	-.0562	169.1691	30.0945	-.0388
4.1407	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3.2915	440.2181	49.4865	-.0898	263.7312	29.6469	-.0599
2.6165	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2.0799	701.9968	49.8062	-.1449	401.9587	28.5531	-.0882
1.6534	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.3143	1095.0784	49.1552	-.0859	580.3912	26.0522	-.1113
1.0448	1242.2519	44.3262	-.0435	671.9758	23.9775	-.1119
.8305	1370.9849	38.8875	.0575	785.4335	22.2785	-.4673
.6602	1531.9706	34.5425	.2534	1059.8599	23.8975	-.7935
.5248	1804.0398	32.3352	.5074	1426.4619	25.5676	-1.3077
.4172	2192.9929	31.2459	.7976	1950.3927	27.7893	-2.1250
.3316	2715.0634	30.7512	1.1679	2827.6760	32.0267	-3.7838
.2636	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.2096	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1666	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1324	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

		MODE 2			MODE 1	
K	J	F	G	V	F	G
13.0449	44.8881	19.9982	-.0214	10.9454	4.8763	-.0154
10.3697	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
8.2431	71.0775	20.0099	-.0339	17.3315	4.8792	-.0245
6.5527	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5.2089	112.6447	20.0390	-.0540	27.4678	4.8864	-.0391
4.1407	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3.2915	178.9062	20.1115	-.0867	43.6252	4.9041	-.0628
2.6165	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2.0799	285.6000	20.2932	-.1419	69.6493	4.9475	-.1026
1.6534	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.3143	462.3962	20.7558	-.2435	112.6677	5.0574	-.1733
1.0448	594.3313	21.2070	-.3268	144.8693	5.1692	-.2311
.8305	738.0838	20.9355	-.0893	189.0628	5.3627	-.3188
.6602	775.1283	17.4774	.0302	253.8574	5.7239	-.4718
.5248	801.4678	14.3653	.2809	361.2988	6.4758	-.8151
.4172	824.4584	13.1718	.8042	574.5741	8.1866	-1.8353
.3316	1335.5129	15.1262	1.9865	1456.9948	16.5022	-10.1162
.2636	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.2096	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1666	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1324	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FIRST CONVERGENCE ANALYSIS

	MODE 6			MODE 5		
K	V	F	G	V	F	G
.7356	2761.5169	69.3801	-.3691	2192.2480	55.0778	-.5663
.6959	2909.6103	69.1504	-.3722	2343.8345	55.7041	-.6207
.6776	2985.4097	69.0852	-.3738	2420.4401	56.0115	-.6486
.6866	2947.3496	69.1136	-.3730	2382.0793	55.8584	-.6346

	MODE 4			MODE 3		
K	V	F	G	V	F	G
.7356	1445.3757	36.3135	.1497	920.6211	23.1296	-.6170
.6959	1486.7473	35.3344	.2010	989.8113	23.5241	-.7026
.6776	1508.8751	34.9168	.2271	1024.7356	23.7134	-.7475
.6866	1497.6688	35.1199	.2140	1007.2478	23.6194	-.7249

	MODE 2			MODE 1		
K	V	F	G	V	F	G
.7356	760.4567	19.1056	-.0367	219.8499	5.5235	-.3874
.6959	768.6767	18.2685	-.0050	236.3919	5.6181	-.4272
.6776	772.0997	17.8671	.0121	245.0008	5.6696	-.4489
.6866	770.4410	18.0664	.0034	240.6665	5.6435	-.4379

```
****FLUTTER CHECK ANALYSIS FOR THE FINAL ITERATION****

     ******FINAL RESULTS ITERATION  4******

      K-VALUE               =     .6866
      FLUTTER MODE NO.      =    2
      FLUTTER VELOCITY      = 770.44 KNOTS
      FLUTTER FREQUENCY     =  18.0664 HZ.
      FLUTTER DAMPING       =     .0034
```

GENERALIZED MASS MATRIX

	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
1	1.0000000E+00	1.5331646E-05	-3.1722680E-06	-2.1221639E-08	-1.6168616E-08	2.0920552E-10
2	1.5331646E-05	1.0000000E+00	-1.2805001E-06	1.0656856E-06	-7.3255433E-08	-3.7270059E-07
3	-3.1722680E-06	-1.2805001E-06	1.0000000E+00	-1.0911985E-05	-3.1339441E-06	2.2684558E-06
4	-2.1221573E-08	1.0656856E-06	-1.0911985E-05	1.0000000E+00	-4.9062228E-06	-3.8340351E-05
5	-1.6168611E-08	-7.3255420E-08	-3.1339440E-06	-4.9062229E-06	1.0000000E+00	4.9490341E-05
6	2.0924661E-10	-3.7279052E-07	2.2684558E-06	-3.8340351E-05	4.9490341E-05	1.0000000E+00

MASS SCALE FACTORS - VIBRATION MODE PRINTOUT

MODE NUMBERS 1--------- 6

	5.9984E-02	5.8742E-02	-1.9405E-02	4.5339E-02	1.4230E-02	-1.2832E-02

H (DEFLECTION-IN)

STA						
2	1.1485E-07	-9.4043E-07	-2.6872E-06	3.1928E-06	1.7010E-05	3.5518E-05
3	9.9796E-05	-1.8325E-04	-2.0486E-03	4.9851E-04	4.7676E-03	2.6059E-03
4	2.7479E-04	-4.6664E-04	-5.6289E-03	1.2300E-03	1.2596E-02	5.8168E-03
5	5.7501E-04	-8.8048E-04	-1.1776E-02	2.1780E-03	2.5353E-02	1.0423E-02
6	2.3120E-02	-5.3858E-02	-4.6360E-01	1.7202E-01	1.0905E+00	2.5744E-01
7	1.0543E-01	-2.8290E-01	-3.3966E-01	5.3610E-01	1.0665E+00	-3.4160E-01
8	1.6188E-01	-4.1369E-01	-2.8421E-01	6.6527E-01	1.0228E+00	-2.7271E-01
9	2.0022E-01	-4.7289E-01	-4.0699E-01	6.6871E-01	1.1656E+00	-7.2510E-02
10	3.1751E-01	-5.6420E-01	-7.3075E-01	4.0035E-01	1.0692E+00	5.1884E-01
11	4.6451E-01	-5.6200E-01	-9.2462E-01	-2.1952E-01	1.3084E-01	5.2362E-01
12	6.3411E-01	-2.2385E-01	-7.7934E-01	-7.5784E-01	-1.0977E+00	-4.2403E-01
13	8.2380E-01	3.1789E-01	-9.6528E-02	-4.6904E-01	-1.1731E+00	-1.0120E+00
14	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00

HPRIME (SLOPE-RAD)

STA						
2	1.9534E-08	-3.9306E-08	-4.0254E-07	1.0992E-07	9.8751E-07	6.6331E-07
3	1.3296E-05	-2.3038E-05	-2.7232E-04	6.1475E-05	6.1346E-04	2.8582E-04
4	2.1609E-05	-3.2834E-05	-4.4211E-04	8.1380E-05	9.4449E-04	3.5839E-04
5	3.0480E-05	-3.6060E-05	-6.2473E-04	7.9114E-05	1.2633E-03	4.4056E-04
6	9.3632E-04	-1.3330E-03	-1.9037E-02	3.2155E-03	3.8710E-02	9.5644E-03
7	2.4432E-03	-6.1767E-03	2.5723E-03	7.9459E-03	-2.4210E-04	-4.1142E-03
8	2.8162E-03	-5.9059E-03	2.7848E-03	3.7443E-03	-4.6007E-03	1.0437E-02
9	2.9267E-03	-3.9664E-03	-9.2430E-03	-1.7577E-03	7.5664E-03	1.6532E-02
10	3.6852E-03	-7.9307E-04	-8.1836E-03	-1.3337E-02	-1.4563E-02	1.2463E-02
11	4.4023E-03	4.4839E-03	-1.5901E-03	-1.8851E-02	-3.4761E-02	-1.4438E-02
12	4.9994E-03	1.1135E-02	1.0493E-02	-7.7389E-03	-2.7155E-02	-3.2639E-02
13	5.5171E-03	1.8976E-02	2.7934E-02	2.7446E-02	3.1535E-02	1.5281E-02
14	5.8014E-03	2.4245E-02	4.1060E-02	6.3522E-02	1.0240E-01	1.0957E-01

ALPHA (TWIST-RAD)

STA						
2	7.8607E-04	-3.1059E-03	1.1625E-02	7.1648E-03	-3.2619E-02	-9.7459E-02
3	7.9570E-04	-3.1439E-03	1.1768E-02	7.2526E-03	-3.3018E-02	-9.8653E-02
4	8.0221E-04	-3.1685E-03	1.1854E-02	7.2943E-03	-3.3167E-02	-9.8841E-02
5	8.0968E-04	-3.1952E-03	1.1941E-02	7.3222E-03	-3.3204E-02	-9.8362E-02
6	1.6796E-03	-6.3140E-03	2.2111E-02	1.0575E-02	-3.7427E-02	-4.2589E-02
7	3.1868E-04	-3.8310E-03	3.7357E-02	5.8324E-03	-6.4559E-02	-2.4091E-02
8	2.5316E-04	-4.3216E-03	4.3396E-02	5.9926E-03	-6.6372E-02	-8.5938E-03
9	9.7973E-04	-6.0120E-03	4.7560E-02	6.1137E-03	-6.7755E-02	8.7794E-03
10	9.9786E-04	-6.7814E-03	6.0968E-02	1.5955E-03	-5.3338E-02	5.4527E-02
11	1.0173E-03	-7.4596E-03	7.4685E-02	-5.9066E-03	-1.3008E-02	8.0656E-02
12	1.0356E-03	-7.9500E-03	8.7641E-02	-1.4984E-02	5.3411E-02	5.3693E-02
13	1.0551E-03	-8.3180E-03	1.0210E-01	-2.5885E-02	1.6592E-01	-6.5518E-02
14	1.0711E-03	-8.5144E-03	1.1505E-01	-3.5054E-02	3.0425E-01	-2.6909E-01

SAMPLE 2

FREE-FREE SYMMERTIC CASE

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SAMPLE CASE NUMBER 2    FREE - FREE SYMMETRIC CASE


*************************************************************************
* STRENGTH CRITERION----  THE EI-GJ CURVE IS INPUT AND INCREASED UNTIL *
* THE FLUTTER VELOCITY IS GREATER  THAN THE INPUT  REFERENCE VELOCITY. *
*************************************************************************

                     *** INPUT DATA ***

MODULUS OF ELASTICITY,E                 =  1.0300000E+07 LB/IN**2
MODULUS OF SHEAR,G                      =  3.9000000E+06 LB/IN**2
DENSITY OF STRUCTURAL MATERIAL          =  1.0100000E-01 LBF/IN**3
DENSITY OF AIR                          =  4.4294000E-05 LBF/IN**3
FLUTTER VELOCITY DESIRED                =  7.5000000E+02 KNOTS
NUMBER OF CONTROL STATIONS              = 15
NUMBER OF MODES                         =  6
NUMBER OF STIFFNESS INSERTIONS          =  1
NUMBER OF MASS ADDITIONS                =  0
MAXIMUM NUMBER OF ITERATIONS            =  4
ROOT FLEXIBILITY INDICATOR              =  1
FREE-FREE OPTION INDICATOR              =  1
<M>       PRINTOUT INDICATOR            =  1
VIBRATION MODE PRINTOUT INDICATOR       =  0
```

FREE-FREE SYMMETRIC DATA

DELY	WEIGHT(LB)	DEA(IN)(-FWD)	IPITCHCG(LB-IN**2)
-0.	1.5000000E+05	-6.0000000E+02	3.2000000E+10

INPUT DISTRIBUTED WEIGHT DATA

STATION	WT(LB)	IROLLCG(LB-IN**2)	IPITCHCG(LB-IN**2)	DEA(IN) (-FWD)	RHOG(LB/IN**2)
2	0.	0.	0.	0.	1.0100000E-01
3	3.2710000E+02	6.3529000E+04	8.7674000E+04	-1.6500000E+01	1.0100000E-01
4	5.3360000E+02	1.3518600E+05	1.7053700E+05	1.2500000E+00	1.0100000E-01
5	0.	0.	0.	0.	1.0100000E-01
6	0.	0.	0.	0.	1.0100000E-01
7	1.7790000E+02	2.8129000E+04	1.4098800E+05	7.7500000E+00	1.0100000E-01
8	0.	0.	0.	0.	1.0100000E-01
9	1.4720000E+02	1.5898000E+04	1.3794700E+05	4.2500000E+00	1.0100000E-01
10	1.2260000E+02	1.3241000E+04	9.6051000E+04	4.5000000E+00	1.0100000E-01
11	1.0340000E+02	1.1167000E+04	6.5603000E+04	4.7500000E+00	1.0100000E-01
12	9.2700000E+01	1.0011000E+04	4.4444000E+04	3.5000000E+00	1.0100000E-01
13	8.8500000E+01	9.5580000E+03	2.9389000E+04	2.0000000E+00	1.0100000E-01
14	7.6800000E+01	3.3950000E+03	1.1907000E+04	7.5000000E-01	1.0100000E-01

INPUT ROOT STIFFNESS

1.0000000E+10	0.	0.
0.	1.0000000E+13	0.
0.	0.	1.6611296E+08

STIFFNESS INSERTION BEAM ELEMENT 5

4.0570000E+05	-8.8190000E+06	0.
-8.8190000E+06	3.8892000E+08	0.
0.	0.	1.4925000E+08

STRUCTURAL BOX GEOMETRY AND CONTROL STATION DATA

STA	DEPTH(IN)	LENGTH(IN)	WIDTH(IN)	ANGLE(DEG)	EI(LB-IN**2)	GJ(LB-IN**2)	E(LB/IN**2)	G(LB/IN**2)
1	15.000	0.000	120.000	0.000	2.000000E+11	2.000000E+11	1.030000E+07	3.900000E+06
2	15.000	14.750	120.000	0.000	2.000000E+11	2.000000E+11	1.030000E+07	3.900000E+06
3	15.000	10.000	120.000	0.000	2.000000E+11	2.000000E+11	1.030000E+07	3.900000E+06
4	15.000	11.500	120.000	0.000	2.000000E+11	2.000000E+11	1.030000E+07	3.900000E+06
5	15.000	9.000	120.000	0.000	2.000000E+11	2.000000E+11	1.030000E+07	3.900000E+06
6	11.340	38.250	88.000	0.000	1.565000E+10	2.080000E+10	1.030000E+07	3.900000E+06
7	10.510	21.500	79.500	49.000	9.600000E+09	1.210000E+10	1.030000E+07	3.900000E+06
8	9.754	13.750	73.750	0.000	7.100000E+09	8.850000E+09	1.030000E+07	3.900000E+06
9	9.190	35.500	70.000	-15.000	5.400000E+09	6.750000E+09	1.030000E+07	3.900000E+06
10	7.784	36.250	62.500	0.000	2.930000E+09	3.630000E+09	1.030000E+07	3.900000E+06
11	6.445	36.000	55.500	0.000	1.570000E+09	1.950000E+09	1.030000E+07	3.900000E+06
12	5.268	36.000	48.000	0.000	8.250000E+08	1.030000E+09	1.030000E+07	3.900000E+06
13	4.182	31.000	40.500	0.000	4.200000E+08	5.200000E+08	1.030000E+07	3.900000E+06
14	3.306	24.000	34.500	0.000	2.000000E+08	2.300000E+08	1.030000E+07	3.900000E+06
15	2.686	8.750	29.500	0.000	8.000000E+07	1.200000E+08	1.030000E+07	3.900000E+06

STRUCTURAL BOX AND AERO STRIP BOUNDARY INDICATORS

STATION	NI1	NI2	NO1	NO2
2	0	0	0	0
3	2	2	3	4
4	3	4	5	5
5	0	0	0	0
6	0	0	0	0
7	6	6	8	8
8	0	0	0	0
9	8	8	9	10
10	9	10	10	11
11	10	11	11	12
12	11	12	12	13
13	12	13	13	14
14	13	14	15	15

AERO STRIP DATA

STATION	WIDTH(IN)	AVG CHORD(IN)	AC TO EA(IN) (-FWD)	CLALPHA
2	0.	1.9400000E+02	-7.5000000E+00	3.9970000E+00
3	1.9750000E+01	1.8900000E+02	-5.5000000E+00	4.1020000E+00
4	1.6500000E+01	1.8650000E+02	-4.0000000E+00	4.1570000E+00
5	0.	1.8275000E+02	0.	4.2330000E+00
6	0.	1.8275000E+02	0.	4.4160000E+00
7	3.9109533E+01	1.6950000E+02	-1.2750000E+01	4.7210000E+00
8	0.	1.6225000E+02	-2.0800000E+01	4.8860000E+00
9	2.6114685E+01	1.5550000E+02	-2.0800000E+01	5.0450000E+00
10	2.9741725E+01	1.3950000E+02	-2.0000000E+01	5.4140000E+00
11	2.9946984E+01	1.2300000E+02	-1.9750000E+01	5.7250000E+00
12	2.9845354E+01	1.0750000E+02	-1.9500000E+01	5.9840000E+00
13	2.7772760E+01	9.1500000E+01	-2.0000000E+01	6.1140000E+00
14	3.7746986E+01	7.7250000E+01	-2.0500000E+01	5.7400000E+00

RIGID BODY MODE SHAPES

	COLUMN 1	COLUMN 2
1	1.0000000E+00	0.
2	0.	0.
3	0.	1.0000000E+00
4	1.0000000E+00	0.
5	0.	0.
6	0.	1.0000000E+00
7	1.0000000E+00	0.
8	0.	0.
9	0.	1.0000000E+00
10	1.0000000E+00	0.
11	0.	0.
12	0.	1.0000000E+00
13	1.0000000E+00	0.
14	0.	0.
15	0.	1.0000000E+00
16	1.0000000E+00	2.8267638E+01
17	0.	7.5477950E-01
18	0.	6.5605912E-01
19	1.0000000E+00	4.5093893E+01
20	0.	7.5477950E-01
21	0.	6.5605912E-01
22	1.0000000E+00	5.2782794E+01
23	0.	5.5919283E-01
24	0.	8.2903762E-01
25	1.0000000E+00	7.2634140E+01
26	0.	5.5919283E-01
27	0.	8.2903762E-01
28	1.0000000E+00	9.2404880E+01
29	0.	5.5919283E-01
30	0.	8.2903762E-01
31	1.0000000E+00	1.1303582E+02
32	0.	5.5919283E-01
33	0.	8.2903762E-01
34	1.0000000E+00	1.3310676E+02
35	0.	5.5919283E-01
36	0.	8.2903762E-01
37	1.0000000E+00	1.5[illegible]5[illegible]174E+02
38	0.	5.5919283E-01
39	0.	8.2903762E-01

*******COMMENCE ITERATION 1*******

STATION	TAU	EI(LB-IN**2)	GJ(LB-IN**2)
1	1.9014102E+00	2.0000000E+11	2.0000000E+11
2	1.9014102E+00	2.0000000E+11	2.0000000E+11
3	1.9014102E+00	2.0000000E+11	2.0000000E+11
4	1.9014102E+00	2.0000000E+11	2.0000000E+11
5	1.9014102E+00	2.0000000E+11	2.0000000E+11
6	2.4694389E-01	1.5650000E+10	2.0800000E+10
7	2.1264293E-01	9.6000000E+09	1.2100000E+10
8	1.9548248E-01	7.1000000E+09	6.8500000E+09
9	1.7734296E-01	5.4000000E+09	6.7500000E+09
10	1.5053435E-01	2.9300000E+09	3.6300000E+09
11	1.3322777E-01	1.5700000E+09	1.9500000E+09
12	1.2207038E-01	8.2500000E+08	1.0300000E+09
13	1.1846520E-01	4.2000000E+08	5.2000000E+08
14	1.0718293E-01	2.0000000E+08	2.3000000E+08
15	7.5309400E-02	8.0000000E+07	1.2000000E+08

*****VIBRATION ANALYSIS*****

MODE	FREQUENCY (HZ.)
1	5.448
2	19.269
3	30.871
4	47.207
5	56.781
6	79.453

****FLUTTER ANALYSIS****

	MODE 6			MODE 5		
K	V	F	G	V	F	G
12.4076	175.1347	74.2131	-.0296	128.3672	54.3955	-.0179
10.6346	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
9.1150	238.2685	74.1726	-.0402	174.3663	54.2781	-.0242
7.8125	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
6.6961	324.0120	74.0980	-.0547	236.3997	54.0620	-.0327
5.7393	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.9192	440.2427	73.9615	-.0740	319.4420	53.6668	-.0440
4.2163	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3.6138	597.2728	73.7148	-.0999	429.0525	52.9532	-.0583
3.0974	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2.6548	808.2061	73.2778	-.1336	570.2113	51.6995	-.0758
2.2754	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.9503	1088.9081	72.5287	-.1760	744.7018	49.6022	-.0978
1.6716	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.4327	1457.2408	71.3047	-.2248	946.6541	46.3211	-.2007
1.2280	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.0525	1932.4866	69.4660	-.2700	1331.5991	47.8662	-.3731
.9021	2219.4914	68.3822	-.2843	1589.7892	48.9812	-.4714
.7732	2553.5156	67.4341	-.2894	1911.9846	50.4903	-.6007
.6627	2961.1048	67.0211	-.2901	2315.7823	52.4150	-.7715
.5680	3481.2059	67.5339	-.3004	2825.3254	54.8101	-.9904
.4869	4167.0095	69.2869	-.3399	3481.4985	57.8886	-1.2673
.4173	5110.0653	72.8347	-.4400	4351.7371	62.0188	-1.6200
.3577	6526.8319	79.7255	-.6822	5532.7231	67.5824	-2.0615
.3066	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.2628	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.2252	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1930	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1654	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1418	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MODE 4

A	V	F	G
12.4076	104.4036	44.2409	-.0277
10.6346	0.0000	0.0000	0.0000
9.1150	142.1552	44.2527	-.0377
7.8125	0.0000	0.0000	0.0000
6.6951	193.5996	44.2741	-.0514
5.7393	0.0000	0.0000	0.0000
4.9142	263.7626	44.3126	-.0700
4.2163	0.0000	0.0000	0.0000
3.6138	359.5855	44.3797	-.0954
3.0974	0.0000	0.0000	0.0000
2.6548	490.6853	44.4891	-.1296
2.2754	0.0000	0.0000	0.0000
1.9503	673.2358	44.6423	-.1713
1.6716	0.0000	0.0000	0.0000
1.4327	915.4733	44.8149	-.1393
1.2280	0.0000	0.0000	0.0000
1.0525	1113.3887	39.6808	-.0419
.9021	1194.4185	36.8122	.0229
.7732	1291.4489	34.0878	.1225
.6627	1413.2068	31.9863	.2592
.5680	1573.0291	30.6441	.4218
.4869	1795.2554	29.8506	.6052
.4173	2064.5450	29.4229	.8179
.3577	2419.3171	29.3200	1.0815
.3066	0.0000	0.0000	0.0000
.2628	0.0000	0.0000	0.0000
.2252	0.0000	0.0000	0.0000
.1930	0.0000	0.0000	0.0000
.1654	0.0000	0.0000	0.0000
.1418	0.0000	0.0000	0.0000

MODE 3

V	F	G
70.2762	29.7790	-.0173
0.0000	0.0000	0.0000
95.4672	29.7188	-.0235
0.0000	0.0000	0.0000
129.4656	29.6074	-.0318
0.0000	0.0000	0.0000
175.0072	29.4015	-.0428
0.0000	0.0000	0.0000
235.1562	29.0227	-.0571
0.0000	0.0000	0.0000
312.4847	28.3321	-.0744
0.0000	0.0000	0.0000
406.8524	27.0991	-.0920
0.0000	0.0000	0.0000
510.8193	24.9951	-.1002
0.0000	0.0000	0.0000
603.1572	21.6813	-.0694
637.7329	19.6485	-.0141
791.1308	20.8916	-.6682
965.5731	21.8546	-.9214
1186.1351	23.0105	-1.2784
1474.0282	24.5094	-1.7914
1877.4246	26.7561	-2.6058
2521.8968	30.8051	-4.1803
0.0000	0.0000	0.0000
0.0000	0.0000	0.0000
0.0000	0.0000	0.0000
0.0000	0.0000	0.0000
0.0000	0.0000	0.0000
0.0000	0.0000	0.0000

	MODE 2			MODE 1		
K	V	F	G	V	F	G
12.4076	42.5304	18.0222	-.0248	12.2240	5.1799	-.0198
11.6346	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
9.1159	57.9182	18.0298	-.0338	16.6475	5.1823	-.0271
7.9125	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
6.6961	78.3914	18.0440	-.0461	22.6807	5.1868	-.0370
5.7393	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.9192	117.5589	18.0701	-.0631	30.9225	5.1950	-.0507
4.2163	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3.6138	149.3045	18.1185	-.0867	42.2149	5.2101	-.0698
3.0974	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2.6548	213.4295	18.2087	-.1200	57.7694	5.2378	-.0969
2.2754	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.9503	275.9429	18.3797	-.1681	79.4069	5.2890	-.1361
1.6716	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.4327	342.5254	18.7175	-.2415	110.0748	5.3861	-.1954
1.2280	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.0525	541.6175	19.4692	-.3713	155.2097	5.5792	-.2926
.9021	652.3449	20.1141	-.4925	186.5275	5.7469	-.3691
.7732	663.2248	17.5668	.0725	227.3214	6.0029	-.4830
.6627	647.3379	15.5571	.2107	283.1745	6.4093	-.6715
.5680	724.4187	14.0534	.4375	364.2069	7.0655	-1.0179
.4869	812.7165	13.5134	.7885	490.1397	8.1498	-1.7027
.4173	967.7781	14.0773	1.3407	727.6748	10.3705	-3.4134
.3577	1325.4499	16.2271	2.4328	1775.6548	21.6897	-18.0919
.3066	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.2628	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.2252	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1930	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1654	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1418	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FIRST CONVERGENCE ANALYSIS

MODE 6

K	V	F	G
.8327	2393.9128	67.8506	-.2880
.8660	2302.5905	68.1040	-.2865

MODE 5

V	F	G
1748.0551	49.7133	-.5339
1668.2083	49.3408	-.5021

MODE 4

K	V	F	G
.8327	1242.9151	35.3475	.0697
.8660	1219.0612	36.0563	.0455

MODE 3

V	F	G
720.6914	20.4959	-.5758
686.4693	20.3038	-.5331

MODE 2

K	V	F	G
.8327	653.0848	18.5732	.0264
.8660	645.3389	19.1020	.0055

MODE 1

V	F	G
206.2544	5.8657	-.4219
196.2381	5.8042	-.3946

******FINAL RESULTS ITERATION 1******

```
K-VALUE            =     .8660
FLUTTER MODE NO.   =    2
FLUTTER VELOCITY   = 645.84 KNOTS
FLUTTER FREQUENCY  =  19.1020 HZ.
FLUTTER DAMPING    =     .0055
```

BEAM ELEMENT	VOLUME(IN**3)	STRAIN ENERGY/VOL.	RATIO(E/V/AVGE(E/V))
1	0.0000	0.	0.0000
2	7359.0600	2.5922141E-01	.0015
3	4089.1932	2.2676028E-01	.0014
4	5737.5722	2.0160215E-01	.0012
5	0.0000	0.	0.0000
6	1662.7605	2.8695347E+01	.1709
7	758.2129	4.6798972E+01	.2787
8	415.3579	7.5291606E+01	.4484
9	867.4999	1.3094054E+02	.7799
10	678.0281	2.8673929E+02	1.7079
11	527.6790	5.2223100E+02	3.1105
12	422.1910	5.7050768E+02	3.3980
13	287.3266	1.8494625E+02	1.1016

	23704.8813		

GENERALIZED MASS MATRIX

	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
1	1.0000000E+00	7.3825003E-05	-5.5115105E-06	-1.0837031E-09	-7.4856865E-08	2.1640586E-09
2	7.3825003E-05	1.0000000E+00	2.0742690E-05	-6.2160783E-06	-5.4122610E-06	3.2895915E-06
3	-5.5115104E-06	2.0742690E-05	1.0000000E+00	3.0486172E-06	1.0323653E-06	-1.6862745E-06
4	-1.0836981E-09	-6.2160783E-06	3.0486122E-06	1.0000000E+00	-4.7330398E-07	-1.3076762E-11
5	-7.4856868E-08	-5.4122610E-06	1.0323653E-06	-4.7330399E-07	1.0000000E+00	-7.0829522E-06
6	2.1640733E-09	3.2895914E-06	-1.6862745E-06	-1.2957191E-11	-7.0829522E-06	1.0000000E+00

NORMALIZED RIGID BODY VIBRATION MODES

	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
1	-6.2081573E-03	3.8832476E-03	5.1425344E-03	-1.9050738E-03	-5.8109217E-03	-5.2577758E-03
2	-6.9232481E-06	4.2067500E-06	5.0840579E-06	-2.0718671E-06	-5.9968999E-06	-5.3015310E-06

RIGID BODY MASS MATRIX

1.5166980E+05	-8.9936740E+07
-8.9936740E+07	8.6007675E+10

MASS SCALE FACTORS - VIBRATION MODE PRINTOUT

MODE NUMBERS 1--------- 6

STA						
	7.0600E-02	6.1149E-02	-1.3385E-02	-3.9910E-02	1.9692E-02	-1.5890E-02
				W (DEFLECTION-IN)		
2	-6.2741E-03	3.8825E-03	5.1395E-03	-1.9024E-03	-5.8000E-03	-5.2377E-03
3	[illegible]	3.0617E-03	2.4266E-03	-1.7816E-03	-2.1620E-03	-2.9482E-03
4	-5.9673E-03	3.3129E-03	-2.3403E-03	-1.6872E-03	3.8919E-03	3.1142E-04
5	-5.7030E-03	2.7629E-03	-1.0559E-02	-1.7995E-03	1.3749E-02	5.6026E-03
6	1.3323E-02	-5.3434E-02	-5.8414E-01	7.8945E-02	8.4323E-01	2.5954E-01
7	[illegible]	-2.7300E-01	-4.2465E-01	4.8316E-01	1.0570E+00	-3.0633E-01
8	1.3140E-01	-4.1305E-01	-3.6293E-01	6.4810E-01	1.1153E+00	-3.1576E-01
9	1.6305E-01	-4.9420E-01	-5.3668E-01	6.5536E-01	1.2476E+00	-1.2209E-01
10	2.6007E-01	-6.2715E-01	-1.0517E+00	3.0667E-01	1.1284E+00	5.4122E-01
11	[illegible]	-5.3740E-01	-1.4962E+00	-2.9962E-01	8.9025E-02	6.8443E-01
12	5.8013E-01	[illegible]	-1.4715E+00	-9.8675E-01	-1.3314E+00	-5.1800E-01
13	7.9454E-01	2.2497E-01	-5.4296E-01	-6.3204E-01	-1.2994E+00	-1.3473E+00
14	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00

STA						
				WPRIME (SLOPE-RAD)		
2	1.6464E-08	-4.3542E-06	-5.1241E-07	3.3310E-08	7.2067E-07	5.1464E-07
3	1.1691E-05	-2.7448E-05	-3.6180E-04	1.2303E-05	4.7275E-04	2.7078E-04
4	1.4956E-05	-4.1921E-05	-5.8969E-04	3.7241E-06	7.3104E-04	3.8805E-04
5	2.6705E-05	-5.2910E-05	-8.3703E-04	-2.6886E-05	9.7363E-04	5.3278E-04
6	7.9324E-04	-1.6905E-03	-2.4556E-02	-5.2384E-05	2.9356E-02	1.2845E-02
7	2.0726E-03	-4.2314E-03	3.0948E-03	9.2635E-03	4.9301E-03	-6.2538E-03
8	2.3424E-03	-6.2741E-03	2.8468E-03	5.8187E-03	-1.7592E-04	5.3959E-03
9	2.4996E-03	-4.7413E-03	-1.3379E-02	-1.3141E-03	6.9299E-03	1.6408E-02
10	3.3052E-03	-2.7011E-03	-1.4766E-02	-1.3706E-02	-1.5511E-02	1.6878E-02
11	4.3426E-03	2.7336E-03	-7.9671E-03	-2.2820E-02	-3.9816E-02	-1.4240E-02
12	5.4449E-03	1.1724E-02	1.1572E-02	-1.0177E-02	-3.0215E-02	-4.5411E-02
13	6.3375E-03	2.2003E-02	4.0361E-02	3.3800E-02	4.0564E-02	2.1840E-02
14	6.7579E-03	2.6935E-02	5.6112E-02	6.5797E-02	9.8263E-02	1.1700E-01

STA						
				ALPHA (TWIST-RAD)		
2	6.6246E-04	-2.9527E-03	1.5009E-02	9.2145E-03	-1.4382E-02	-6.7054E-02
3	6.7306E-04	-2.9371E-03	1.5193E-02	9.3274E-03	-1.4558E-02	-6.7875E-02
4	6.7526E-04	-2.8594E-03	1.5305E-02	9.3851E-03	-1.4635E-02	-6.8046E-02
5	6.8255E-04	-2.8340E-03	1.5418E-02	9.4303E-03	-1.4677E-02	-6.7810E-02
6	1.4222E-03	-5.7516E-03	2.8664E-02	1.4707E-02	-1.9495E-02	-4.0274E-02
7	2.6901E-04	-2.9329E-03	4.8442E-02	1.2342E-02	-4.3150E-02	-3.4185E-02
8	2.1443E-04	-3.2329E-03	5.6398E-02	1.3359E-02	-4.6527E-02	-2.4954E-02
9	4.3257E-04	-4.9737E-03	6.1837E-02	1.4596E-02	-4.8882E-02	-1.3325E-02
10	9.5442E-04	-5.0336E-03	8.3462E-02	1.1158E-02	-5.0100E-02	3.5426E-02
11	8.8595E-04	-6.3991E-03	1.1392E-01	3.3759E-04	-3.2112E-02	9.3141E-02
12	9.2333E-04	-7.0724E-03	1.5262E-01	-1.9133E-02	2.0318E-02	8.6218E-02
13	9.6101E-04	-7.5098E-03	1.9528E-01	-4.2969E-02	1.1411E-01	-5.3696E-02
14	[illegible]	-7.0244E-03	2.2079E-01	-5.6686E-02	1.8781E-01	-1.9969E-01

*******COMMENCE ITERATION 2*******

STATION	TAU	EI(LB-IN**2)	GJ(LB-IN**2)
1	1.9014102E+00	2.0760906E+11	2.0000000E+11
2	1.9014102E+00	2.0760906E+11	2.0000000E+11
3	1.9014102E+00	2.0760906E+11	2.0000000E+11
4	1.9014102E+00	2.0760906E+11	2.0000000E+11
5	1.9014102E+00	2.0760906E+11	2.0000000E+11
6	2.4694389E-01	1.5662721E+10	2.0800000E+10
7	2.1264293E-01	9.6073025E+09	1.2100000E+10
8	1.9548248E-01	7.1052685E+09	8.8500000E+09
9	1.7734296E-01	5.4037233E+09	6.7500000E+09
10	1.5053435E-01	2.9320039E+09	3.6300000E+09
11	1.6793615E-01	1.9574691E+09	2.4307421E+09
12	2.0325549E-01	1.3296422E+09	1.6607891E+09
13	1.6817102E-01	5.8185736E+08	7.2007241E+08
14	1.0718293E-01	2.0037375E+08	2.3000000E+08
15	7.5309400E-02	8.0109711E+07	1.2000000E+08

*****VIBRATION ANALYSIS*****

MODE	FREQUENCY (HZ.)
1	5.254
2	20.350
3	31.185
4	50.061
5	60.679
6	81.821

****FLUTTER ANALYSIS****

	MODE 6			MODE 5		
K	V	F	G	V	F	G
1.4434	1476.4096	72.7799	-.2355	992.3519	48.9182	-.1133
1.2130	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.0194	2026.0543	70.5369	-.2938	1447.5320	50.3957	-.3776
.8567	2367.4767	69.2678	-.3124	1767.6304	51.7175	-.4892
.7200	2780.1123	68.3579	-.3211	2174.5024	53.4670	-.6423
.6050	3312.1195	68.4404	-.3346	2689.4480	55.5738	-.8432
.5085	4031.2396	70.0045	-.3800	3344.8077	58.0842	-1.0902

	MODE 4			MODE 3		
K	V	F	G	V	F	G
1.4434	980.7677	48.3471	-.2182	526.9135	25.9743	-.1033
1.2130	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.0194	1206.9243	42.0190	-.0330	647.9577	22.5586	-.0900
.8567	1309.4414	38.3117	.0466	727.2333	21.2774	-.4922
.7200	1424.1679	35.0177	.1766	908.9731	22.3500	-.7113
.6050	1587.8402	32.8105	.3508	1140.8866	23.5749	-1.0399
.5085	1817.1440	31.5556	.5512	1440.7350	25.0191	-1.5095

	MODE 2			MODE 1		
K	V	F	G	V	F	G
1.4434	400.1822	19.7270	-.2312	105.2943	5.1905	-.1720
1.2130	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.0194	588.0282	20.4722	-.3650	154.4688	5.3778	-.2680
.8567	683.3400	20.1863	-.0479	189.6979	5.5502	-.3460
.7200	718.6040	17.6692	.0443	237.0261	5.8280	-.4671
.6050	733.6901	15.2847	.2060	304.9782	6.3020	-.6827
.5085	740.3011	13.6545	.4905	411.0066	7.1373	-1.1284

FIRST CONVERGENCE ANALYSIS

K	V	F	G	V	F	G
		MODE 6			MODE 5	
.7824	2571.3496	68.7081	-.3177	1967.7983	52.5808	-.5632
.7499	2674.9103	68.5047	-.3195	2070.3816	53.0226	-.6022
.7658	2622.9489	68.5995	-.3186	2018.8919	52.8012	-.5825
		MODE 4			MODE 3	
.7824	1365.4419	36.4855	.1077	816.3969	21.8146	-.5940
.7499	1394.2063	35.7057	.1414	862.2846	22.0832	-.6509
.7658	1379.7003	36.0841	.1244	839.2370	21.9490	-.6220
		MODE 2			MODE 1	
.7824	706.4041	18.8756	-.0062	212.4841	5.6777	-.4017
.7499	712.9717	18.2593	.0180	224.5122	5.7498	-.4330
.7658	709.8149	18.5642	.0056	218.4405	5.7130	-.4170

******FINAL RESULTS ITERATION 2******

```
K-VALUE            =    .7658
FLUTTER MODE NO.   =   2
FLUTTER VELOCITY   = 709.81 KNOTS
FLUTTER FREQUENCY  =  18.5642 HZ.
FLUTTER DAMPING    =    .0056
```

BEAM ELEMENT	VOLUME(IN**3)	STRAIN ENERGY/VOL.	RATIO(E/V/AVGE(E/V))
1	0.0000	0.	0.0000
2	7359.0600	1.0968593E-01	.0026
3	4989.1932	9.5488102E-02	.0022
4	5737.5722	8.4700598E-02	.0020
5	0.0000	0.	0.0000
6	1662.7605	1.2884520E+01	.3011
7	758.2129	2.1914986E+01	.5122
8	415.3579	3.5891133E+01	.8389
9	867.4999	6.3218154E+01	1.4776
10	758.7055	1.0222544E+02	2.3893
11	762.9759	1.0008026E+02	2.3392
12	451.6882	8.9024884E+01	2.0808
13	351.8355	4.5101242E+01	1.0541

	24311.6618		

*******COMMENCE ITERATION 3*******

STATION	TAU	EI (LB-IN**2)	GJ (LB-IN**2)
1	1.9014102E+00	2.0760906E+11	2.0000000E+11
2	1.9014102E+00	2.0760906E+11	2.0000000E+11
3	1.9014102E+00	2.0760906E+11	2.0000000E+11
4	1.9014102E+00	2.0760906E+11	2.0000000E+11
5	1.9014102E+00	2.0760906E+11	2.0000000E+11
6	2.4694389E-01	1.5662721E+10	2.0800000E+10
7	2.1764293E-01	9.6073025E+09	1.2100000E+10
8	1.9548248E-01	7.1052685E+09	8.8500000E+09
9	1.7734296E-01	5.4037233E+09	6.7500000E+09
10	1.7383109E-01	3.3637115E+09	4.1658937E+09
11	2.2072504E-01	2.5271732E+09	3.1407008E+09
12	2.5257820E-01	1.6187517E+09	2.0234027E+09
13	1.9540753E-01	6.6654747E+08	8.2527616E+08
14	1.0718293E-01	2.0037375E+08	2.3000000E+08
15	7.5309400E-02	8.0109711E+07	1.2000000E+08

*****VIBRATION ANALYSIS*****

MODE	FREQUENCY (HZ.)
1	5.152
2	20.958
3	31.279
4	51.482
5	62.807
6	82.968

****FLUTTER ANALYSIS****

MODE 6

K	V	F	G
1.2763	1670.7791	72.8281	-.2709
1.0896	1926.5276	71.7667	-.3015
.9302	2221.2313	70.5680	-.3271
.7942	2558.9978	69.4067	-.3431
.6780	2969.0035	68.7479	-.3522
.5788	3497.3352	69.1359	-.3719
.4942	4202.9415	70.9311	-.4276

MODE 5

V	F	G
1157.7615	50.4660	-.2648
1375.4935	51.1865	-.3290
1642.9015	52.1946	-.4106
1975.2867	53.5748	-.5219
2386.8107	55.2673	-.6721
2890.7864	57.1455	-.8596
3509.3106	59.2250	-1.0775

MODE 4

K	V	F	G
1.2763	1102.4003	48.0528	-.0847
1.0896	1204.4490	44.8214	-.0534
.9302	1298.1118	41.2407	.0001
.7942	1389.0562	37.6748	.0916
.6780	1503.3317	34.8100	.2290
.5788	1668.9845	32.9927	.3970
.4942	1890.8399	31.9108	.5820

MODE 3

V	F	G
585.6247	25.5270	-.1085
646.3871	24.0539	-.1070
697.9837	22.1748	-.1000
822.4583	22.3072	-.5351
1010.3724	23.3954	-.7664
1240.7536	24.5274	-1.0871
1528.8201	25.8012	-1.5189

MODE 2

K	V	F	G
1.2763	470.8388	20.5235	-.2594
1.0896	559.8446	20.8336	-.3178
.9302	672.0055	21.3495	-.3935
.7942	731.6506	19.8443	-.0548
.6780	755.1908	17.4866	.0356
.5788	771.7795	15.2567	.1848
.4942	808.2756	13.6409	.4373

MODE 1

V	F	G
117.8080	5.1352	-.1842
140.1120	5.2140	-.2248
167.7172	5.3283	-.2786
202.7566	5.4993	-.3537
249.0217	5.7662	-.4676
313.8801	6.2048	-.6631
411.7971	6.9497	-1.0475

FIRST CONVERGENCE ANALYSIS

	MODE 6			MODE 5		
K	V	F	G	V	F	G
.7315	276[illegible].4562	68.9628	-.3479	2178.5496	54.4251	-.5950
.7037	2863.0610	68.8256	-.3500	2282.1154	54.8486	-.6332
.7173	2911.8111	68.8868	-.3489	2230.1891	54.6374	-.6139
.7105	28[illegible]7.6715	68.9543	-.3494	2256.1117	54.7431	-.6235

	MODE 4			MODE 3		
K	V	F	G	V	F	G
.7315	1443.2697	36.0563	.1578	915.2924	22.8662	-.6445
.7037	1472.4465	35.3890	.1930	962.5774	23.1347	-.7041
.7173	1457.6523	35.7111	.1753	938.8641	23.0014	-.6739
.7105	1464.9965	35.5472	.1841	950.7065	23.0683	-.6889

	MODE 2			MODE 1		
K	V	F	G	V	F	G
.7315	745.2166	18.6173	-.0132	225.0535	5.6224	-.4062
.7037	75[illegible].6032	18.0401	.0102	236.8074	5.6915	-.4356
.7173	743.0182	18.3258	-.0017	230.8757	5.6562	-.4206
.7105	74[illegible].3368	18.1822	.0042	233.8276	5.6737	-.4281

******FINAL RESULTS ITERATION 3******

```
K-VALUE            =    .7105
FLUTTER MODE NO.   =   2
FLUTTER VELOCITY   = 749.34 KNOTS
FLUTTER FREQUENCY  =  18.1822 HZ.
FLUTTER DAMPING    =    .0042
```

BEAM ELEMENT	VOLUME(IN**3)	STRAIN ENERGY/VOL.	RATIO(E/V/AVGE(E/V))
1	0.0000	0.	0.0000
2	7359.0600	1.0935659E-01	.0036
3	4989.1932	9.6432299E-02	.0032
4	5737.5722	8.6655597E-02	.0029
5	0.0000	0.	0.0000
6	1662.7605	1.3622032E+01	.4488
7	758.2129	2.3321831E+01	.7684
8	415.3579	3.7972432E+01	1.2512
9	927.5291	5.5713485E+01	1.8357
10	937.5808	6.4513178E+01	2.1257
11	971.8173	5.5152481E+01	1.8173
12	785.5247	5.1363226E+01	1.6924
13	387.0967	3.1890376E+01	1.0508

	24931.7055		

*******COMMENCE ITERATION 4*******

STATION	TAU	EI(LB-IN**2)	GJ(LB-IN**2)
1	1.9014102E+00	2.0760906E+11	2.0000000E+11
2	1.9014102E+00	2.0760906E+11	2.0000000E+11
3	1.9014102E+00	2.0760906E+11	2.0000000E+11
4	1.9014102E+00	2.0760906E+11	2.0000000E+11
5	1.9014102E+00	2.0760906E+11	2.0000000E+11
6	2.4694389E-01	1.5662721E+10	2.0800000E+10
7	2.1264293E-01	9.6073025E+09	1.2100000E+10
8	1.9548249E-01	7.1052685E+09	8.8500000E+09
9	1.9025399E-01	5.7793173E+09	7.2203801E+09
10	2.0203263E-01	3.8785721E+09	4.8054577E+09
11	2.5134206E-01	2.8479250E+09	3.5408572E+09
12	2.7202551E-01	1.7292983E+09	2.1621609E+09
13	2.0476811E-01	6.9506414E+08	8.6071688E+08
14	1.0718293E-01	2.0037375E+08	2.3000000E+08
15	7.5309400E-02	8.0109711E+07	1.2000000E+08

*****VIBRATION ANALYSIS*****

MODE	FREQUENCY (HZ.)
1	5.129
2	21.229
3	31.347
4	52.202
5	63.714
6	83.544

****FLUTTER ANALYSIS****

MODE 6				MODE 5		
K	V	F	G	V	F	G
1.1841	18[illegible]2.0721	72.9012	-.2981	1272.1358	51.4460	-.2842
1.0201	2062.5060	71.8577	-.3290	1498.5008	52.2052	-.3454
.8768	2355.5525	70.6951	-.3539	1775.6705	53.2916	-.4270
.7570	2642.7393	69.6193	-.3688	2117.0476	54.7351	-.5393
.6522	3104.0496	69.1359	-.3786	2533.3811	56.4255	-.6888
.5618	3635.5216	69.7559	-.4031	3033.9399	58.2132	-.8699
.4840	4344.0142	71.8033	-.4675	3636.3602	60.1063	-1.0737

MODE 4				MODE 3		
K	V	F	G	V	F	G
1.1841	1163.9980	47.0728	-.0711	622.9488	25.1924	-.1123
1.0201	1256.0340	43.7581	-.0366	680.9163	23.7220	-.1117
.8768	1339.6310	40.2051	.0245	725.9871	21.7884	-.1042
.7570	1426.0891	36.8708	.1252	887.2084	22.9383	-.5757
.6522	1543.4341	34.3766	.2658	1076.9826	23.9874	-.8139
.5618	1716.7809	32.8253	.4281	1305.0257	25.0399	-1.1289
.4840	1927.7295	31.8639	.6032	1585.6136	26.2090	-1.5403

MODE 2				MODE 1		
K	V	F	G	V	F	G
1.1841	516.1275	20.9534	-.2777	127.1642	5.1426	-.1945
1.0201	611.0264	21.2871	-.3364	149.9966	5.2256	-.2355
.8768	730.3723	21.9200	-.4163	178.0734	5.3444	-.2897
.7570	755.5358	19.5340	-.0509	213.4774	5.5193	-.3649
.6522	776.3167	17.2907	.0399	259.8739	5.7881	-.4780
.5618	791.0334	15.1778	.1862	324.2379	6.2213	-.6696
.4840	825.1590	13.6393	.4278	419.8478	6.9398	-1.0366

FIRST CONVERGENCE ANALYSIS

		MODE 6			MODE 5	
G	V	F	G	V	F	G
.7007	2894.0592	69.2559	-.3735	2323.1337	55.5934	-.6123
.6750	2937.7996	69.1648	-.3759	2427.8059	56.0140	-.6502
.6879	2945.0333	69.2025	-.3747	2375.3500	55.8047	-.6312

		MODE 4			MODE 3	
G	V	F	G	V	F	G
.7007	1481.2517	35.4469	.1941	981.3023	23.4829	-.6898
.6750	1511.4477	34.8719	.2299	1028.9637	23.7401	-.7508
.6879	1496.1220	35.1488	.2119	1005.0867	23.6128	-.7200

		MODE 2			MODE 1	
G	V	F	G	V	F	G
.7007	767.5978	18.3689	-.0089	235.8340	5.6436	-.4171
.6750	772.3172	17.9188	.0146	247.6228	5.7131	-.4463
.6879	770.1564	18.0911	.0026	241.6733	5.6777	-.4314

******FINAL RESULTS ITERATION 4******

```
K-VALUE            =    .6879
FLUTTER MODE NO.   =   2
FLUTTER VELOCITY   = 770.06 KNOTS
FLUTTER FREQUENCY  =  18.0911 HZ.
FLUTTER DAMPING    =    .0026
```

BEAM ELEMENT	VOLUME(IN**3)	STRAIN ENERGY/VOL.	RATIO(E/V/AVGE(E/V))
1	0.0000	0.	0.0000
2	7359.0600	1.3233243E-01	.0044
3	4989.1932	1.1806200E-01	.0039
4	5737.5722	1.0728739E-01	.0035
5	0.0000	0.	0.0000
6	1662.7505	1.7077980E+01	.5638
7	758.2129	2.8995913E+01	.9572
8	429.5400	4.3652599E+01	1.4410
9	1034.7152	5.3658493E+01	1.7714
10	1076.6159	5.6844447E+01	1.8765
11	1074.4346	5.0312379E+01	1.6609
12	835.8614	4.9217255E+01	1.6247
13	399.2011	3.3099798E+01	1.0927

	25357.1671		

******THE CRITERION IS SATISFIED.******

****FLUTTER CHECK ANALYSIS FOR THE FINAL ITERATION****

****FLUTTER ANALYSIS****

	MODE 4			MODE 5		
K	V	F	G	V	F	G
13.0465	173.9061	77.4870	-.0298	137.2563	61.1571	-.0186
10.3751	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
8.2507	274.6679	77.3957	-.0471	216.2912	60.9463	-.0292
6.5612	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5.2177	433.0612	77.1742	-.0744	339.0614	60.4201	-.0452
4.1493	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3.2947	683.2662	76.6613	-.1173	524.5751	59.1160	-.0680
2.6241	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2.0868	1059.4807	75.5778	-.1831	785.7039	55.9952	-.0932
1.6595	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.3197	1632.1861	73.5624	-.2745	1132.6572	51.0487	-.2469
1.0495	2013.7515	72.0678	-.3234	1451.8903	52.0376	-.3325
.8346	2466.2325	70.2934	-.3603	1885.9053	53.7527	-.4618
.6637	3056.4819	69.1426	-.3772	2480.3748	56.2205	-.6694
.5278	3996.0307	70.4169	-.4236	3272.7187	58.9907	-.9530
.4197	5283.2629	75.7311	-.6015	4325.2508	61.9988	-1.2788
.3338	8163.9765	93.1084	-1.2838	5615.8808	64.0157	-1.5332
.2654	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.2111	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1679	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1335	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

K	MODE 4 V	MODE 4 F	MODE 4 G	MODE 3 V	MODE 3 F	MODE 3 G
13.0465	110.5308	49.2490	-.0223	68.1240	30.3539	-.0157
10.3751	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
8.2507	174.8616	49.2723	-.0354	107.4674	30.2821	-.0247
6.5612	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5.2177	276.8293	49.3305	-.0562	168.9289	30.1028	-.0387
4.1493	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3.2997	439.0345	49.4762	-.0897	263.1698	29.6574	-.0597
2.6241	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2.0868	699.4795	49.8502	-.1445	400.8879	28.5703	-.0879
1.6595	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.3197	1092.3481	49.2184	-.0865	578.8110	26.0869	-.1111
1.0495	1239.2477	44.4162	-.0448	670.3895	24.0276	-.1119
.8346	1368.9711	38.9932	.0544	780.9763	22.2596	-.4615
.6637	1527.1890	34.6155	.2478	1052.8786	23.8647	-.7821
.5278	1795.8411	32.3700	.4998	1414.9697	25.5048	-1.2871
.4197	2180.4863	31.2554	.7874	1928.6541	27.6456	-2.0814
.3338	2695.7684	30.7292	1.1518	2775.1300	31.6339	-3.6546
.2654	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.2111	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1679	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1335	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

K	MODE 2 V	MODE 2 F	MODE 2 G	MODE 1 V	MODE 1 F	MODE 1 G
13.0465	44.9371	20.0226	-.0214	11.0403	4.3192	-.0152
10.3751	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
8.2507	71.9988	20.0342	-.0339	17.4678	4.9221	-.0242
6.5612	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5.2177	112.5884	20.0630	-.0539	27.6612	4.9292	-.0385
4.1493	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3.2997	173.6693	20.1348	-.0864	43.8947	4.9466	-.0618
2.6241	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2.0868	285.0445	20.3144	-.1413	70.0109	4.9895	-.1009
1.6595	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.3197	460.3441	20.7702	-.2420	113.1048	5.0976	-.1793
1.0495	591.8453	21.2125	-.3244	145.2942	5.2075	-.2269
.8346	737.0269	21.0070	-.0909	189.3575	5.3971	-.3127
.6637	774.3931	17.5525	.0270	253.6748	5.7498	-.4618
.5278	840.4352	14.4278	.2733	359.4293	6.4787	-.7034
.4197	919.3851	13.1786	.7867	565.2573	8.1025	-1.7570
.3338	1315.1178	15.0025	1.9255	1313.3979	14.0715	-8.1995
.2654	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.2111	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1679	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1335	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FIRST CONVERGENCE ANALYSIS

K	V	F (MODE 6)	G (MODE 6)	V	F (MODE 5)	G (MODE 5)
.7344	2751.8217	69.4873	-.3704	2177.7515	54.9913	-.5605
.6945	2834.8319	69.2503	-.3737	2327.9794	55.6132	-.6140
.6811	2974.0110	69.1800	-.3753	2403.9329	55.9191	-.6415

K	V	F (MODE 4)	G (MODE 4)	V	F (MODE 3)	G (MODE 3)
.7344	1441.8090	36.4077	.1452	914.9689	23.1042	-.6084
.6995	1482.6155	35.4182	.1958	983.5103	23.4951	-.6926
.6811	1534.4250	34.9952	.2217	1018.0990	23.6825	-.7368

K	V	F (MODE 2)	G (MODE 2)	V	F (MODE 1)	G (MODE 1)
.7344	759.5081	19.1786	-.0390	219.9610	5.5543	-.3796
.6945	767.8352	18.3428	-.0078	236.3726	5.6467	-.4184
.6811	771.3130	17.9419	.0091	244.9044	5.6968	-.4395

```
****FLUTTER CHECK ANALYSIS FOR THE FINAL ITERATION****

     ******FINAL RESULTS ITERATION  *******

       K-VALUE              =     .6811
       FLUTTER MODE NO.     =    2
       FLUTTER VELOCITY     = 771.31 KNOTS
       FLUTTER FREQUENCY    =  17.9419 HZ.
       FLUTTER DAMPING      =     .0091
```

GENERALIZED MASS MATRIX

	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
1	1.0000000E+00	1.6139599E-05	-3.3536748E-06	-2.2388739E-08	-1.7202380E-08	2.2476581E-10
2	1.6139599E-05	1.0000000E+00	-1.6595434E-06	1.7963378E-06	6.3414302E-08	-3.4633151E-07
3	-3.3536748E-06	-1.6595435E-06	1.0000000E+00	-1.0940916E-05	-3.1455304E-06	2.2776637E-06
4	-2.2388735E-08	1.7963377E-06	-1.0940916E-05	1.0000000E+00	-4.9134716E-06	-3.8883142E-05
5	-1.7202398E-08	6.3414230E-08	-3.1455305E-06	-4.9134716E-06	1.0000000E+00	4.8988590E-05
6	2.2484320E-10	-3.4633148E-07	2.2776638E-06	-3.8883142E-05	4.8988590E-05	1.0000000E+00

NORMALIZED RIGID BODY VIBRATION MODES

	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
1	-8.4637879E-03	3.8084263E-03	4.3510647E-03	-2.0967252E-03	-6.9497968E-03	-8.2857105E-03
2	-9.4209444E-06	4.1166026E-06	4.3309788E-06	-2.2442879E-06	-7.1229297E-06	-8.4093767E-06

RIGID BODY MASS MATRIX

1.5183484E+05	-8.9919981E+07
-8.9919981E+07	8.6009508E+10

MASS SCALE FACTORS - VIBRATION MODE PRINTOUT

MODE NUMBERS 1--------- 6

5.9944E-02	5.0739E-02	-1.9459E-02	4.5276E-02	1.4299E-02	-1.2927E-02

W (DEFLECTION-IN)

STA						
2	-9.4037E-03	3.8375E-03	4.3486E-03	-2.0936E-03	-6.9331E-03	-8.2511E-03
3	-9.3634E-03	3.0251E-03	2.3100E-03	-1.6041E-03	-2.2210E-03	-5.7341E-03
4	-8.1874E-03	3.3435E-03	-1.2565E-03	-8.8047E-04	5.5537E-03	-2.5814E-03
5	-7.8852E-03	2.9313E-03	-7.3837E-03	5.7246E-05	1.8237E-02	1.9466E-03
6	1.4313E-02	-5.1125E-02	-4.5803E-01	1.6958E-01	1.0801E+00	2.4848E-01
7	9.7471E-02	-2.8915E-01	-3.3598E-01	5.3492E-01	1.0618E+00	-3.4505E-01
8	1.5421E-01	-4.1153E-01	-2.8175E-01	6.6486E-01	1.0209E+00	-2.7481E-01
9	1.9279E-01	-4.7125E-01	-6.0486E-01	6.6862E-01	1.1643E+00	-7.3321E-02
10	3.1091E-01	-5.6379E-01	-7.2973E-01	4.0083E-01	1.0692E+00	5.2119E-01
11	4.5912E-01	-5.1231E-01	-9.2504E-01	-2.1939E-01	1.3125E-01	5.2689E-01
12	6.3029E-01	-2.2530E-01	-7.8080E-01	-7.5877E-01	-1.0978E+00	-6.2464E-01
13	8.2141E-01	3.1679E-01	-9.7767E-02	-4.7007E-01	-1.1732E+00	-1.0163E+00
14	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00

WPRIME (SLOPE-RAD)

STA						
2	1.9630E-08	-3.3058E-08	-4.0071E-07	1.0852E-07	9.7843E-07	6.4894E-07
3	1.3373E-05	-2.2945E-05	-2.7127E-04	6.0791E-05	6.0888E-04	2.8010E-04
4	2.1746E-05	-3.2758E-05	-4.4060E-04	8.0528E-05	9.3853E-04	3.5273E-04
5	3.0687E-05	-3.4833E-05	-6.2279E-04	7.8177E-05	1.2564E-03	4.3622E-04
6	3.4324E-04	-1.3371E-03	-1.8990E-02	3.2039E-03	3.8588E-02	9.6204E-03
7	2.4549E-03	-6.2002E-03	2.5192E-03	7.9804E-03	-1.0733E-04	-4.0232E-03
8	2.8314E-03	-5.9404E-03	2.7230E-03	3.7810E-03	-4.4787E-03	1.0471E-02
9	2.9455E-03	-3.9985E-03	-9.2685E-03	-1.7349E-03	7.6076E-03	1.6626E-02
10	3.7133E-03	-8.2931E-04	-8.2209E-03	-1.3332E-02	-1.4534E-02	1.2537E-02
11	4.4410E-03	4.4579E-03	-1.6284E-03	-1.8875E-02	-3.4766E-02	-1.4478E-02
12	5.0481E-03	1.1130E-02	1.0478E-02	-7.7649E-03	-2.7174E-02	-3.2795E-02
13	5.5752E-03	1.9012E-02	2.7965E-02	2.7476E-02	3.1569E-02	1.9301E-02
14	5.8642E-03	2.4285E-02	4.1103E-02	6.3544E-02	1.0235E-01	1.0078E-01

ALPHA (TWIST-RAD)

STA						
2	7.8244E-04	-3.1198E-03	1.1567E-02	7.2109E-03	-3.2242E-02	-9.6636E-02
3	7.9205E-04	-3.1531E-03	1.1709E-02	7.2992E-03	-3.2637E-02	-9.7820E-02
4	7.9920E-04	-3.1827E-03	1.1794E-02	7.3411E-03	-3.2785E-02	-9.8007E-02
5	8.0512E-04	-3.2096E-03	1.1881E-02	7.3690E-03	-3.2822E-02	-9.7534E-02
6	1.6829E-03	-6.3407E-03	2.2008E-02	1.0629E-02	-3.7099E-02	-4.2369E-02
7	3.1475E-04	-3.4609E-03	3.7229E-02	5.8802E-03	-6.4235E-02	-2.4190E-02
8	2.4856E-04	-4.3385E-03	4.3250E-02	6.0409E-03	-6.6075E-02	-8.8313E-03
9	9.7928E-04	-6.0370E-03	4.7389E-02	6.1702E-03	-6.7462E-02	8.4448E-03
10	9.9759E-04	-6.6139E-03	6.0772E-02	1.6354E-03	-5.3235E-02	5.4447E-02
11	1.0173E-03	-7.4985E-03	7.4483E-02	-5.9122E-03	-1.3176E-02	8.0793E-02
12	1.0359E-03	-7.9942E-03	8.7447E-02	-1.5060E-02	5.2965E-02	5.3653E-02
13	1.0557E-03	-8.3671E-03	1.0193E-01	-2.6082E-02	1.6513E-01	-6.4921E-02
14	1.0720E-03	-8.5684E-03	1.1487E-01	-3.5304E-02	3.0272E-01	-2.6689E-01

SAMPLE 3

FREE-FREE ANTISYMMETRIC CASE

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SAMPLE CASE NUMBER 3    FREE - FREE ANTI-SYMMETRIC CASE

*********************************************************************
* STRENGTH CRITERION----  THE EI-GJ CURVE IS INPUT AND INCREASED UNTIL *
* THE FLUTTER VELOCITY IS GREATER  THAN THE INPUT  REFERENCE VELOCITY. *
*********************************************************************

                         *** INPUT DATA ***

MODULUS OF ELASTICITY,E                    =  1.0300000E+07 LB/IN**2
MODULUS OF SHEAR,G                         =  3.9000000E+06 LB/IN**2
DENSITY OF STRUCTURAL MATERIAL             =  1.0100000E-01 LBF/IN**3
DENSITY OF AIR                             =  4.4294000E-05 LBF/IN**3
FLUTTER VELOCITY DESIRED                   =  7.5000000E+02 KNOTS
NUMBER OF CONTROL STATIONS                 = 15
NUMBER OF MODES                            =  6
NUMBER OF STIFFNESS INSERTIONS             =  1
NUMBER OF MASS ADDITIONS                   =  1
MAXIMUM NUMBER OF ITERATIONS               =  4
ROOT FLEXIBILITY INDICATOR                 =  1
FREE-FREE OPTION INDICATOR                 =  2
<M>        PRINTOUT INDICATOR              =  1
VIBRATION MODE PRINTOUT INDICATOR          =  0
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FREE-FREE ANTI-SYMMETRIC DATA

DFLY	I-ROLL(LB-IN**2)
1.0750000E+01	6.0000000E+08

INPUT DISTRIBUTED WEIGHT DATA

STATION	WT(LB)	IROLLCG(LB-IN**2)	IPITCHCG(LB-IN**2)	DEA(IN) (-FWD)	RHOG(LB/IN**2)
2	0.	0.	0.	0.	1.0100000E-01
3	3.2710000E+02	6.3529000E+04	8.7674000E+04	-1.6500000E+01	1.0100000E-01
4	5.3300000E+02	1.3518600E+05	1.7053700E+05	1.2500000E+00	1.0100000E-01
5	0.	0.	0.	0.	1.0100000E-01
6	0.	0.	0.	0.	1.0100000E-01
7	1.7790000E+02	2.8129000E+04	1.4098800E+05	7.7500000E+00	1.0100000E-01
8	0.	0.	0.	0.	1.0100000E-01
9	1.4720000E+02	1.5898000E+04	1.3794700E+05	4.2500000E+00	1.0100000E-01
10	1.2260000E+02	1.3241000E+04	9.6051000E+04	4.5000000E+00	1.0100000E-01
11	1.0340000E+02	1.1167000E+04	6.5603000E+04	4.7500000E+00	1.0100000E-01
12	9.2700000E+01	1.0011000E+04	4.4444000E+04	3.5000000E+00	1.0100000E-01
13	8.8500000E+01	9.5580000E+03	2.9389000E+04	2.0000000E+00	1.0100000E-01
14	7.6800000E+01	3.3950000E+03	1.1907000E+04	7.5000000E-01	1.0100000E-01

MASS ADDED TO STATION 14

1.0000000E+01	-5.5900000E+01	8.2900000E+01
-5.5900000E+01	1.6940000E+03	8.8000000E+02
8.2900000E+01	8.8000000E+02	2.4060000E+03

INPUT ROOT STIFFNESS

1.0000000E+10	0.	0.
0.	1.0000000E+13	0.
0.	0.	1.6611296E+08

STIFFNESS INSERTION BEAM ELEMENT 5

4.0570000E+05	-8.8190000E+06	0.
-8.8190000E+06	3.8892000E+08	0.
0.	0.	1.4925000E+08

STRUCTURAL BOX GEOMETRY AND CONTROL STATION DATA

STA	DEPTH(IN)	LENGTH(IN)	WIDTH(IN)	ANGLE(DEG)	EI(LB-IN**2)	GJ(LB-IN**2)	E(LB/IN**2)	G(LB/IN**2)
1	15.000	[illegible]	120.000	0.000	2.000000E+11	2.000000E+11	1.030000E+07	3.900000E+06
2	15.000	14.750	120.000	0.000	2.000000E+11	2.000000E+11	1.030000E+07	3.900000E+06
3	15.000	1[illegible].000	120.000	0.000	2.000000E+11	2.000000E+11	1.030000E+07	3.900000E+06
4	15.000	11.500	120.000	0.000	2.000000E+11	2.000000E+11	1.030000E+07	3.900000E+06
5	15.000	[illegible].000	120.000	0.000	2.000000E+11	2.000000E+11	1.030000E+07	3.900000E+06
6	11.84[illegible]	38.250	88.000	0.000	1.565000E+10	2.080000E+10	1.030000E+07	3.900000E+06
7	10.516	21.500	79.500	49.000	9.600000E+09	1.210000E+10	1.030000E+07	3.900000E+06
8	9.784	13.750	73.750	0.000	7.100000E+09	8.850000E+09	1.030000E+07	3.900000E+06
9	9.190	35.500	70.000	-15.000	5.400000E+09	6.750000E+09	1.030000E+07	3.900000E+06
10	7.734	36.250	62.500	0.000	2.930000E+09	3.630000E+09	1.030000E+07	3.900000E+06
11	6.445	36.[illegible]	55.500	0.000	1.570000E+09	1.950000E+09	1.030000E+07	3.900000E+06
12	5.268	36.[illegible]	48.000	0.000	8.250000E+08	1.030000E+09	1.030000E+07	3.900000E+06
13	4.102	41.[illegible]	40.500	0.000	4.200000E+08	5.200000E+08	1.030000E+07	3.900000E+06
14	3.3[illegible]6	24.[illegible]	34.500	0.000	2.000000E+08	2.300000E+08	1.030000E+07	3.900000E+06
15	2.686	4.750	29.500	0.000	6.000000E+07	1.200000E+08	1.030000E+07	3.900000E+06

STRUCTURAL BOX AND AERO STRIP BOUNDARY INDICATORS

STATION	NI1	NI2	NO1	NO2
2	0	0	0	0
3	2	2	3	4
4	3	4	5	5
5	0	0	0	0
6	0	0	0	0
7	6	6	8	8
8	0	0	0	0
9	8	8	9	10
10	9	10	10	11
11	10	11	11	12
12	11	12	12	13
13	12	13	13	14
14	13	14	15	15

AERO STRIP DATA

STATION	WIDTH(IN)	AVG CHORD(IN)	AC TO EA(IN) (-FWD)	CLALPHA
2	0.	1.9400000E+02	-7.5000000E+00	3.9970000E+00
3	3.[illegible]50[illegible]000E+01	1.8900000E+02	-5.5000000E+00	4.1020000E+00
4	1.650[illegible]000E+01	1.8650000E+02	-4.0000000E+00	4.1570000E+00
5	0.	1.8275000E+02	0.	4.2330000E+00
6	0.	1.8275000E+02	0.	4.4160000E+00
7	3.9104533E+01	1.6950000E+02	-1.2750000E+01	4.7210000E+00
8	0.	1.6225000E+02	-2.0800000E+01	4.8860000E+00
9	2.6114685E+01	1.5550000E+02	-2.0800000E+01	5.0450000E+00
10	2.9741725E+01	1.3950000E+02	-2.0000000E+01	5.4140000E+00
11	2.9948984E+01	1.2300000E+02	-1.9750000E+01	5.7250000E+00
12	2.9845354E+01	1.0750000E+02	-1.9500000E+01	5.9840000E+00
13	2.7772760E+01	9.1500000E+01	-2.0000000E+01	6.1140000E+00
14	3.2746926E+01	7.7250000E+01	-2.0500000E+01	5.7400000E+00

RIGID BODY MODE SHAPES

	COLUMN 1
1	1.375000E+01
2	1.000000E+00
3	-0.
4	2.550000E+01
5	1.000000E+00
6	-0.
7	3.550000E+01
8	1.000000E+00
9	-0.
10	4.700000E+01
11	1.000000E+00
12	-0.
13	4.700000E+01
14	1.000000E+00
15	-0.
16	7.2094261E+01
17	6.5605912E-01
18	-7.5471958E-01
19	8.6199593E+01
20	6.5605912E-01
21	-7.5471958E-01
22	9.7594800E+01
23	8.2903762E-01
24	-5.5919283E-01
25	1.2702964E+02
26	8.2903762E-01
27	-5.5919283E-01
28	1.5706225E+02
29	8.2903762E-01
30	-5.5919283E-01
31	1.8609274E+02
32	8.2903762E-01
33	-5.5919283E-01
34	2.1677296E+02
35	8.2903762E-01
36	-5.5919283E-01
37	2.4247312E+02
38	8.2903762E-01
39	-5.5919283E-01

*******COMMENCE ITERATION 1*******

STATION	TAU	EI(LB-IN**2)	GJ(LB-IN**2)
1	1.9014102E+00	2.0000000E+11	2.0000000E+11
2	1.9014102E+00	2.0000000E+11	2.0000000E+11
3	1.9014102E+00	2.0000000E+11	2.0000000E+11
4	1.9014102E+00	2.0000000E+11	2.0000000E+11
5	1.9014102E+00	2.0000000E+11	2.0000000E+11
6	2.4694389E-01	1.5650000E+10	2.0800000E+10
7	2.1264293E-01	9.6000000E+09	1.2100000E+10
8	1.9548248E-01	7.1000000E+09	8.8500000E+09
9	1.7734296E-01	5.4000000E+09	6.7500000E+09
10	1.5053435E-01	2.9300000E+09	3.6300000E+09
11	1.3322777E-01	1.5700000E+09	1.9500000E+09
12	1.2207038E-01	8.2500000E+08	1.0300000E+09
13	1.1846520E-01	4.2000000E+08	5.2000000E+08
14	1.0718293E-01	2.0000000E+08	2.3000000E+08
15	7.5309400E-02	8.0000000E+07	1.2000000E+08

*****VIBRATION ANALYSIS*****

MODE	FREQUENCY (HZ.)
1	5.369
2	19.027
3	30.383
4	47.135
5	55.067
6	79.029

****FLUTTER ANALYSIS****

	MODE 6			MODE 5		
K	V	F	G	V	F	G
12.3414	173.6072	73.1734	-.0319	125.3045	52.8160	-.0168
10.5745	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
9.0626	236.3099	73.1237	-.0434	170.3209	52.7041	-.0228
7.7664	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
6.6519	321.4743	73.0321	-.0590	231.0852	52.4976	-.0308
5.6996	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.8836	436.8719	72.8640	-.0801	312.4915	52.1191	-.0415
4.1844	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3.5863	592.5679	72.5584	-.1081	420.0443	51.4336	-.0553
3.0720	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2.6322	801.0719	72.0133	-.1446	558.6769	50.2229	-.0725
2.2554	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.9325	1076.8468	71.0700	-.1898	729.6550	48.1559	-.0961
1.6558	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.4187	1434.7421	69.5180	-.2399	951.0982	46.0838	-.2464
1.2156	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.0416	1889.6701	67.2203	-.2792	1337.3924	47.5744	-.4035
.8925	2163.7405	65.9500	-.2857	1596.3840	48.6572	-.5107
.7647	2487.8576	64.9727	-.2822	1914.4709	49.9982	-.6513
.6552	2890.6362	64.6836	-.2784	2302.8897	51.5317	-.8285
.5614	3407.0880	65.3251	-.2888	2778.4799	53.2726	-1.0416
.4811	4086.0714	67.1271	-.3293	3368.0537	55.3313	-1.2921
.4122	5021.9675	70.6639	-.4275	4106.3433	57.8020	-1.5795
.3532	6433.4449	77.5998	-.6566	5020.6001	60.5535	-1.8810
.3026	9164.0471	94.7035	-1.3310	6058.6412	62.6115	-2.0952
.2593	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.2222	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1903	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1631	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1397	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

MODE 4 | MODE 3

K	V	F	G	V	F	G
12.3414	1 4.6382	44.1038	-.0286	69.5665	29.3214	-.0166
10.5745	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
9.6036	142.5076	44.1161	-.0390	94.5611	29.2610	-.0226
7.7634	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
6.6519	144.2907	44.1387	-.0532	128.3088	29.1490	-.0306
5.0995	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.8836	204.8875	44.1794	-.0726	173.5278	28.9420	-.0413
4.1844	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3.5853	351.3887	44.2511	-.0990	233.2470	28.5605	-.0552
3.0720	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2.6322	443.5773	44.3707	-.1346	309.9639	27.8646	-.0721
2.2554	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.9325	675.2473	44.5684	-.1772	403.3813	26.6224	-.0894
1.6558	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.4187	922.7802	43.7427	-.1048	505.7491	24.5052	-.0977
1.2156	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.0410	1049.1231	38.7428	-.0349	594.9829	21.1650	-.0676
.8925	1173.4543	35.9189	.0286	628.0566	19.1429	-.0113
.7647	1273.7066	33.2640	.1283	791.0411	20.6588	-.6793
.6552	1345.9244	31.2365	.2646	964.5419	21.5835	-.9359
.5614	1561.1524	29.9324	.4252	1182.8388	22.6789	-1.2037
.4916	1773.1672	29.1301	.6049	1465.8817	24.0819	-1.8021
.4122	2035.1996	28.6480	.8113	1857.7033	26.1495	-2.5945
.3532	2357.5902	28.4349	1.0630	2468.0748	29.7674	-4.0719
.3026	2764.9724	28.5739	1.3971	3701.7476	38.2548	-8.1018
.2543	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.2222	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1933	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1631	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1347	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

K	V (MODE 2)	F (MODE 2)	G (MODE 2)	V (MODE 1)	F (MODE 1)	G (MODE 1)
12.3414	42.2225	17.7963	-.0247	12.1487	5.1205	-.0189
10.5745	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
9.0606	57.6354	17.8037	-.0337	16.5552	5.1228	-.0258
7.7634	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
6.6519	78.4298	17.8176	-.0461	22.5685	5.1271	-.0353
5.6996	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.8830	106.9826	17.8432	-.0631	30.7875	5.1349	-.0484
4.1844	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3.5853	145.1089	17.8907	-.0867	42.0530	5.1493	-.0667
3.0720	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2.6322	201.0024	17.9794	-.1200	57.5742	5.1757	-.0926
2.2554	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.9325	274.9822	18.1483	-.1682	79.1639	5.2247	-.1301
1.6558	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.4187	381.4872	18.4843	-.2416	109.7467	5.3176	-.1867
1.2156	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.0410	541.2545	19.2538	-.3732	154.6934	5.5027	-.2794
.8925	652.9746	19.9024	-.4994	185.8160	5.6636	-.3522
.7647	594.1189	17.1829	.0743	226.2829	5.9096	-.4608
.6552	674.0248	15.0826	.2104	281.5372	6.2999	-.6410
.5614	708.1013	13.5766	.4363	361.2089	6.9256	-.9725
.4810	792.8350	13.0249	.7870	482.7256	7.9304	-1.6157
.4122	961.5959	13.5357	1.3337	701.2484	9.8710	-3.1193
.3532	1295.6713	15.5065	2.3928	1443.5891	17.4111	-11.8254
.3026	2143.7772	22.1543	6.1327	0.0000	0.0000	0.0000
.2593	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.2222	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1903	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1631	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1397	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

FIRST CONVERGENCE ANALYSIS

	MODE 6			MODE 5		
K	V	F	G	V	F	G
.8236	2324.2063	65.3789	-.2848	1753.5207	49.3258	-.5792
.8567	2243.7065	65.6452	-.2855	1674.4417	48.9900	-.5444

	MODE 4			MODE 3		
K	V	F	G	V	F	G
.8236	1220.017[illegible]	34.4873	.0754	720.7682	20.2749	-.5851
.8567	12[illegible]2.391[illegible]	35.1789	.0512	686.5871	20.0878	-.5413

	MODE 2			MODE 1		
K	V	F	G	V	F	G
.8236	642.747[illegible]	18.0892	.0291	205.3980	5.7778	-.4026
.8567	635.9432	18.6032	.0086	195.4587	5.7186	-.3765

******FINAL RESULTS ITERATION 1******

```
K-VALUE              =     .8567
FLUTTER MODE NO.     =    2
FLUTTER VELOCITY     =  635.84 KNOTS
FLUTTER FREQUENCY    =   18.6032 HZ.
FLUTTER DAMPING      =     .0086
```

BEAM ELEMENT	VOLUME(IN**3)	STRAIN ENERGY/VOL.	RATIO(E/V/AVGE(E/V))
1	0.0000	0.	0.0000
2	7359.0600	2.3623195E-01	.0014
3	4989.1932	2.0473573E-01	.0012
4	5737.5722	1.8051740E-01	.0011
5	0.0000	0.	0.0000
6	1662.7605	2.5376167E+01	.1513
7	758.2129	4.1403646E+01	.2468
8	415.3579	6.6427633E+01	.3960
9	867.4999	1.1651889E+02	.6946
10	678.0281	2.6035904E+02	1.5520
11	527.6790	4.9342191E+02	2.9413
12	422.1910	5.8757720E+02	3.5026
13	287.3266	2.5359492E+02	1.5117

	2370 .8813		

GENERALIZED MASS MATRIX

	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
1	1.0000000E+00	7.6808916E-05	-5.4313836E-06	1.2396746E-09	-8.4922730E-08	2.2299978E-09
2	7.6808916E-05	1.0000000E+00	2.0529773E-05	-5.5950596E-06	-5.2160473E-06	3.1126877E-06
3	-5.4313836E-06	2.0529773E-05	1.0000000E+00	2.5726834E-06	5.3954312E-07	-1.7117306E-07
4	1.2396773E-09	-5.5950596E-06	2.5726834E-06	1.0000000E+00	-3.0953270E-06	-1.4327165E-07
5	-8.4922748E-08	-5.2160474E-06	5.3954312E-07	-3.0953271E-06	1.0000000E+00	-6.0771533E-06
6	2.2299797E-09	3.1126877E-06	-1.7117304E-07	-1.4327153E-07	-6.0771533E-06	1.0000000E+00

NORMALIZED RIGID BODY VIBRATION MODES

	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
1	-9.94[illegible]39[illegible]E-05	2.5131283E-05	1.2445455E-04	-4.5868502E-06	-6.0047532E-05	-1.8427195E-05

RIGID BODY MASS MATRIX

6.2015353E+08

MASS SCALE FACTORS - VIBRATION MODE PRINTOUT

MODE NUMBERS 1--------- 6

STA						
	6.8663E-02	5.7254E-02	-9.7914E-03	-3.9377E-02	1.4280E-02	-1.8012E-02
STA			W (DEFLECTION-IN)			
2	-1.0685E-03	2.6934E-04	1.3341E-03	-4.6947E-05	-6.3134E-04	-1.7956E-04
3	-2.4469E-03	4.0563E-04	-3.5170E-04	2.4485E-05	3.3604E-03	1.8142E-03
4	-3.2866E-03	2.7445E-04	-5.3066E-03	1.0035E-04	1.0900E-02	4.9557E-03
5	-4.1647E-03	-3.5337E-05	-1.4588E-02	-2.4626E-05	2.3506E-02	1.0080E-02
6	1.4950E-02	-6.0131E-02	-7.5546E-01	8.4694E-02	1.1294E+00	3.0103E-01
7	8.2925E-02	-2.9552E-01	-4.9890E-01	4.9451E-01	1.4044E+00	-1.6850E-01
8	1.2994E-01	-4.3703E-01	-3.9343E-01	6.6179E-01	1.4849E+00	-1.8276E-01
9	1.6178E-01	-5.1136E-01	-6.1279E-01	6.6981E-01	1.6759E+00	-1.9606E-02
10	2.6242E-01	-6.6485E-01	-1.2914E+00	4.0838E-01	1.5860E+00	4.8984E-01
11	3.9926E-01	-6.8305E-01	-1.9384E+00	-2.9981E-01	2.8200E-01	5.0742E-01
12	5.7549E-01	-4.3151E-01	-2.0419E+00	-1.0035E+00	-1.6475E+00	-5.4982E-01
13	7.9173E-01	1.7645E-01	-9.8025E-01	-6.5297E-01	-1.8696E+00	-1.1221E+00
14	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
STA			WPRIME (SLOPE-RAD)			
2	-9.9387E-05	2.5084E-05	1.2379E-04	-4.5496E-06	-5.9084E-05	-1.7921E-05
3	-8.7687E-05	-5.1204E-06	-3.4559E-04	9.9535E-06	5.7464E-04	2.5466E-04
4	-8.0338E-05	-2.0385E-05	-6.4315E-04	2.2943E-06	9.2470E-04	3.7517E-04
5	-7.2474E-05	-3.2531E-05	-9.6786E-04	-2.7739E-05	1.2559E-03	5.1541E-04
6	6.9846E-04	-1.8096E-03	-3.1873E-02	5.2650E-05	3.9520E-02	1.3307E-02
7	2.0285E-03	-6.5187E-03	5.2764E-03	9.3960E-03	6.5076E-03	-5.2414E-03
8	2.3527E-03	-6.5870E-03	4.7715E-03	5.8986E-03	1.1287E-04	3.8960E-03
9	2.4428E-03	-5.2440E-03	-1.7071E-02	-1.2875E-03	1.0548E-02	1.3476E-02
10	3.2629E-03	-2.9804E-03	-2.0157E-02	-1.3903E-02	-1.8218E-02	1.1800E-02
11	4.3159E-03	2.5982E-03	-1.3264E-02	-2.3269E-02	-5.1642E-02	-1.4815E-02
12	5.4749E-03	1.1928E-02	1.0651E-02	-1.0575E-02	-4.4419E-02	-3.7233E-02
13	6.4735E-03	2.2741E-02	4.9482E-02	3.4073E-02	4.4660E-02	2.3834E-02
14	6.8654E-03	2.7953E-02	7.4501E-02	6.6791E-02	1.3030E-01	1.0210E-01
STA			ALPHA (TWIST-RAD)			
2	6.7436E-04	-2.8987E-03	2.0294E-02	9.2615E-03	-1.9152E-02	-5.8290E-02
3	6.8262E-04	-2.9342E-03	2.0543E-02	9.3749E-03	-1.9387E-02	-5.9004E-02
4	6.8820E-04	-2.9573E-03	2.0694E-02	9.4331E-03	-1.9492E-02	-5.9155E-02
5	6.9460E-04	-2.9828E-03	2.0649E-02	9.4788E-03	-1.9554E-02	-5.8957E-02
6	1.4402E-03	-5.9544E-03	3.8902E-02	1.4808E-02	-2.6802E-02	-3.5880E-02
7	3.5260E-04	-2.9641E-03	6.4347E-02	1.2331E-02	-5.8860E-02	-3.2478E-02
8	2.9677E-04	-3.2535E-03	7.4972E-02	1.3346E-02	-6.3937E-02	-2.4627E-02
9	9.0240E-04	-5.0669E-03	8.2459E-02	1.4592E-02	-6.7324E-02	-1.4941E-02
10	9.2597E-04	-5.6985E-03	1.1139E-01	1.1102E-02	-7.1146E-02	2.8027E-02
11	9.6080E-04	-5.4080E-03	1.5253E-01	1.9194E-04	-5.1249E-02	8.2030E-02
12	1.0054E-03	-6.9728E-03	2.0572E-01	-1.9387E-02	1.3603E-02	8.3753E-02
13	1.0566E-03	-7.1924E-03	2.6666E-01	-4.3277E-02	1.3872E-01	-3.3947E-02
14	1.1031E-03	-6.9580E-03	3.0925E-01	-5.6905E-02	2.5789E-01	-1.7852E-01

*******COMMENCE ITERATION 2*******

STATION	TAU	EI(LB-IN**2)	GJ(LB-IN**2)
1	1.9014102E+00	2.0760906E+11	2.0000000E+11
2	1.9014102E+00	2.0760906E+11	2.0000000E+11
3	1.9014102E+00	2.0760906E+11	2.0000000E+11
4	1.9014102E+00	2.0760906E+11	2.0000000E+11
5	1.9014102E+00	2.0760906E+11	2.0000000E+11
6	2.4694380E-01	1.5662721E+10	2.0800000E+10
7	2.1264293E-01	9.6073025E+09	1.2100000E+10
8	1.9548240E-01	7.1052685E+09	8.8500000E+09
9	1.7734296E-01	5.4037233E+09	6.7500000E+09
10	1.5053435E-01	2.9320039E+09	3.6300000E+09
11	1.6731876E-01	1.9506800E+09	2.4222879E+09
12	2.0581794E-01	1.3449743E+09	1.6800082E+09
13	1.7265066E-01	5.9596306E+08	7.3758927E+08
14	1.0718293E-01	2.0037375E+08	2.3000000E+08
15	7.5309400E-02	8.0109711E+07	1.2000000E+08

*****VIBRATION ANALYSIS*****

MODE	FREQUENCY (HZ.)
1	5.189
2	20.127
3	30.757
4	50.051
5	58.920
6	81.300

****FLUTTER ANALYSIS****

MODE 6 / MODE 5

K	V	F	G	V	F	G
1.4278	1449.4071	70.6767	-.2535	994.2964	48.4844	-.2506
1.1968	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.0032	1978.6465	67.7955	-.3033	1465.1317	50.1956	-.4157
.8409	2309.8721	66.3327	-.3095	1791.2049	51.4381	-.5441
.7048	2723.6963	65.5617	-.3082	2194.1123	52.8142	-.7145
.5908	3268.1433	65.9392	-.3210	2685.2641	54.1789	-.9189
.4952	4004.1060	67.7173	-.3707	3285.4484	55.5634	-1.1481

MODE 4 / MODE 3

K	V	F	G	V	F	G
1.4278	970.8491	47.3410	-.0931	523.4378	25.5241	-.1012
1.1968	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.0032	1190.8738	40.7995	-.0249	642.7446	22.0205	-.0854
.8409	1292.2642	37.1100	.0564	735.4081	21.1188	-.5114
.7048	1419.1039	33.9183	.1903	920.8139	22.1648	-.7413
.5908	1577.5874	31.8300	.3657	1157.0136	23.3443	-1.0822
.4952	1859.9176	30.6093	.5635	1461.7905	24.7218	-1.5651

MODE 2 / MODE 1

K	V	F	G	V	F	G
1.4278	460.3637	19.5227	-.2325	105.3022	5.1348	-.1644
1.1968	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.0032	592.7811	20.3087	-.3734	155.2308	5.3182	-.2577
.8409	684.0331	19.6434	-.0395	191.1305	5.4887	-.3340
.7048	711.3099	17.1218	.0532	239.5435	5.7660	-.4537
.5908	730.1942	14.7327	.2196	309.4448	6.2435	-.6708
.4952	778.0594	13.1585	.5185	418.7901	7.0826	-1.1271

FIRST CONVERGENCE ANALYSIS

		MODE 6			MODE 5	
K	V	F	G	V	F	G
.7668	2512.6345	65.8046	-.3085	1991.4113	52.1540	-.6281
		MODE 4			MODE 3	
K	V	F	G	V	F	G
.7668	1345.8414	35.3255	.1196	826.4062	21.6430	-.6186
		MODE 2			MODE 1	
K	V	F	G	V	F	G
.7668	700.3318	18.3335	.0024	214.4266	5.6157	-.3889

******FINAL RESULTS ITERATION 2******

```
K-VALUE            =    .7668
FLUTTER MODE NO.   =   2
FLUTTER VELOCITY   = 700.03 KNOTS
FLUTTER FREQUENCY  =  18.3335 HZ.
FLUTTER DAMPING    =    .0024
```

BEAM ELEMENT	VOLUME(IN**3)	STRAIN ENERGY/VOL.	RATIO(E/V/AVGE(E/V))
1	0.0000	0.	0.0000
2	7359.0600	1.0397610E-01	.0024
3	4989.1932	8.9029728E-02	.0020
4	5737.5722	7.7798013E-02	.0018
5	0.0000	0.	0.0000
6	1662.7605	1.1629280E+01	.2670
7	758.2129	1.9906363E+01	.4571
8	415.3579	3.2713494E+01	.7512
9	867.4999	5.8646642E+01	1.3467
10	757.2715	9.8166029E+01	2.2541
11	766.7891	9.9221686E+01	2.2784
12	663.8168	9.3942512E+01	2.1572
13	357.6392	6.4542811E+01	1.4821

	24335.1733		

*******COMMENCE ITERATION 3*******

STATION	TAU	EI(LB-IN**2)	GJ(LB-IN**2)
1	1.9014102E+00	2.0760906E+11	2.0000000E+11
2	1.9014102E+00	2.0760906E+11	2.0000000E+11
3	1.9014102E+00	2.0760906E+11	2.0000000E+11
4	1.9014102E+00	2.0760906E+11	2.0000000E+11
5	1.9014102E+00	2.0760906E+11	2.0000000E+11
6	2.4694389E-01	1.5662721E+10	2.0800000E+10
7	2.1264293E-01	9.6073025E+09	1.2100000E+10
8	1.9548248E-01	7.1052685E+09	8.8500000E+09
9	1.7734296E-01	5.4037233E+09	6.7500000E+09
10	1.7271991E-01	3.3432522E+09	4.1404891E+09
11	2.1973873E-01	2.5167231E+09	3.1276687E+09
12	2.6028317E-01	1.6627809E+09	2.0786617E+09
13	2.0600849E-01	6.9882045E+08	8.6538583E+08
14	1.0718293E-01	2.0037375E+08	2.3000000E+08
15	7.5309400E-02	8.0109711E+07	1.2000000E+08

*****VIBRATION ANALYSIS*****

MODE	FREQUENCY (HZ.)
1	5.085
2	20.739
3	30.862
4	51.515
5	61.045
6	82.454

****FLUTTER ANALYSIS****

K	V	F	G	V	F	G
	MODE 6				MODE 5	
1.2761	1614.2254	70.4596	-.2910	1152.4177	50.3020	-.2865
1.0866	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.9258	2133.7257	67.5678	-.3349	1642.3174	52.0066	-.4464
.7888	2457.0910	66.2944	-.3371	1972.9657	53.2149	-.5753
.6717	2866.3576	65.8502	-.3377	2367.2363	54.3836	-.7381
.5730	3398.6339	66.5034	-.3576	2831.2758	55.4015	-.9223
.4873	4105.2835	68.4219	-.4149	3377.9871	56.3002	-1.1182
	MODE 4				MODE 3	
1.2761	1077.7956	47.0449	-.0760	576.9915	25.1851	-.1059
1.0866	0.0000	0.0000	.0000	0.0000	0.0000	0.0000
.9258	1272.4719	40.2948	-.0001	689.5845	21.8368	-.0948
.7888	1362.2187	36.7418	.0900	816.9588	22.0350	-.5398
.6717	1475.6804	33.9015	.2266	1004.7305	23.0824	-.7718
.5730	1640.1966	32.0948	.3920	1234.3480	24.1533	-1.0927
.4873	1858.6522	30.9778	.5711	1519.5536	25.3261	-1.5199
	MODE 2				MODE 1	
1.2761	465.2597	20.3082	-.2573	116.1648	5.0705	-.1727
1.0866	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.9258	667.3604	21.1330	-.3973	165.8855	5.2530	-.2617
.7888	724.6785	19.5461	-.0526	200.7759	5.4153	-.3325
.6717	747.6077	17.1751	.0330	246.7912	5.6697	-.4399
.5730	761.7716	14.9061	.1785	311.2047	6.0896	-.6249
.4873	794.2544	13.2378	.4304	408.1233	6.8021	-.9911

FIRST CONVERGENCE ANALYSIS

		MODE 6			MODE 5	
K	V	F	G	V	F	G
.7265	2657.2253	65.9329	-.3362	2169.9024	53.8411	-.6566
.9966	2760.5109	65.8594	-.3365	2268.5518	54.1224	-.6974

		MODE 4			MODE 3	
K	V	F	G	V	F	G
.7265	1415.9771	35.1342	.1559	909.7567	22.5735	-.6494
.9966	1444.9732	34.4737	.1909	957.0169	22.8322	-.7092

		MODE 2			MODE 1	
K	V	F	G	V	F	G
.7265	738.1529	18.3156	-.0136	222.9737	5.5326	-.3821
.9966	743.3231	17.7340	.0087	234.6503	5.5984	-.4098

******FINAL RESULTS ITERATION 3******

K-VALUE	=	.6986
FLUTTER MODE NO.	=	2
FLUTTER VELOCITY	=	743.32 KNOTS
FLUTTER FREQUENCY	=	17.7340 HZ.
FLUTTER DAMPING	=	.0087

BEAM ELEMENT	VOLUME(IN**3)	STRAIN ENERGY,VOL.	RATIO(E/V/AVGE(E/V))
1	0.0000	0.	0.0000
2	7359.0600	9.7379818E-02	.0034
3	4989.1932	8.4681741E-02	.0029
4	5737.5722	7.5181906E-02	.0026
5	0.0000	0.	0.0000
6	1662.7605	1.1776488E+01	.4063
7	758.2129	2.0450044E+01	.7055
8	415.3579	3.3387827E+01	1.1518
9	924.6671	5.0142714E+01	1.7298
10	932.6073	5.9709250E+01	2.0598
11	985.0600	5.1136442E+01	1.7640
12	817.0521	4.9335595E+01	1.7019
13	400.8045	4.2674702E+01	1.4721

	24982.3477		

*******COMMENCE ITERATION 4********

STATION	TAU	EI(LB-IN**2)	GJ(LB-IN**2)
1	1.9014102E+00	2.0760906E+11	2.0000000E+11
2	1.9014102E+00	2.0760906E+11	2.0000000E+11
3	1.9014102E+00	2.0760906E+11	2.0000000E+11
4	1.9014102E+00	2.0760906E+11	2.0000000E+11
5	1.9014102E+00	2.0760906E+11	2.0000000E+11
6	2.4694389E-01	1.5662721E+10	2.0800000E+10
7	2.1264293E-01	9.6073025E+09	1.2100000E+10
8	1.9548248E-01	7.1052685E+09	8.8500000E+09
9	1.8768188E-01	5.7046817E+09	7.1268971E+09
10	1.9837316E-01	3.8122389E+09	4.7230311E+09
11	2.4923294E-01	2.8260547E+09	3.5135631E+09
12	2.8103932E-01	1.7798841E+09	2.2256731E+09
13	2.1802592E-01	7.3494291E+08	9.1029104E+08
14	1.0718293E-01	2.0037375E+08	2.3000000E+08
15	7.5309400E-02	8.0109711E+07	1.2000000E+08

*****VIBRATION ANALYSIS*****

MODE	FREQUENCY (HZ.)
1	5.061
2	20.995
3	30.930
4	52.201
5	61.882
6	83.027

****FLUTTER ANALYSIS****

	MODE 6			MODE 5		
K	V	F	G	V	F	G
1.1643	1763.4493	70.1194	-.3246	1291.0697	51.3366	-.3114
1.0016	2108.9123	68.7217	-.3492	1524.6900	52.1576	-.3820
.8617	2245.6493	67.2665	-.3604	1909.7067	53.2595	-.4817
.7414	2610.4794	66.2464	-.3590	2151.2428	54.4672	-.6172
.6378	3038.8030	66.1917	-.3633	2548.4184	55.5101	-.7792
.5487	3587.5266	67.2283	-.3926	3007.1981	56.3533	-.9547
.4721	4314.2746	69.5538	-.4635	3537.3679	57.0287	-1.1350

	MODE 4			MODE 3		
K	V	F	G	V	F	G
1.1643	1149.4448	45.7250	-.0649	620.5451	24.6746	-.1089
1.0016	1239.6654	42.4139	-.0317	677.3208	23.1701	-.1065
.8617	1321.5881	38.8942	.0306	721.3162	21.2283	-.0946
.7414	1408.2087	35.6543	.1339	897.3640	22.7203	-.5997
.6378	1528.3695	33.2912	.2752	1089.0550	23.7220	-.8441
.5487	1697.6295	31.8127	.4344	1318.4402	24.7069	-1.1636
.4721	1913.3501	30.8466	.6031	1590.2679	25.7831	-1.5766

	MODE 2			MODE 1		
K	V	F	G	V	F	G
1.1643	521.9957	20.7560	-.2828	127.8291	5.0828	-.1864
1.0016	617.0283	21.1076	-.3453	150.9549	5.1639	-.2261
.8617	739.0985	21.7516	-.4341	179.4212	5.2804	-.2786
.7414	750.6656	19.0060	-.0423	215.3632	5.4528	-.3517
.6378	769.2642	16.7567	.0478	262.5598	5.7191	-.4628
.5487	781.5100	14.6451	.1969	328.2239	6.1507	-.6533
.4721	815.2901	13.1439	.4473	425.7527	6.8639	-1.0226

FIRST CONVERGENCE ANALYSIS

MODE 6 / MODE 5

K	V	F	G	V	F	G
.6857	2921.9471	66.0837	-.3591	2350.2027	55.0365	-.6990
.6609	2928.9470	66.1074	-.3606	2449.4025	55.2839	-.7394
.6731	2875.8694	66.0876	-.3597	2399.8270	55.1631	-.7192
.6793	2848.4288	66.0836	-.3593	2375.0211	55.1005	-.7091

MODE 4 / MODE 3

K	V	F	G	V	F	G
.6857	1464.7056	34.3001	.2037	992.5348	23.2429	-.7171
.6609	1495.6652	33.7577	.2395	1040.6473	23.4878	-.7796
.6731	1479.9590	34.0187	.2216	1016.5511	23.3667	-.7481
.6793	1472.2751	34.1568	.2127	1004.5311	23.3051	-.7325

MODE 2 / MODE 1

K	V	F	G	V	F	G
.6857	761.7404	17.8383	-.0010	238.0985	5.5757	-.4028
.6609	765.8820	17.2862	.0224	250.0918	5.6447	-.4315
.6731	763.9139	17.5595	.0105	244.0386	5.6095	-.4169
.6793	762.8540	17.6982	.0047	241.0548	5.5925	-.4098

******FINAL RESULTS ITERATION 4******

```
K-VALUE            =    .6793
FLUTTER MODE NO.   =   2
FLUTTER VELOCITY   = 762.85 KNOTS
FLUTTER FREQUENCY  =  17.6982 HZ.
FLUTTER DAMPING    =    .0047
```

BEAM ELEMENT	VOLUME(IN**3)	STRAIN ENERGY/VOL.	RATIO(E/V/AVGE(E/V))
1	0.0000	0.	0.0000
2	7359.0600	1.1280076E-01	.0040
3	4989.1932	9.8993538E-02	.0035
4	5737.5722	8.8680949E-02	.0032
5	0.0000	0.	0.0000
6	1662.7605	1.4069052E+01	.5017
7	758.2129	2.4297085E+01	.8665
8	426.7152	3.7245010E+01	1.3282
9	1018.4116	4.7565375E+01	1.6963
10	1062.8991	5.1588933E+01	1.8398
11	1087.9058	4.5332277E+01	1.6166
12	874.1341	4.5389540E+01	1.6187
13	416.3326	4.2666246E+01	1.5216

	25393.1971		

******THE CRITERION IS SATISFIED.******

****FLUTTER CHECK ANALYSIS FOR THE FINAL ITERATION****

****FLUTTER ANALYSIS****

	MODE 4			MODE 5		
K	V	F	G	V	F	G
12.9058	171.7389	76.0482	-.0329	134.0770	59.3710	-.0182
10.3973	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
8.1938	271.3605	75.9369	-.0521	211.4398	59.1689	-.0286
6.5137	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5.1781	427.9571	75.6661	-.0825	331.7159	58.6621	-.0443
4.1164	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3.2723	671.3911	75.0333	-.1305	513.5873	57.3975	-.0664
2.6014	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2.0680	1043.1357	73.6726	-.2038	769.1062	54.3189	-.0900
1.6439	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.3069	1592.0216	71.0559	-.3009	1140.5484	50.9055	-.2705
1.0389	1946.9582	69.0762	-.3442	1463.6289	51.9308	-.3626
.8259	2372.0295	66.9048	-.3607	1900.4488	53.6035	-.5164
.6565	2948.7819	66.1185	-.3610	2467.4848	55.3267	-.7467
.5219	3805.7907	67.8373	-.4105	3175.2496	56.5980	-1.0146
.4149	5166.5536	73.1246	-.5815	4050.6121	57.3967	-1.2827
.3298	7853.3821	88.4696	-1.1463	5044.3762	56.8221	-1.4655
.2622	24683.9400	221.0919	-9.6153	5933.1321	53.1296	-1.4412
.2084	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1557	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1317	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

K	MODE 4 V	MODE 4 F	MODE 4 G	MODE 3 V	MODE 3 F	MODE 3 G
12.9653	111.0924	49.1933	-.0232	67.6489	29.9558	-.0153
10.3373	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
8.1934	175.8912	49.2182	-.0368	106.7884	29.8834	-.0242
6.5137	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5.1781	278.6075	49.2809	-.0585	167.9580	29.7025	-.0389
4.1164	0.0000	0.0000	.0000	0.0000	0.0000	0.0000
3.2723	442.3976	49.4415	-.0937	261.7474	29.2524	-.0587
2.6014	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2.0680	700.3470	49.8865	-.1527	398.6127	28.1524	-.0864
1.6439	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1.3069	1074.7389	47.9683	-.0775	574.4790	25.6404	-.1084
1.0389	1218.9301	43.2487	-.0419	664.1817	23.5657	-.1073
.8259	1344.4734	37.9219	.0552	780.4083	22.0120	-.4723
.6565	1511.5077	33.6673	.2460	1049.4601	23.5313	-.7913
.5219	1764.4287	31.4505	.4894	1405.1403	25.0463	-1.2887
.4149	2133.7426	30.2349	.7589	1900.4841	26.9297	-2.0482
.3298	2615.0657	29.4573	1.0851	2681.8844	30.2099	-3.4546
.2622	3257.4456	29.1696	1.5448	4317.8386	38.6651	-7.4957
.2084	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1657	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1317	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

K	MODE 2 V	MODE 2 F	MODE 2 G	MODE 1 V	MODE 1 F	MODE 1 G
12.9653	44.7177	19.8016	-.0213	10.9916	4.8672	-.0145
10.3373	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
8.1934	70.6018	19.8130	-.0339	17.4027	4.8699	-.0230
6.5137	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
5.1781	112.1979	19.8416	-.0539	27.5759	4.8767	-.0366
4.1164	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3.2723	178.1792	19.9130	-.0865	43.7841	4.8932	-.0588
2.6014	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2.0680	284.4928	20.0926	-.1416	69.8606	4.9340	-.0960
1.6439	0.0000	0.0000	.0000	0.0000	0.0000	0.0000
1.3069	450.5299	20.5546	-.2435	112.8522	5.0369	-.1619
1.0389	597.1034	21.0063	-.3289	144.9108	5.1416	-.2155
.8259	731.5782	20.6065	-.0839	188.6904	5.3221	-.2966
.6565	760.5530	17.1879	.0269	252.3363	5.6578	-.4370
.5219	780.0324	14.0465	.2666	356.2378	6.3499	-.7489
.4149	898.4885	12.7386	.7750	553.7936	7.8472	-1.6396
.3298	1270.9742	14.3844	1.8820	1169.7798	13.1769	-6.3906
.2622	3106.3775	27.7631	9.9284	0.0000	0.0000	0.0000
.2084	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1657	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
.1317	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

*****FIRST CONVERGENCE ANALYSIS*****

	MODE 6			MODE 5		
K	V	F	G	V	F	G
.7315	2642.6684	66.1985	-.3588	2184.1681	54.5686	-.6307
.6920	2790.3284	66.0879	-.3589	2326.0200	54.9727	-.6890
.6738	2471.4280	66.0869	-.3596	2396.8021	55.1555	-.7180

	MODE 4			MODE 3		
K	V	F	G	V	F	G
.7315	1417.0746	35.4038	.1451	912.9755	22.8095	-.6183
.6920	1457.4449	34.4450	.1951	980.8633	23.1815	-.7022
.6738	1477.0157	34.0353	.2205	1015.0840	23.3592	-.7462

	MODE 2			MODE 1		
K	V	F	G	V	F	G
.7315	752.7794	18.8072	-.0359	219.0155	5.4718	-.3597
.6920	760.6020	17.9759	-.0064	235.2452	5.5597	-.3962
.6738	763.7875	17.5764	.0098	243.6732	5.6074	-.4160

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****FLUTTER CHECK ANALYSIS FOR THE FINAL ITERATION****

    ******FINAL RESULTS ITERATION  4******

      K-VALUE            =     .6738
      FLUTTER MODE NO.   =    2
      FLUTTER VELOCITY   = 763.79 KNOTS
      FLUTTER FREQUENCY  =  17.5764 HZ.
      FLUTTER DAMPING    =     .0098
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GENERALIZED MASS MATRIX

	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
1	1.0000000E+00	1.7157074E-05	-3.3155017E-06	-2.3079496E-08	-1.9068130E-08	-4.0255084E-10
2	1.7157174E-05	1.0000000E+00	-3.6532899E-06	1.8446580E-06	-3.0069103E-07	-3.3993808E-07
3	-3.3155017E-06	-3.6532899E-06	1.0000000E+00	-5.5665535E-06	-2.2196201E-06	1.4774837E-06
4	-2.3079482E-08	1.8446580E-06	-5.5665534E-06	1.0000000E+00	-2.3181318E-05	-5.1340540E-05
5	-1.9068151E-08	-3.0069101E-07	-2.2196201E-06	-2.3181318E-05	1.0000000E+00	2.9825166E-05
6	-4.0255083E-10	-3.3993807E-07	1.4774838E-06	-5.1340540E-05	2.9825166E-05	1.0000000E+00

NORMALIZED RIGID BODY VIBRATION MODES

	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
1	-1.3446401E-04	1.9775976E-05	8.3297658E-05	-9.4891336E-06	-8.4209358E-05	-2.2783994E-05

RIGID BODY MASS MATRIX

6.2540219E+08

MASS SCALE FACTORS - VIBRATION MODE PRINTOUT

MODE NUMBERS 1--------- 6

STA	5.7977E-02	5.5964E-02	-1.6451E-02	4.3967E-02	7.8090E-03	-1.5412E-02
			H (DEFLECTION-IN)			
2	-1.4454E-03	2.1101E-04	8.9754E-04	-9.8621E-05	-8.7813E-04	-2.1442E-04
3	-3.3272E-03	3.3337E-04	-2.9636E-04	3.1571E-04	6.0365E-03	1.9994E-03
4	-4.4935E-03	1.3794E-04	-3.4539E-03	1.0496E-03	1.8734E-02	5.1356E-03
5	-5.7336E-03	-4.7551E-05	-9.5154E-03	2.0435E-03	4.0007E-02	9.8077E-03
6	1.7232E-02	-5.7447E-02	-5.2246E-01	1.8713E-01	1.8552E+00	3.2827E-01
7	9.7967E-02	-2.9836E-01	-3.6169E-01	5.6373E-01	1.7218E+00	-1.3285E-01
8	1.5381E-01	-4.3650E-01	-2.8928E-01	6.9786E-01	1.6249E+00	-8.7134E-02
9	1.9153E-01	-5.0019E-01	-4.2788E-01	7.0420E-01	1.9030E+00	7.0390E-02
10	3.0813E-01	-6.0100E-01	-8.0603E-01	4.2940E-01	1.9135E+00	4.6350E-01
11	4.5602E-01	-5.4122E-01	-1.0574E+00	-2.1671E-01	5.1343E-01	3.2625E-01
12	6.2787E-01	-2.5569E-01	-9.3959E-01	-7.7960E-01	-1.5982E+00	-4.6513E-01
13	6.2001E-01	2.3995E-01	-2.2184E-01	-4.9918E-01	-2.2061E+00	-7.5078E-01
14	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00	1.0000E+00
STA			HPRIME (SLOPE-RAD)			
2	-1.3444E-04	1.9733E-05	8.2840E-05	-9.3670E-06	-8.2524E-05	-2.2149E-05
3	-1.2092E-04	-5.3742E-06	-2.2676E-04	5.9631E-05	9.7273E-04	2.6904E-04
4	-1.1243E-04	-1.6678E-05	-4.2099E-04	8.3549E-05	1.5549E-03	3.5855E-04
5	-1.0337E-04	-2.3141E-05	-6.3079E-04	8.4715E-05	2.1278E-03	4.5059E-04
6	8.2165E-04	-1.4689E-03	-2.1667E-02	3.6966E-03	6.7521E-02	1.1471E-02
7	2.4096E-03	-6.5132E-03	3.4090E-03	8.2400E-03	-2.1644E-03	-3.1881E-03
8	2.7934E-03	-6.2554E-03	3.5399E-03	3.8959E-03	-8.1073E-03	7.2831E-03
9	2.9875E-03	-4.2833E-03	-1.0521E-02	-1.6339E-03	1.6190E-02	1.2467E-02
10	3.6872E-03	-9.3424E-[illegible]	-9.8773E-03	-1.3842E-02	-1.8722E-02	6.3630E-03
11	4.4485E-03	4.5530E-03	-2.9995E-03	-1.0679E-02	-5.5493E-02	-1.4916E-02
12	5.0750E-03	1.1451E-02	1.0420E-02	-8.2010E-03	-5.2194E-02	-2.3915E-02
13	5.6098E-03	1.9419E-02	3.0139E-02	2.7413E-02	3.3565E-02	1.8890E-02
14	5.9093E-03	2.4920E-02	4.6969E-02	6.5743E-02	1.7014E-01	8.9066E-02
STA			ALPHA (TWIST-RAD)			
2	8.0359E-04	-3.2269E-03	1.3547E-02	7.1677E-03	-5.7058E-02	-8.0285E-02
3	8.1344E-04	-3.2664E-03	1.3713E-02	7.2555E-03	-5.7757E-02	-8.1269E-02
4	8.2009E-04	-3.2919E-03	1.3813E-02	7.2972E-03	-5.8030E-02	-8.1429E-02
5	8.2772E-04	-3.3198E-03	1.3916E-02	7.3252E-03	-5.8122E-02	-8.1049E-02
6	1.7169E-03	-6.5664E-03	2.5856E-02	1.0580E-02	-6.8745E-02	-3.6745E-02
7	4.2815E-04	-3.8862E-03	4.3140E-02	5.3773E-03	-1.1644E-01	-2.4706E-02
8	3.6096E-04	-4.3729E-03	5.0162E-02	5.4761E-03	-1.2101E-01	-1.2106E-02
9	1.0785E-03	-6.1591E-03	5.5100E-02	5.5719E-03	-1.2413E-01	1.7291E-03
10	1.0985E-03	-6.9144E-03	7.1014E-02	8.0217E-04	-1.0171E-01	4.1837E-02
11	1.1206E-03	-7.5728E-03	8.7446E-02	-6.8785E-03	-3.3836E-02	6.8854E-02
12	1.1419E-03	-8.0073E-03	1.0287E-01	-1.5664E-02	7.9053E-02	5.3824E-02
13	1.1674E-03	-8.2444E-03	1.2018E-01	-2.5275E-02	2.7345E-01	-3.5386E-02
14	1.2036E-03	-8.0931E-03	1.3907E-01	-3.2015E-02	5.6665E-01	-2.2589E-01