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NUMERICAL ANALYSIS OF SHELLS

Volume II

Users' Manual for "STARS-II" — Shell Theory Automated for Rotational Structures-II Digital Computer Program

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16. ABSTRACT

This report contains the information necessary for application of the STARS II (Shell Theory Automated for Rotational Structures II) program. The fundamental structural theory is detailed in volume I of this series.

17. KEY WORDS	18. DISTRIBUTION STATEMENT

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LIST OF FIGURES

SYMBOLS

Lower Case Latin

a semi-diameter perpendicular to Z-axis in ellipsoid

b semi-diameter parallel to Z-axis in ellipsoid

f position parameter for parabola; distributed loads in local coordinates

h shell thickness; face sheet thickness

i index: beginning edge of shell segment; independent joint of kinematic link; subscript "inside"

j index: ending edge of shell segment; dependent joint of kinematic link

n index on harmonic

o subscript "outside"

r radius

s index of segment; coordinate in cylinder or cone

t core thickness in sandwich shell

w normal deflection, positive inward

Upper Case Latin

C stiffness eccentricity parameters; offset distance in ogive

D bending stiffness parameters

E Young's modulus (lb/in^2)

F lineal force (lb/in)

G shear modulus (lb/in^2)

K extensional stiffness parameters

M bending moment on shell (in-lb/in)

N membrane stress resultant (lb/in)

$\bar{N}$ assumed membrane stress resultant (lb/in)

SYMBOLS (continued)

Q	transverse shear stress resultant (lb/in)
R	radius
T	temperature
X	Cartesian coordinate, $\theta = 0$ at X-axis
Y	Cartesian coordinate
Z	Cartesian coordinate coincides with axis of revolution

Greek

α	angle between rotated coordinates
β	ratio of semi-diameter parallel to Z-axis in ellipsoid to semi-diameter perpendicular to Z-axis
γ	shear strain; non-linear parameter; angle of inclination of kinematic link
ζ	normal coordinate, positive inward
θ	circumferential angular coordinate (rad)
λ	shell parameter
ν	Poisson's ratio
σ	normal stress (lb/in^2)
τ	shear stress (lb/in^2)
ϕ	meridional angular coordinate (rad)
ω	rotational displacement (rad)
Ω	rotational displacement in "global" coordinates (rad)
Δ	displacements in fixed or "global" coordinates
Λ	segment length parameter

Miscellaneous

eq	equivalent
sϕ	sin ϕ
cϕ	cos ϕ

Other symbols are defined in text where used.

SECTION 1

PROGRAM CAPABILITY

The use of an accurate shell theory to analyze structural shell problems usually involves complex mathematics and numerical techniques, which are nearly impossible to treat without the aid of automated procedures. On this basis, a digital computer program based upon the Love-Reissner first order shell theory has been developed. This program can analyze orthotropic thin shells of revolution, subjected to unsymmetric distributed loading or concentrated line loads, as well as thermal strains (Reference 2). Furthermore, a shell with arbitrary boundary conditions, under loads which vary arbitrarily with position and under a temperature variation through the thickness, is tractable with this program. The shell can consist of any of the following geometric shapes:

1) Ellipsoidal - spherical
2) Ogival - toroidal
3) Modified ellipse shape
4) Conical - circular plate
5) Cylindrical
6) Parabola

The shell wall crossection can be a sheet, sandwich, or reinforced sheet or sandwich. The reinforcement can consist of rings and/or stringers, or a waffle construction rotated 45 degrees to the principal coordinates. The reinforcement material properties can also differ from those of the main shell.

The basic approach to the problem (Reference 1) is to cut the structure into several shell regions. These regions need to be singly-connected shells, and can only have line loads applied at their end points. There are no restrictions on geometry, or uniform or thermal loads. The regions are further subdivided into several shell segments, each being free to have its own geometric shape, provided that the shape falls into one of the categories mentioned above.

Stiffness matrices obtained for each segment, are coupled by standard matrix methods to obtain region stiffnesses, which, after being reduced in size, are in turn coupled to form the total shell structure under analysis. Currently, the program is capable of handling a structure composed of up to 24 segments in each of 19 regions arbitrarily connected to each other. There is a limitation on the size of a shell segment, which is a consequence of the demand that boundary disturbances be felt throughout the segment. This limitation is mathematically described in Section 2 pages 2-18 to 2-20 as a length parameter. This parameter, however, is not reliable near the apex of any shell shape ($\phi = 0$), and the segments needed in this region are actually much smaller than predicted by the parameter. A mathematical singularity occurs at the apex where r_0 (the radius of revolution) becomes zero. It is this singularity which prevents the length parameter from being meaningful near the apex. Furthermore, the point ($\phi = 0$) is not an acceptable input point of the program, although any point outside a circle of infinitesimal radius is satisfactory.

There is considerable latitude in what can be done within each shell segment. The thickness of any segment can be symmetrically tapered and it can contain up to 14 points of discontinuity, provided that the segment centerline remains continuous and describable by a single shell geometry. A temperature distribution through the thickness can be specified at three points in a homogeneous shell, and 4 points in a shell of rigid core sandwich construction. The distribution is considered to be linear between these points. Thus, it is possible to approximate temperature distributions other than linear distributions. In the event of physically discontinuous shell centerlines, a kinematic link is available for use in the analysis. The link relates displacements across the discontinuity. This link may be used between regions, and between segments within a region.

The present program is also capable of a non-linear analysis of axisymmetrically loaded shells. The analysis of this large deformation case is accomplished by use of iteration. Details of the non-linear theory involved are presented in References 1 and 4, and the program utilization of this option is described in detail in Section 2 of this report. In the linear analysis of unsymmetrically loaded shells, the partial differential equations of the shell theory are reduced to ordinary first order differential equations, which are solved with the aid of a Runge-Kutta method of numerical integration. The reduction is accomplished by use of a Fourier series expansion in the circumferential coordinate, θ. Axisymmetric loading is represented by the "zeroth" term of the Fourier series alone. For distributed loads, such as aerodynamic pressure, inertia loads, and aerodynamic heating, the Fourier series expansion is convenient since these loads vary smoothly in the circumferential direction. For the most general inertia loads, only the zeroth, first, and second terms of the series are necessary. For reasonably smooth pressure distributions, the same terms will usually describe the loading adequately for the purposes of the stress analyst. Concentrated point loads can also be described by Fourier series expansions. Although, in general, many terms are necessary for a good representation, occasionally for certain cases of loading and structure, only a few representative terms need be computed, the remaining ones being obtained by interpolation on log plots. Such was the case in the analysis of the Spacecraft adapter for the Lunar Module under various load conditions (Reference 2), in which a conical shell was loaded at four discrete points.

Fundamentally different types of loading are represented by the various "harmonics". Pressure and temperature affect all harmonics. In addition, certain components of the three harmonics $n = 0, 1, 2$ reflect particular physical loads (see Reference 3, Appendix A).

- $n = 0$ (Zeroth Harmonic): This is the axisymmetric contribution. Loads are due to axial translational acceleration, and centrifugal forces. Net axial load is produced only by this type of loading.
- $n = 1$ (First Harmonic): This is the antisymmetric contribution. Loads are due to angular, centrifugal, and lateral translational accelerations. Net lateral load and a bending moment, which do not cause circular cross-sections to deform, are produced by this load contribution.
- $n = 2$ (Second Harmonic): Because of the character of the deformation, this is called the "ovalizing" contribution. Loads are due to centrifugal accelerations (see Reference 3, Appendix A).

No net loads can be obtained for $n \geq 2$; these higher harmonics contribute self-equilibrating loads due to pressure, temperature, and concentrated forces.

The output of the program for each harmonic is the amplitude of the displacements, stress resultants, and stresses at the inside and outside surfaces, as a function of the radial coordinate, r_0. A value V at a particular point (r_0, θ) on the shell is thus given by:

$$V(r_0, \theta) = \sum_{n = 0, 1...} V^{(n)}(r_0) \cos n\theta$$

This output is printed out for each segment of the shell at intervals specified by the user of the program.

SECTION 2

INPUT INFORMATION

The preceding section provides some insight into the capability of the program, and the potential that it might have for future use. If the program is applied judiciously it can be an extremely powerful tool. The mechanics of applying it should be clearly understood. With this in mind, the remaining section should be studied carefully.

The required input data may be subdivided into three main parts, namely: geometric, topological (or coupling orientation) and joint data (degree of freedom description for each joint component). Each segment requires its own geometric configuration and numerical integration control.

The output consists of stiffness coefficients for each shell segment and the actual symmetry of the coefficients is presented in a convenient form for a check on the accuracy of the integration through the segment. Region stiffness and their symmetry checks are also provided. Final stresses, displacements and Huber-Von Mises-Hencky "effective stresses" are printed out for each shell segment at intervals along the segment as specified by the user of the program. The output will be further discussed in Section 3.

The full program capacity is described in the table below:

Table of Program Capacity

I.	Segments:	24
II.	Segment joints:	25
III.	Regions:	19
IV.	Region joints:	20
V.	Number of points available per segment for specifying geometric or load data:	30

Table of Program Capacity (continued)

VI.	Number of points available through the thickness for specifying temperature data:	4
VII.	Geometries:	ellipsoid, sphere, modified ellipsoid, ogive, toroid, cone, annular plate, cylinder, second order parabola.
VIII.	Wall cross-section options:	single sheet, equal face sheet sandwich, unequal face sheet sandwich, eccentric reinforcement (rings, stringers or both), waffle reinforcement rotated 45° to coordinate axes.
IX.	Number of material property tables per submission:	10
X.	Number of points per material property table:	10
XI.	Number of consecutive load conditions per submission:	10 (Except thermal or non-linear = 1)
XII.	Orthotropy options:	isotropic or orthotropic sheet, isotropic or orthotropic sandwich, isotropic or orthotropic sheet or sandwich reinforced by different property rings or different property stringers or both, isotropic or orthotropic sheet or sandwich reinforced by a different property waffle system rotated 45° to coordinate axes, other combinations obtained by redefining stiffness parameter formulas (see Reference 1 Section 4 and Appendix A, and pages 2-27 to 2-33 of this report).

Figure 2-1 shows the detailed option flow chart for the present program.

GENERAL NOTES

Before discussing the specific input order, it would be advantageous to introduce some general guidelines in the area of idealizations and topology. In many computer programs there is such an abundance of numerical computation, that minimizing numerical roundoff errors becomes as important as getting the final answers. In some cases the engineer can aid the program in this effort through the use of judicious idealizations. Such a possibility exists in the

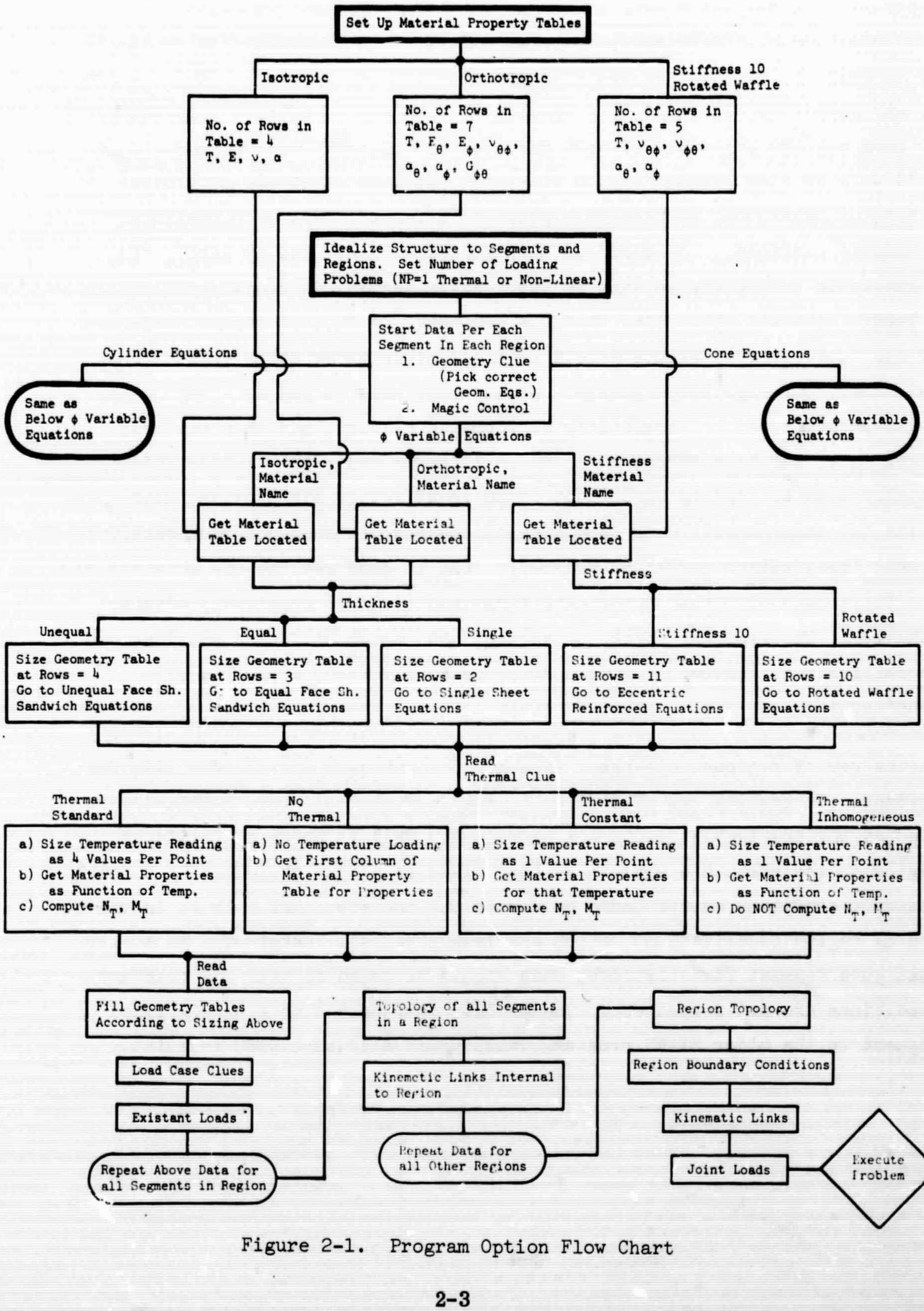


Figure 2-1. Program Option Flow Chart

STARS II program, since many internal operations are involved with building and inverting stiffness matrices. The object of the user therefore, should be to help the computer by avoiding the creation of ill-conditioned matrices at any step (see Reference 5). Physically, the way to achieve this end is to have all the segment stiffness matrices of the same order of magnitude. This will in turn produce region stiffness matrices which are of similar orders of magnitude, and minimize possible ill-conditioning in the total structure matrices. The user can help to achieve this end by sizing his segments in such a way so that no short stiff segment is contained alone in a region with all other long flexible segments, or that no region comprised of all short stiff segments exists in a structure whose other regions contain only long flexible segments. No accurate measure can be given on the relative stiffness or flexibility of segments allowed, and thus the best check is to see if a structure is in equilibrium under the applied loading. It also must be kept in mind, that if an idealization has provided useful results for axisymmetric (zeroth harmonic) loading, it need not necessarily be a good idealization for other harmonics, but if good results are obtained for the first harmonic, then other harmonics should also encounter no adverse behavior. The symmetry checks of segment and region stiffness matrices are useful for many reasons, but will not necessarily alert a user to ill-conditioning.

In the use of regions, one other type of accident must be avoided. If, for instance, in problem two of Section 4, the four segments were combined into one region, the problem could not be solved. This is because the single region in the structure would have both fixed ends, and therefore no suitable boundary condition matrix could be formed for the structure. Thus, in the use of region idealizations, which are less physically meaningful to a user than pure segment idealizations, care should be taken so that all boundary conditions are not zeroed out. The problem corresponds to a single fixed segment in the older STARS program, which would also have been rejected.

ORDER OF INPUT (See Figures 2-1, 2-2)

GENERAL INTRODUCTORY CARDS	Column	Format
1. Title Card		
A. Alphameric title (submission description)	1-64	16A4
2. Program Control Card		
A. Number of regions to be coupled (Max. = 19)	1-2	I2
B. Total number of segments (Max. = 19 x 24 = 456)	3-5	I3
C. Number of Material Property Tables (Max. = 10)	6-7	I2
D. Value of the harmonic	8-16	F9.6

To use this program for an axisymmetric shell analysis, one has to set the value of the harmonic equal to zero on the program control card. This will automatically reduce the shell equations to an axisymmetric form. The use of harmonics is discussed on pages 1-3 and 1-4.

E. Number of problems in this submission	17-18	I2

The user is able, in one submission, to analyze his structure under several independent loading conditions (Max. = 10). The number of these loading conditions will determine the number of load clue cards which will be necessary per segment. If there is a thermal load or if the run is to be non-linear, this number can only be unity (1).

F. Coupling code	19	I1

1. Coupling to occur Code = 1
2. No coupling Code = 0 or blank

If no coupling occurs program will give only individual stiffness matrix of each segment; if coupling occurs the program will run to completion and give state of stress and deformation of the entire structure. Items 10 through 12 of the segment cards and the boundary condition cards of the regions are not included in an uncoupled run. In addition, the number of regions is one (1), the total number of segments and the number of segments on the first region identification card must be the same. Also the second region introductory card (topology) is not included. Uncoupled runs present a way to size segments by use of stiffness symmetry checks, without a full execution of the problem.

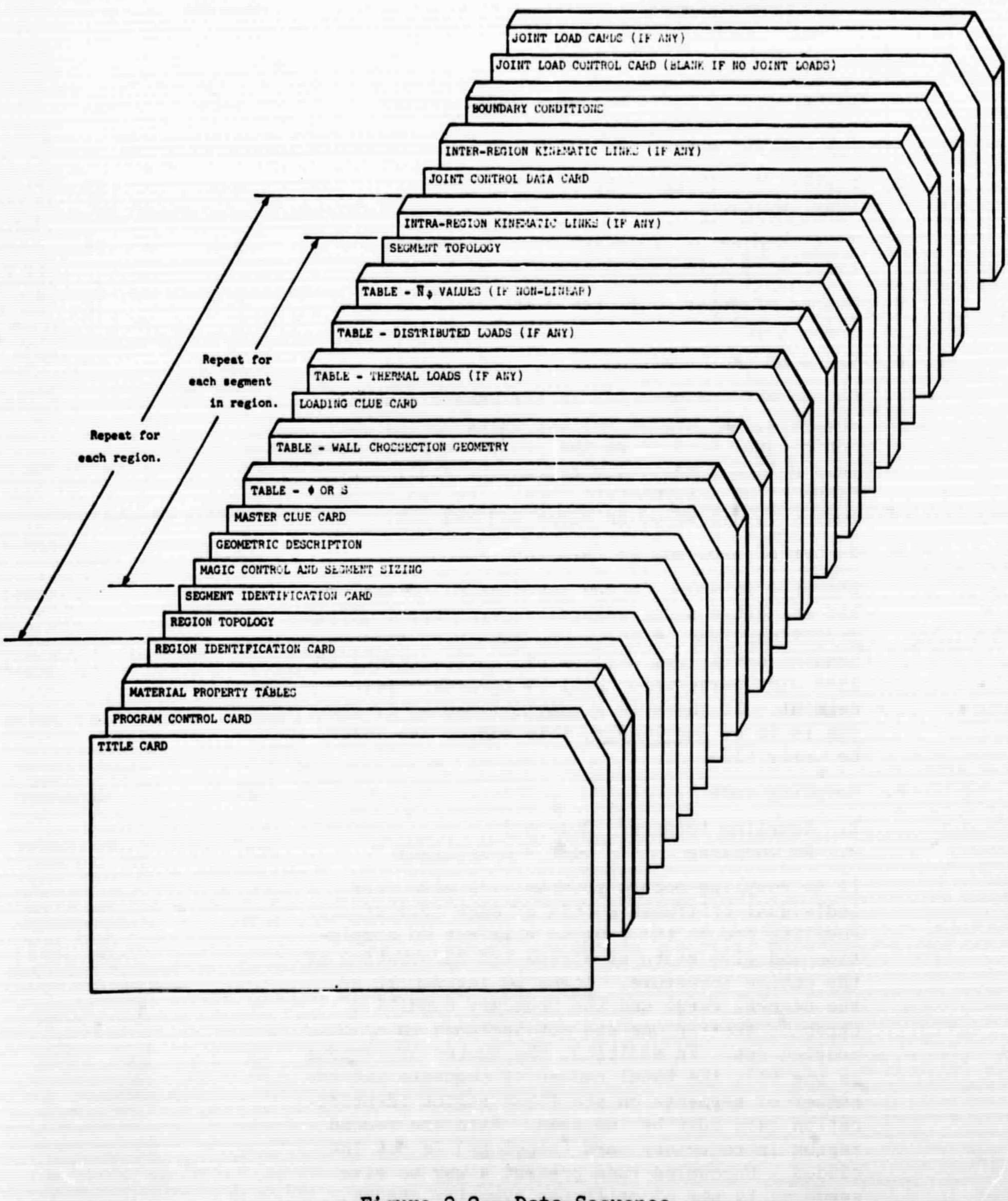


Figure 2-2. Data Sequence

MATERIAL PROPERTY TABLES (Max. = 10 sets) — Column — Format

As many sets of these cards are used (≤10) as there are different material property segments in the structure to be analyzed. These tables will be used to obtain the thermal variation of material properties if thermal loadings exist. Thus the range of temperature in this table should be greater than that of the thermal loads. If no thermal loads exist, the values given in the first column of this table will be used, and the rest of the table can be left blank. If there are thermal loads, the range of the table is to be considered as that between the second and tenth columns.

1. Identification Card

   A. Material Title (Alphameric) — 1-4 — A4

      Any name can be made up as long as it is consistently used on the segment cards to which it refers. The same name cannot appear on more than one (1) table.

   B. Type of Table — 11-14 — A4

      One of several possible alphameric clues is written here. These clues serve to size the number of cards in the property table, and define which properties belong on which card. The possible clues are:

      ISOT
      ORTH
      STIF

      Their definitions are provided in Item 2 below.

2. Material Property Cards

   The material property cards below are given depending upon which table type clue is used. If the table type clue is "ISOT" (isotropic table):

   A. Temperature values (5 values per card; 2 cards) — 5E14.7

      These are the temperatures at which the values of material properties will be given. The first value in the table must always be the room or stress-free temperature, since the material properties in only the first column of the table will be used in an analysis involving no thermal load.

MATERIAL PROPERTY TABLES (continued)	Column	Format
B. Values of Young's Modulus at the given temperatures. (5 values per card; 2 cards)		5E14.7
C. Values of Poisson's Ratio at the given temperatures. (5 values per card; 2 cards)		5E14.7
D. Values of the thermal coefficient of expansion at the given temperatures. (5 values per card; 2 cards)		5E14.7

If the table type clue is "ORTH" (orthotropic table):

A. Temperature values (5 values per card; 2 cards) These are the temperatures at which the values of material properties will be given.		5E14.7
B. Values of Young's Modulus in the θ direction (E_θ) at the given temperatures. (5 values per card; 2 cards)		5E14.7
C. Values of Young's Modulus in the ϕ direction (E_ϕ) at the given temperatures. (5 values per card; 2 cards)		5E14.7
D. Values of the Poisson's Ratio $\nu_{\theta\phi}$ at the given temperatures. (5 values per card; 2 cards)		5E14.7
E. Values of the thermal coefficient of expansion in the θ direction (α_θ) at the given temperatures. (5 values per card; 2 cards)		5E14.7
F. Values of the thermal coefficient of expansion in the ϕ direction (α_ϕ) at the given temperatures. (5 values per card; 2 cards)		5E14.7
G. Values of the Shear Modulus $G_{\phi\theta}$ at the given temperatures. (5 values per card; 2 cards)		5E14.7

If the table type is "STIF" (table to be used for reinforced shells):

A.-G. The values in these locations are the same as those above for the "ORTH" clue case, and refer to the basic shell.		5E14.7
H. Values of ring Young's Modulus (E_R) at the given temperatures. (5 values per card; 2 cards)		5E14.7

MATERIAL PROPERTY TABLES (continued)	Column	Format
I. Values of stringer Young's Modulus (E_s) at the given temperatures. (5 values per card; 2 cards)		5E14.7
J. Values of ring thermal coefficient of expansion (α_R) at the given temperatures. (5 values per card; 2 cards)		5E14.7
K. Values of stringer thermal coefficient of expansion (α_s) at the given temperatures. (5 values per card; 2 cards)		5E14.7

Note: In a rotated waffle construction, items H and I, and J and K, are respectively identical.

REGION INTRODUCTORY CARDS

These two cards are placed at the beginning of each region data information. Each region contains the following data set (see Figure 2-2): a) Two region introductory cards; b) data cards for each segment within the region; and c) kinematic link cards describing the kinematic links within the region, if any.

	Column	Format
1. Identification Card		
A. Number of segments within the region (≤24)	1-2	I2
B. Number of kinematic links between segments within the region.	3-4	I2
C. Any alphameric information (region description)	5-69	16A4
2. Topology Card (Coupling Orientation)		
A. Region Number Number of the region under consideration.	1-5	I5
B. Joint (i) Joint associated with i^{th} (beginning) end of the region (TIC).	6-10	I5
C. Joint (j) Joint associated with jth (ending) end of the region (STOP).	11-15	I5

There is no coordinate flow in regions, such as that shown for segments in Figures 2-3 to 2-9. However, the start joint of a region must match with 1 in segment numbering, and the end joint must match with the highest segment joint number in the region (see Figure 2-12 and page 2-41).

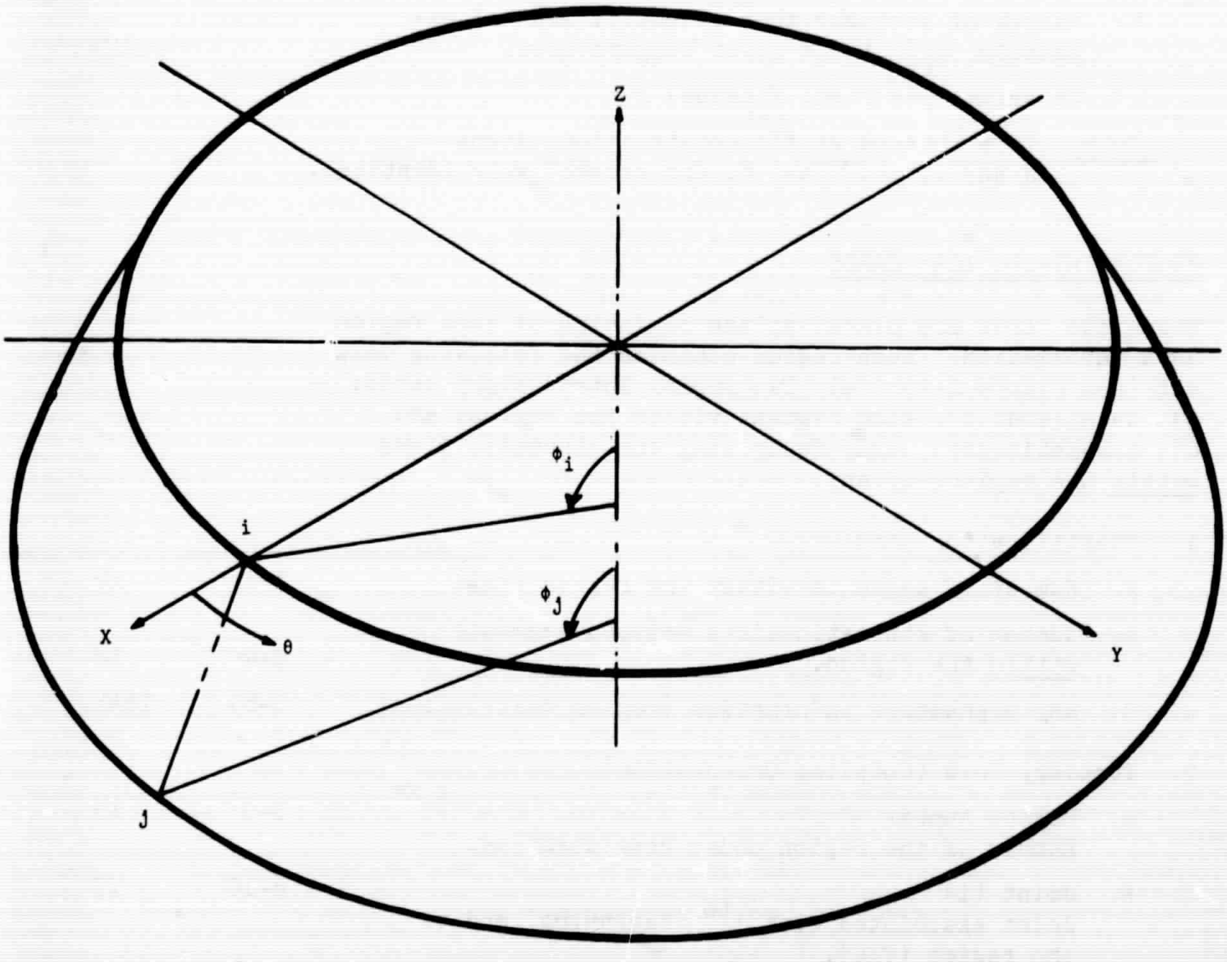


Figure 2-3. Typical Shell Segment

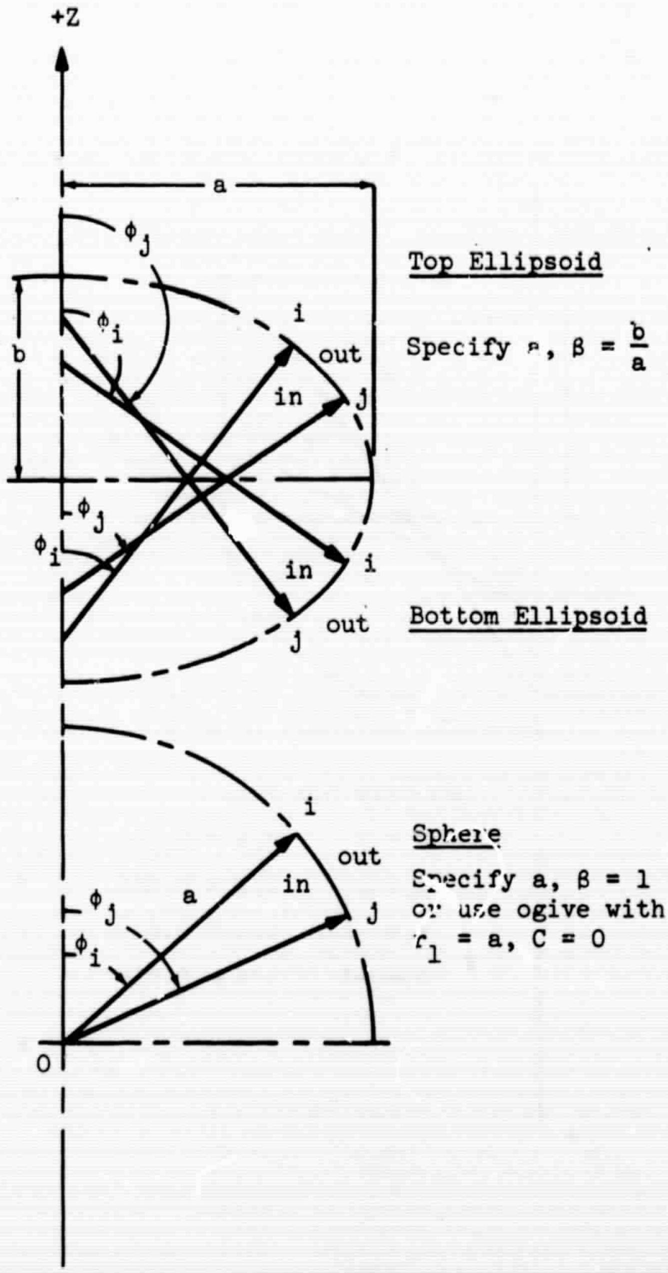
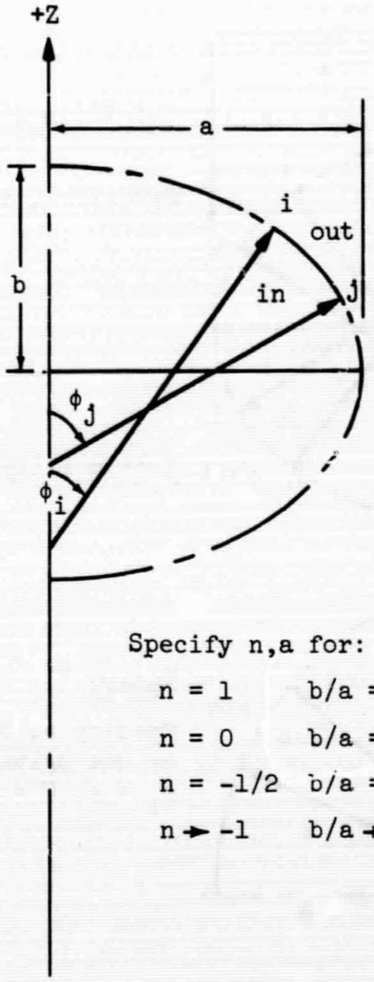


Figure 2-4. Ellipsoid



Specify n,a for:

n = 1	b/a = 0.707
n = 0	b/a = 0.666
n = -1/2	b/a = 0.639
n → -1	b/a → 0.618

Figure 2-5. Modified Ellipsoid

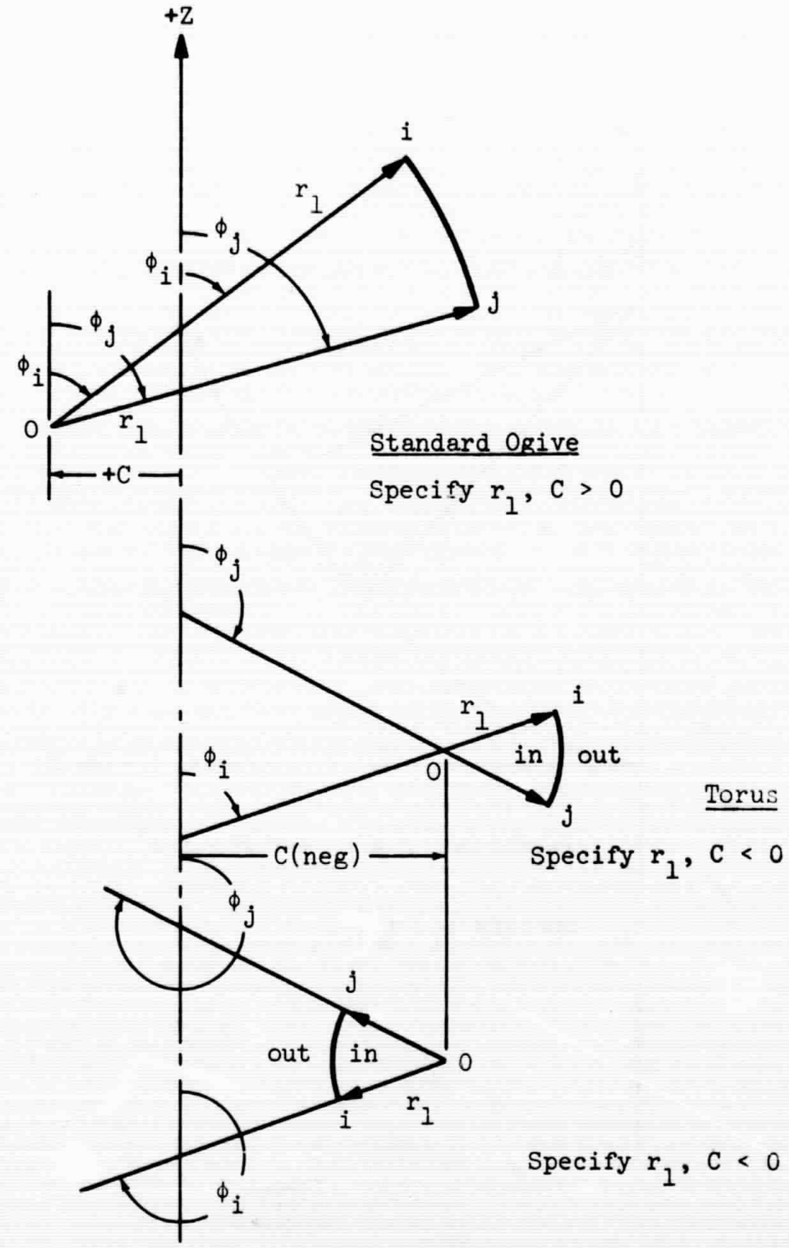


Figure 2-6. Ogive

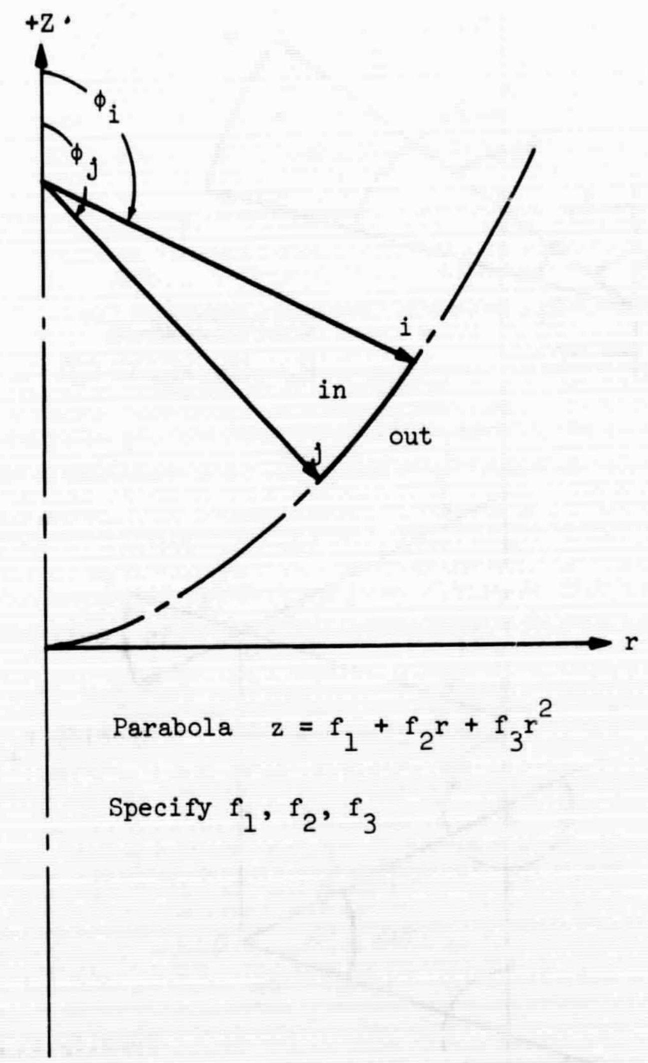


Figure 2-7. Paraboloid

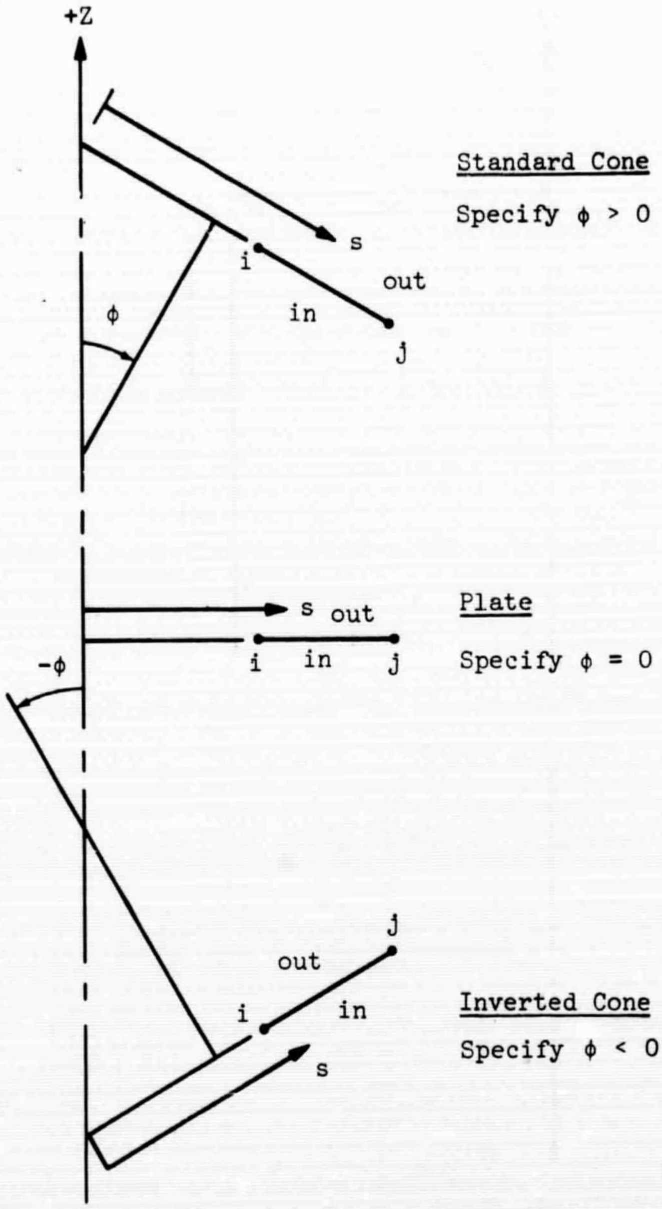


Figure 2-8. Cone

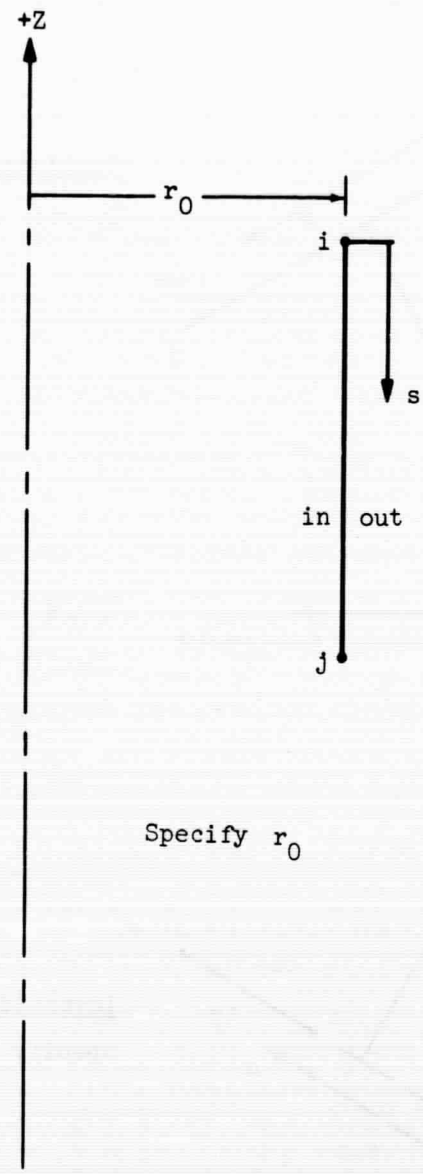


Figure 2-9. Cylinder

SEGMENT CARDS	Column	Format
This sequence of cards is repeated for each segment witwithin the region.		
1. Identification Card		
A. Segment identification code	1-2	F2.0
1. Ellipsoidal or spherical shell Code = 11 2. Modified ellipse shape Code = 12 3. Ogival - Toroidal Code = 13 4. Paraboloid Code = 14 5. Conical - Circular Plate Code = 21		
The plate is treated as a cone with zero angle.		
6. Cylindrical shell Code = 31		
B. Any alphameric information (segment description)	3-66	16A4
2. "MAGIC" Control and Segment Sizing Card		
A. Initial value of ϕ in radians or s in inches (TIC)	1-14	E14.1
B. Final value of ϕ in radians or s in inches (STOP)	15-28	E14.1
C. Interval at which final answers are printed out (DTAU)	29-42	E14.1
The ϕ-coordinate is defined for all geometric shapes except the cylinder, cone and plate, for which the s coordinate is used. Figures 2-3 through 2-8 describe these coordinates for each shape.		
D. Difference	43-56	E14.1
The value recommended depends upon the computer used. For the IBM 7094 it is 1.0 E-6; for the IBM 360-75 it is 1.0 E-4.		
E. Integration interval	57-70	E14.1
Recommended interval = .01 x segment length		
F. Delta For a fixed-step integration, Delta = 0.	71-72	F2.0
This card controls the Runge-Kutta numerical integration scheme. The suggested values above yield accurate results for a fixed-step integration method.		

Calculation of Segment Length

There is a restriction on the length of the shell segments. Physically, the restriction demands that boundary disturbances at one edge be distinctly felt at the other edge. This is a consequence of using a matrix approach which requires the calculation of stiffness matrices for the segments. Since the stiffness matrices must be symmetric, the magnitude of each matrix element must be such that a computer round-off error never becomes prominent. Limiting the segment length insures satisfaction of this criterion. This length is a function of both geometric shape and segment location within a specific geometry. One of the limiting factors is that the ratio of the radii of revolution at the initial and final points of a segment be greater than one hundredth and less than one hundred. This requires smaller segments than will normally be predicted by formula in the area of an apex. In addition, note that ($\phi = 0$) is <u>not</u> an acceptable input point.

For a cylinder, the segment length parameter,

$$\Lambda = (1 + \gamma)^{\frac{1}{2}} \beta \; \Delta s$$

should be held to about 4.0. In this expression, "γ" is a non-linear parameter. For homogeneous shells:

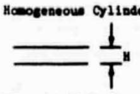
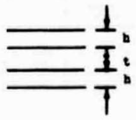
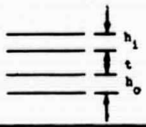
$$\gamma = \left[3\left(1 - \nu^2\right)\right]^{\frac{1}{2}} \left(\frac{\overline{N}_\phi r_0}{EH^2}\right)$$

It is zero for a linear problem.

"β" is a measure of the rate of decay of a disturbance in the shell.

"Δs" is the meridional length.

The values of β^4 and Δs for various shell geometries are given below:

		For $\nu = 0.3$, $\Lambda \leq 4$
Homogeneous Cylinder 	$\beta^4 = \frac{3(1 - \nu^2)}{r_0^2 H^2}$	$\Delta s \leq \frac{3.11 (r_0 H)^{\frac{1}{2}}}{(1 + \gamma)^{\frac{1}{4}}}$
Sandwich Cylinder - Equal Face Sheets 	$\beta^4 = \frac{3(1 - \nu^2)}{r_0^2 (4h^2 + 6ht + 3t^2)}$	$\Delta s \leq 3.11 \left[r_0^2 (4h^2 + 6ht + 3t^2) \right]^{\frac{1}{4}}$
Sandwich Cylinder - Unequal Face Sheets 	$\beta^4 = \frac{3(1 - \nu^2)}{(h_i + h_o)^4 + 12 h_i h_o t (h_i + h_o + t)} \left[\frac{h_i + h_o}{r_0} \right]^2$	$\Delta s \leq 3.11 \left[\frac{r_0}{h_i + h_o} \right]^{\frac{1}{2}} \left[(h_i + h_o)^4 + 12 h_i h_o t (h_i + h_o + t) \right]^{\frac{1}{4}}$

Approximate formulas can be obtained for near cylindrical regions of generally curved surfaces. The length parameter,

$$\Lambda = (1 + \gamma)^{\frac{1}{2}} \lambda \Delta\phi$$

should be held to about 4.0. In this expression "γ" has the same definition as in the cylinder case.

"λ" is a measure of the rate of decay of a disturbance in the shell.

"$\Delta\phi$" $= \frac{\Delta s}{r_1}$ is the angle intercepted by a meridional arc length "Δs".

The values of λ^4 and Δs for various shell geometries are given below:

		For $\nu = 0.3$, $\Lambda \leq 4$:
Homogeneous Construction	$\lambda^4 = 3(1 - \nu^2) \frac{r_1^4}{r_2^2 H^2}$	$\Delta s \leq \frac{3.11 (r_2 H)^{\frac{1}{2}}}{(1 + \gamma)^{\frac{1}{4}}}$
Sandwich Construction - Equal Face Sheets	$\lambda^4 = \frac{3(1 - \nu^2) r_1^4}{r_2^2 (4h^2 + 6ht + 3t^2)}$	$\Delta s \leq 3.11 \left[r_2^2 (4h^2 + 6ht + 3t^2) \right]^{\frac{1}{4}}$
Sandwich Construction - Unequal Face Sheets	$\lambda^4 = \frac{3(1 - \nu^2) r_1^4}{(h_i + h_o)^4 + 12 h_i h_o t (h_i + h_o + t)} \left[\frac{h_i + h_o}{r_2} \right]^2$	$\Delta s \leq 3.11 \left[\frac{r_2}{h_i + h_o} \right]^{\frac{1}{2}} \left[(h_i + h_o)^4 + 12 h_i h_o t (h_i + h_o + t) \right]^{\frac{1}{4}}$

The minimum allowable segment length is 1×10^{-3} (inches or radians).

	Column	Format
3. Geometric Description Card		
A. Ellipsoid and sphere (Figure 2-4)		
1. Semi-axis perpendicular to Z-direction (a)	1-14	E14.1
2. Ratio of semi-axis in the Z-direction (b) to (a), $\beta = (\frac{b}{a})$	15-28	E14.1
B. Modified ellipse shape (Figure 2-5)		
1. Axis ratio coefficient (n)	1-14	E14.1
2. Semi-axis perpendicular to Z-direction (a)	15-28	E14.1
C. Ogive (Figure 2-6)		
1. R_1 = radius	1-14	E14.1
2. C = offset distance	15-28	E14.1
D. Paraboloid (Figure 2-7)		
1. f_1 = position parameter	1-14	E14.1
2. f_2 = shape parameter	15-28	E14.1
3. f_3 = shape parameter	29-42	E14.1
E. Cone (Figure 2-8)		
1. Angle ϕ in radians (for flat plate, $\phi = 0$). Keep in mind that this ϕ is a constant for a given cone and should not be confused with the ϕ on the MAGIC Control and Segment Sizing Card.	1-14	E14.1
F. Cylinder (Figure 2-9)		
1. Radius	1-14	E14.1

4. Master Clue Card

This card contains a series of clues which determine the program and table locations to be used for the segment being described. For a master flow chart of clues and options in the program see Figure 2-1.

		Column	Format
A.	Material Table Type Clue	1-4	A4

This clue defines the type of material property table to be expected for the segment. This, as well as the following clue determines the material properties that will be used in the structural analysis for the segment. Thus these two clues should match the two clues used on the identification card of the corresponding material property table. As mentioned before on page 2-7, the three possibilities are:

ISOT
ORTH
STIF

		Column	Format
B.	Material Title	11-14	A4

This name should be the same as the name which appears on the material property table which contains the properties to be utilized for this segment.

		Column	Format
C.	Sheet Clue	21-24	A4

This clue informs the program as to what kind of shell wall crossection to expect. If the shell is of single sheet construction, the clue to be used is: <u>SING</u>. If the shell wall is an equal-size face sheet sandwich, the clue to be used is: <u>EQUA</u>. If the shell wall is a sandwich but the face sheets are not equal, the clue to be used is: <u>UNEQ</u>. Finally, if the shell is reinforced by rings, stringers, or a waffle, the clue to be used is: <u>BLAN</u>.

		Column	Format
D.	Reinforcement Clue	31-34	A4

This clue describes the type of reinforcement that is present on the shell. If the shell is purely of single sheet or equal or unequal-size face sheet honeycomb construction (no reinforcing), the clue to be used is: <u>THIC</u>. If the reinforcement consists of rings or stringers or both, located along the coordinate axes (θ and ϕ or s), then the clue to be used is: <u>ST10</u>. If the reinforcement consists of a waffle which is rotated 45 degrees to the coordinate axes, then the clue to be used is: <u>RWAF</u>. If another shell crosssection (for instance some sort of layer combination) can be cast so as to have the same integrated Hooke's Laws as either of the

D. Reinforcement Clue (continued) — Column / Format

reinforced cases (see Reference 1, Appendix A), then the appropriate clue, ST10 or RWAF, can be used for its description. The formulas for the appropriate stiffnesses need only be changed (Ref. 1 and pages 2-27 to 2-33 of this report) so as to describe the new shape properly. The numbers based on these new formulas can be input in card set 6 as described on pages 2-25 to 2-26, and this new crossection will be analyzed by the program.

E. Thermal Clue — Column 41-44 — Format A4

This clue describes the type of thermal problem which exists in the segment. The user is reminded that if there is a thermal loading on the structure, only one load problem may be run in the submission (see page 2-5). If there is no thermal load on the segment, the clue to be used is NOTH. If the thermal loading on the segment is of a general, standard type, that is if there is variation of temperature through the thickness as well as in the coordinate directions, the clue to be used is THST. If the thermal load is such that the variation is all in the coordinate directions, and there is no thermal variation through the thickness, the clue to be used is THCN. The last clue concerns a shell which is inhomogeneous in the meridional direction. This is not really a thermal problem at all, but merely a manipulation of the material property tables. If a structure has a wide variation in material properties in the meridional direction, without this last option one must take short segments of constant properties for analysis. With this option, however, the property variation is placed in the material property table, and expressed on the segment as a function of temperature. No thermal loads are calculated, however, and the temperatures are only used to interpolate for material properties as integration is progressing along the segment. Thus continual variation of properties in the meridional direction is accommodated. The clue for this option is THIN.

F. Stress-free Temperature — Column 51-60 — Format E10.1

The value of the temperature (usually room temperature) at which the segment has no thermal stresses or distortions induced, is provided here. This is the temperature at which the shell was manufactured. If there is to be no thermal analysis, this value is not used and can be set to zero (0.0).

		Column	Format
G.	Non-Linear Clue	61-64	A4

If the analysis is to be linear the clue is LINE. For a non-linear analysis see Reference 1 Section 7 and use the clue NPHI.

H.	Table control - Number of points in each of the following tables.	71-72	I2

This can vary from 2 to 30 depending upon the shell geometry and loading. For a linearly varying geometry and/or loading only 2 input points would be required. These two points would be the end points. For more general loading and/or geometry a larger number of points are required. In particular, each abrupt change is specified by two points. One should use as many points as necessary (up to 30) in order to completely describe the problem.

5. Table of ϕ or s Values

A.	Initial, intermediate and final values of ϕ or s. Each point requires 14 columns on a card and thus there can be 5 values per card and up to 6 cards to make a total of up to 30 points.		5E14.7

In preparing input data for this card, one should always make the first table value slightly smaller than the initial value of ϕ specified under item 2A. The last value has to be slightly greater than the final value of ϕ given under item 2B. The minimum value of this overlap is 1×10^{-4}. The table overlap is necessary to initialize the interpolation scheme.

6. Table of Wall Crossection Geometry

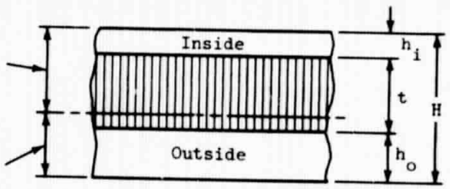
The contents of these cards (up to 6 cards per item below) are dependent upon the clues registered on the Master Clue Card. If the shell to be described contains no reinforcing, the pertinent clue is item 4C, the Sheet Clue. For these cases the geometry is input and the stiffnesses are calculated internally by the program (see Figure 2-10). The input is presented below as a function of the Sheet Clue.

If the Sheet Clue is SING (single sheet construction):

A.	Initial, intermediate and final values of wall thickness (h_i) at points defined by table of ϕ or s values.		5E14.7

$$\bar{\zeta}_{in} = \frac{h_i^2 + h_o^2 + 2h_ih_o + 2h_ot}{2(h_i + h_o)}$$

$$\bar{\zeta}_{out} = \frac{h_i^2 + h_o^2 + 2h_ih_o + 2h_it}{2(h_i + h_o)}$$



E,ν, Constant through thickness

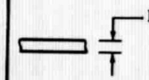
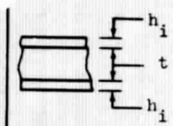
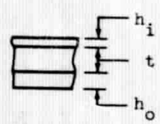
Configuration	Extensional Stiffnesses	Flexural Stiffnesses	Shear Stiffnesses
 h_i Ortho-tropic	$K_{11} = \frac{E_\theta h_i}{1 - \nu_{\phi\theta}\nu_{\theta\phi}}$ $K_{22} = \frac{E_\phi h_i}{1 - \nu_{\phi\theta}\nu_{\theta\phi}}$	$D_{11} = \frac{E_\theta h_i^3}{12(1 - \nu_{\phi\theta}\nu_{\theta\phi})}$ $D_{22} = \frac{E_\phi h_i^3}{12(1 - \nu_{\phi\theta}\nu_{\theta\phi})}$	$K_{33} = G_{\phi\theta}h_i$ $D_{33} = \frac{G_{\phi\theta}h_i^3}{12}$
 h_i, t, h_i Equal Face Sheets	$K_{11} = \frac{2E_\theta h_i}{1 - \nu_{\phi\theta}\nu_{\theta\phi}}$ $K_{22} = \frac{2E_\phi h_i}{1 - \nu_{\phi\theta}\nu_{\theta\phi}}$	$D_{11} = \frac{E_\theta h_i\left[4h_i^2 + 6h_it + 3t^2\right]}{6(1 - \nu_{\phi\theta}\nu_{\theta\phi})}$ $D_{22} = \frac{E_\phi h_i\left[4h_i^2 + 6h_it + 3t^2\right]}{6(1 - \nu_{\phi\theta}\nu_{\theta\phi})}$	$K_{33} = 2\,G_{\phi\theta}h_i$ $D_{33} = \frac{G_{\phi\theta}h_i\left[4h_i^2 + 6h_it + 3t^2\right]}{6}$
 h_i, t, h_o Unequal Face Sheets	$K_{11} = \frac{E_\theta(h_i + h_o)}{1 - \nu_{\phi\theta}\nu_{\theta\phi}}$ $K_{22} = \frac{E_\phi(h_i + h_o)}{1 - \nu_{\phi\theta}\nu_{\theta\phi}}$	$D_{11} = E_\theta\left[\frac{(h_i + h_o)^4 + 12h_ih_ot(h_i + h_o + t)}{12\,(h_i + h_o)\,(1 - \nu_{\phi\theta}\nu_{\theta\phi})}\right]$ $D_{22} = E_\phi\left[\frac{(h_i + h_o)^4 + 12h_ih_ot(h_i + h_o + t)}{12(h_i + h_o)\,(1 - \nu_{\phi\theta}\nu_{\theta\phi})}\right]$	$K_{33} = G_{\phi\theta}(h_i + h_o)$ $D_{33} = G_{\phi\theta}\left[\frac{(h_i + h_o)^4 + 12h_ih_ot(h_i + h_o + t)}{12\,(h_i + h_o)}\right]$

Figure 2-10. Calculated Shell Section Properties

	Column	Format
If the Sheet Clue is EQUA (equal-size face sheet sandwich):		
A. Initial, intermediate and final values of face sheet thickness (h_i) at points defined by table of ϕ or s values.		5E14.7
B. Initial, intermediate and final values of core thickness (t) at points defined by table of ϕ or s values.		5E14.7
If the Sheet Clue is UNEQ (unequal-size face sheet sandwich):		
A. Initial, intermediate and final values of <u>inner</u> face sheet thickness (h_i) at points defined by table of ϕ or s values.		5E14.7
B. Initial, intermediate and final values of core thickness (t) at points defined by table of ϕ or s values.		5E14.7
C. Initial, intermediate and final values of <u>outer</u> face sheet thickness (h_O) at points defined by table of ϕ or s values.		5E14.7

If the shell is reinforced, the Sheet Clue will be BLAN. In this case it is the following, or Reinforcement Clue (item 4D) which will determine the contents of card series 6. For the reinforcement cases the geometry can be complex and varied, since all types of reinforcing are to be included. Thus rather than geometry, actual stiffness parameters will be input. Formulas for calculating these parameters are derived in Reference 1 (Appendix A and Section 4). They are presented for those and additional cases on the following pages. The reinforced shell input is presented below as a function of the Reinforcement Clue.

	Column	Format
If the Reinforcement Clue is RWAF (waffle reinforcing rotated 45° to the coordinate axes):		
A. Initial, intermediate and final values of the reinforced shell extensional stifness in the θ direction (K_{11}) at points defined by table of ϕ or s values.		5E14.7
B. Initial, intermediate and final values of the reinforced shell Poisson's ratio effective extensional stifness (K_{12}) at points defined by table of ϕ or s values.		5E14.7

	Column	Format
C. Initial, intermediate and final values of the reinforced shell extensional stiffness in the ϕ direction (K_{22}) at points defined by table of ϕ or s values.		5E14.7
D. Initial, intermediate and final values of the reinforced shell shear extensional stiffness (K_{33}) at points defined by table of ϕ or s values.		5E14.7
E. Initial, intermediate and final values of the reinforced shell bending stiffness in the θ direction (D_{11}) at points defined by table of ϕ or s values.		5E14.7
F. Initial, intermediate and final values of the reinforced shell Poisson's ratio effective bending stiffness (D_{12}) at points defined by table of ϕ or s values.		5E14.7
G. Initial, intermediate and final values of the reinforced shell bending stiffness in the ϕ direction (D_{22}) at points defined by table of ϕ or s values.		5E14.7
H. Initial, intermediate and final values of the reinforced shell shear bending stiffness (D_{33}) at points defined by table of ϕ or s values.		5E14.7
I. Initial, intermediate and final values of the reinforced shell waffle eccentricity parameter (C_{11}) at points defined by table of ϕ or s values.		5E14.7

If the Reinforcing Clue is ST10 (reinforcement consisting of rings or stringers or both):

A. through H. The items contained on these cards are identical to those described for the RWAF clue above.		8 sets of 5E14.7
I. Initial, intermediate and final values of the reinforced shell ring eccentricity parameter (C_{11}) at points defined by table of ϕ or s values.		5E14.7
J. Initial, intermediate and final values of the reinforced shell stringer eccentricity parameter (C_{22}) at points defined by table of ϕ or s values.		5E14.7

Reinforced Shell Stiffness Formulas

I. Waffle Construction (RWAF Clue)

A. Single sheet reinforced by rotated waffle:

$$K_{11} = \frac{E_\theta h}{1-\nu_{\phi\theta}\nu_{\theta\phi}} + \frac{E_R A}{S} \qquad K_{22} = \frac{E_\phi h}{1-\nu_{\phi\theta}\nu_{\theta\phi}} + \frac{E_R A}{S}$$

$$K_{12} = \frac{\nu_{\theta\phi} E_\theta h}{1-\nu_{\phi\theta}\nu_{\theta\phi}} + \frac{E_R A}{S} \qquad K_{33} = G_{\phi\theta} h + \frac{E_R A}{S}$$

$$C_{11} = \frac{E_R AC}{S} \qquad D_{22} = \frac{-E_\phi h^3}{12(1-\nu_{\phi\theta}\nu_{\theta\phi})} - \frac{E_R I}{S}$$

$$D_{11} = \frac{-E_\theta h^3}{12(1-\nu_{\phi\theta}\nu_{\theta\phi})} - \frac{E_R I}{S} \qquad D_{33} = \frac{G_{\phi\theta} h^3}{12} + \frac{E_R I}{S}$$

$$D_{12} = \frac{-\nu_{\theta\phi} E_\theta h^3}{12(1-\nu_{\phi\theta}\nu_{\theta\phi})} - \frac{E_R I}{S}$$

B. Equal-size face sheet sandwich reinforced by rotated waffle:

$$K_{11} = \frac{2E_\theta h_i}{1-\nu_{\phi\theta}\nu_{\theta\phi}} + \frac{E_R A}{S} \qquad K_{22} = \frac{2E_\phi h_i}{1-\nu_{\phi\theta}\nu_{\theta\phi}} + \frac{E_R A}{S}$$

$$K_{12} = \frac{2\nu_{\theta\phi} E_\theta h_i}{1-\nu_{\phi\theta}\nu_{\theta\phi}} + \frac{E_R A}{S} \qquad K_{33} = 2G_{\phi\theta} h_i + \frac{E_R A}{S}$$

$$C_{11} = \frac{E_R AC}{S} \qquad D_{22} = \frac{-E_\phi h_i \left[4h_i^2 + 6h_i t + 3t^2\right]}{6(1-\nu_{\phi\theta}\nu_{\theta\phi})} - \frac{E_R I}{S}$$

$$D_{11} = \frac{-E_\theta h_i \left[4h_i^2 + 6h_i t + 3t^2\right]}{6(1-\nu_{\phi\theta}\nu_{\theta\phi})} - \frac{E_R I}{S}$$

$$D_{12} = \frac{-\nu_{\theta\phi} E_\theta h_i \left[4h_i^2 + 6h_i t + 3t^2\right]}{6(1-\nu_{\phi\theta}\nu_{\theta\phi})} - \frac{E_R I}{S}$$

$$D_{33} = \frac{G_{\phi\theta} h_i \left[4h_i^2 + 6h_i t + 3t^2\right]}{6} + \frac{E_R I}{S}$$

C. Unequal-size face sheet sandwich reinforced by rotated waffle:

$$K_{11} = \frac{E_\theta(h_i + h_o)}{1-\nu_{\phi\theta}\nu_{\theta\phi}} + \frac{E_R A}{S} \qquad K_{22} = \frac{E_\phi(h_i + h_o)}{1-\nu_{\phi\theta}\nu_{\theta\phi}} + \frac{E_R A}{S}$$

$$K_{12} = \frac{\nu_{\theta\phi} E_\theta(h_i + h_o)}{1-\nu_{\phi\theta}\nu_{\theta\phi}} + \frac{E_R A}{S} \qquad K_{33} = G_{\phi\theta}(h_i + h_o) + \frac{E_R A}{S}$$

$$C_{11} = \frac{E_R AC}{S}$$

$$D_{11} = -E_\theta \left[\frac{(h_i + h_o)^4 + 12h_i h_o t(h_i + h_o + t)}{12(h_i + h_o)(1-\nu_{\phi\theta}\nu_{\theta\phi})}\right] - \frac{E_R I}{S}$$

$$D_{12} = -\nu_{\theta\phi} E_\theta \left[\frac{(h_i + h_o)^4 + 12h_i h_o t(h_i + h_o + t)}{12(h_i + h_o)(1-\nu_{\phi\theta}\nu_{\theta\phi})}\right] - \frac{E_R I}{S}$$

$$D_{22} = -E_\phi \left[\frac{(h_i + h_o)^4 + 12h_i h_o t(h_i + h_o + t)}{12(h_i + h_o)(1-\nu_{\phi\theta}\nu_{\theta\phi})}\right] - \frac{E_R I}{S}$$

$$D_{33} = G_{\phi\theta} \left[\frac{(h_i + h_o)^4 + 12h_i h_o t(h_i + h_o + t)}{12(h_i + h_o)}\right] + \frac{E_R I}{S}$$

where in the above presentation:

A = area of reinforcement

C = eccentricity of reinforcement (measured inwards from the shell middle surface as positive)

I = moment of inertia of reinforcement about basic shell centroidal axis

S = spacing of reinforcement

and subscript R refers to reinforcement properties.

As can be seen from the changes in corresponding equations for the single sheet and sandwich basic constructions, any basic construction reinforced by a rotated waffle can be analyzed by the program, by merely calculating its stiffnesses and adding to them the appropriate reinforcing stiffness terms. In addition, any other wall crossection which is not explicitly reinforced can be analyzed by this option if the integrated Hooke's Laws of the cross-section can be cast into the form of Equations 4-10 in Reference 1, and the definitions of the stiffness parameters thus derived are used.

II. Ring - Stringer Reinforced Construction (ST10 Clue)

A. Single sheet reinforced by rings and/or stringers:

$$K_{11} = \frac{E_\theta h}{1-\nu_{\phi\theta}\nu_{\theta\phi}} + \frac{E_{\theta_R} A_\theta}{S_\theta} \qquad K_{22} = \frac{E_\phi h}{1-\nu_{\phi\theta}\nu_{\theta\phi}} + \frac{E_{\phi_R} A_\phi}{S_\phi}$$

$$K_{12} = \frac{\nu_{\theta\phi} E_\theta h}{1-\nu_{\phi\theta}\nu_{\theta\phi}} \qquad K_{33} = G_{\phi\theta} h$$

$$C_{11} = \frac{E_{\theta_R} C_\theta A_\theta}{S_\theta} \qquad C_{22} = \frac{E_{\phi_R} C_\phi A_\phi}{S_\phi}$$

$$D_{11} = \frac{-E_\theta h^3}{12(1-\nu_{\phi\theta}\nu_{\theta\phi})} - \frac{E_{\theta_R} I_\theta}{S_\theta} \qquad D_{22} = \frac{-E_\phi h^3}{12(1-\nu_{\phi\theta}\nu_{\theta\phi})} - \frac{E_{\phi_R} I_\phi}{S_\phi}$$

$$D_{12} = \frac{-\nu_{\theta\phi} E_\theta h^3}{12(1-\nu_{\phi\theta}\nu_{\theta\phi})} \qquad D_{33} = \frac{G_{\phi\theta} h^3}{12} + \frac{G_{\phi_R} J_\phi}{4S_\phi} + \frac{G_{\theta_R} J_\theta}{4S_\theta}$$

B. Equal-size face sheet sandwich reinforced by rings and/or stringers:

$$K_{11} = \frac{2E_\theta h_i}{1-\nu_{\phi\theta}\nu_{\theta\phi}} + \frac{E_{\theta_R} A_\theta}{S_\theta}$$

$$K_{22} = \frac{2E_\phi h_i}{1-\nu_{\phi\theta}\nu_{\theta\phi}} + \frac{E_{\phi_R} A_\phi}{S_\phi}$$

$$K_{12} = \frac{2\nu_{\theta\phi} E_\theta h_i}{1-\nu_{\phi\theta}\nu_{\theta\phi}}$$

$$K_{33} = 2G_{\phi\theta} h_i$$

$$C_{11} = \frac{E_{\theta_R} C_\theta A_\theta}{S_\theta}$$

$$C_{22} = \frac{E_{\phi_R} C_\phi A_\phi}{S_\phi}$$

$$D_{11} = \frac{-E_\theta h_i \left[4h_i^2 + 6h_i t + 3t^2\right]}{6(1-\nu_{\phi\theta}\nu_{\theta\phi})} - \frac{E_{\theta_R} I_\theta}{S_\theta}$$

$$D_{22} = \frac{-E_\phi h_i \left[4h_i^2 + 6h_i t + 3t^2\right]}{6(1-\nu_{\phi\theta}\nu_{\theta\phi})} - \frac{E_{\phi_R} I_\phi}{S_\phi}$$

$$D_{12} = \frac{-\nu_{\theta\phi} E_\theta h_i \left[4h_i^{\,2} + 6h_i t + 3t^2 \right]}{6(1-\nu_{\phi\theta}\nu_{0\phi})}$$

$$D_{33} = \frac{G_{\phi\theta} h_i \left[4h_i^{\,2} + 6h_i t + 3t^2 \right]}{6} + \frac{G_{\phi_R} J_\phi}{4S_\phi} + \frac{G_{\theta_R} J_\theta}{4S_\theta}$$

C. Unequal-size face sheet sandwich reinforced by rings and/or stringers:

$$K_{11} = \frac{E_\theta (h_i + h_o)}{1-\nu_{\phi\theta}\nu_{\theta\phi}} + \frac{E_{\theta_R} A_\theta}{S_\theta}$$

$$K_{22} = \frac{E_\phi (h_i + h_o)}{1-\nu_{\phi\theta}\nu_{\theta\phi}} + \frac{E_{\phi_R} A_\phi}{S_\phi}$$

$$K_{12} = \frac{\nu_{\theta\phi} E_\theta (h_i + h_o)}{1-\nu_{\phi\theta}\nu_{\theta\phi}}$$

$$K_{33} = G_{\phi\theta}(h_i + h_o)$$

$$C_{11} = \frac{E_{\theta_R} C_\theta A_\theta}{S_\theta}$$

$$C_{22} = \frac{E_{\phi_R} C_\phi A_\phi}{S_\phi}$$

$$D_{11} = -E_\theta \left[\frac{(h_i + h_o)^4 + 12 h_i h_o t (h_i + h_o + t)}{12(1-\nu_{\phi\theta}\nu_{\theta\phi})(h_i + h_o)} \right] - \frac{E_{\theta_R} I_\theta}{S_\theta}$$

$$D_{22} = -E_\phi \left[\frac{(h_i + h_o)^4 + 12h_ih_ot(h_i + h_o + t)}{12(1-\nu_{\phi\theta}\nu_{\theta\phi})(h_i + h_o)} \right] - \frac{E_{\phi_R} I_\phi}{S_\phi}$$

$$D_{12} = -\nu_{\theta\phi}E_\theta \left[\frac{(h_i + h_o)^4 + 12h_ih_ot(h_i + h_o + t)}{12(h_i + h_o)(1-\nu_{\phi\theta}\nu_{\theta\phi})} \right]$$

$$D_{33} = G_{\phi\theta} \left[\frac{(h_i + h_o)^4 + 12h_ih_ot(h_i + h_o + t)}{12(h_i + h_o)} \right] + \frac{G_{\phi_R} J_\phi}{4S_\phi} + \frac{G_{\theta_R} J_\theta}{4S_\theta}$$

where in the above presentation:

A = area of reinforcement

C = eccentricity of reinforcement (measured inwards from the shell middle surface as positive)

I = moment of inertia of reinforcement about basic shell centroidal axis

J = twist constant of reinforcement crossection

S = spacing of reinforcement

subscripts θ or ϕ indicate coordinate directions, and subscript R refers to reinforcement properties. With reference to reinforcement properties, ϕ refers to stringers and θ refers to rings.

The ST10 equations are somewhat approximate. First, since the reinforcement properties are "smeared", the equations will not be accurate where the reinforcement is widely spaced. To this end, when loading a shell with a high circumferential harmonic (n) loading, one should check if the load peaks attain closer spacing than the stringer reinforcement. If this is so, the ST10 equations are not applicable. The load patterns should similarly be checked in the meridional direction. Second, due to the first order theory assumption that $M_{\phi\theta} = -M_{\theta\phi}$, the torsional constant is only approximate in cases where reinforcement properties GJ/S are not equal in the two coordinate directions. For an axisymmetric loading this approximation will have no effect, unless a pure torsion load is applied.

As previously, changes in corresponding equations for the single sheet and sandwich basic constructions indicate that any basic construction with reinforcement can be analyzed by the program, by calculating its basic stiffnesses and adding them to the appropriate reinforcing stiffness terms. Again, any other wall crossection which is not explicitly reinforced can be analyzed by this option if the integrated Hooke's Laws of the crossection can be cast into the form of Equations 4-1 in Reference 1, and the definitions of the stiffness parameters thus derived are used.

Both the ST10 and the RWAF equations are applicable to obtain accurate stress resultants for a reinforced shell structure. Stress calculations based upon "smeared" properties, however, are inaccurate, and are not carried out by the program. The user, having the actual geometry and the stress resultants can easily make this calculation (see Appendix B).

7. Loading Clue Card — Column — Format

The contents of this card are numerical clues which alert the program to the types of loads that exist on the segment. In addition, if the clue indicates that some load does not exist, the appropriate cards in series 8 which would ordinarily contain the numerical values of this load are omitted from the sequence.

The series of cards 7 and 8 are repeated for the number of problems indicated on the Program Control Card (item E) up to a maximum of 10. If for one of these problems, no load exists on the segment, then a blank Loading Clue Card is inserted in the sequence at this point and the load cards are entirely omitted. For instance if there are four load patterns to be investigated, and for the second pattern some segment is completely unloaded, the card sequence for that segment would be:

Loading Clue Card for pattern one (card 7)
Load Values for pattern one (cards 8)
Blank Card
Loading Clue Card for pattern three (card 7)
Load Values for pattern three (cards 8)
Loading Clue Card for pattern four (card 7)
Load Values for pattern four (cards 8)

	Column	Format
The appropriate clues are as follows:		
A. Thermal Clue	1	I1
B. Circumferential Load Clue (f_θ)	2	I1
C. Meridional Load Clue (f_ϕ)	3	I1
D. Normal Load Clue (f_ζ)	4	I1
E. Circumferential Moment Load Clue (m_θ)	5	I1

The appropriate clues are as follows:

A. Thermal Clue — Column 1, Format I1

If there are no thermal loads (Item 4E is NOTH) the clue number is zero (0).

If there is a standard thermal variation through the thickness (Item 4E is THST) the clue number is four (4).

If the temperature is constant through the thickness (Item 4E is THCN) or if the inhomogeneous option is used (Item 4E is THIN) the clue number is one (1).

If a thermal loading <u>does</u> exist on the structure, then the stiffnesses matrix is thermal dependent, and only one loading problem may be run per submission (see Program Control Card, item E).

B. Circumferential Load Clue (f_θ) — Column 2, Format I1

If there are <u>no</u> circumferential loads, then the clue number is zero (0).

If there are circumferential loads, then the clue number is one (1).

C. Meridional Load Clue (f_ϕ) — Column 3, Format I1

If there are <u>no</u> meridional loads, then the clue number is zero (0).

If there are meridional loads, then the clue number is one (1).

D. Normal Load Clue (f_ζ) — Column 4, Format I1

If there are <u>no</u> normal loads, then the clue number is zero (0).

If there are normal loads, then the clue number is one (1).

E. Circumferential Moment Load Clue (m_θ) — Column 5, Format I1

If there are <u>no</u> circumferential moment loads then the clue number is zero (0).

If there are circumferential moment loads, then the clue number is one (1).

	Column	Format
F. Meridional Moment Load Clue (m_ϕ)	6	I1
If there are <u>no</u> meridional moment loads, then the clue number is zero (0).		
If there are meridional moment loads, then the clue number is one (1).		
G. Any alphameric information (load description)	7-70	16A4

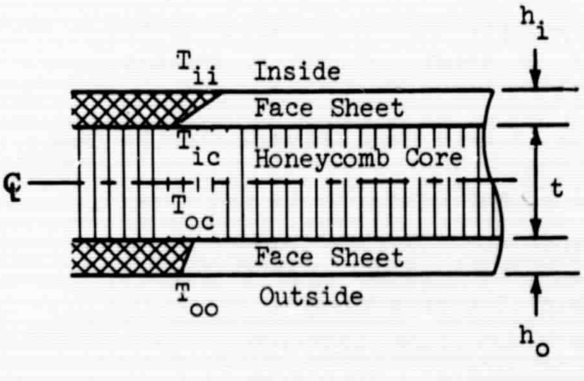
8. Table of Applied Loads (see Figures 2-11a, b for sign convention)

The appropriate card sequence is given below as a function of the Loading Clues on card 7. If the Thermal Clue is one (1):

A. Initial, intermediate and final values of the temperature of the shell at points defined by table of ϕ or s values. (These values will be used either for a thermal problem where there is no thermal variation through the thickness {Clue = THCN}, or to calculate varying material properties along the shell for an inhomogeneous problem {Clue = THIN}.) — 5E14.7

If the Thermal Clue is four (4):

A. Initial, intermediate and final values of the temperature T_{ii} at points defined by table of ϕ or s values. (The subscripts "nm" indicate temperature location - see below.) — 5E14.7



Column Format

B. Initial, intermediate and final values of the temperature T_{ic} at points defined by table of ϕ or s values. — 5E14.7

C. Initial, intermediate and final values of the temperature T_{oc} at points defined by table of ϕ or s values. — 5E14.7

D. Initial, intermediate and final values of the temperature T_{oo} at points defined by table of ϕ or s values. — 5E14.7

If the Thermal Clue is zero (0), the above cards are omitted.

If the Circumferential Load Clue is one (1):

E. Initial, intermediate and final values of the circumferential loads f_θ at points defined by table of ϕ or s values. — 5E14.7

For a discussion of distributed loads see Reference 3, Appendix A.

If the Circumferential Load Clue is zero (0), cards E are omitted.

If the Meridional Load Clue is one (1):

F. Initial, intermediate and final values of the meridional loads f_ϕ at points defined by table of ϕ or s values. — 5E14.7

If the Meridional Load Clue is zero (0), cards F are omitted.

If the Normal Load Clue is one (1):

G. Initial, intermediate and final values of the normal loads f_ζ at points defined by table of ϕ or s values. — 5E14.7

If the Normal Load Clue is zero (0), cards G are omitted.

If the Circumferential Moment Load Clue is one (1):

H. Initial, intermediate and final values of the circumferential moment loads m_θ at points defined by table of ϕ or s values. — 5E14.7

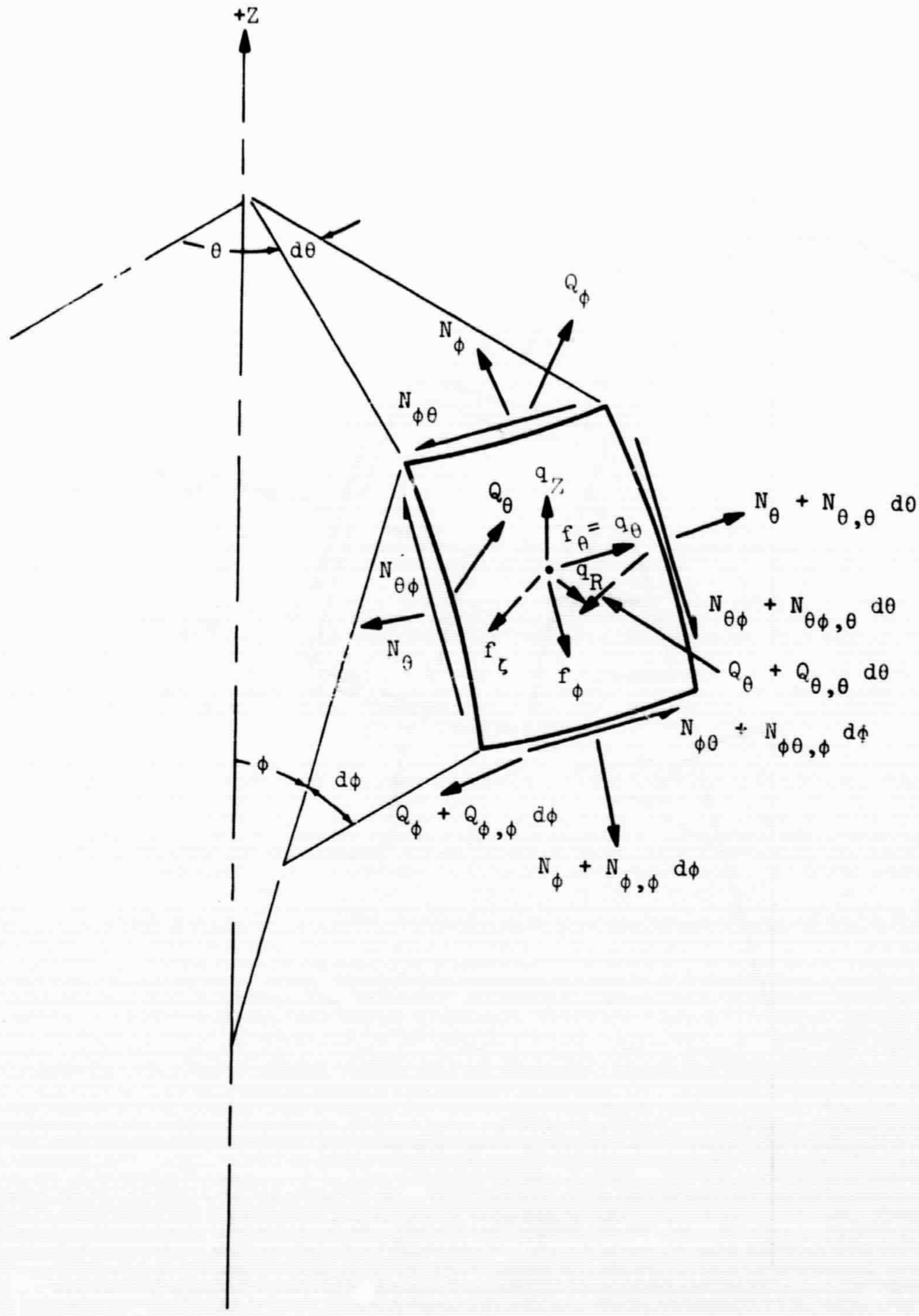


Figure 2-11a. Forces on Shell Element

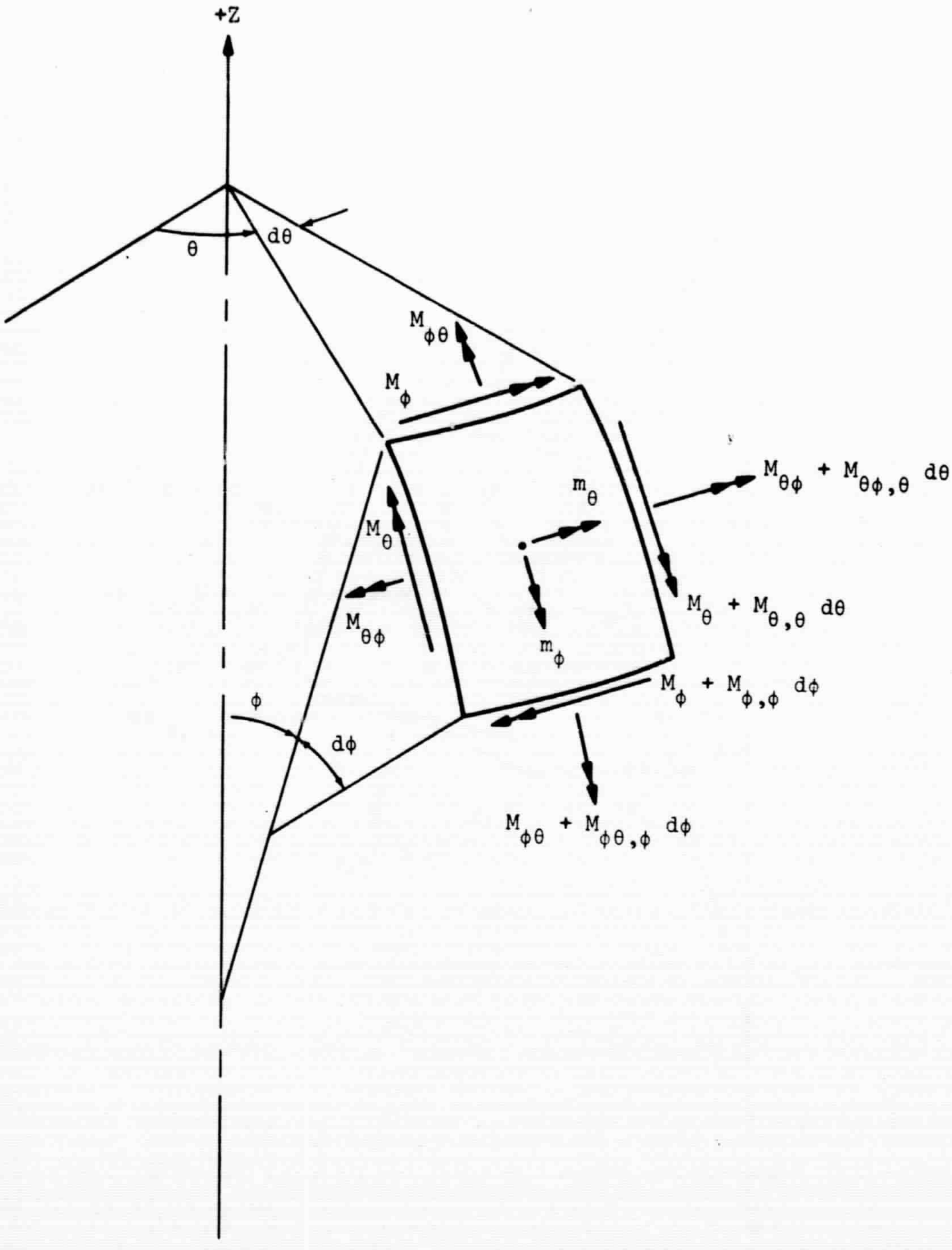


Figure 2-11b. Moments on Shell Element

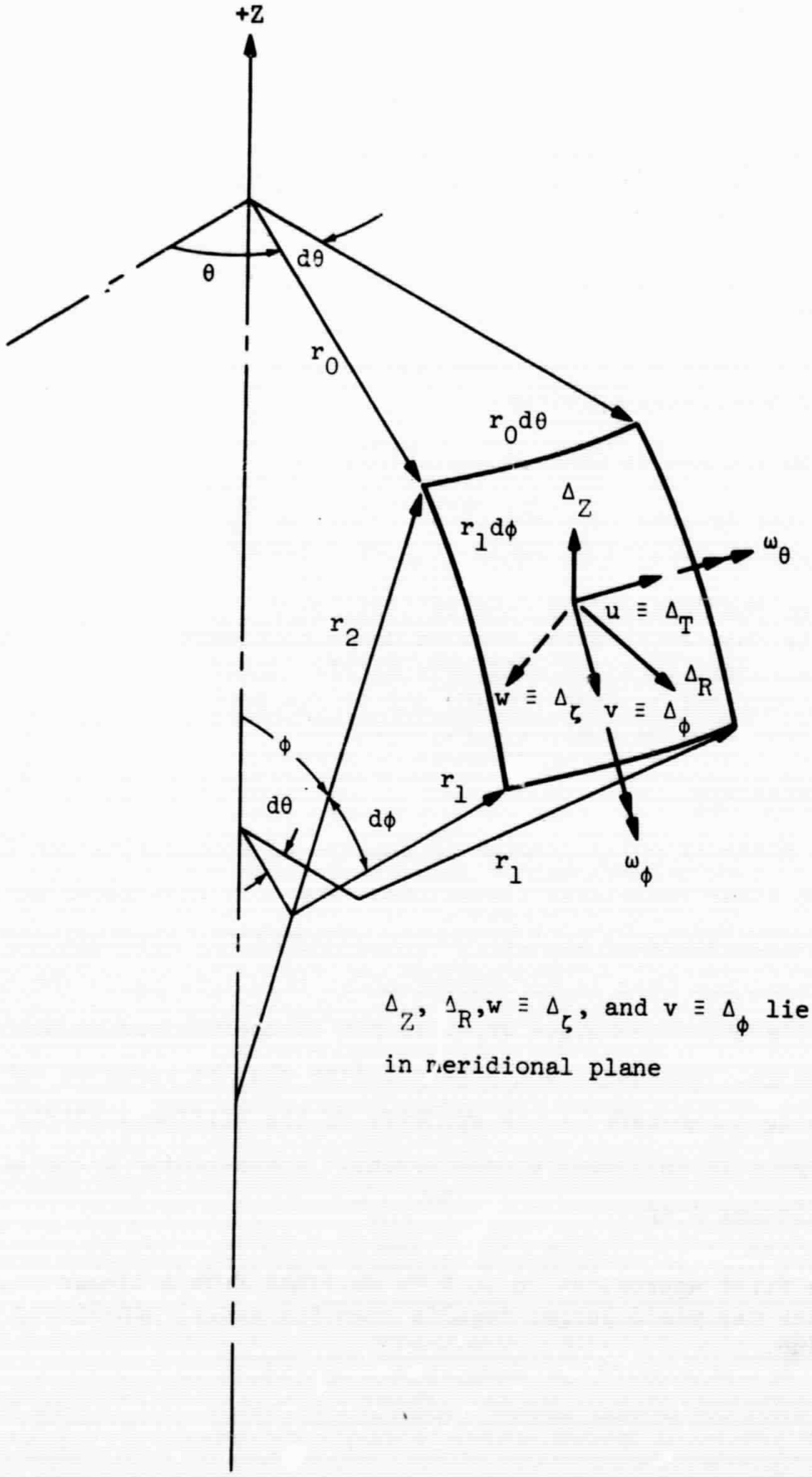


Figure 2-11c. Shell Element Geometry and Displacements

	Column	Format
If the Circumferential Moment Load Clue is zero (0), cards H are omitted.		
If the Meridional Moment Load Clue is one (1):		
I. Initial, intermediate and final values of the meridional moment loads m_ϕ at points defined by table of ϕ or s values.		5E14.7
If the Meridional Moment Load Clue is zero (0), cards I are omitted.		
9. Table of assumed Meridional Membrane Force $\overline{N}_\phi$ for axisymmetric non-linear problems.		
If item 4G on the Master Clue Card is NPHI:		
A. Initial intermediate and final values of $\overline{N}_\phi$ at points defined by table of ϕ or s values.		5E14.7
If Item 4G on the Master Clue Card is LINE, card sequence 9 is omitted. If the problem under consideration is non-linear, then the stiffness matrix depends upon $\overline{N}_\phi$ and only one loading problem may be run per submission (see Program Control Card, item E).		

Non-Linear Analysis

The present STARS II shell program is capable of considering non-linear effects, but under restricted conditions. The only non-linear behavior that can be currently analyzed is that due to axisymmetric loading, and the only mode of deformation that is considered under this loading is the axisymmetric mode. The iteration technique which is not automated, can be accidentally made to diverge. To ensure convergence, care must be taken to satisfy the segment sizing parameters, since symmetry of the stiffness matrix for a non-linear analysis is no longer a requirement. A non-linear analysis would then use the following steps:

1) The first approximation to N is obtained from a linear solution, which may yield larger results than the actual non-linear final value.

2) After the preliminary values are obtained, the structure segments should be resized in the areas where local non-linear behavior is suspected, using the non-linear sizing parameter (γ) described on pages 2-18 to 2-20.

3) If non-linear effects are locally large, the value for $\bar{N}$ obtained from a linear solution (step 1) may dominate the loading terms in a non-linear analysis, and cause oscillations. To eliminate this possibility, the first $\bar{N}$ approximation should be lower than the value predicted by a linear analysis (90 to 50 percent depending on the suspected magnitude of non-linearity). If oscillations are encountered at any stage, they can be eliminated, and a trend toward convergence reestablished by using smaller values of $\bar{N}$.

4) With this step the procedure is repeated. A non-linear analysis is made and the N output is compared with the barred (assumed) quantities. This procedure is carried out until convergence is reached.

	Column	Format
10. Stress Clue Card		
This card contains a series of clues which are used to identify the proper Hooke's Law to be used for stress calculations.		
A. Meridional Stress Inner Edge Clue	1-4	A4
B. Meridional Stress Outer Edge Clue	11-14	A4

10. Stress Clue Card

This card contains a series of clues which are used to identify the proper Hooke's Law to be used for stress calculations.

A. Meridional Stress Inner Edge Clue — Column 1-4, Format A4

This clue informs the program as to what kind of construction exists at the meridional inner edge of the shell segment. If the construction is part of the basic shell, the clue is: SHEL. If the construction is part of the rotated waffle reinforcement, the clue is: WAFF. If the construction is part of a stringer, the clue is: STRI.

B. Meridional Stress Outer Edge Clue — Column 11-14, Format A4

This clue informs the program as to what kind of construction exists at the meridional outer edge of the shell segment. The same possibilities as in Item A exist, and the possible clues again are:

SHEL
WAFF
STRI

	Column	Format
C. Hoop Stress Inner Edge Clue	21-24	A4

This clue informs the program as to what kind of construction exists at the hoop inner edge of the shell segment. If the construction is part of the basic shell, the clue is: SHEL. If the construction is part of the rotated waffle reinforcement, the clue is: WAFF. If the construction is part of a ring, the clue is: RING.

	Column	Format
D. Hoop Stress Outer Edge Clue	31-34	A4

This clue informs the program as to what kind of construction exists at the hoop outer edge of the shell segment. The same possibilities as in Item C exist, and the possible clues again are:

SHEL
WAFF
RING

11. Reinforced Stress Calculation Table

The contents of these cards are dependent upon the Reinforcement Clue (Item 4D). If this clue is THIC, the whole set of cards 10 and 11 is omitted.

If the Reinforcement Clue is RWAF:

	Format
A. Initial, intermediate and final values of extreme inward distance to reinforcement edge at points defined by ϕ or s table. This is a signed (±) value, measured from the basic shell centroid to the extreme point of shell or reinforcement, positive inwards.	5E14.7
B. Initial, intermediate and final values of extreme outward distance to reinforcement edge at points defined by ϕ or s table. This is a signed (±) value, measured from the basic shell centroid to the extreme point of shell or reinforcement, positive inwards.	5E14.7
C. Initial, intermediate and final values of waffle reinforcement spacing at points defined by ϕ or s table.	5E14.7
D. Initial, intermediate and final values of waffle rib thickness at points defined by ϕ or s table.	5E14.7

	Column	Format

If the Reinforcement Clue is ST10:

A. Initial, intermediate and final values of extreme inward θ distance to reinforcement edge at points defined by φ or s table. This is a signed (±) value, measured from the basic shell centroid to the extreme point of shell or ring, positive inwards.		5E14.7
B. Initial, intermediate and final values of extreme outward θ distance to reinforcement edge at points defined by φ or s table. This is a signed (±) value, measured from the basic shell centroid to the extreme point of shell or ring, positive inwards.		5E14.7
C. Initial, intermediate and final values of extreme inward φ distance to reinforcement edge at points defined by φ or s table. This is a signed (±) value, measured from the basic shell centroid to the extreme point of shell or stringer, positive inwards.		5E14.7
D. Initial, intermediate and final values of extreme outward φ distance to reinforcement edge at points defined by φ or s table. This is a signed (±) value, measured from the basic shell centroid to the extreme point of shell or stringer, positive inwards.		5E14.7
E. Initial, intermediate and final values of ring reinforcement spacing at points defined by φ or s table.		5E14.7
F. Initial, intermediate and final values of stringer reinforcement spacing at points defined by φ or s table.		5E14.7
G. Initial, intermediate and final values of ring thickness at points defined by φ or s table.		5E14.7

If the rings or stringers are other than a plate rib in shape (i.e. hat or "c" sections), the values in items G and H should be the largest width dimension of the reinforcement construction.

	Column	Format
H. Initial, intermediate and final values of stringer thickness at points defined by ϕ or s table.		5E14.7

If the reinforcement is uni-directional (i.e., only rings or only stringers), the appropriate values in items E through H referring to the non-existant reinforcement can be replaced by blank cards.

12. Segment Topology Cards

	Column	Format
A. Segment number	1-5	I5
Number of the segment under consideration.		
B. Joint (i)	6-10	I5
Joint associated with i^{th} end of the segment (TIC).		
C. Joint (j)	11-15	I5
Joint associated with the j^{th} end of the segment (STOP).		

Since within a region the segments are all singly connected, the segment joint numbers should be in adjacent numerical pairs. That is, if joint (j) is 6, joint (i) could only be 5 or 7. This is true only within a region. In addition, the initial joint of each region must be 1 in segment topology numbering, and the final joint of each region must be the last (highest) number in the segment topology numbering (see Figure 2-12). The coordinate ϕ or s increases from TIC to STOP, i to j. The user is again advised to see Figures 2-3 to 2-9.

INTRA-REGION KINEMATIC LINK CARDS

These cards, if any exist (region introductory card, item 1B), are placed at the end of all the segment data for the region. They contain the following information:

	Column	Format
A. Joint (j) dependent joint	1-2	I2
B. Joint (i) Independent joint	3-4	I2

For intra-region kinematic links these joints must be in consecutive decending order. That is, joint (j) should always be greater than joint (i) by one.

C. Angle γ in radians (see Figure 2-13)	5-19	E14.7

γ cannot equal 0 or π.

The angle γ describes the orientation of the link; it is the inclination angle of the link from the vertical (Z axis). The number of kinematic link cards must equal the number specified in item 1B, of the region introductory card.

REGION JOINT CONTROL DATA

These cards are placed at the end of the data for all regions.

1. Joint Control Data Card

A. Number of region joints	1-5	I5

Total number of region joints for problem (Max. = 20).

B. Number of kinematic links	6-10	I5

Total number of kinematic links between regions for problem.

2. Kinematic Link Cards (inter-region)

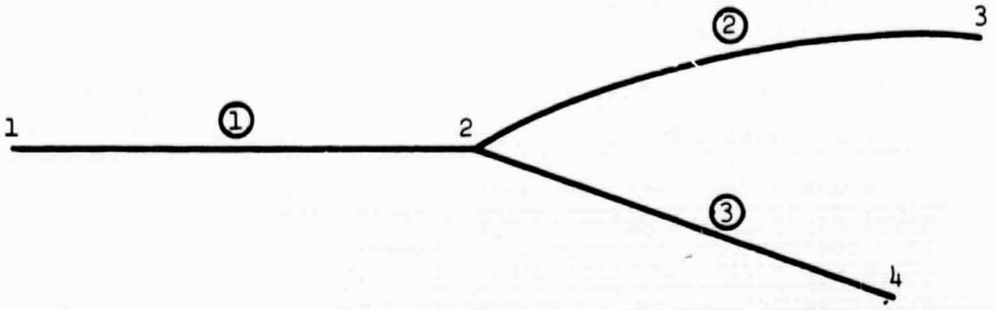
A. Joint (j) dependent joint	1-2	I2
B. Joint (i) independent joint	3-4	I2

For kinematic links between regions there are no restrictions upon joint numbering.

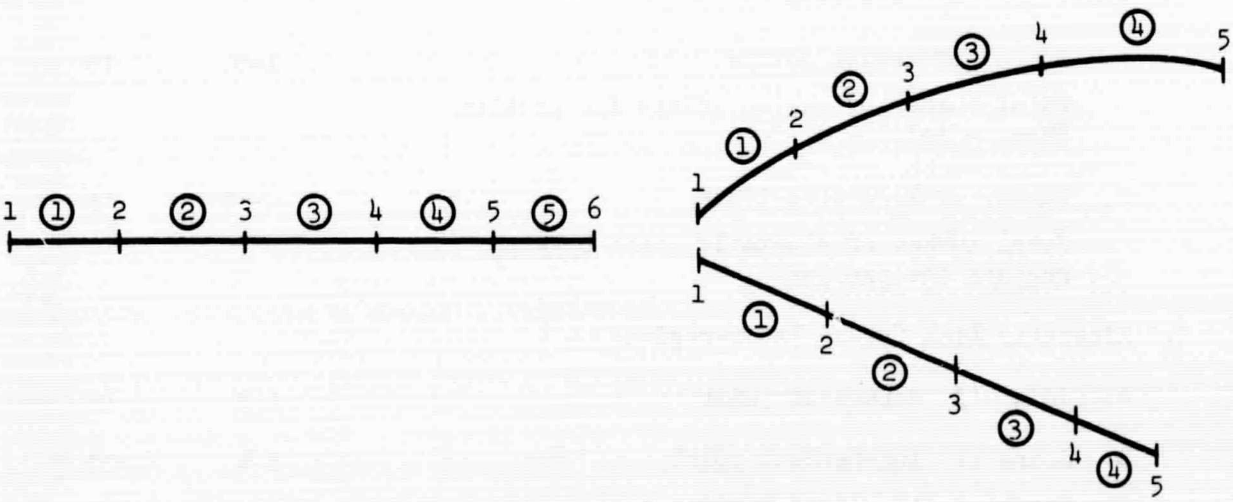
C. Angle γ in radians (see Figure 2-13)	5-19	E14.7

γ cannot equal 0 or π.

The angle γ describes the orientation of the link; it is the inclination of angle of the link from the vertical (Z axis). The number of kinematic link cards must equal the number specified in item 1B of the Joint Control Data Card.

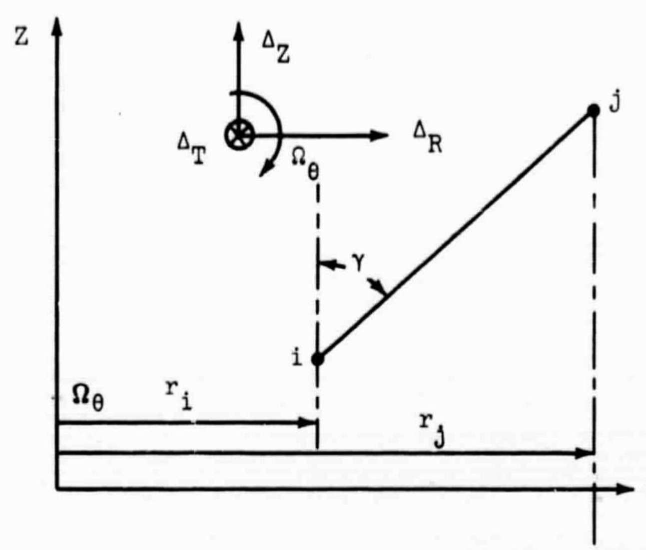


Region Numbering



Numbering of Segments Within Regions

Figure 2-12. Topology Schemes



Express joint j
in terms of joint i

$$
\begin{Bmatrix} \Delta_{T_j} \\ \Delta_{Z_j} \\ \Delta_{R_j} \\ \Omega_{\theta_j} \end{Bmatrix}
=
\left[\begin{array}{c:c:c:c}
\frac{r_j}{r_i} & 0 & 0 & 0 \\
0 & +1 & 0 & -(r_j - r_i) \\
0 & 0 & +1 & (r_j - r_i)\cot\gamma \\
0 & 0 & 0 & +1
\end{array}\right]
\begin{Bmatrix} \Delta_{T_i} \\ \Delta_{Z_i} \\ \Delta_{R_i} \\ \Omega_{\theta_i} \end{Bmatrix}
$$

Figure 2-13. Kinematic Link

	Column	Format
3. Boundary Condition Cards (Joint Data - one card per region joint)		
A. Joint Number	1-2	I2
B. Joint component conditions on:		
1) Δ_T	3-4	F2.0
2) Δ_Z or Δ_N (see Figure 2-14)	5-6	F2.0
3) Δ_R or Δ_Q	7-8	F2.0
4) Ω_θ	9-10	F2.0

There are 4 different codes that are used to prescribe joint component conditions. They are:

a. 0 = no displacement allowed.

b. 1 = displacement allowed in the indicated direction.

c. 2 = Δ_Z and Δ_R are rotated through an angle of $(\pi/2 - \alpha)$ and become Δ_N and Δ_Q respectively, while a displacement is allowed in the Δ_N direction.

d. 3 = Δ_Z and Δ_R rotated through an angle of $(\pi/2 - \alpha)$ and become Δ_N and Δ_Q respectively, while a displacement is allowed in the Δ_Q direction.

When using rotation codes:

Code 2 can exist only as Δ_Z coding;

Code 3 can exist only as Δ_R coding.

Codes 0 and 1 can appear in either column 4 or column 6, in addition to columns 8 and 10. Thus, there are twelve possible boundary conditions when rotation codes are used.
($\alpha = \phi$ for table below)

2

	Free edge (possible to apply shear and/ or membrane loads)	Δ_Q = 0, normal support (possible to apply membrane load)	Δ_N = 0, membrane support (possible to apply shear load)
Δ_T, Ω_θ free	1,2,3,1	1,2,0,1	1,0,3,1
Δ_T, Ω_θ fixed	0,2,3,0	0,2,0,0	0,0,3,0
Δ_T fixed Ω_θ free	0,2,3,1	0,2,0,1	0,0,3,1
Δ_T free Ω_θ fixed	1,2,3,0	1,2,0,0	1,0,3,0

Column Format

See Figure 2-14 for an explanation of codes 2 and 3.

NOTES: 1) To establish a datum for measuring displacement, free body motion must be eliminated from the structure. This should be accomplished by suitably applied boundary conditions.

2) The ability of a dependent joint in a kinematic link to prescribe motion independently should be removed by setting all boundary conditions of that joint to zero. See pages 2-42 and 2-53.

C. Angle α in radians 11-24 E14.1

To be used only in conjunction with a 2 or 3 code.

NOTE: There must be as many boundary condition cards as there are joints as indicated in item 1A of the Joint Control Data Card.

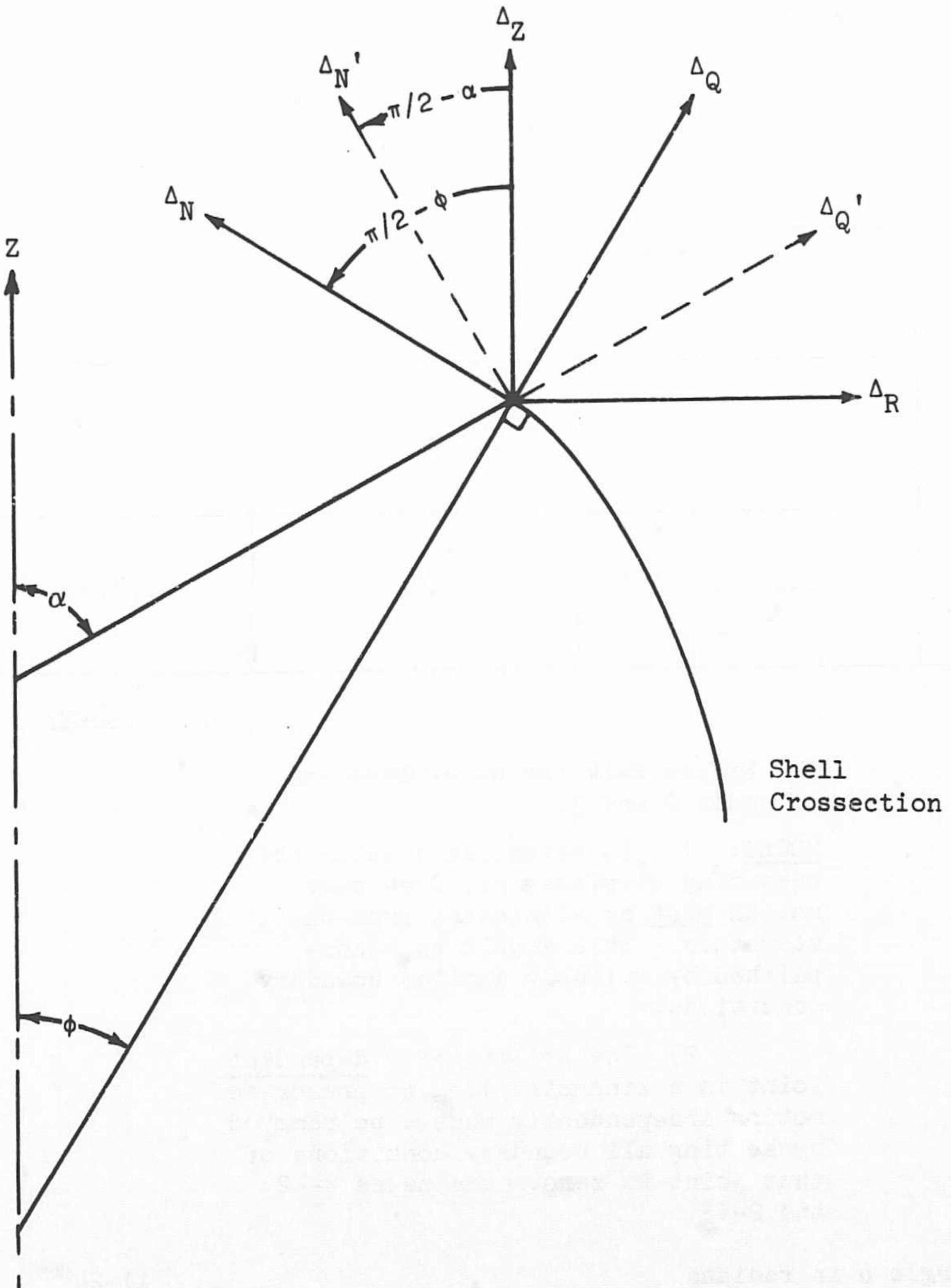
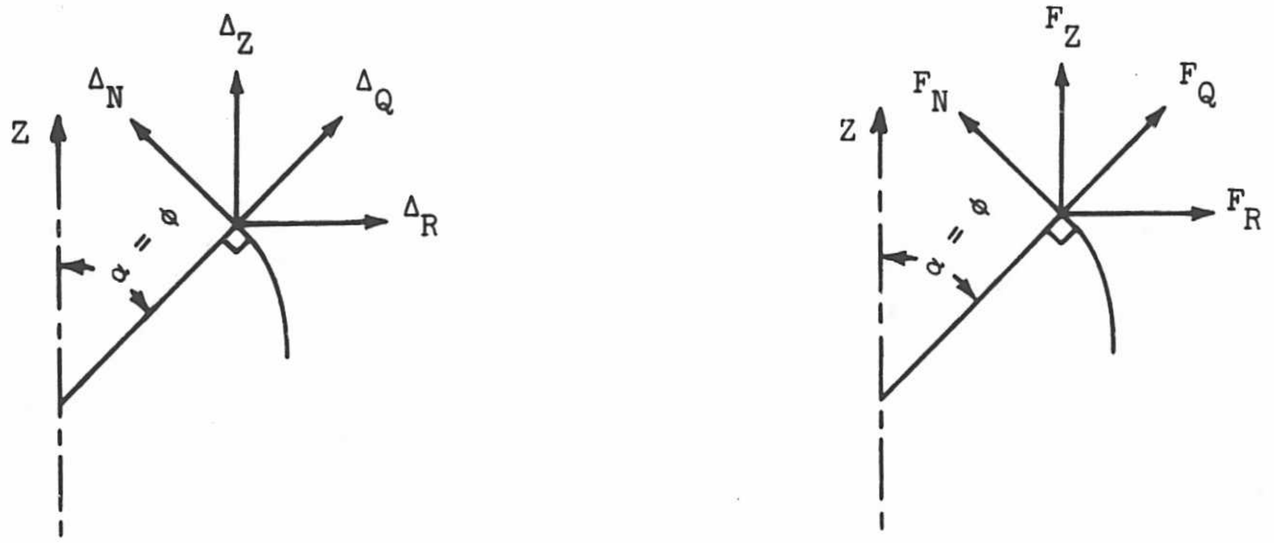


Figure 2-14a. Description of General Coordinate Rotation ($\alpha \neq \phi$)



Rotation Code 1 2 3 1

Matrix

$$\begin{Bmatrix} \Delta_T \\ \Delta_Z \\ \Delta_R \\ \Omega_\theta \end{Bmatrix} = \left[\begin{array}{c|c|c|c} +1 & 0 & 0 & 0 \\ 0 & \sin\alpha & \cos\alpha & 0 \\ 0 & -\cos\alpha & \sin\alpha & 0 \\ 0 & 0 & 0 & +1 \end{array}\right] \begin{Bmatrix} \Delta_T \\ \Delta_N \\ \Delta_Q \\ \Omega_\theta \end{Bmatrix}$$

Rotation Code 1 2 0 1

Matrix

$$\begin{Bmatrix} \Delta_T \\ \Delta_Z \\ \Delta_R \\ \Omega_\theta \end{Bmatrix} = \left[\begin{array}{c|c|c} +1 & 0 & 0 \\ 0 & \sin\alpha & 0 \\ 0 & -\cos\alpha & 0 \\ 0 & 0 & +1 \end{array}\right] \begin{Bmatrix} \Delta_T \\ \Delta_N \\ \Omega_\theta \end{Bmatrix}$$

Rotation Code 1 0 3 1

Matrix

$$\begin{Bmatrix} \Delta_T \\ \Delta_Z \\ \Delta_R \\ \Omega_\theta \end{Bmatrix} = \left[\begin{array}{c|c|c} +1 & 0 & 0 \\ 0 & \cos\alpha & 0 \\ 0 & \sin\alpha & 0 \\ 0 & 0 & +1 \end{array}\right] \begin{Bmatrix} \Delta_T \\ \Delta_Q \\ \Omega_\theta \end{Bmatrix}$$

Figure 2-14b. Provision for Local Rotations

	Column	Format
JOINT LOAD DATA		
1. Load Control Data Card		
A. Number of Joint Loads	1-4	I4
Total number of joint loads in analysis. (Line loads can only be applied to region joints.)		
B. Any alphameric information (load description)	5-69	16A4
2. Joint Load Cards (as many as in item 1A above)		
A. Problem Number	1-5	I5
Number of loading problem in which the line load exists. (See Program Control Card item 2E.)		
B. Row Identification	6-10	I5
The identification is the location of the degree of freedom at which the load is applied. This is obtained by counting the non-zero codes entered in the Boundary Conditions Cards, starting with Joint 1; T, Z, R, Ω_θ, Joint 2; T, Z,......etc., and stopping at the joint and degree of freedom where the line load is to be applied. The location number of this degree of freedom is the information necessary.		
C. Applied Joint Load	11-24	E14.7
The input is $2\pi r_0$ times the running load in lb./in. In the particular case of the axial axisymmetric load, this is simply the net force. For sign convention see Figures 2-11 and 2-14.		
3. Problem Termination Card		
A. A blank card is required by the program only if there is no Joint Load Data.		

NEW PROBLEM CARDS

It may be necessary to repeat a problem with some different data. This may be accomplished in the following ways:

1. Loading changes - With the present program ten separate loading problems can be run simultaneously. This applies both to distributed and line loads. No backup cards are needed for this purpose. (See input Information.)
2. Harmonic changes on uncoupled runs - A new Program Control Card must be included at the end of the data deck. This card will contain the same information as the original Program Control Card, except that it will have the new harmonic value. The sequence of new problem cards can be repeated as often as desired.
3. Full data duplication - If it is desired to analyze a new <u>structure</u>, it is necessary to submit the complete individual data decks backed up. The number of full data decks that can be backed up on one submission is limited only by time requirements.

It is hoped that the user is now able to use the STARS II program to good advantage. It is a powerful tool, which will increase in value to the user as he uses it. One of the more complex areas of useage is the description of topology, especially when involved with rotation codes and joint loads. An illustrative example of a Y joint representation is therefore presented below. (See Figures 2-15 and 2-16 for the structure and idealization.) The idealized structure contains four regions and two kinematic links. The joints are numbered from 1 to 7. Membrane loading is applied to joints 1 and 5 and the structure is supported by membrane action at joint 7. All regions must be coupled and we are interested in the 4^{th} harmonic.

The second card in each region description (topology card) is as follows:

Region	Joint (i)	Joint (j)
1	1	2
2	2	3
3	4	5
4	6	7

The Joint Control Data card would contain a 7 in column 5 and a 2 in column 10.

In this example, the restraints at joints 1, 5 and 7 must be rotated from the fixed (global system) to a local system such that membrane action may be applied. In addition, joints 3 and 4, and 6 and 3 are to be coupled with

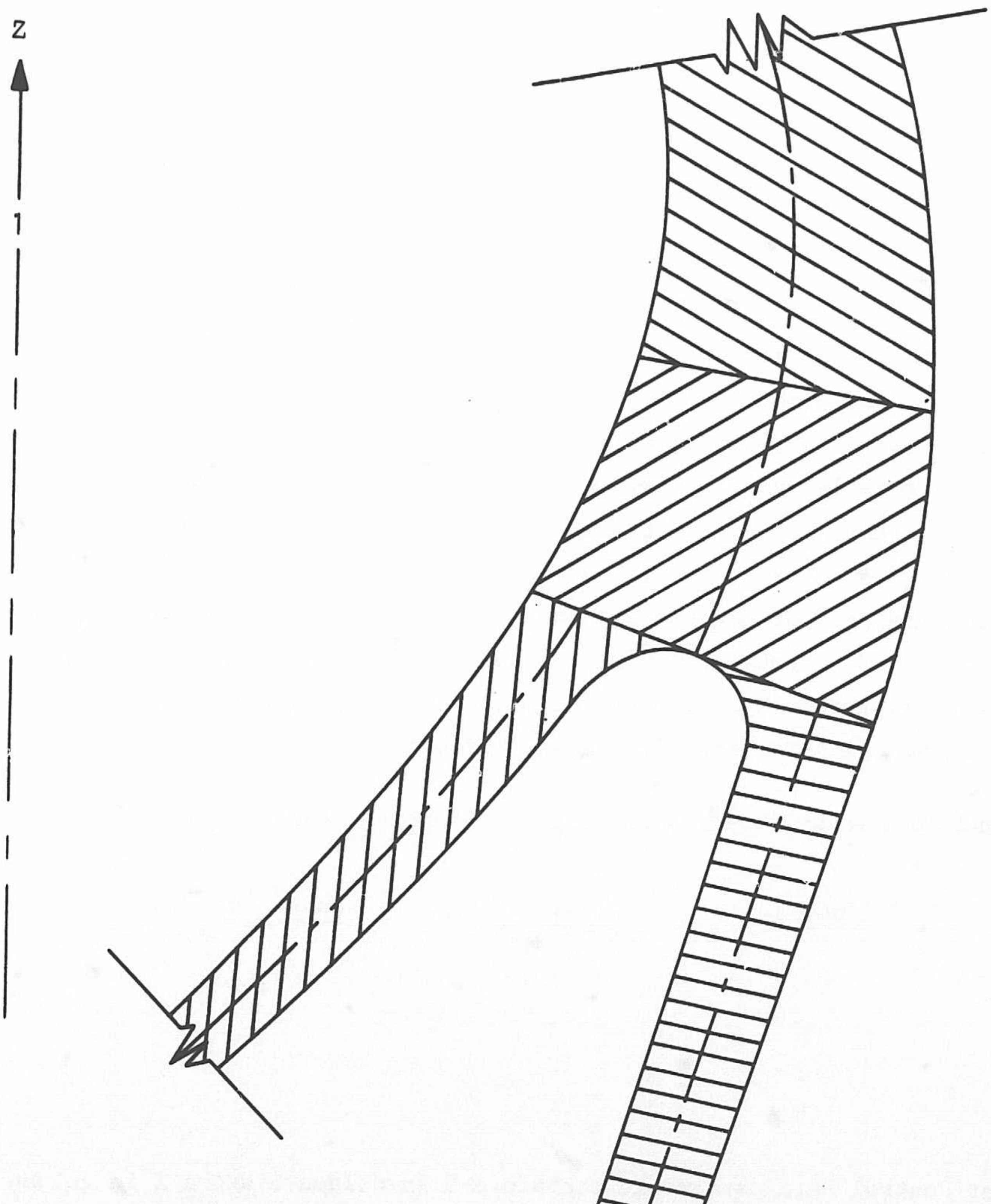


Figure 2-15. Y-Joint (Distorted Geometry)

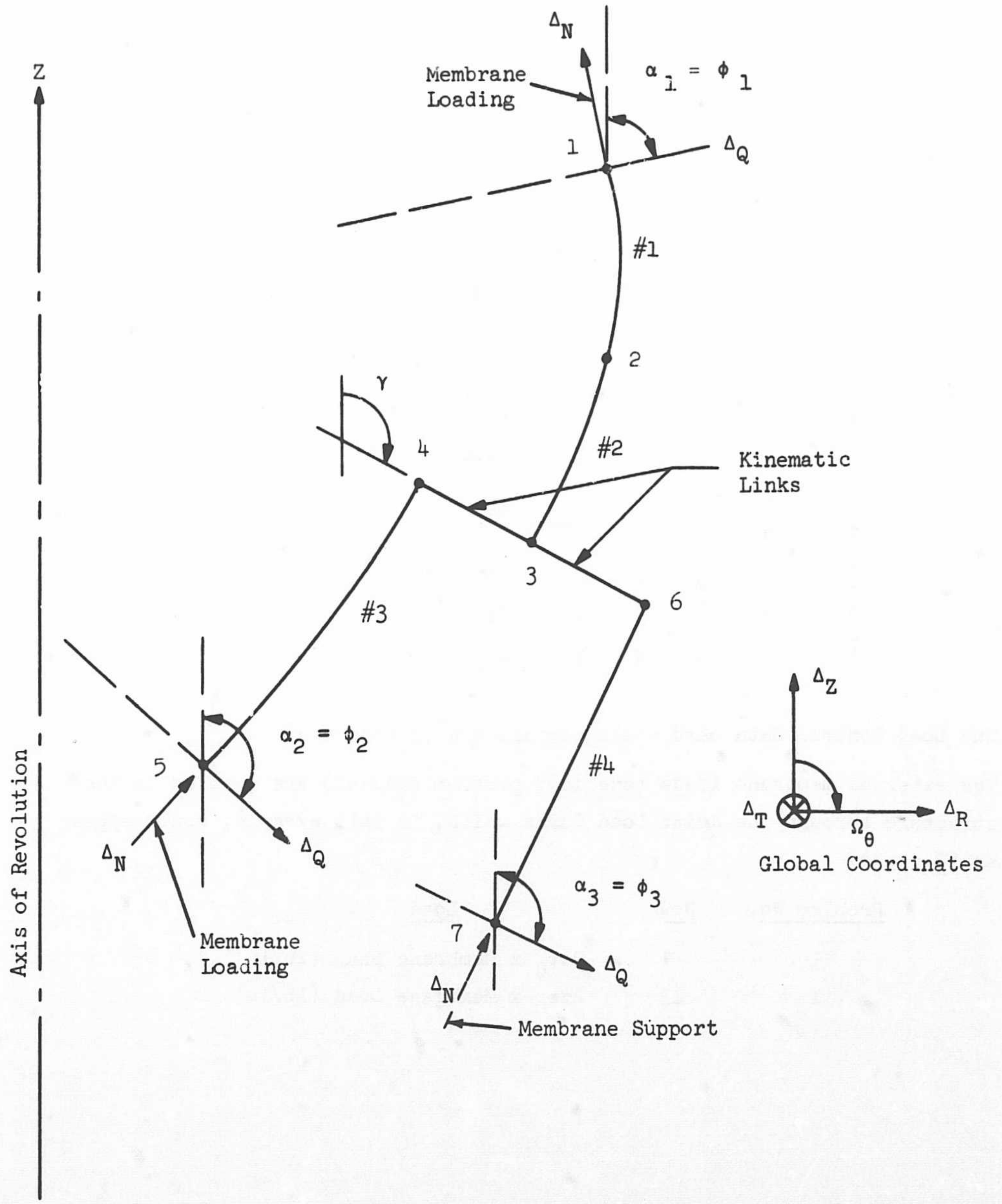


Figure 2-16. Idealized Y-Joint

kinematic links. Thus, the motions of joints 4 and 6 are dependent upon the motion of joint 3. This dependence will be insured by using 2 kinematic link cards and setting the displacements of joints 4 and 6 equal to zero. It should be noted in this particular case that the motion of joints 4 and 6 is not being equated to zero, but rather, the ability to prescribe motion independently is being removed. The required data has the following appearance.

A. Kinematic Link Cards (2 cards)

Joint (j)	Joint (i)	Angle
4	3	γ
6	3	γ

Note: In a double link of the type shown in Figure 2-16, one joint must be consistently independent (joint 3 in example).

B. Boundary Condition Cards (7 cards)

Joint	T	Z	R	θ	Angle
1	1	2	3	1	α_1
2	1	1	1	1	
3	1	1	1	1	
4	0	0	0	0	
5	1	2	3	1	α_2
6	0	0	0	0	
7	0	0	3	1	α_3

The Load Control Data card would contain a 2 in column 4.

The external membrane loads (one load problem assumed) are applied to the structure through the Joint Load Cards which, in this example, would appear as (2 cards):

Problem No.	Row	Load
1	1	$2\pi r_0$ x Membrane Load (lb/in)
1	13	$2\pi r_0$ x Membrane Load (lb/in)

SECTION 3

OUTPUT INFORMATION

The output of the STARS II program is straightforward, however a description is in order since the user should learn the significance of the various checks that are provided. In addition, familiarity will be required with the possible error messages. It is important to point out that the output of the program will include a print-out of the input data. This gives the user the opportunity to check whether or not the input data was correct. In the detailed description of the complete output which follows, the user should refer to the output of the problems in Section 4 as examples.

The title page of the output contains all the data from the General Introductory Cards, prominently placed, and needs no comment. The next page of the output contains the first region Identification Card in the center. The following output is then presented for each segment in this region (in order of appearance):

1. Contents of segment Identification Card
2. Contents of MAGIC Control and Segment Sizing Card
3. Contents of Geometric Description Card
4. Contents of Master Clue Card
5. The material property table used for the segment
6. Crossection description table
7. Temperature load table (if any)
8. Distributed load tables (printed per problem)
9. Contents of Non-Linear Cards (if any)
10. Segment influence coefficients (MAGIC output)
11. Segment stiffness matrix
12. Stiffness matrix symmetry check
13. Segment load matrices

Item 12, the stiffness matrix symmetry check, is a check upon the validity of segment sizing and the accumulation of round-off error. For perfect symmetry to exist, it is necessary to have zeros above the main diagonal, and zeros or ones below the diagonal. The amount of error induced by improper sizing or round-off is related to the amount that the off-diagonal terms in the lower triangle differ from unity. An attempt should be made to keep the upper limit on this difference at one percent (maximum number in lower triangle should be 0.1010... E 01).

As mentioned previously, items 1-13 are repeated for all the segments within region one. At this stage in the output, the topology of the segments within the region, and the description of the intra-region kinematic links is presented. In the segment topology, the radius of revolution at every joint is also given. These should be checked at corresponding joints of adjacent segments to make sure that proper coupling has been specified.

At this point in the output the region matrices are presented. Given in order are: the region stiffness matrix, the stiffness matrix symmetry check, and the region load matrices. Again the numerical round-off, evident in the symmetry check, should be kept to a maximum of one percent (0.1010... E 01 in lower triangle). The output to this point, that is, sets of items 1-13, segment topology and links, and the region matrices, are now repeated as a group for each region within the structure. When this is completed, the region topology is presented. In this area, the appropriate radii of revolution are again provided for checks. The next items to be provided by the output are the descriptions of the inter-region kinematic links and the boundary conditions. At external points of the structure these are physical boundary conditions. At internal points they merely state the fact that no restraint exists and the joint in question is free to move. The last column in this set, gives the angle α, which is zero unless a rotation code is indicated. It is important to refer to Figure 2-14 once more and point out that α represents a rotation of the coordinate system.

There are a variety of errors that can be made in submitting input data. Certain errors may be detected and can be signaled by specially programmed error messages. The messages are mainly self-explanatory, and are presented below:

IERROR = 8000

ONE OF THE MATERIAL PROPERTY TABLES CANNOT BE IDENTIFIED AS ISOT, ORTH, OR STIF.

IERROR = 8036

A MATERIAL PROPERTY TABLE NAME FOR A SEGMENT CANNOT BE FOUND IN THE TABLE LIST.

IERROR = 8086

THE TYPE OF GEOMETRY OF A SEGMENT CANNOT BE IDENTIFIED AS ONE HANDLED BY THE PROGRAM.

IERROR = 8087

THE TYPE OF MATERIAL PROPERTY TABLE FOR A SEGMENT CANNOT BE IDENTIFIED AS ISOT, ORTH, OR STIF.

IERROR = 8089

THE WALL CONSTRUCTION OF A SEGMENT CANNOT BE IDENTIFIED AS SING, EQUA, UNEQ OR BLAN.

IERROR = 8090

THE TYPE OF TEMPERATURE INPUT FOR A SEGMENT CANNOT BE IDENTIFIED AS THST, NOTH, THCN, OR THIN.

IERROR = 8013

THE PROGRAM CANNOT DETERMINE WHETHER THE PROBLEM INPUT IS LINEAR OR NON-LINEAR.

IERROR = 8009

THE PROGRAM CAN EXECUTE ONLY ONE NON-LINEAR PROBLEM PER DATA DECK.

IERROR = 8031

THE LOAD INDICATOR CLUES CAN ONLY BE ZERO, BLANK, ONE OR FOUR.

IERROR = 8008

THE PROGRAM CAN EXECUTE ONLY ONE THERMAL LOAD PROBLEM PER DATA DECK.

IERROR = 8001

THE MAGIC CYCLE HAS GONE PAST STOP BY MORE THAN THE PERMITTED VALUE. CHECK TO SEE IF FIXED STEP SIZE IS TOO LARGE.

IERROR = 8003

THE FIRST ST TABLE VALUE (PHI OR S) SHOULD BE OVERLAPPED.

IERROR = 8006

THE LAST ST TABLE VALUE (PHI OR S) SHOULD BE OVERLAPPED.

IERROR = 8007

THE INTERPOLATED VALUE OF TEMPERATURE FOR THE MATERIAL PROPERTY TABLE IS LESS THAN THE SECOND TEMPERATURE VALUE.

IERROR = 8067

THE INTERPOLATED VALUE OF TEMPERATURE FOR THE MATERIAL PROPERTY TABLE IS GREATER THAN THE LAST VALUE OF TEMPERATURE.

IERROR = 8101

THE K11 STIFFNESS PARAMETER IS ZERO.

IERROR = 8102

THE K12 STIFFNESS PARAMETER IS ZERO.

IERROR = 8104

THE K22 STIFFNESS PARAMETER IS ZERO.

IERROR = 8105

THE K33 STIFFNESS PARAMETER IS ZERO.

IERROR = 8106

THE D11 STIFFNESS PARAMETER IS ZERO.

IERROR = 8107

THE D12 STIFFNESS PARAMETER IS ZERO.

IERROR = 8109

THE D22 STIFFNESS PARAMETER IS ZERO.

IERROR = 8110

THE D33 STIFFNESS PARAMETER IS ZERO.

IERROR = 8088

THE PROGRAM CANNOT DETERMINE WHETHER THE PROBLEM INPUT IS THIC, RWAF, OR ST10.

IERROR = 8120

THE Y2 BLOCK IN THE SEGMENT MAGIC OUTPUT IS SINGULAR.

IERROR = 8841

IN THE COMPUTATION OF THE REGION STIFFNESSES, THE K22 MATRIX WAS NOT POSITIVE DEFINITE.

IERROR = 8777

IN THE COMPUTATION OF THE REDUCED FLEXIBILITY MATRIX, THE REDUCED STIFFNESS MATRIX IS NOT POSITIVE DEFINITE.

IERROR = 8797

FOR KINEMATIC LINKS BETWEEN SEGMENTS, THE DEPENDENT JOINT NUMBER MUST BE GREATER THAN THE INDEPENDENT JOINT NUMBER.

IERROR = 8787

THE NUMBER OF POINTS IN ST TABLE MUST BE BETWEEN 2 AND 30.

IERROR = 8501

FOR NON-LINEAR ANALYSIS, HARMONIC MUST BE ZERO.

All the above error messages will undoubtedly be caused by erroneous input data, including the ones on matrix singularity. Error 8120 will most likely be caused by improper segment sizing. Error 8841 could be caused by bad segment sizing, bad segment topology, or bad intra-region links. Error 8777 could be caused by bad region topology, bad inter-region links, or improper boundary conditions. If the problem is correctly set up and idealized, only an unfortunately awkward geometric combination could cause matrices which are so ill-conditioned so as to trip one of the singularity errors (see Reference 5).

After having corrected any errors, so that it is now possible for the program to run to completion, the problem solution can be discussed. The first item provided which represents the solution of the problem is the structure flexibility matrix. This matrix should also be checked for symmetry. After the reduced flexibility matrix, the applied line loads and the region end deflections are presented per problem. The deflection values are given for the region joints in numerical order, starting from joint 1.

Following this output, the program prints the internal load distribution results per segment. First there is a reproduction of some input data previously discussed. Next, there appears a diagram which outlines the format of the tabulated results. Below that appear the numerical results for each point where a print-out is called. They are printed-out at a prescribed interval, and per problem. Special cases can occur depending upon meridional and wall crossection geometries. Treating the block of numbers as a matrix:

1. The 1,2 element will be zero for cylinders or cones.
2. The 6,2 and 7,2 elements will be zero for a non-sandwich construction.
3. The 6,2 and 7,2 and the 6,6 and 7,6 elements will be zero for any reinforced construction
4. The 3,2 and the 4,2 elements will be the same for linear analyses.

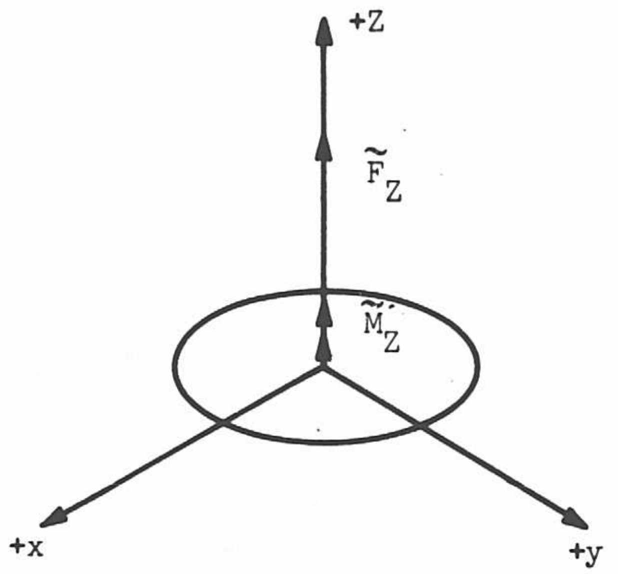
This completes the program output. The user is reminded to check continuity of stress resultants across segment boundaries where applicable.

In utilizing the program, it is frequently necessary to relate applied edge loads to the net forces across a section. The relation between forces in the fixed (global) coordinate system and any rotated coordinate system is given by (References 1, 3 and 4):

$$\begin{Bmatrix} F_T \\ F_Z \\ F_R \\ M \end{Bmatrix}^{(n)} = \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & -s\phi & -c\phi & 0 \\ 0 & +c\phi & -s\phi & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{Bmatrix} F_T \\ F_N \\ F_Q \\ M \end{Bmatrix}^{(n)} \qquad (3\text{-}1)$$

for any harmonic "n" (see Figure 2-14b).

The relations between the net resultant external loads and the magnitudes of distributed edge loads are:



Axisymmetric Loads (n = 0)

$$\begin{Bmatrix} \widetilde{F}_Z \\ \widetilde{M}_Z \end{Bmatrix} = 2\pi r_0 \begin{bmatrix} 0 & 1 & 0 & 0 \\ r_0 & 0 & 0 & 0 \end{bmatrix} \begin{pmatrix} F_T \\ F_Z \\ F_R \\ M \end{pmatrix}^{(0)} \qquad (3\text{-}2)$$

Antisymmetric Loads (n = 1)

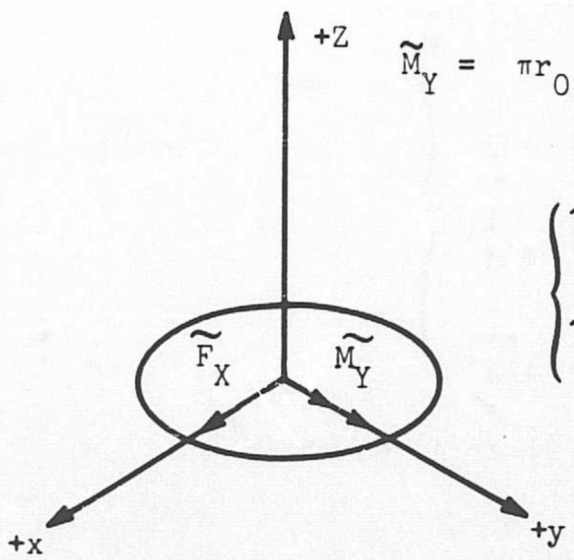
Here, the integration of the distributed forces is not obvious.

$$\widetilde{F}_X = \int_0^{2\pi} \left(-F_T^{(1)} r_0 d\theta\right) \sin\theta + \int_0^{2\pi} \left(F_R^{(1)} r_0 d\theta\right) \cos\theta$$

$$\widetilde{F}_X = \pi r_0 \left[-F_T^{(1)} + F_R^{(1)}\right]$$

$$\widetilde{M}_Y = \int_0^{2\pi} \left(- F_Z^{(1)} r_0 d\theta\right) (r_0 \cos\theta) + \int_0^{2\pi} \left(M^{(1)} r_0 d\theta\right) \cos\theta$$

$$\widetilde{M}_Y = \pi r_0 \left[-r_0 F_Z^{(1)} + M^{(1)}\right] \qquad (3\text{-}3)$$



$$\begin{Bmatrix} \widetilde{F}_X \\ \widetilde{M}_Y \end{Bmatrix} = \pi r_0 \begin{bmatrix} -1 & 0 & +1 & 0 \\ 0 & -r_0 & 0 & +1 \end{bmatrix} \begin{pmatrix} F_T \\ F_Z \\ F_R \\ M \end{pmatrix}^{(1)}$$

When the loaded edge has standard coordinates, Equations (3-2 or 3-3) are used to relate the applied edge loads to the net forces across a section. In the axisymmetric case, this is straight forward; contributions to $\tilde{F}_Z$ are made only by $F_Z^{(0)}$ and there is a similar relation between $\tilde{M}_Z$ and $F_T^{(0)}$. However, in the antisymmetric case, there are four unknowns and only two equations. Thus, additional data is required. Often, these loads are applied in a region of assumed membrane stress; then $F_R^{(1)} = 0$ (cylinder) or $F_Z^{(1)} = 0$ (plate) and $M^{(1)} = 0$ since these are transverse shear and bending stress resultants. When the load is applied at an angle to the fixed (global) coordinates, Equation (3-1) is used to transform (3-2 and 3-3) into a form which permits evaluation of $F_T^{(1)}$ and $F_N^{(1)}$ (for membrane problems only: $\phi = \alpha$, $M = F_Q = 0$).

It is frequently desirable to be able to calculate net forces at a cut section, or a built-in edge directly from output values, in order to check equilibrium. The net forces in terms of the stress resultants (in local coordinates as they appear in the output) are:

$$\begin{Bmatrix} \tilde{F}_Z(^i_j) \\ \tilde{M}_Z(^i_j) \end{Bmatrix} = \pm 2\pi r_0 \begin{bmatrix} 0 & +s\phi & +c\phi & 0 \\ -r_0 & 0 & 0 & 0 \end{bmatrix} \begin{Bmatrix} T_{\phi\theta}(^i_j) \\ N_\phi(^i_j) \\ J_\phi(^i_j) \\ M_\phi(^i_j) \end{Bmatrix}^{(0)} \qquad (3\text{-}^4_5)$$

and

$$\begin{Bmatrix} \tilde{F}_X(^i_j) \\ \tilde{M}_Y(^i_j) \end{Bmatrix} = \pm \pi r_0 \begin{bmatrix} +1 & -c\phi & +s\phi & 0 \\ 0 & -r_0 s\phi & -r_0 c\phi & +1 \end{bmatrix} \begin{Bmatrix} T_{\phi\theta}(^i_j) \\ N_\phi(^i_j) \\ J_\phi(^i_j) \\ M_\phi(^i_j) \end{Bmatrix}^{(1)} \qquad (3\text{-}^6_7)$$

where the sign is chosen to correspond with the edge (i or j) on which the applied force is desired.

Equations (3-4 through 3-5) should be used to check overall shell equilibrium for unfamiliar geometries since it is a good check on the solution to the problem.

SECTION 4

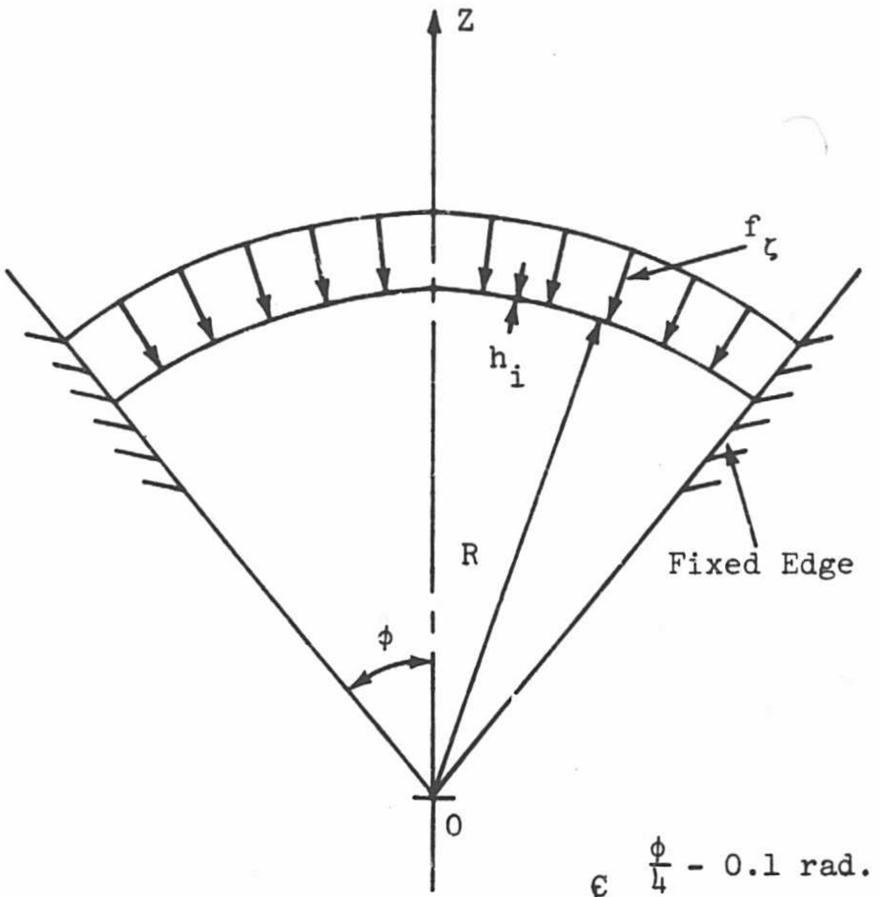
EXAMPLES OF INPUT AND SOLUTIONS

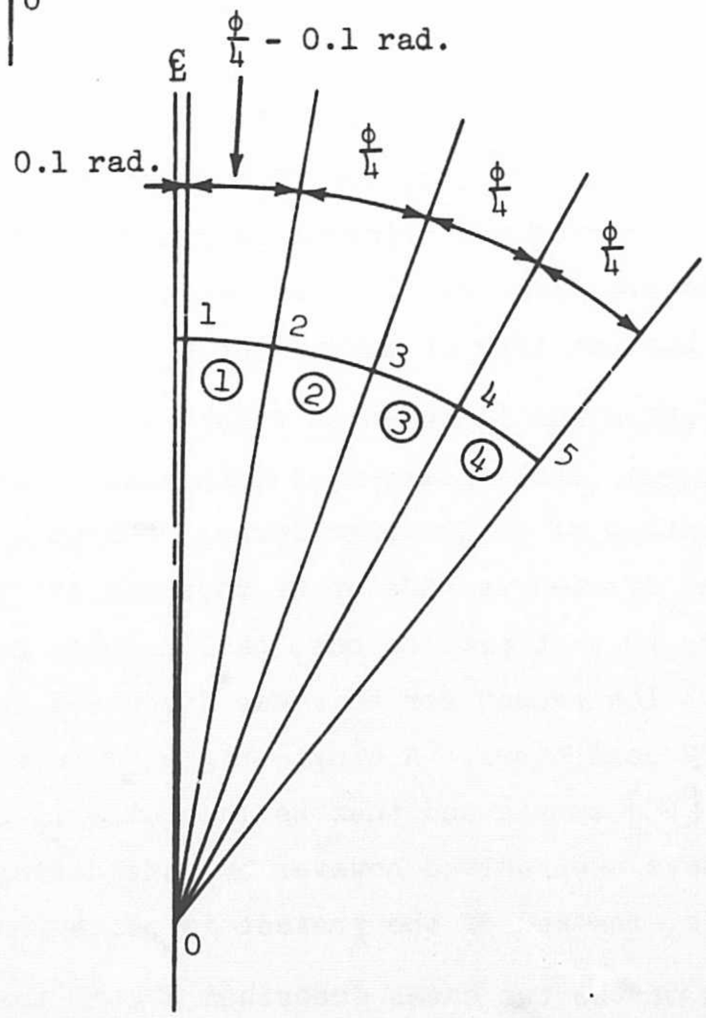
This section contains the full input and output maps of the two standard test problems which were used with the original STARS program. These problems were rerun with the STARS II program, and the necessary inputs and computer output sheets are provided on the following pages.

Test problem one is shown in Figure 4-1. The structure is a spherical cap, clamped at the bottom edges, and under a uniform external pressure of 2,000 psi. The top edge contains boundary conditions to simulate a closed apex. The apex condition could be further approached by adding a few more small segments. Although the problem is a small one (only 4 segments), it has been broken into two (2) regions so that a more typical input and output example is obtained. This is certainly not necessary in this case, since a region can contain 24 segments. In addition, two load problems have been called out, so that another facet of the printout is included in the example. The loads in both problems are identical in this case, so that no new information will be provided, but the type of output per problem will be shown.

Test problem two is shown in Figure 4-2. The structure is a cylindrical shell clamped at both ends. The only loading is a linear distribution of temperature through the wall thickness. This problem has been treated as made up of four regions each containing one segment. Contrary to test problem one, this problem cannot be solved as a single region. The reason for this was discussed in Section 2, and concerns the boundary conditions. A single region with both fixed ends would create a null [BC] matrix and thus be insoluble in that form. The problem could have been solved however by considering two regions each with two segments, instead of the present idealization.

In each of the two cases described above, the results of the STARS II program runs essentially duplicate the original results from the earlier STARS program, as expected.





Shell Constants

$R = 56.3''$
$h_i = 2.36''$
$\phi = 0.6806784$ rad.
$\nu = 0.2$
$E = 3.0 \times 10^7$ psi
$f_\zeta = 2000$ psi

Figure 4-1. Test Problem One

```
  M.S.F.C.      TWØ REGIØNS EQUAL FØUR SEGMENTS
 2  4  1  0.0   021
STEE      ØRTH
0.0           0.0           0.0           0.0           0.0
0.0           0.0           0.0           0.0           0.0
0.30      E+080.0           0.0           0.0           0.0
 BLANK  CARD
0.30      E+080.0           0.0           0.0           0.0
0.0           0.0           0.0           0.0           0.0
0.2           0.0           0.0           0.0           0.0
0.0           0.0           0.0           0.0           0.0
1.25      E-060.0           0.0           0.0           0.0
0.0           0.0           0.0           0.0           0.0
1.25      E-060.0           0.0           0.0           0.0
 BLANK  CARD
0.125     E+08
 BLANK  CARD
 20   1  REGIØN  =  2 SEGMENTS
    1     1   2
11 FIRST PART ØF REG. NØ. 1
 1.01     E-01 1.7016959E-01 0.01     E+00 1.0     E-04 1.7017  E-030.
 56.3          1.0
ØRTH      STEE      SING      THIC      NØTH      0.0       LINE       2
 1.0099995E-01 1.7016965E-01
 2.36          2.36
000100
2000.         2000.
000120
2000.         2000.
    1     1   2
```

CODING INSTRUCTIONS:

1. Alphabetical characters are written as follows
   A B C D E F G H I J K L M N Ø P Q R S T U V W X Y Z
2. Numerical characters are written as follows
   1 2 3 4 5 6 7 8 9 0

ENG 100.1 2-64

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```
11 SECØND PART ØF REG. NØ.1
 1.7016959E-01 3.4033918E-01 0.01      E+00 1.0      E-04 1.7017   E-030.0
 56.3          1.0
ØRTH      STEE      SING      THIC      NØTH      0.0       LINE       2
 1.7016947E-01 3.4033924E-01
 2.36          2.36
000100
2000.         2000.
000100
2000.         2000.
    2    2    3
 2 0   1 REGIØN = 2 SEGMENTS
    2    2    3
11 FIRST PART ØF REG. NØ. 2
 3.4033918E-01 5.1050878E-01 0.01      E+00 1.0      E-04 1.7017   E-030.0
 56.3          1.0
ØRTH      STEE      SING      THIC      NØTH      0.0       LINE       2
 3.4033906E-01 5.1050879E-01
 2.36          2.36
000100
2000.         2000.
000100
2000.         2000.
    1    1    2
11 SECØND PART ØF REG. NØ.2
 5.1050878E-01 6.8067837E-01 0.01      E+00 1.0      E-04 1.7017   E-030.0
 56.3          1.0
ØRTH      STEE      SING      THIC      NØTH      0.0       LINE       2
 5.1050866E-01 6.8067849E-01
 2.36          2.36
```

CODING INSTRUCTIONS:

1. Alphabetical characters are written as follows
   A B C D E F G H I J K L M N Ø P Q R S T U V W X Y Z
2. Numerical characters are written as follows
   1 2 3 4 5 6 7 8 9 0

ENG 100.1 2-64

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```
01020304050607080910111213141516171819202122232425262728293031323334353637383940414243444546474849505152535455565758596061626364656667686970717273747576777879 80
000100
2000.         2000.
000100
2000.         2000.
    2    2    3
    3    0
 1 1 0 3 00.101
 2 1 1 1 1
 3 0 0 0 0
BLANK CARD
```

CODING INSTRUCTIONS:

1. Alphabetical characters are written as follows
   A B C D E F G H I J K L M N Ø P Q R $ T U V W X Y Z
2. Numerical characters are written as follows
   1 2 3 4 5 6 7 8 9 0

ENG 100.1 2-64

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```
UNSYMMETRIC, ORTHOTROPIC, REINFORCED SHELL ANALYSIS WITH COUPLING OF AT MOST 29 SHELL REGIONS
                                   USING
                        LOVE-REISSNER ACCURACY THEORY

                             DECK NUMBER 45218
                             AS OF MAY 5, 1968

NUMBER OF SEGMENTS =    4 NUMBER OF REGIONS =  2 NUMBER OF MATERIAL PROPERTY TABLES USED =  1 NUMBER OF PROBLEMS =  2
                             HARMONIC (N) =  0.0

          THE GIVEN INPUT DATA INDICATES THAT THE SHELL SEGMENTS ARE TO BE COUPLED

  M.S.F.C.     TWO REGIONS EQUAL FOUR SEGMENTS
```

REGION NUMBER 1

THERE ARE 2 SEGMENTS AND 0 KINEMATIC LINKS WITHIN THIS REGION

SEGMENT NUMBER 1 SEGMENT CODE 11 FIRST PART OF REG. NO. 1

TIC	STOP	DTAU	DIFF	STEP	DELTA
0.1010000E 00	0.1701695E 00	0.9999998E-02	0.9999999E-04	0.1701700E-02	.0

GEOMETRY INPUT VARIABLES

0.5629999E 02 0.1000000E 01 0.0

ORTH STEE SING THIC NOTH T FREE = 0.0 LINE NUMBER OF TABLE COLUMNS = 2

MATERIAL PROPERTY TABLE USED

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.300000E 08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.300000E 08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.200000E 00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.125000E-05	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.125000E-05	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.125000E 08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE ORDER PHI OR S VS. CROSSECTION PROPERTIES

0.1009999E 00	0.1701696E 00
0.2360000E 01	0.2360000E 01

PROBLEM 1 TABLE ORDER PHI OR S VS. DISTRIBUTED LOADS (F THETA, F PHI, F ZETA, M THETA, M PHI)
LOAD IDENTIFICATION CLUES 000100

0.2000000E 04 0.2000000E 04

PROBLEM 2 TABLE ORDER PHI OR S VS. DISTRIBUTED LOADS (F THETA, F PHI, F ZETA, M THETA, M PHI)
LOAD IDENTIFICATION CLUES 000100

0.2000000E 04 0.2000000E 04

MATRIX X AND Y (TRANSPOSED) MAGIC OUTPUT

0.3607151E-10	0.0	0.0	0.0	0.1679634E 01	0.0	0.0	0.0
0.0	0.3977616E 07	-0.6834880E 06	-0.1275697E 07	0.0	0.1027421E 01	-0.1822291E-01	0.4988718E-01
0.0	-0.4031027E 06	0.6926656E 05	0.1292835E 06	0.0	0.6609720E-01	0.9924505E 00	-0.5055752E-02
0.0	-0.8422027E 06	0.1447180E 06	-0.1673601E 07	0.0	0.1380957E 00	0.3863266E 01	0.1024350E 01
0.3544624E 00	0.0	0.0	0.0	0.1051687E-06	0.0	0.0	0.0
0.0	0.7391205E 00	-0.6609720E-01	-0.1233677E 00	0.0	0.4211125E-07	0.3331788E-08	0.4824400E-08
0.0	0.7151496E-01	0.5837263E 00	0.2515946E 01	0.0	-0.3089085E-08	-0.2201924E-06	-0.1575432E-06
0.0	0.2942259E-01	-0.5055755E-02	0.7367435E 00	0.0	-0.4824400E-08	-0.1878098E-06	-0.9062387E-07
0.0	-0.2500856E 03	-0.6202105E 04	-0.1157598E 05	0.0	0.3545404E-05	0.4579711E-03	0.4526891E-03
0.0	-0.2500856E 03	-0.6202105E 04	-0.1157598E 05	0.0	0.3545404E-05	0.4579711E-03	0.4526891E-03

STIFFNESS COEFFICIENTS

	DELTA T1	DELTA Z1	DELTA R1	THETA 1	DELTA T2	DELTA Z2	DELTA R2	THETA 2
FORCE T1	0.5696371E 09	0.0	0.0	0.0	-0.3391437E 09	0.0	0.0	0.0
FORCE Z1	0.0	0.3455890E 09	-0.6715178E 08	-0.5805389E 09	0.0	-0.3455890E 09	0.8063602E 08	-0.6849021E 09
FORCE R1	0.0	-0.6715195E 08	0.8633139E 09	-0.6153050E 08	0.0	0.6714870E 08	-0.8365184E 09	-0.1119417E 09
MOMENT 1	0.0	-0.5805386E 09	-0.6153054E 08	0.1418168E 10	0.0	0.5805389E 09	0.5190002E 08	0.8128873E 09
FORCE T2	-0.3391327E 09	0.0	0.0	0.0	0.2019087E 09	0.0	0.0	0.0
FORCE Z2	0.0	-0.3455780E 09	0.6714618E 08	0.5805212E 09	0.0	0.3455777E 09	-0.8062938E 08	0.6848819E 09
FORCE R2	0.0	0.8063326E 08	-0.8364900E 09	0.5189827E 08	0.0	-0.8062966E 08	0.1046800E 10	0.1273193E 09
MOMENT 2	0.0	-0.6848804E 09	-0.1119384E 09	0.8128643E 09	0.0	0.6848812E 09	0.1273196E 09	0.1930050E 10

SEGMENT SYMMETRY CHECK

0.5696371E 09	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.3455890E 09	0.0	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.1000002E 01	0.8633139E 09	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.1000000E 01	0.1000000E 01	0.1418168E 10	0.0	0.0	0.0	0.0
0.1000032E 01	0.1000000E 01	0.1000000E 01	0.1000000E 01	0.2019087E 09	0.0	0.0	0.0
0.1000000E 01	0.1000031E 01	0.1000037E 01	0.1000030E 01	0.1000000E 01	0.3455777E 09	0.0	0.0
0.1000000E 01	0.1000033E 01	0.1000033E 01	0.1000033E 01	0.1000000E 01	0.1000003E 01	0.1046800E 10	0.0
0.1000000E 01	0.1000031E 01	0.1000029E 01	0.1000028E 01	0.1000000E 01	0.1000001E 01	0.1000001E 01	0.1930050E 10

SEGMENT LOAD MATRICES

0.0	0.0
0.1598289E 06	0.1598289E 06
0.1906802E 05	0.1906802E 05
-0.1017629E 06	-0.1017629E 06
0.0	0.0
0.2088907E 06	0.2088907E 06
0.3160752E 05	0.3160752E 05
0.1387265E 06	0.1387265E 06

SEGMENT NUMBER 2   SEGMENT CODE 11   SECOND PART OF REG. NO.1

TIC	STOP	DTAU	DIFF	STEP	DELTA
0.1701695E 00	0.3403391E 00	0.9999998E-02	0.9999999E-04	0.1701700E-02	.0

GEOMETRY INPUT VARIABLES

0.5629999E 02   0.1000000E 01   0.0

ORTH   STEE   SING   THIC   NOTH   T FREE = 0.0   LINE   NUMBER OF TABLE COLUMNS = 2

MATERIAL PROPERTY TABLE USED

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C.300C0E 08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.300C0E 08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C.200C0E 00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.125C0E-05	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.125C0E-05	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.125C0E 08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE ORDER PHI OR S VS. CROSSECTION PROPERTIES

0.1701694E 00	0.3403392E 00
C.236C0C0E C1	0.23600C0E 01

PROBLEM 1   TABLE ORDER PHI OR S VS. DISTRIBUTED LOADS (F THETA, F PHI, F ZETA, M THETA, M PHI)
LOAD IDENTIFICATION CLUES C00100

C.2000000E C4   C.2CC00C0E C4

PROBLEM 2   TABLE ORDER PHI OR S VS. DISTRIBUTED LOADS (F THETA, F PHI, F ZETA, M THETA, M PHI)
LOAD IDENTIFICATION CLUES C0C100

C.20C0000E C4   0.20000C0E 04

MATRIX X AND Y (TRANSPOSED) MAGIC OUTPUT

C.1810641E-10	0.0	0.0	0.0	0.1971137E 01	0.0	0.0	0.0
0.0	0.2524696E 07	-0.8940286E 06	-0.4184452E 07	0.0	0.1118012E 01	0.8507136E 00	0.4071751E 00
C.0	-0.4338096E 06	0.1536179E 06	0.7190059E 06	0.0	0.1465896E 00	0.8102793E 00	-0.6996441E-01
0.0	-0.2378784E 07	0.8423530E 06	0.1287706E 07	0.0	0.8038087E 00	0.9322920E 01	0.9172898E 00
0.2573748E C0	0.0	0.0	0.0	0.2430130E-06	0.0	0.0	0.0
0.0	0.6713367E 0C	-0.1465895E 00	-0.6861070E 00	0.0	0.1031657E-06	0.1587495E-06	0.6676294E-07
0.0	C.5270411E 00	0.3437867E 00	0.5147664E 01	0.0	-0.1383966E-06	-0.2976819E-05	-0.8427030E-06
0.0	0.1975787E 0C	-0.6996459E-01	0.5383693E 00	0.0	-0.6676299E-07	-0.1066096E-05	-0.2013165E-06
0.0	-0.2966521E 04	-0.1375493E 05	-0.6437955E 05	0.0	0.5580261E-03	0.1573258E-01	0.6264582E-02
0.0	-0.2966521E 04	-0.1375493E 05	-0.6437955E 05	0.0	0.5580261E-03	0.1573258E-01	0.6264582E-02

STIFFNESS COEFFICIENTS

	DELTA T1	DELTA Z1	DELTA R1	THETA 1	DELTA T2	DELTA Z2	DELTA R2	THETA 2
FORCE T1	0.4855133E 09	0.0	0.0	0.0	-0.2465143E 09	0.0	0.0	0.0
FORCE Z1	0.0	0.8136378E 08	-0.1352349E 09	-0.1910297E 09	0.0	-0.8136390E 08	0.1618426E 09	-0.1796675E 09
FORCE R1	0.0	-0.1352354E 09	0.6371128E 09	0.1338016E 08	0.0	0.1352353E 09	-0.5672852E 09	-0.1354108E 09
MOMENT 1	0.0	-0.1910295E 09	0.1337850E 08	0.1036465E 10	0.0	0.1910299E 09	-0.7103750E 08	0.5738053E 09
FORCE T2	-0.2465038E 09	0.0	0.0	0.0	0.1250566E 09	0.0	0.0	0.0
FORCE Z2	0.0	-0.8136043E 08	0.1352291E 09	0.1910220E 09	0.0	0.8136058E 08	-0.1618372E 09	0.1796596E 09
FORCE R2	0.0	0.1618363E 09	-0.5672609E 09	-0.7103773E 08	0.0	-0.1618377E 09	0.8065551E 09	0.2248949E 09
MOMENT 2	0.0	-0.1796595E 09	-0.1354073E 09	0.5737810E 09	0.0	0.1796588E 09	0.2248989E 09	0.1559742E 10

SEGMENT SYMMETRY CHECK

0.4855133E 09	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.8136378E 08	0.0	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.1000003E 01	0.6371128E 09	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.1000000E 01	0.1000123E 01	0.1036465E 10	0.0	0.0	0.0	0.0
0.1000042E 01	0.1000000E 01	0.1000000E 01	0.1000000E 01	0.1250566E 09	0.0	0.0	0.0
0.1000000E 01	0.1000042E 01	0.1000046E 01	0.1000041E 01	0.1000000E 01	0.8136058E 08	0.0	0.0
0.1000000E 01	0.1000039E 01	0.1000042E 01	0.1000003E 01	0.1000000E 01	0.1000003E 01	0.8065551E 09	0.0
0.1000000E 01	0.1000044E 01	0.1000026E 01	0.1000042E 01	0.1000000E 01	0.1000004E 01	0.1000017E 01	0.1559742E 10

SEGMENT LOAD MATRICES

0.0	0.0
0.6685517E 06	0.6685517E 06
0.1982717E 06	0.1982717E 06
-0.1061756E 07	-0.1061756E 07
0.0	0.0
0.9794011E 06	0.9794011E 06
0.1843362E 06	0.1843362E 06
0.1591318E 07	0.1591318E 07

INPUT DATA FOR SEGMENT COUPLING

REGION NUMBER 1 NUMBER OF SEGMENT JOINTS 3 NUMBER OF KINEMATIC LINKS 0

SEGMENT	JOINT(I)	JOINT(J)	RZERO(I)	RZERO(J)
1	1	2	0.5676628E 01	0.9534368E 01
2	2	3	0.9534368E 01	0.1879277E 02

REGION STIFFNESS MATRIX

	DELTA T1	DELTA Z1	DELTA R1	THETA 1	DELTA T2	DELTA Z2	DELTA R2	THETA 2
FORCE T1	0.4024212E 09	0.0	0.0	0.0	-0.1215485E 09	0.0	0.0	0.0
FORCE Z1	0.0	0.3041357E 08	-0.5968925E 08	-0.8364672E 08	0.0	-0.3041336E 08	0.8628846E 08	-0.6352477E 08
FORCE R1	0.0	-0.5968939E 08	0.4437079E 09	0.2297670E 08	0.0	0.5968781E 08	-0.2773018E 09	-0.9045606E 08
MOMENT 1	0.0	-0.8364723E 08	0.2297675E 08	0.5516800E 09	0.0	0.8364669E 08	-0.1102390E 09	0.2736202E 09
FORCE T2	-0.1215394E 09	0.0	0.0	0.0	0.3671006E 08	0.0	0.0	0.0
FORCE Z2	0.0	-0.3041117E 08	0.5968302E 08	0.8364058E 08	0.0	0.3041098E 08	-0.8628256E 08	0.6352011E 08
FORCE R2	0.0	0.8628208E 08	-0.2722808E 09	-0.1102317E 09	0.0	-0.8628235E 08	0.5872886E 09	0.2735135E 09
MOMENT 2	0.0	-0.6352026E 08	-0.9045021E 08	0.2735992E 09	0.0	0.6351965E 08	0.2735150E 09	0.1146326E 10

REGION SYMMETRY CHECK

0.4024212E 09	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.3041357E 08	0.0	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.1000002E 01	0.4437079E 09	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.1000006E 01	0.1000002E 01	0.5516800E 09	0.0	0.0	0.0	0.0
0.1000074E 01	0.1000000E 01	0.1000000E 01	0.1000000E 01	0.3671006E 08	0.0	0.0	0.0
0.1000000E 01	0.1000072E 01	0.1000080E 01	0.1000072E 01	0.1000000E 01	0.3041098E 08	0.0	0.0
0.1000000E 01	0.1000073E 01	0.1000076E 01	0.1000065E 01	0.1000000E 01	0.1000002E 01	0.5872886E 09	0.0
0.1000000E 01	0.1000071E 01	0.1000064E 01	0.1000076E 01	0.1000000E 01	0.1000007E 01	0.1000005E 01	0.1146326E 10

REGION LOAD MATRIX

0.0	0.0
0.6705410E 06	0.6705410E 06
0.2328787E 06	0.2328787E 06
-0.1391570E 07	-0.1391570E 07
0.0	0.0
0.1346131E 07	0.1346131E 07
-0.6693294E 05	-0.6693294E 05
0.2824464E 07	0.2824464E 07

REGION NUMBER 2

THERE ARE 2 SEGMENTS AND 0 KINEMATIC LINKS WITHIN THIS REGION

SEGMENT NUMBER 1 SEGMENT CODE 11 FIRST PART OF REG. NO. 2

TIC	STOP	DTAU	DIFF	STEP	DELTA
0.3403391E 00	0.5105088E 00	0.9999998E-02	0.9999999E-04	0.1701700E-02	.0

GEOMETRY INPUT VARIABLES

0.5629999E 02 0.1000000E 01 0.0

ORTH STEE SING THIC NOTH T FREE = 0.0 LINE NUMBER OF TABLE COLUMNS = 2

MATERIAL PROPERTY TABLE USED

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.30000E 08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.30000E 08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.20000E 00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.12500E-05	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.12500E-05	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.12500E 08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE ORDER PHI OR S VS. CROSSECTION PROPERTIES

0.3403390E 00	0.5105088E 00
0.2360000E 01	0.2360000E 01

PROBLEM 1 TABLE ORDER PHI OR S VS. DISTRIBUTED LOADS (F THETA, F PHI, F ZETA, M THETA, M PHI)
LOAD IDENTIFICATION CLUES 000100

0.2000000E 04 0.2000000E 04

PROBLEM 2 TABLE ORDER PHI OR S VS. DISTRIBUTED LOADS (F THETA, F PHI, F ZETA, M THETA, M PHI)
LOAD IDENTIFICATION CLUES 000100

0.2000000E 04 0.2000000E 04

MATRIX X AND Y (TRANSPOSED) MAGIC OUTPUT

0.2604018E-11	0.0	0.0	0.0	0.1463792E 01	0.0	0.0	0.0
0.0	0.8640616E 06	-0.4838926E 06	-0.2317537E 07	0.0	0.1002042E 01	0.3870555E 00	0.2238847E 00
0.0	-0.3059753E 06	0.1713525E 06	0.8206736E 06	0.0	0.1635116E 00	0.7885240E 00	-0.7928103E-01
0.0	-0.1589605E 07	0.8902074E 06	0.2336841E 07	0.0	0.8494708E 00	0.9014202E 01	0.8010378E 00
0.4667036E 00	0.0	0.0	0.0	0.2713220E-06	0.0	0.0	0.0
0.0	0.7586777E 00	-0.1635116E 00	-0.7831191E 00	0.0	0.1153321E-06	0.1774620E-06	0.7565302E-07
0.0	0.4462428E 00	0.4881761E 00	0.6528643E 01	0.0	-0.1646584E-06	-0.3482153E-05	-0.1021891E-05
0.0	0.1415691E 00	-0.7928103E-01	0.5985116E 00	0.0	-0.7565302E-07	-0.1163433E-05	-0.2245631E-06
0.0	-0.2627711E 04	-0.1534281E 05	-0.7348256E 05	0.0	0.6369157E-03	0.1756527E-01	0.7098772E-02
0.0	-0.2627711E 04	-0.1534281E 05	-0.7348256E 05	0.0	0.6369157E-03	0.1756527E-01	0.7098772E-02

STIFFNESS COEFFICIENTS

	DELTA T1	DELTA Z1	DELTA R1	THETA 1	DELTA T2	DELTA Z2	DELTA R2	THETA 2
FORCE T1	0.6370552E 09	0.0	0.0	0.0	-0.4352090E 09	0.0	0.0	0.0
FORCE Z1	0.0	0.2439481E 09	-0.3670223E 09	-0.3449318E 09	0.0	-0.2439484E 09	0.4059077E 09	-0.2346357E 09
FORCE R1	0.0	-0.3670231E 09	0.9094006E 09	-0.1220230E 08	0.0	0.3670231E 09	-0.8945815E 09	-0.2822013E 09
MOMENT 1	0.0	-0.3449306E 09	-0.1220593E 08	0.1884436E 10	0.0	0.3449308E 09	-0.5255053E 08	0.9725560E 09
FORCE T2	-0.4351985E 09	0.0	0.0	0.0	0.2973089E 09	0.0	0.0	0.0
FORCE Z2	0.0	-0.2439424E 09	0.3670134E 09	0.3449236E 09	0.0	0.2439425E 09	-0.4058988E 09	0.2346294E 09
FORCE R2	0.0	0.4058988E 09	-0.8945592E 09	-0.5255394E 08	0.0	-0.4058998E 09	0.1068877E 10	0.3651753E 09
MOMENT 2	0.0	-0.2346235E 09	-0.2821985E 09	0.9725297E 09	0.0	0.2346278E 09	0.3651799E 09	0.2376991E 10

SEGMENT SYMMETRY CHECK

0.6370552E 09	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.2439481E 09	0.0	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.1000002E 01	0.9094006E 09	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.1000003E 01	0.1000298E 01	0.1884436E 10	0.0	0.0	0.0	0.0
0.1000024E 01	0.1000000E 01	0.1000000E 01	0.1000000E 01	0.2973089E 09	0.0	0.0	0.0
0.1000000E 01	0.1000024E 01	0.1000026E 01	0.1000020E 01	0.1000000E 01	0.2439425E 09	0.0	0.0
0.1000000E 01	0.1000022E 01	0.1000025E 01	0.1000065E 01	0.1000000E 01	0.1000002E 01	0.1068877E 10	0.0
0.1000000E 01	0.1000031E 01	0.1000010E 01	0.10000[illegible]7E 01	0.1000000E 01	0.1000006E 01	0.1000012E 01	0.2376981E 10

SEGMENT LOAD MATRICES

0.0	0.0
0.1109288E 07	0.1109288E 07
0.5615149E 06	0.5615149E 06
-0.1932146E 07	-0.1932146E 07
0.0	0.0
0.1426430E 07	0.1426430E 07
0.5401433E 06	0.5401433E 06
0.2427463E 07	0.2427463E 07

SEGMENT NUMBER 2 SEGMENT CODE 11 SECOND PART OF REG. NO.2

TIC	STOP	DTAU	DIFF	STEP	DELTA
0.5105088E 00	0.6806784E 00	0.9999998E-02	0.9999999E-04	0.1701700E-02	.0

GEOMETRY INPUT VARIABLES

0.5629999E 02 0.1000000E 01 0.0

ORTH STEE SING THIC NOTH T FREE = 0.0 LINE NUMBER OF TABLE COLUMNS = 2

MATERIAL PROPERTY TABLE USED

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.30000E 08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.30000E 08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.20000E 00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.12500E-05	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.12500E-05	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.12500E 08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE ORDER PHI OR S VS. CROSSECTION PROPERTIES

0.5105087E 00	0.6806785E 00
0.2360000E 01	0.2360000E 01

PROBLEM 1 TABLE ORDER PHI OR S VS. DISTRIBUTED LOADS (F THETA, F PHI, F ZETA, M THETA, M PHI)
LOAD IDENTIFICATION CLUES C001C0

0.2000000E 04 0.2000000E 04

PROBLEM 2 TABLE ORDER PHI OR S VS. DISTRIBUTED LOADS (F THETA, F PHI, F ZETA, M THETA, M PHI)
LOAD IDENTIFICATION CLUES C001C0

0.2000000E 04 0.2000000E 04

MATRIX X AND Y (TRANSPOSED) MAGIC OUTPUT

0.8981928E-12	0.0	0.0	0.0	0.1287955E 01	0.0	0.0	0.0
0.0	0.3986729E 06	-0.3228359E 06	-0.1562687E 07	0.0	0.9798924E 00	0.2012333E 00	0.1500013E 00
0.0	-0.2232648E 06	0.1807945E 06	0.8751392E 06	0.0	0.1725213E 00	0.7780207E 00	-0.8400416E-01
0.0	-0.1139201E 07	0.9224939E 06	0.2703831E 07	0.0	0.8802794E 00	0.8985291E 01	0.7766075E 00
0.5028349E 00	0.0	0.0	0.0	0.2863453E-06	0.0	0.0	0.0
0.0	0.8158831E 00	-0.1725213E 00	-0.8350918E 00	0.0	0.1217604E-06	0.1864929E-06	0.8015996E-07
0.0	0.3774694E 00	0.5660208E 00	0.7266464E 01	0.0	-0.1775109E-06	-0.3719862E-05	-0.1111120E-05
0.0	0.1037382E 00	-0.8400422E-01	0.6409330E 00	0.0	-0.8016002E-07	-0.1210603E-05	-0.2369389E-06
0.0	-0.2369386E 04	-0.1618823E 05	-0.7835937E 05	0.0	0.6761409E-03	0.1844990E-01	0.7521678E-02
0.0	-0.2369386E 04	-0.1618823E 05	-0.7835937E 05	0.0	0.6761409E-03	0.1844990E-01	0.7521678E-02

STIFFNESS COEFFICIENTS

	DELTA T1	DELTA Z1	DELTA R1	THETA 1	DELTA T2	DELTA Z2	DELTA R2	THETA 2
FORCE T1	0.7774469E 09	0.0	0.0	0.0	-0.6036288E 09	0.0	0.0	0.0
FORCE Z1	0.0	0.5371356E 09	-0.6293632E 09	-0.4810429E 09	0.0	-0.5371359E 09	0.6805025E 09	-0.2379914E 09
FORCE R1	0.0	-0.6293647E 09	0.1036809E 10	-0.8531010E 08	0.0	0.6293647E 09	-0.1039711E 10	-0.4367224E 09
MOMENT 1	0.0	-0.4810394E 09	-0.8531611E 08	0.2675887E 10	0.0	0.4810399E 09	0.1745435E 08	0.1334524E 10
FORCE T2	-0.6036193E 09	0.0	0.0	0.0	0.4686648E 09	0.0	0.0	0.0
FORCE Z2	0.0	-0.5371272E 09	0.6293530E 09	0.4810358E 09	0.0	0.5371274E 09	-0.6804923E 09	0.2379871E 09
FORCE R2	0.0	0.6804928E 09	-0.1039695E 10	0.1744686E 08	0.0	-0.6804938E 09	0.1181741E 10	0.5167421E 09
MOMENT 2	0.0	-0.2379844E 09	-0.4367209E 09	0.1334498E 10	0.0	0.2379840E 09	0.5167488E 09	0.3123514E 10

SEGMENT SYMMETRY CHECK

0.7774469E 09	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.5371356E 09	0.0	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.1000002E 01	0.1036809E 10	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.1000007E 01	0.1000070E 01	0.2675887E 10	0.0	0.0	0.0	0.0
0.1000015E 01	0.1000000E 01	0.1000000E 01	0.1000000E 01	0.4686648E 09	0.0	0.0	0.0
0.1000000E 01	0.1000015E 01	0.1000018E 01	0.1000008E 01	0.1000000E 01	0.5371274E 09	0.0	0.0
0.1000000E 01	0.1000013E 01	0.1000016E 01	0.1000429E 01	0.1000000E 01	0.1000002E 01	0.1181741E 10	0.0
0.1000000E 01	0.1000029E 01	0.1000003E 01	0.1000019E 01	0.1000000E 01	0.1000012E 01	0.1000012E 01	0.3123514E 10

SEGMENT LOAD MATRICES

0.0	0.0
0.1403604E 07	0.1403604E 07
0.1051032E 07	0.1051032E 07
-0.2742406E 07	-0.2742406E 07
0.0	0.0
0.1728990E 07	0.1728990E 07
0.1024670E 07	0.1024670E 07
0.3191800E 07	0.3191800E 07

INPUT DATA FOR SEGMENT COUPLING

REGION NUMBER 2 NUMBER OF SEGMENT JOINTS 3 NUMBER OF KINEMATIC LINKS 0

SEGMENT	JOINT(I)	JOINT(J)	RZERO(I)	RZERO(J)
1	1	2	0.1879330E 02	0.2750935E 02
2	2	3	0.2750935E 02	0.3543027E 02

REGION STIFFNESS MATRIX

	DELTA T1	DELTA Z1	DELTA R1	THETA 1	DELTA T2	DELTA Z2	DELTA R2	THETA 2
FORCE T1	0.4608269E 09	0.0	0.0	0.0	-0.2444319E 09	0.0	0.0	0.0
FORCE Z1	0.0	0.1395919E 09	-0.2183103E 09	-0.2145419E 09	0.0	-0.1395920E 09	0.2418042E 09	0.8498210E 08
FORCE R1	0.0	-0.2183101E 09	0.5024312E 09	0.9368960E 08	0.0	0.2183092E 09	-0.3877632E 09	-0.2597782E 09
MOMENT 1	0.0	-0.2145421E 09	0.9369016E 08	0.1262389E 10	0.0	0.2145430E 09	-0.2742625E 09	0.2502461E 09
FORCE T2	-0.2444221E 09	0.0	0.0	0.0	0.1296466E 09	0.0	0.0	0.0
FORCE Z2	0.0	-0.1395857E 09	0.2182992E 09	0.2145352E 09	0.0	0.1395860E 09	-0.2417964E 09	-0.8498275E 08
FORCE R2	0.0	0.2417941E 09	-0.3877463E 09	-0.2742531E 09	0.0	-0.2417958E 09	0.5529700E 09	0.5284132E 09
MOMENT 2	0.0	0.8498018E 08	-0.2597700E 09	0.2502344E 09	0.0	-0.8498178E 08	0.5284132E 09	0.1984534E 10

REGION SYMMETRY CHECK

0.4608269E 09	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.1395919E 09	0.0	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.1000000E 01	0.5024312E 09	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.1000001E 01	0.1000006E 01	0.1262389E 10	0.0	0.0	0.0	0.0
0.1000039E 01	0.1000000E 01	0.1000000E 01	0.1000000E 01	0.1296466E 09	0.0	0.0	0.0
0.1000000E 01	0.1000044E 01	0.1000045E 01	0.1000036E 01	0.1000000E 01	0.1395860E 09	0.0	0.0
0.1000000E 01	0.1000041E 01	0.1000043E 01	0.1000034E 01	0.1000000E 01	0.1000002E 01	0.5529700E 09	0.0
0.1000000E 01	0.1000022E 01	0.1000031E 01	0.1000047E 01	0.1000000E 01	0.1000011E 01	0.1000000E 01	0.1984534E 10

REGION LOAD MATRIX

0.0	0.0
0.1448377E 07	0.1448377E 07
0.2239562E 07	0.2239562E 07
-0.6333308E 07	-0.6333308E 07
0.0	0.0
0.4219925E 07	0.4219925E 07
-0.4789368E 06	-0.4789368E 06
0.9308260E 07	0.9308260E 07

INPUT DATA FOR REGION COUPLING

NUMBER OF REGION JOINTS 3 NUMBER OF KINEMATIC LINKS 0

REGION	JOINT(I)	JOINT(J)	RZERO(I)	RZERO(J)
1	1	2	0.5676628E 01	0.1879330E 02
2	2	3	0.1879330E 02	0.3543027E 02

BOUNDARY CONDITIONS

JOINT	DELTA T	DELTA Z	DELTA R	THETA	ANGLE ALPHA
1	1	0	3	0	0.1010000E 00
2	1	1	1	1	0.0
3	0	0	0	0	0.0

THE REDUCED FLEXIBILITY MATRIX

ROW	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6
1	0.2682914E-08	0.0	0.6554373E-09	0.0	0.0	0.0
2	0.0	0.6827690E-07	0.0	0.8034931E-08	-0.2396423E-08	0.2919112E-08
3	0.6553884E-09	0.0	0.2170014E-08	0.0	0.0	0.0
4	0.0	0.8034387E-08	0.0	0.1287292E-07	0.2966787E-08	0.5960588E-09
5	0.0	-0.2396241E-08	0.0	0.2966791E-08	0.1936368E-08	-0.1811300E-09
6	0.0	0.2918915E-08	0.0	0.5960596E-09	-0.1811313E-09	0.5677843E-09

THE EXPANDED REGION JOINT DISPLACEMENT MATRIX (REGION END DEFLECTIONS)

JOINT	PROBLEM	DELTA T	DELTA Z	DELTA R	OMEGA-THETA
1	1	0.0	-0.5388073E-01	-0.5460527E-02	0.0
1	2	0.0	-0.5388073E-01	-0.5460527E-02	0.0
2	1	0.0	-0.4587631E-01	-0.1147843E-01	-0.1295712E-02
2	2	0.0	-0.4587631E-01	-0.1147843E-01	-0.1295712E-02
3	1	0.0	0.0	0.0	0.0
3	2	0.0	0.0	0.0	0.0

```
                                        REGION NUMBER  1

                        THERE ARE  2 SEGMENTS AND  0 KINEMATIC LINKS WITHIN THIS REGION

          SEGMENT NUMBER  1      SEGMENT CODE 11      FIRST PART OF REG. NO. 1

                                 TABLE ORDER PHI OR S VS. CROSSECTION PROPERTIES
  C.1009999E 0C    0.1701696E 00
  C.236CCC0E C1    0.2360000E C1

             PRCBLEM  1      TABLE ORDER  PHI OR S VS. DISTRIBUTED LOADS (F THETA, F PHI, F ZETA, M THETA, M PHI)
 LOAD ICENTIFICATION CLUES 00C100

  C.2CCC000E 04    C.2C00000E 04

             PROBLEM  2      TABLE ORDER  PHI OR S VS. DISTRIBUTED LOADS (F THETA, F PHI, F ZETA, M THETA, M PHI)
 LOAD ICENTIFICATION CLUES 000100

  C.20CC000E 04    0.2C00000E 04
```

PHI (RAD. OR IN.)	DEGREES	PRINT INTERVAL	STEP	R ZERO	NUMBER OF CYCLES
EPSILON THETA	EPSILON PHI	GAMMA PHI THETA	K PHI	K THETA	N TEMPERATURE THETA
U	Q PHI	K PHI THETA	J PHI STAR	T PHI THETA	N TEMPERATURE PHI
V	J PHI	N THETA	N PHI	N PHI THETA	M TEMPERATURE THETA
W	Q THETA	M THETA	M PHI	M PHI THETA	M TEMPERATURE PHI
OMEGA THETA	TAU ZETA PHI = Q/T	SIGMA THETA IN	SIGMA PHI IN	TAU PHI THETA IN	SIGMA F IN
OMEGA PHI	TAU ZETA THETA = Q/T	SIGMA THETA OUT	SIGMA PHI OUT	TAU PHI THETA OUT	SIGMA F OUT

PROBLEM NUMBER 1

0.1010000E 00	0.5786870E 01	0.9999998E-02	0.1701700E-02	0.5676628E 01	1
-0.9619305E-03	-0.3924884E-03	0.0	-0.5189089E-04	0.0	0.0
0.0	-0.1601563E 00	0.0	-0.1601563E 00	0.0	0.0
-0.3725290E-08	-0.1601563E 00	-0.7673156E 05	-0.4313448E 05	0.0	0.0
0.5415672E-01	0.0	0.3552427E 03	0.1776215E 04	-0.0	0.0
0.0	0.0	-0.3213070E 05	-0.1636385E 05	0.0	0.2782759E 05
0.0	0.0	-0.3289608E 05	-0.2019081E 05	0.0	0.2873364E 05

PROBLEM NUMBER 2

0.1010000E 00	0.5786870E 01	0.9999998E-02	0.1701700E-02	0.5676628E 01	1
-0.9619305E-03	-0.3924884E-03	0.0	-0.5189089E-04	0.0	0.0
0.0	-0.1601563E 00	0.0	-0.1601563E 00	0.0	0.0
-0.3725290E-08	-0.1601563E 00	-0.7673156E 05	-0.4313448E 05	0.0	0.0
0.5415672E-01	0.0	0.3552427E 03	0.1776215E 04	-0.0	0.0
0.0	0.0	-0.3213070E 05	-0.1636385E 05	0.0	0.2782759E 05
0.0	0.0	-0.3289608E 05	-0.2019081E 05	0.0	0.2873364E 05

PROBLEM NUMBER 1

0.1112095E 00	0.6371835E 01	0.9999998E-02	0.1701700E-02	0.6248194E 01	25
-0.9120773E-03	-0.4422185E-03	0.0	-0.4794415E-04	-0.4545414E-05	0.0
0.0	0.7061334E 02	0.0	0.7061334E 02	0.0	0.0
0.3123179E-03	0.7061334E 02	-0.7378844E 05	-0.4606674E 05	0.0	0.0
0.5414677E-01	0.0	0.4838123E 03	0.1672236E 04	-0.0	0.0
-0.2857718E-04	0.0	-0.3074510E 05	-0.1771835E 05	0.0	0.2672916E 05
0.0	0.0	-0.3178750E 05	-0.2132128E 05	0.0	0.2805872E 05

PROBLEM NUMBER 2

0.1112095E 00	0.6371835E 01	0.9999998E-02	0.1701700E-02	0.6248194E 01	25
-0.9120773E-03	-0.4422185E-03	0.0	-0.4794415E-04	-0.4545414E-05	0.0
0.0	0.7061334E 02	0.0	0.7061334E 02	0.0	0.0
0.3123179E-03	0.7061334E 02	-0.7378844E 05	-0.4606674E 05	0.0	0.0
0.5414677E-01	0.0	0.4838123E 03	0.1672236E 04	-0.0	0.0
-0.2857718E-04	0.0	-0.3074510E 05	-0.1771835E 05	0.0	0.2672916E 05
0.0	0.0	-0.3178750E 05	-0.2132128E 05	0.0	0.2805872E 05

PROBLEM NUMBER 1

0.1214191E 00	0.6956800E 01	0.9999998E-02	0.1701700E-02	0.6819106E 01	49
-0.8739717E-03	-0.4799652E-03	0.0	-0.4613861E-04	-0.8083120E-05	0.0
0.0	0.1355361E 03	0.0	0.1355361E 03	0.0	0.0
0.5995084E-03	0.1355361E 03	-0.7153487E 05	-0.4828850E 05	0.0	0.0
0.5411788E-01	0.0	0.5925464E 03	0.1634652E 04	-0.0	0.0
-0.5552849E-04	0.0	-0.2967306E 05	-0.1870026E 05	0.0	0.2598646E 05
0.0	0.0	-0.3094974E 05	-0.2222221E 05	0.0	0.2763949E 05

PROBLEM NUMBER 2

0.1214191E 00	0.6956800E 01	0.9999998E-02	0.1701700E-02	0.6819106E 01	49
-0.8739717E-03	-0.4799652E-03	0.0	-0.4613861E-04	-0.8083120E-05	0.0
0.0	0.1355361E 03	0.0	0.1355361E 03	0.0	0.0
0.5995084E-03	0.1355361E 03	-0.7153487E 05	-0.4828850E 05	0.0	0.0
0.5411788E-01	0.0	0.5925464E 03	0.1634652E 04	-0.0	0.0
-0.5552849E-04	0.0	-0.2967306E 05	-0.1870026E 05	0.0	0.2598646E 05
0.0	0.0	-0.3094974E 05	-0.2222221E 05	0.0	0.2763949E 05

PROBLEM NUMBER 1

0.1316286E 00	0.7541764E 01	0.9999998E-02	0.1701700E-02	0.7389304E 01	73
-0.8440663E-03	-0.5092861E-03	0.0	-0.4600624E-04	-0.1099319E-04	0.0
0.0	0.1957428E 03	0.0	0.1957428E 03	0.0	0.0
0.8671705E-03	0.1957428E 03	-0.6976181E 05	-0.5000981E 05	0.0	0.0
0.5407086E-01	0.0	0.6912515E 03	0.1650043E 04	-0.0	0.0
-0.8194089E-04	0.0	-0.2881543E 05	-0.1941305E 05	0.0	0.2545191E 05
0.0	0.0	-0.3030477E 05	-0.2296816E 05	0.0	0.2738377E 05

PROBLEM NUMBER 2

0.1316286E 00	0.7541764E 01	0.9999998E-02	0.1701700E-02	0.7389304E 01	73
-0.8440663E-03	-0.5092861E-03	0.0	-0.4600624E-04	-0.1099319E-04	0.0
0.0	0.1957428E 03	0.0	0.1957428E 03	0.0	0.0
0.8671705E-03	0.1957428E 03	-0.6976181E 05	-0.5000981E 05	0.0	0.0
0.5407086E-01	0.0	0.6912515E 03	0.1650043E 04	-0.0	0.0
-0.8194089E-04	0.0	-0.2881543E 05	-0.1941305E 05	0.0	0.2545191E 05
0.0	0.0	-0.3030477E 05	-0.2296816E 05	0.0	0.2738377E 05

PROBLEM NUMBER 1

0.1418382E 00	0.8126729E 01	0.9999998E-02	0.1701700E-02	0.7958736E 01	97
-0.8200333E-03	-0.5325091E-03	0.0	-0.4723202E-04	-0.1351831E-04	0.0
0.0	0.2520011E 03	0.0	0.2520011E 03	0.0	0.0
0.1119250E-02	0.2520011E 03	-0.6833194E 05	-0.5136802E 05	0.0	0.0
0.5400595E-01	0.0	0.7860769E 03	0.1709289E 04	-0.0	0.0
-0.1086800E-03	0.0	-0.2810740E 05	-0.1992474E 05	0.0	0.2503974E 05
0.0	0.0	-0.2980105E 05	-0.2360750E 05	0.0	0.2723762E 05

PROBLEM NUMBER 2

0.1418382E 00	0.8126729E 01	0.9999998E-02	0.1701700E-02	0.7958736E 01	97
-0.8200333E-03	-0.5325091E-03	0.0	-0.4723202E-04	-0.1351831E-04	0.0
0.0	0.2520011E 03	0.0	0.2520011E 03	0.0	0.0
0.1119250E-02	0.2520011E 03	-0.6833194E 05	-0.5136802E 05	0.0	0.0
0.5400595E-01	0.0	0.7860769E 03	0.1709289E 04	-0.0	0.0
-0.1086800E-03	0.0	-0.2810740E 05	-0.1992474E 05	0.0	0.2503974E 05
0.0	0.0	-0.2980105E 05	-0.2360750E 05	0.0	0.2723762E 05

PROBLEM NUMBER 1

0.1520478E 00	0.8711694E 01	0.9999998E-02	0.1701700E-02	0.8527340E 01	121
-0.8002943E-03	-0.5512089E-03	0.0	-0.4959470E-04	-0.1581795E-04	0.0
0.0	0.3048303E 03	0.0	0.3048303E 03	0.0	0.0
0.1358586E-02	0.3048303E 03	-0.6715200E 05	-0.5245597E 05	0.0	0.0
0.5392290E-01	0.0	0.8809683E 03	0.1805906E 04	-0.0	0.0
-0.1364595E-03	0.0	-0.2750520E 05	-0.2028165E 05	0.0	0.2469879E 05
0.0	0.0	-0.2940330E 05	-0.2417258E 05	0.0	0.2716825E 05

PROBLEM NUMBER 2

0.1520478E 00	0.8711694E 01	0.9999998E-02	0.1701700E-02	0.8527340E 01	121
-0.8002943E-03	-0.5512089E-03	0.0	-0.4959470E-04	-0.1581795E-04	0.0
0.0	0.3048303E 03	0.0	0.3048303E 03	0.0	0.0
0.1358586E-02	0.3048303E 03	-0.6715200E 05	-0.5245597E 05	0.0	0.0
0.5392290E-01	0.0	0.8809683E 03	0.1805906E 04	-0.0	0.0
-0.1364595E-03	0.0	-0.2750520E 05	-0.2028165E 05	0.0	0.2469879E 05
0.0	0.0	-0.2940330E 05	-0.2417258E 05	0.0	0.2716825E 05

PROBLEM NUMBER 1

0.1622573E 00	0.9296659E 01	0.9999998E-02	0.1701700E-02	0.9095050E 01	145
-0.7837415E-03	-0.5664818E-03	0.0	-0.5293240E-04	-0.1799935E-04	0.0
0.0	0.3545740E 03	0.0	0.3545740E 03	0.0	0.0
0.1587260E-02	0.3545740E 03	-0.6615650E 05	-0.5333820E 05	0.0	0.0
0.5382105E-01	0.0	0.9784871E 03	0.1935088E 04	-0.0	0.0
-0.1658840E-03	0.0	-0.2697832E 05	-0.2051631E 05	0.0	0.2439781E 05
0.0	0.0	-0.2908653E 05	-0.2468557E 05	0.0	0.2715485E 05

PROBLEM NUMBER 2

0.1622573E 00	0.9296659E 01	0.9999998E-02	0.1701700E-02	0.9095050E 01	145
-0.7837415E-03	-0.5664818E-03	0.0	-0.5293240E-04	-0.1799935E-04	0.0
0.0	0.3545740E 03	0.0	0.3545740E 03	0.0	0.0
0.1587260E-02	0.3545740E 03	-0.6615650E 05	-0.5333820E 05	0.0	0.0
0.5382105E-01	0.0	0.9784871E 03	0.1935088E 04	-0.0	0.0
-0.1658840E-03	0.0	-0.2697832E 05	-0.2051631E 05	0.0	0.2439781E 05
0.0	0.0	-0.2908653E 05	-0.2468557E 05	0.0	0.2715485E 05

PROBLEM NUMBER 1

0.1690637E 00	0.9686635E 01	0.9999998E-02	0.1701700E-02	0.9473001E 01	161
-0.7740732E-03	-0.5751560E-03	0.0	-0.5563714E-04	-0.1942510E-04	0.0
0.0	0.3861318E 03	0.0	0.3861318E 03	0.0	0.0
0.1734560E-02	0.3861318E 03	-0.6557144E 05	-0.5383532E 05	0.0	0.0
0.5374222E-01	0.0	0.1045807E 04	0.2037431E 04	-0.0	0.0
-0.1866756E-03	0.0	-0.2665789E 05	-0.2061671E 05	0.0	0.2420937E 05
0.0	0.0	-0.2891114E 05	-0.2500647E 05	0.0	0.2717005E 05

PROBLEM NUMBER 2

0.1690637E 00	0.9686635E 01	0.9999998E-02	0.1701700E-02	0.9473001E 01	161
-0.7740732E-03	-0.5751560E-03	0.0	-0.5563714E-04	-0.1942510E-04	0.0
0.0	0.3861318E 03	0.0	0.3861318E 03	0.0	0.0
0.1734560E-02	0.3861318E 03	-0.6557144E 05	-0.5383532E 05	0.0	0.0
0.5374222E-01	0.0	0.1045807E 04	0.2037431E 04	-0.0	0.0
-0.1866756E-03	0.0	-0.2665789E 05	-0.2061671E 05	0.0	0.2420937E 05
0.0	0.0	-0.2891114E 05	-0.2500647E 05	0.0	0.2717005E 05

PROBLEM NUMBER 1

0.1701695E 00	0.9749991E 01	0.9999998E-02	0.1701700E-02	0.9534364E 01	165
-0.7725894E-03	-0.5764673E-03	0.0	-0.5611016E-04	-0.1965600E-04	0.0
0.0	0.3911411E 03	0.0	0.3911411E 03	0.0	0.0
0.1758134E-02	0.3911411E 03	-0.6548136E 05	-0.5391014E 05	0.0	0.0
0.5372856E-01	0.0	0.1056948E 04	0.2055203E 04	-0.0	0.0
-0.1901542E-03	0.0	-0.2660772E 05	-0.2062927E 05	0.0	0.2417932E 05
0.0	0.0	-0.2888498E 05	-0.2505732E 05	0.0	0.2717408E 05

PROBLEM NUMBER 2

0.1701695E 00	0.9749991E 01	0.9999998E-02	0.1701700E-02	0.9534364E 01	165
-0.7725894E-03	-0.5764673E-03	0.0	-0.5611016E-04	-0.1965600E-04	0.0
0.0	0.3911411E 03	0.0	0.3911411E 03	0.0	0.0
0.1758134E-02	0.3911411E 03	-0.6548136E 05	-0.5391014E 05	0.0	0.0
0.5372856E-01	0.0	0.1056948E 04	0.2055203E 04	-0.0	0.0
-0.1901542E-03	0.0	-0.2660772E 05	-0.2062927E 05	0.0	0.2417932E 05
0.0	0.0	-0.2888498E 05	-0.2505732E 05	0.0	0.2717408E 05

```
SEGMENT NUMBER  2      SEGMENT CODE 11       SECOND PART OF REG. NO.1

                                        TABLE ORDER PHI OR S VS. CROSSECTION PROPERTIES
 0.1701694E CC    0.3403392E 00
 0.236C000E 01    0.236C000E C1

              PROBLEM  1     TABLE ORDER  PHI OR S VS. DISTRIBUTED LOADS (F THETA, F PHI, F ZETA, M THETA, M PHI)
LCAD ICENTIFICATION CLUES 000100

 0.200C000E 04    C.2000000E 04

              PROBLEM  2     TABLE ORDER  PHI OR S VS. DISTRIBUTED LOADS (F THETA, F PHI, F ZETA, M THETA, M PHI)
LCAD ICENTIFICATION CLUES 000100

 C.2000000E 04    0.2600000E 04
```

PHI (RAD. OR IN.)	DEGREES	PRINT INTERVAL	STEP	R ZERO	NUMBER OF CYCLES
EPSILON THETA	EPSILON PHI	GAMMA PHI THETA	K PHI	K THETA	N TEMPERATURE THETA
U	Q PHI	K PHI THETA	J PHI STAR	T PHI THETA	N TEMPERATURE PHI
V	J PHI	N THETA	N PHI	N PHI THETA	M TEMPERATURE THETA
W	Q THETA	M THETA	M PHI	M PHI THETA	M TEMPERATURE PHI
OMEGA THETA	TAU ZETA PHI = Q/T	SIGMA THETA IN	SIGMA PHI IN	TAU PHI THETA IN	SIGMA F IN
OMEGA PHI	TAU ZETA THETA = Q/T	SIGMA THETA OUT	SIGMA PHI OUT	TAU PHI THETA OUT	SIGMA F OUT

PROBLEM NUMBER 1

0.1701695E 00	0.9749995E 01	0.9999998E-02	0.1701700E-02	0.9534368E 01	1
-0.7725896E-03	-0.5764656E-03	0.0	-0.5612301E-04	-0.1965556E-04	0.0
0.0	0.3911758E 03	0.0	0.3911758E 03	0.0	0.0
0.1758128E-02	0.3911758E 03	-0.6548137E 05	-0.5391002E 05	0.0	0.0
0.5372856E-01	0.0	0.1057021E 04	0.2055641E 04	-0.0	0.0
-0.1901500E-03	0.0	-0.2660765E 05	-0.2062874E 05	0.0	0.2417911E 05
0.0	0.0	-0.2888506E 05	-0.2505773E 05	0.0	0.2717430E 05

PROBLEM NUMBER 2

0.1701695E 00	0.9749995E 01	0.9999998E-02	0.1701700E-02	0.9534368E 01	1
-0.7725896E-03	-0.5764656E-03	0.0	-0.5612301E-04	-0.1965556E-04	0.0
0.0	0.3911758E 03	0.0	0.3911758E 03	0.0	0.0
0.1758128E-02	0.3911758E 03	-0.6548137E 05	-0.5391002E 05	0.0	0.0
0.5372856E-01	0.0	0.1057021E 04	0.2055641E 04	-0.0	0.0
-0.1901500E-03	0.0	-0.2660765E 05	-0.2062874E 05	0.0	0.2417911E 05
0.0	0.0	-0.2888506E 05	-0.2505773E 05	0.0	0.2717430E 05

PROBLEM NUMBER 1

0.1803791E 00	0.1033496E 02	0.9999998E-02	0.1701700E-02	0.1010036E 02	25
-0.7598619E-03	-0.5874471E-03	0.0	-0.6090385E-04	-0.2179331E-04	0.0
0.0	0.4358997E 03	0.0	0.4358997E 03	0.0	0.0
0.1971401E-02	0.4358997E 03	-0.6470466E 05	-0.5453217E 05	0.0	0.0
0.5359069E-01	0.0	0.1162926E 04	0.2233923E 04	-0.0	0.0
-0.2237506E-03	0.0	-0.2616445E 05	-0.2070030E 05	0.0	0.2390541E 05
0.0	0.0	-0.2867004E 05	-0.2551342E 05	0.0	0.2722930E 05

PROBLEM NUMBER 2

0.1803791E 00	0.1033496E 02	0.9999998E-02	0.1701700E-02	0.1010036E 02	25
-0.7598619E-03	-0.5874471E-03	0.0	-0.6090385E-04	-0.2179331E-04	0.0
0.0	0.4358997E 03	0.0	0.4358997E 03	0.0	0.0
0.1971401E-02	0.4358997E 03	-0.6470466E 05	-0.5453217E 05	0.0	0.0
0.5359069E-01	0.0	0.1162926E 04	0.2233923E 04	-0.0	0.0
-0.2237506E-03	0.0	-0.2616445E 05	-0.2070030E 05	0.0	0.2390541E 05
0.0	0.0	-0.2867004E 05	-0.2551342E 05	0.0	0.2722930E 05

PROBLEM NUMBER 1

0.1905887E 00	0.1091992E 02	0.9999998E-02	0.1701700E-02	0.1066529E 02	49
-0.7485747E-03	-0.5966956E-03	0.0	-0.6637437E-04	-0.2396441E-04	0.0
0.0	0.4778960E 03	0.0	0.4778960E 03	0.0	0.0
0.2177357E-02	0.4778960E 03	-0.6400866E 05	-0.5504775E 05	0.0	0.0
0.5343052E-01	0.0	0.1274694E 04	0.2436041E 04	-0.0	0.0
-0.2603012E-03	0.0	-0.2574912E 05	-0.2070104E 05	0.0	0.2363296E 05
0.0	0.0	-0.2849552E 05	-0.2594962E 05	0.0	0.2731171E 05

PROBLEM NUMBER 2

0.1905887E 00	0.1091992E 02	0.9999998E-02	0.1701700E-02	0.1066529E 02	49
-0.7485747E-03	-0.5966956E-03	0.0	-0.6637437E-04	-0.2396441E-04	0.0
0.0	0.4778960E 03	0.0	0.4778960E 03	0.0	0.0
0.2177357E-02	0.4778960E 03	-0.6400866E 05	-0.5504775E 05	0.0	0.0
0.5343052E-01	0.0	0.1274694E 04	0.2436041E 04	-0.0	0.0
-0.2603012E-03	0.0	-0.2574912E 05	-0.2070104E 05	0.0	0.2363296E 05
0.0	0.0	-0.2849552E 05	-0.2594962E 05	0.0	0.2731171E 05

PROBLEM NUMBER 1

0.2007982E 00	0.1150489E 02	0.9999998E-02	0.1701700E-02	0.1122912E 02	73
-0.7383619E-03	-0.6045522E-03	0.0	-0.7246222E-04	-0.2619492E-04	0.0
0.0	0.5171436E 03	0.0	0.5171436E 03	0.0	0.0
0.2376656E-02	0.5171436E 03	-0.6337134E 05	-0.5547656E 05	0.0	0.0
0.5324635E-01	0.0	0.1392720E 04	0.2659698E 04	-0.0	0.0
-0.3001771E-03	0.0	-0.2535193E 05	-0.2064179E 05	0.0	0.2335583E 05
0.0	0.0	-0.2835262E 05	-0.2637226E 05	0.0	0.2741613E 05

PROBLEM NUMBER 2

0.2007982E 00	0.1150489E 02	0.9999998E-02	0.1701700E-02	0.1122912E 02	73
-0.7383619E-03	-0.6045522E-03	0.0	-0.7246222E-04	-0.2619492E-04	0.0
0.0	0.5171436E 03	0.0	0.5171436E 03	0.0	0.0
0.2376656E-02	0.5171436E 03	-0.6337134E 05	-0.5547656E 05	0.0	0.0
0.5324635E-01	0.0	0.1392720E 04	0.2659698E 04	-0.0	0.0
-0.3001771E-03	0.0	-0.2535193E 05	-0.2064179E 05	0.0	0.2335583E 05
0.0	0.0	-0.2835262E 05	-0.2637226E 05	0.0	0.2741613E 05

PROBLEM NUMBER 1

0.2110078E 00	0.1208985E 02	0.9999998E-02	0.1701700E-02	0.1179177E 02	97
-0.7289334E-03	-0.6112792E-03	0.0	-0.7910283E-04	-0.2850215E-04	0.0
0.0	0.5535623E 03	0.0	0.5535623E 03	0.0	0.0
0.2569762E-02	0.5535623E 03	-0.6277520E 05	-0.5583359E 05	0.0	0.0
0.5303621E-01	0.0	0.1517157E 04	0.2902799E 04	-0.0	0.0
-0.3437146E-03	0.0	-0.2496527E 05	-0.2053119E 05	0.0	0.2307006E 05
0.0	0.0	-0.2823407E 05	-0.2678544E 05	0.0	0.2753834E 05

PROBLEM NUMBER 2

0.2110078E 00	0.1208985E 02	0.9999998E-02	0.1701700E-02	0.1179177E 02	97
-0.7289334E-03	-0.6112792E-03	0.0	-0.7910283E-04	-0.2850215E-04	0.0
0.0	0.5535623E 03	0.0	0.5535623E 03	0.0	0.0
0.2569762E-02	0.5535623E 03	-0.6277520E 05	-0.5583359E 05	0.0	0.0
0.5303621E-01	0.0	0.1517157E 04	0.2902799E 04	-0.0	0.0
-0.3437146E-03	0.0	-0.2496527E 05	-0.2053119E 05	0.0	0.2307006E 05
0.0	0.0	-0.2823407E 05	-0.2678544E 05	0.0	0.2753834E 05

PROBLEM NUMBER 1

0.2212173E 00	0.1267482E 02	0.9999998E-02	0.1701700E-02	0.1235320E 02	121
-0.7200551E-03	-0.6170792E-03	0.0	-0.8623587E-04	-0.3089725E-04	0.0
0.0	0.5870193E 03	0.0	0.5870193E 03	0.0	0.0
0.2756989E-02	0.5870193E 03	-0.6220597E 05	-0.5613039E 05	0.0	0.0
0.5279797E-01	0.0	0.1647974E 04	0.3163359E 04	-0.0	0.0
-0.3912135E-03	0.0	-0.2458315E 05	-0.2037626E 05	0.0	0.2277302E 05
0.0	0.0	-0.2813380E 05	-0.2719189E 05	0.0	0.2767486E 05

PROBLEM NUMBER 2

0.2212173E 00	0.1267482E 02	0.9999998E-02	0.1701700E-02	0.1235320E 02	121
-0.7200551E-03	-0.6170792E-03	0.0	-0.8623587E-04	-0.3089725E-04	0.0
0.0	0.5870193E 03	0.0	0.5870193E 03	0.0	0.0
0.2756989E-02	0.5870193E 03	-0.6220597E 05	-0.5613039E 05	0.0	0.0
0.5279797E-01	0.0	0.1647974E 04	0.3163359E 04	-0.0	0.0
-0.3912135E-03	0.0	-0.2458315E 05	-0.2037626E 05	0.0	0.2277302E 05
0.0	0.0	-0.2813380E 05	-0.2719189E 05	0.0	0.2767486E 05

PROBLEM NUMBER 1

0.2314269E 00	0.1325978E 02	0.9999998E-02	0.1701700E-02	0.1291333E 02	145
-0.7115349E-03	-0.6221118E-03	0.0	-0.9380330E-04	-0.3338652E-04	0.0
0.0	0.6173330E 03	0.0	0.6173330E 03	0.0	0.0
0.2938524E-02	0.6173330E 03	-0.6165182E 05	-0.5637587E 05	0.0	0.0
0.5252935E-01	0.0	0.1784988E 04	0.3439433E 04	-0.0	0.0
-0.4429403E-03	0.0	-0.2420074E 05	-0.2018287E 05	0.0	0.2246293E 05
0.0	0.0	-0.2804659E 05	-0.2759332E 05	0.0	0.2782272E 05

PROBLEM NUMBER 2

0.2314269E 00	0.1325978E 02	0.9999998E-02	0.1701700E-02	0.1291333E 02	145
-0.7115349E-03	-0.6221118E-03	0.0	-0.9380330E-04	-0.3338652E-04	0.0
0.0	0.6173330E 03	0.0	0.6173330E 03	0.0	0.0
0.2938524E-02	0.6173330E 03	-0.6165182E 05	-0.5637587E 05	0.0	0.0
0.5252935E-01	0.0	0.1784988E 04	0.3439433E 04	-0.0	0.0
-0.4429403E-03	0.0	-0.2420074E 05	-0.2018287E 05	0.0	0.2246293E 05
0.0	0.0	-0.2804659E 05	-0.2759332E 05	0.0	0.2782272E 05

PROBLEM NUMBER 1

0.2416365E 00	0.1384475E 02	0.9999998E-02	0.1701700E-02	0.1347212E 02	169
-0.7032102E-03	-0.6265042E-03	0.0	-0.1017473E-03	-0.3597260E-04	0.0
0.0	0.6442771E 03	0.0	0.6442771E 03	0.0	0.0
0.3114448E-02	0.6442771E 03	-0.6110268E 05	-0.5657702E 05	0.0	0.0
0.5222790E-01	0.0	0.1927892E 04	0.3729057E 04	-0.0	0.0
-0.4991284E-03	0.0	-0.2381410E 05	-0.1995609E 05	0.0	0.2213867E 05
0.0	0.0	-0.2796786E 05	-0.2799056E 05	0.0	0.2797921E 05

PROBLEM NUMBER 2

0.2416365E 00	0.1384475E 02	0.9999998E-02	0.1701700E-02	0.1347212E 02	169
-0.7032102E-03	-0.6265042E-03	0.0	-0.1017473E-03	-0.3597260E-04	0.0
0.0	0.6442771E 03	0.0	0.6442771E 03	0.0	0.0
0.3114448E-02	0.6442771E 03	-0.6110268E 05	-0.5657702E 05	0.0	0.0
0.5222790E-01	0.0	0.1927892E 04	0.3729057E 04	-0.0	0.0
-0.4991284E-03	0.0	-0.2381410E 05	-0.1995609E 05	0.0	0.2213867E 05
0.0	0.0	-0.2796786E 05	-0.2799056E 05	0.0	0.2797921E 05

PROBLEM NUMBER 1

0.2518460E 00	0.1442971E 02	0.9999998E-02	0.1701700E-02	0.1402951E 02	193
-0.6949422E-03	-0.6303582E-03	0.0	-0.1100087E-03	-0.3865504E-04	0.0
0.0	0.6675830E 03	0.0	0.6675830E 03	0.0	0.0
0.3284749E-02	0.6675830E 03	-0.6054977E 05	-0.5673931E 05	0.0	0.0
0.5189105E-01	0.0	0.2076269E 04	0.4030207E 04	-0.0	0.0
-0.5599768E-03	0.0	-0.2341997E 05	-0.1970044E 05	0.0	0.2179950E 05
0.0	0.0	-0.2789341E 05	-0.2838375E 05	0.0	0.2814178E 05

PROBLEM NUMBER 2

0.2518460E 00	0.1442971E 02	0.9999998E-02	0.1701700E-02	0.1402951E 02	193
-0.6949422E-03	-0.6303582E-03	0.0	-0.1100087E-03	-0.3865504E-04	0.0
0.0	0.6675830E 03	0.0	0.6675830E 03	0.0	0.0
0.3284749E-02	0.6675830E 03	-0.6054977E 05	-0.5673931E 05	0.0	0.0
0.5189105E-01	0.0	0.2076269E 04	0.4030207E 04	-0.0	0.0
-0.5599768E-03	0.0	-0.2341997E 05	-0.1970044E 05	0.0	0.2179950E 05
0.0	0.0	-0.2789341E 05	-0.2838375E 05	0.0	0.2814178E 05

PROBLEM NUMBER 1

0.2620556E 00	0.1501468E 02	0.9999998E-02	0.1701700E-02	0.1458543E 02	217
-0.6866104E-03	-0.6337571E-03	0.0	-0.1185261E-03	-0.4143106E-04	0.0
0.0	0.6869404E 03	0.0	0.6869404E 03	0.0	0.0
0.3449338E-02	0.6869404E 03	-0.5998542E 05	-0.5686707E 05	0.0	0.0
0.5151613E-01	0.0	0.2229601E 04	0.4340758E 04	-0.0	0.0
-0.6256509E-03	0.0	-0.2301566E 05	-0.1942002E 05	0.0	0.2144512E 05
0.0	0.0	-0.2781946E 05	-0.2877243E 05	0.0	0.2830798E 05

PROBLEM NUMBER 2

0.2620556E 00	0.1501468E 02	0.9999998E-02	0.1701700E-02	0.1458543E 02	217

0.6866104E-03	-0.6337571E-03	0.0	-0.1185261E-03	-0.4143106E-04	0.0
0.0	0.6869404E 03	0.0	0.6869404E 03	0.0	0.0
0.3449338E-02	0.6869404E 03	-0.5998542E 05	-0.5686707E 05	0.0	0.0
0.5151613E-01	0.0	0.2229601E 04	0.4340758E 04	-0.0	0.0
-0.6256509E-03	0.0	-0.2301566E 05	-0.1942002E 05	0.0	0.2144512E 05
0.0	0.0	-0.2781946E 05	-0.2877243E 05	0.0	0.2830798E 05

PROBLEM NUMBER 1

0.2722651E 00	0.1559964E 02	0.9999998E-02	0.1701700E-02	0.1513984E 02	241
-0.6781071E-03	-0.6367678E-03	0.0	-0.1272344E-03	-0.4429572E-04	0.0
0.0	0.7020000E 03	0.0	0.7020000E 03	0.0	0.0
0.3608054E-02	0.7020000E 03	-0.5940274E 05	-0.5696370E 05	0.0	0.0
0.5110039E-01	0.0	0.2387275E 04	0.4658453E 04	-0.0	0.0
-0.6962789E-03	0.0	-0.2259890E 05	-0.1911872E 05	0.0	0.2107543E 05
0.0	0.0	-0.2774242E 05	-0.2915563E 05	0.0	0.2847533E 05

PROBLEM NUMBER 2

0.2722651E 00	0.1559964E 02	0.9999998E-02	0.1701700E-02	0.1513984E 02	241
-0.6781071E-03	-0.6367678E-03	0.0	-0.1272344E-03	-0.4429572E-04	0.0
0.0	0.7020000E 03	0.0	0.7020000E 03	0.0	0.0
0.3608054E-02	0.7020000E 03	-0.5940274E 05	-0.5696370E 05	0.0	0.0
0.5110039E-01	0.0	0.2387275E 04	0.4658453E 04	-0.0	0.0
-0.6962789E-03	0.0	-0.2259890E 05	-0.1911872E 05	0.0	0.2107543E 05
0.0	0.0	-0.2774242E 05	-0.2915563E 05	0.0	0.2847533E 05

PROBLEM NUMBER 1

0.2824747E 00	0.1618460E 02	0.9999998E-02	0.1701700E-02	0.1569267E 02	265
-0.6693371E-03	-0.6394470E-03	0.0	-0.1360644E-03	-0.4724227E-04	0.0
0.0	0.7123735E 03	0.0	0.7123735E 03	0.0	0.0
0.3760671E-02	0.7123735E 03	-0.5879544E 05	-0.5703192E 05	0.0	0.0
0.5064102E-01	0.0	0.2548584E 04	0.4980875E 04	-0.0	0.0
-0.7719514E-03	0.0	-0.2216780E 05	-0.1880029E 05	0.0	0.2069060E 05
0.0	0.0	-0.2765886E 05	-0.2953187E 05	0.0	0.2864133E 05

PROBLEM NUMBER 2

0.2824747E 00	0.1618460E 02	0.9999998E-02	0.1701700E-02	0.1569267E 02	265
-0.6693371E-03	-0.6394470E-03	0.0	-0.1360644E-03	-0.4724227E-04	0.0
0.0	0.7123735E 03	0.0	0.7123735E 03	0.0	0.0
0.3760671E-02	0.7123735E 03	-0.5879544E 05	-0.5703192E 05	0.0	0.0
0.5064102E-01	0.0	0.2548584E 04	0.4980875E 04	-0.0	0.0
-0.7719514E-03	0.0	-0.2216780E 05	-0.1880029E 05	0.0	0.2069060E 05
0.0	0.0	-0.2765886E 05	-0.2953187E 05	0.0	0.2864133E 05

PROBLEM NUMBER 1

0.2926843E 00	0.1676956E 02	0.9999998E-02	0.1701700E-02	0.1624385E 02	289
-0.6602129E-03	-0.6418407E-03	0.0	-0.1449415E-03	-0.5026229E-04	0.0

0.0	0.7176355E 03	0.0	0.7176355E 03	0.0	0.0
0.3906906E-02	0.7176355E 03	-0.5815783E 05	-0.5707386E 05	0.0	0.0
0.5013516E-01	0.0	0.2712731E 04	0.5305410E 04	-0.0	0.0
-0.8527169E-03	0.0	-0.2172079E 05	-0.1846845E 05	0.0	0.2029105E 05
0.0	0.0	-0.2756552E 05	-0.2989926E 05	0.0	0.2880339E 05

PROBLEM NUMBER 2

0.2926843E 00	0.1676956E 02	0.9999998E-02	0.1701700E-02	0.1624385E 02	289
-0.6602129E-03	-0.6418407E-03	0.0	-0.1449415E-03	-0.5026229E-04	0.0
0.0	0.7176355E 03	0.0	0.7176355E 03	0.0	0.0
0.3906906E-02	0.7176355E 03	-0.5815783E 05	-0.5707386E 05	0.0	0.0
0.5013516E-01	0.0	0.2712731E 04	0.5305410E 04	-0.0	0.0
-0.8527169E-03	0.0	-0.2172079E 05	-0.1846845E 05	0.0	0.2029105E 05
0.0	0.0	-0.2756552E 05	-0.2989926E 05	0.0	0.2880339E 05

PROBLEM NUMBER 1

0.3028938E 00	0.1735452E 02	0.9999998E-02	0.1701700E-02	0.1679335E 02	313
-0.6506534E-03	-0.6439879E-03	0.0	-0.1537853E-03	-0.5334568E-04	0.0
0.0	0.7173230E 03	0.0	0.7173230E 03	0.0	0.0
0.4046425E-02	0.7173230E 03	-0.5748449E 05	-0.5709121E 05	0.0	0.0
0.4957994E-01	0.0	0.2878820E 04	0.5629242E 04	-0.0	0.0
-0.9385797E-03	0.0	-0.2125655E 05	-0.1812694E 05	0.0	0.1987739E 05
0.0	0.0	-0.2745914E 05	-0.3025547E 05	0.0	0.2895873E 05

PROBLEM NUMBER 2

0.3028938E 00	0.1735452E 02	0.9999998E-02	0.1701700E-02	0.1679335E 02	313
-0.6506534E-03	-0.6439879E-03	0.0	-0.1537853E-03	-0.5334568E-04	0.0
0.0	0.7173230E 03	0.0	0.7173230E 03	0.0	0.0
0.4046425E-02	0.7173230E 03	-0.5748449E 05	-0.5709121E 05	0.0	0.0
0.4957994E-01	0.0	0.2878820E 04	0.5629242E 04	-0.0	0.0
-0.9385797E-03	0.0	-0.2125655E 05	-0.1812694E 05	0.0	0.1987739E 05
0.0	0.0	-0.2745914E 05	-0.3025547E 05	0.0	0.2895873E 05

PROBLEM NUMBER 1

0.3131034E 00	0.1793950E 02	0.9999998E-02	0.1701700E-02	0.1734109E 02	337
-0.6405867E-03	-0.6459209E-03	0.0	-0.1625089E-03	-0.5648111E-04	0.0
0.0	0.7109370E 03	0.0	0.7109370E 03	0.0	0.0
0.4178841E-02	0.7109370E 03	-0.5677058E 05	-0.5708530E 05	0.0	0.0
0.4897253E-01	0.0	0.3045865E 04	0.5949312E 04	-0.0	0.0
-0.1029496E-02	0.0	-0.2077410E 05	-0.1777963E 05	0.0	0.1945051E 05
0.0	0.0	-0.2733659E 05	-0.3059777E 05	0.0	0.2910453E 05

PROBLEM NUMBER 2

0.3131034E 00	0.1793950E 02	0.9999998E-02	0.1701700E-02	0.1734109E 02	337
-0.6405867E-03	-0.6459209E-03	0.0	-0.1625089E-03	-0.5648111E-04	0.0
0.0	0.7109370E 03	0.0	0.7109370E 03	0.0	0.0

0.4178641E-02	0.7109370E 03	-0.5677058E 05	-0.5708530E 05	0.0	0.0
0.4897253E-01	0.0	0.3045865E 04	0.5949312E 04	-0.0	0.0
-0.1029496E-02	0.0	-0.2077410E 05	-0.1777963E 05	0.0	0.1945051E 05
0.0	0.0	-0.2733659E 05	-0.3059777E 05	0.0	0.2910453E 05

PROBLEM NUMBER 1

0.3233129E 00	0.1852446E 02	0.9999998E-02	0.1701700E-02	0.1788704E 02	361
-0.6299445E-03	-0.6476676E-03	0.0	-0.1710178E-03	-0.5965559E-04	0.0
0.0	0.6979443E 03	0.0	0.6979443E 03	0.0	0.0
0.4303716E-02	0.6979443E 03	-0.5601148E 05	-0.5705715E 05	0.0	0.0
0.4831010E-01	0.0	0.3212779E 04	0.6262301E 04	-0.0	0.0
-0.1125370E-02	0.0	-0.2027263E 05	-0.1743052E 05	0.0	0.1901158E 05
0.0	0.0	-0.2719475E 05	-0.3092302E 05	0.0	0.2923770E 05

PROBLEM NUMBER 2

0.3233129E 00	0.1852446E 02	0.9999998E-02	0.1701700E-02	0.1788704E 02	361
-0.6299445E-03	-0.6476676E-03	0.0	-0.1710178E-03	-0.5965559E-04	0.0
0.0	0.6979443E 03	0.0	0.6979443E 03	0.0	0.0
0.4303716E-02	0.6979443E 03	-0.5601148E 05	-0.5705715E 05	0.0	0.0
0.4831010E-01	0.0	0.3212779E 04	0.6262301E 04	-0.0	0.0
-0.1125370E-02	0.0	-0.2027263E 05	-0.1743052E 05	0.0	0.1901158E 05
0.0	0.0	-0.2719475E 05	-0.3092302E 05	0.0	0.2923770E 05

PROBLEM NUMBER 1

0.3335225E 00	0.1910942E 02	0.9999998E-02	0.1701700E-02	0.1843111E 02	385
-0.6186657E-03	-0.6492510E-03	0.0	-0.1792099E-03	-0.6285500E-04	0.0
0.0	0.6777783E 03	0.0	0.6777783E 03	0.0	0.0
0.4420582E-02	0.6777783E 03	-0.5520302E 05	-0.5700755E 05	0.0	0.0
0.4758995E-01	0.0	0.3378377E 04	0.6564621E 04	-0.0	0.0
-0.1226049E-02	0.0	-0.1975167E 05	-0.1708383E 05	0.0	0.1856210E 05
0.0	0.0	-0.2703057E 05	-0.3122768E 05	0.0	0.2935503E 05

PROBLEM NUMBER 2

0.3335225E 00	0.1910942E 02	0.9999998E-02	0.1701700E-02	0.1843111E 02	385
-0.6186657E-03	-0.6492510E-03	0.0	-0.1792099E-03	-0.6285500E-04	0.0
0.0	0.6777783E 03	0.0	0.6777783E 03	0.0	0.0
0.4420582E-02	0.6777783E 03	-0.5520302E 05	-0.5700755E 05	0.0	0.0
0.4758995E-01	0.0	0.3378377E 04	0.6564621E 04	-0.0	0.0
-0.1226049E-02	0.0	-0.1975167E 05	-0.1708383E 05	0.0	0.1856210E 05
0.0	0.0	-0.2703057E 05	-0.3122768E 05	0.0	0.2935503E 05

PROBLEM NUMBER 1

0.3403289E 00	0.1949940E 02	0.9999998E-02	0.1701700E-02	0.1879277E 02	401
-0.6107634E-03	-0.6502257E-03	0.0	-0.1844412E-03	-0.6499403E-04	0.0
0.0	0.6600549E 03	0.0	0.6600549E 03	0.0	0.0
0.4493788E-02	0.6600549E 03	-0.5463461E 05	-0.5696289E 05	0.0	0.0

0.4707647E-01	0.0	0.3487409E 04	0.6758328E 04	-0.0	0.0
-0.1295735E-02	0.0	-0.1939336E 05	-0.1685622E 05	0.0	0.1825748E 05
0.0	0.0	-0.2690718E 05	-0.3141743E 05	0.0	0.2942272E 05

PROBLEM NUMBER 2

0.3403289E 00	0.1949940E 02	0.9999998E-02	0.1701700E-02	0.1879277E 02	401
-0.6107634E-03	-0.6502257E-03	0.0	-0.1844412E-03	-0.6499403E-04	0.0
0.0	0.6600549E 03	0.0	0.6600549E 03	0.0	0.0
0.4493788E-02	0.6600549E 03	-0.5463461E 05	-0.5696289E 05	0.0	0.0
0.4707647E-01	0.0	0.3487409E 04	0.6758328E 04	-0.0	0.0
-0.1295735E-02	0.0	-0.1939336E 05	-0.1685622E 05	0.0	0.1825748E 05
0.0	0.0	-0.2690718E 05	-0.3141743E 05	0.0	0.2942272E 05

```
                                        REGION NUMBER  2

                          THERE ARE  2 SEGMENTS AND  0 KINEMATIC LINKS WITHIN THIS REGION

            SEGMENT NUMBER  1      SEGMENT CODE 11       FIRST  PART OF REG. NO. 2

                                   TABLE ORDER PHI OR S VS. CROSSECTION PROPERTIES
  0.34C3390E 0C    0.5105088E 00
  0.2360000E 01    0.2360000E 01

                 PROBLEM  1      TABLE ORDER  PHI OR S VS. DISTRIBUTED LOADS (F THETA, F PHI, F ZETA, M THETA, M PHI)
LOAD ICENTIFICATION CLUES C00100

  0.20CCC00E C4    0.2CC00C0E 04

                 PROBLEM  2      TABLE ORDER  PHI OR S VS. DISTRIBUTED LOADS (F THETA, F PHI, F ZETA, M THETA, M PHI)
LCAD ICENTIFICATION CLUES 000100

  C.2CCC000E C4    0.2C00000E C4
```

PHI (RAD. OR IN.)	DEGREES	PRINT INTERVAL	STEP	R ZERO	NUMBER OF CYCLES
EPSILON THETA	EPSILON PHI	GAMMA PHI THETA	K PHI	K THETA	N TEMPERATURE THETA
U	Q PHI	K PHI THETA	J PHI STAR	T PHI THETA	N TEMPERATURE PHI
V	J PHI	N THETA	N PHI	N PHI THETA	M TEMPERATURE THETA
W	Q THETA	M THETA	M PHI	M PHI THETA	M TEMPERATURE PHI
OMEGA THETA	TAU ZETA PHI = Q/T	SIGMA THETA IN	SIGMA PHI IN	TAU PHI THETA IN	SIGMA F IN
OMEGA PHI	TAU ZETA THETA = Q/T	SIGMA THETA OUT	SIGMA PHI OUT	TAU PHI THETA OUT	SIGMA F OUT

PROBLEM NUMBER 1

0.3403391E 00	0.1949998E 02	0.9999998E-02	0.1701700E-02	0.1879330E 02	1
-0.6107721E-03	-0.6502029E-03	0.0	-0.1844276E-03	-0.6499077E-04	0.0
0.0	0.6601289E 03	0.0	0.6601289E 03	0.0	0.0
0.4493780E-02	0.6601289E 03	-0.5463491E 05	-0.5696132E 05	0.0	0.0
0.4707650E-01	0.0	0.3487203E 04	0.6757844E 04	-0.0	0.0
-0.1295712E-02	0.0	-0.1939371E 05	-0.1685609E 05	0.0	0.1825764E 05
0.0	0.0	-0.2690708E 05	-0.3141624E 05	0.0	0.2942196E 05

PROBLEM NUMBER 2

0.3403391E 00	0.1949998E 02	0.9999998E-02	0.1701700E-02	0.1879330E 02	1
-0.6107721E-03	-0.6502029E-03	0.0	-0.1844276E-03	-0.6499077E-04	0.0
0.0	0.6601289E 03	0.0	0.6601289E 03	0.0	0.0
0.4493780E-02	0.6601289E 03	-0.5463491E 05	-0.5696132E 05	0.0	0.0
0.4707650E-01	0.0	0.3487203E 04	0.6757844E 04	-0.0	0.0
-0.1295712E-02	0.0	-0.1939371E 05	-0.1685609E 05	0.0	0.1825764E 05
0.0	0.0	-0.2690708E 05	-0.3141624E 05	0.0	0.2942196E 05

PROBLEM NUMBER 1

0.3505487E 00	0.2008495E 02	0.9999998E-02	0.1701700E-02	0.1933415E 02	25
-0.5983058E-03	-0.6515570E-03	0.0	-0.1918435E-03	-0.6819575E-04	0.0
0.0	0.6266482E 03	0.0	0.6266482E 03	0.0	0.0
0.4596140E-02	0.6266482E 03	-0.5373548E 05	-0.5687731E 05	0.0	0.0
0.4625438E-01	0.0	0.3647677E 04	0.7033625E 04	-0.0	0.0
-0.1403885E-02	0.0	-0.1883972E 05	-0.1652339E 05	0.0	0.1779497E 05
0.0	0.0	-0.2669884E 05	-0.3167775E 05	0.0	0.2950506E 05

PROBLEM NUMBER 2

0.3505487E 00	0.2008495E 02	0.9999998E-02	0.1701700E-02	0.1933415E 02	25
-0.5983058E-03	-0.6515570E-03	0.0	-0.1918435E-03	-0.6819575E-04	0.0
0.0	0.6266482E 03	0.0	0.6266482E 03	0.0	0.0
0.4596140E-02	0.6266482E 03	-0.5373548E 05	-0.5687731E 05	0.0	0.0
0.4625438E-01	0.0	0.3647677E 04	0.7033625E 04	-0.0	0.0
-0.1403885E-02	0.0	-0.1883972E 05	-0.1652339E 05	0.0	0.1779497E 05
0.0	0.0	-0.2669884E 05	-0.3167775E 05	0.0	0.2950506E 05

PROBLEM NUMBER 1

0.3607582E 00	0.2066992E 02	0.9999998E-02	0.1701700E-02	0.1987297E 02	49
-0.5850620E-03	-0.6527936E-03	0.0	-0.1986277E-03	-0.7138093E-04	0.0
0.0	0.5843342E 03	0.0	0.5843342E 03	0.0	0.0
0.4689042E-02	0.5843342E 03	-0.5277700E 05	-0.5677317E 05	0.0	0.0
0.4536789E-01	0.0	0.3803150E 04	0.7287656E 04	-0.0	0.0
-0.1516147E-02	0.0	-0.1826610E 05	-0.1620560E 05	0.0	0.1732797E 05
0.0	0.0	-0.2646019E 05	-0.3190728E 05	0.0	0.2956253E 05

PROBLEM NUMBER 2

0.3607582E 00	0.2066992E 02	0.9999998E-02	0.1701700E-02	0.1987297E 02	49
-0.5850620E-03	-0.6527936E-03	0.0	-0.1986277E-03	-0.7138093E-04	0.0
0.0	0.5843342E 03	0.0	0.5843342E 03	0.0	0.0
0.4689042E-02	0.5843342E 03	-0.5277700E 05	-0.5677317E 05	0.0	0.0
0.4536789E-01	0.0	0.3803150E 04	0.7287656E 04	-0.0	0.0
-0.1516147E-02	0.0	-0.1826610E 05	-0.1620560E 05	0.0	0.1732797E 05
0.0	0.0	-0.2646019E 05	-0.3190728E 05	0.0	0.2956253E 05

PROBLEM NUMBER 1

0.3709678E 00	0.2125488E 02	0.9999998E-02	0.1701700E-02	0.2040973E 02	73
-0.5709974E-03	-0.6539251E-03	0.0	-0.2046451E-03	-0.7452691E-04	0.0
0.0	0.5325142E 03	0.0	0.5325142E 03	0.0	0.0
0.4771870E-02	0.5325142E 03	-0.5175642E 05	-0.5664916E 05	0.0	0.0
0.4441489E-01	0.0	0.3952031E 04	0.7515168E 04	-0.0	0.0
-0.1632094E-02	0.0	-0.1767327E 05	-0.1590796E 05	0.0	0.1686006E 05
0.0	0.0	-0.2618813E 05	-0.3209982E 05	0.0	0.2959024E 05

PROBLEM NUMBER 2

0.3709678E 00	0.2125488E 02	0.9999998E-02	0.1701700E-02	0.2040973E 02	73
-0.5709974E-03	-0.6539251E-03	0.0	-0.2046451E-03	-0.7452691E-04	0.0
0.0	0.5325142E 03	0.0	0.5325142E 03	0.0	0.0
0.4771870E-02	0.5325142E 03	-0.5175642E 05	-0.5664916E 05	0.0	0.0
0.4441489E-01	0.0	0.3952031E 04	0.7515168E 04	-0.0	0.0
-0.1632094E-02	0.0	-0.1767327E 05	-0.1590796E 05	0.0	0.1686006E 05
0.0	0.0	-0.2618813E 05	-0.3209982E 05	0.0	0.2959024E 05

PROBLEM NUMBER 1

0.3811774E 00	0.2183984E 02	0.9999998E-02	0.1701700E-02	0.2094435E 02	97
-0.5560752E-03	-0.6549614E-03	0.0	-0.2097504E-03	-0.7761300E-04	0.0
0.0	0.4704927E 03	0.0	0.4704927E 03	0.0	0.0
0.4843999E-02	0.4704927E 03	-0.5067120E 05	-0.5650550E 05	0.0	0.0
0.4339350E-01	0.0	0.4092618E 04	0.7711047E 04	-0.0	0.0
-0.1751246E-02	0.0	-0.1706197E 05	-0.1563607E 05	0.0	0.1639558E 05
0.0	0.0	-0.2587975E 05	-0.3224997E 05	0.0	0.2958379E 05

PROBLEM NUMBER 2

0.3811774E 00	0.2183984E 02	0.9999998E-02	0.1701700E-02	0.2094435E 02	97
-0.5560752E-03	-0.6549614E-03	0.0	-0.2097504E-03	-0.7761300E-04	0.0
0.0	0.4704927E 03	0.0	0.4704927E 03	0.0	0.0
0.4843999E-02	0.4704927E 03	-0.5067120E 05	-0.5650550E 05	0.0	0.0
0.4339350E-01	0.0	0.4092618E 04	0.7711047E 04	-0.0	0.0
-0.1751246E-02	0.0	-0.1706197E 05	-0.1563607E 05	0.0	0.1639558E 05
0.0	0.0	-0.2587975E 05	-0.3224997E 05	0.0	0.2958379E 05

PROBLEM NUMBER 1

0.3913869E 00	0.2242480E 02	0.9999998E-02	0.1701700E-02	0.2147679E 02	121
-0.5402649E-03	-0.6559112E-03	0.0	-0.2137882E-03	-0.8061704E-04	0.0
0.0	0.3975559E 03	0.0	0.3975559E 03	0.0	0.0
0.4904773E-02	0.3975559E 03	-0.4951920E 05	-0.5634233E 05	0.0	0.0
0.4230215E-01	0.0	0.4223086E 04	0.7869824E 04	-0.0	0.0
-0.1873033E-02	0.0	-0.1643329E 05	-0.1539589E 05	0.0	0.1593991E 05
0.0	0.0	-0.2553216E 05	-0.3235187E 05	0.0	0.2953848E 05

PROBLEM NUMBER 2

0.3913869E 00	0.2242480E 02	0.9999998E-02	0.1701700E-02	0.2147679E 02	121
-0.5402649E-03	-0.6559112E-03	0.0	-0.2137882E-03	-0.8061704E-04	0.0
0.0	0.3975559E 03	0.0	0.3975559E 03	0.0	0.0
0.4904773E-02	0.3975559E 03	-0.4951920E 05	-0.5634233E 05	0.0	0.0
0.4230215E-01	0.0	0.4223086E 04	0.7869824E 04	-0.0	0.0
-0.1873033E-02	0.0	-0.1643329E 05	-0.1539589E 05	0.0	0.1593991E 05
0.0	0.0	-0.2553216E 05	-0.3235187E 05	0.0	0.2953848E 05

PROBLEM NUMBER 1

0.4015965E 00	0.2300978E 02	0.9999998E-02	0.1701700E-02	0.2200700E 02	145
-0.5235421E-03	-0.6567806E-03	0.0	-0.2165920E-03	-0.8351548E-04	0.0
0.0	0.3129739E 03	0.0	0.3129739E 03	0.0	0.0
0.4953519E-02	0.3129739E 03	-0.4829872E 05	-0.5615979E 05	0.0	0.0
0.4113964E-01	0.0	0.4341492E 04	0.7985641E 04	-0.0	0.0
-0.1996794E-02	0.0	-0.1578857E 05	-0.1519377E 05	0.0	0.1549973E 05
0.0	0.0	-0.2514256E 05	-0.3239929E 05	0.0	0.2944930E 05

PROBLEM NUMBER 2

0.4015965E 00	0.2300978E 02	0.9999998E-02	0.1701700E-02	0.2200700E 02	145
-0.5235421E-03	-0.6567806E-03	0.0	-0.2165920E-03	-0.8351548E-04	0.0
0.0	0.3129739E 03	0.0	0.3129739E 03	0.0	0.0
0.4953519E-02	0.3129739E 03	-0.4829872E 05	-0.5615979E 05	0.0	0.0
0.4113964E-01	0.0	0.4341492E 04	0.7985641E 04	-0.0	0.0
-0.1996794E-02	0.0	-0.1578857E 05	-0.1519377E 05	0.0	0.1549973E 05
0.0	0.0	-0.2514256E 05	-0.3239929E 05	0.0	0.2944930E 05

PROBLEM NUMBER 1

0.4118060E 00	0.2359474E 02	0.9999998E-02	0.1701700E-02	0.2253491E 02	169
-0.5058914E-03	-0.6575743E-03	0.0	-0.2179849E-03	-0.8628343E-04	0.0
0.0	0.2160075E 03	0.0	0.2160075E 03	0.0	0.0
0.4989550E-02	0.2160075E 03	-0.4700868E 05	-0.5595798E 05	0.0	0.0
0.3990516E-01	0.0	0.4445777E 04	0.8052270E 04	-0.0	0.0
-0.2121771E-02	0.0	-0.1512961E 05	-0.1503648E 05	0.0	0.1508326E 05
0.0	0.0	-0.2470828E 05	-0.3238556E 05	0.0	0.2931095E 05

PROBLEM NUMBER 2

0.4118060E 00	0.2359474E 02	0.9999998E-02	0.1701700E-02	0.2253491E 02	169
-0.5058914E-03	-0.6575743E-03	0.0	-0.2179849E-03	-0.8628343E-04	0.0
0.0	0.2160075E 03	0.0	0.2160075E 03	0.0	0.0
0.4989550E-02	0.2160075E 03	-0.4700868E 05	-0.5595798E 05	0.0	0.0
0.3990516E-01	0.0	0.4445777E 04	0.8052270E 04	-0.0	0.0
-0.2121771E-02	0.0	-0.1512961E 05	-0.1503648E 05	0.0	0.1508326E 05
0.0	0.0	-0.2470828E 05	-0.3238556E 05	0.0	0.2931095E 05

PROBLEM NUMBER 1

0.4220156E 00	0.2417970E 02	0.9999998E-02	0.1701700E-02	0.2306047E 02	193
-0.4873045E-03	-0.6582956E-03	0.0	-0.2177790E-03	-0.8889451E-04	0.0
0.0	0.1059111E 03	0.0	0.1059111E 03	0.0	0.0
0.5012173E-02	0.1059111E 03	-0.4564854E 05	-0.5573702E 05	0.0	0.0
0.3859840E-01	0.0	0.4533742E 04	0.8063098E 04	-0.0	0.0
-0.2247098E-02	0.0	-0.1445851E 05	-0.1493119E 05	0.0	0.1470055E 05
0.0	0.0	-0.2422671E 05	-0.3230360E 05	0.0	0.2911779E 05

PROBLEM NUMBER 2

0.4220156E 00	0.2417970E 02	0.9999998E-02	0.1701700E-02	0.2306047E 02	193
-0.4873045E-03	-0.6582956E-03	0.0	-0.2177790E-03	-0.8889451E-04	0.0
0.0	0.1059111E 03	0.0	0.1059111E 03	0.0	0.0
0.5012173E-02	0.1059111E 03	-0.4564854E 05	-0.5573702E 05	0.0	0.0
0.3859840E-01	0.0	0.4533742E 04	0.8063098E 04	-0.0	0.0
-0.2247098E-02	0.0	-0.1445851E 05	-0.1493119E 05	0.0	0.1470055E 05
0.0	0.0	-0.2422671E 05	-0.3230360E 05	0.0	0.2911779E 05

PROBLEM NUMBER 1

0.4322252E 00	0.2476466E 02	0.9999998E-02	0.1701700E-02	0.2358362E 02	217
-0.4677831E-03	-0.6589456E-03	0.0	-0.2157752E-03	-0.9132098E-04	0.0
0.0	-0.1805894E 02	0.0	-0.1805894E 02	0.0	0.0
0.5020693E-02	-0.1805894E 02	-0.4421843E 05	-0.5549704E 05	0.0	0.0
0.3721956E-01	0.0	0.4603082E 04	0.8011117E 04	-0.0	0.0
-0.2371800E-02	0.0	-0.1377784E 05	-0.1468550E 05	0.0	0.1436373E 05
0.0	0.0	-0.2369543E 05	-0.3214591E 05	0.0	0.2886385E 05

PROBLEM NUMBER 2

0.4322252E 00	0.2476466E 02	0.9999998E-02	0.1701700E-02	0.2358362E 02	217

-0.4677831E-03	-0.6589456E-03	0.0	-0.2157752E-03	-0.9132096E-04	0.0
0.0	-0.1805894E 02	0.0	-0.1805894E 02	0.0	0.0
0.5020693E-02	-0.1805894E 02	-0.4421843E 05	-0.5549704E 05	0.0	0.0
0.3721956E-01	0.0	0.4603082E 04	0.8011117E 04	-0.0	0.0
-0.2371800E-02	0.0	-0.1377784E 05	-0.1488550E 05	0.0	0.1436373E 05
0.0	0.0	-0.2369543E 05	-0.3214591E 05	0.0	0.2886385E 05

PROBLEM NUMBER 1

0.4424347E 00	0.2534964E 02	0.9999998E-02	0.1701700E-02	0.2410432E 02	241
-0.4473382E-03	-0.6595249E-03	0.0	-0.2117637E-03	-0.9353364E-04	0.0
0.0	-0.1566393E 03	0.0	-0.1566393E 03	0.0	0.0
0.5014416E-02	-0.1566393E 03	-0.4271917E 05	-0.5523820E 05	0.0	0.0
0.3576947E-01	0.0	0.4651359E 04	0.7888953E 04	-0.0	0.0
-0.2494783E-02	0.0	-0.1309055E 05	-0.1490743E 05	0.0	0.1408713E 05
0.0	0.0	-0.2311216E 05	-0.3190463E 05	0.0	0.2854281E 05

PROBLEM NUMBER 2

0.4424347E 00	0.2534964E 02	0.9999998E-02	0.1701700E-02	0.2410432E 02	241
-0.4473382E-03	-0.6595249E-03	0.0	-0.2117637E-03	-0.9353364E-04	0.0
0.0	-0.1566393E 03	0.0	-0.1566393E 03	0.0	0.0
0.5014416E-02	-0.1566393E 03	-0.4271917E 05	-0.5523820E 05	0.0	0.0
0.3576947E-01	0.0	0.4651359E 04	0.7888953E 04	-0.0	0.0
-0.2494783E-02	0.0	-0.1309055E 05	-0.1490743E 05	0.0	0.1408713E 05
0.0	0.0	-0.2311216E 05	-0.3190463E 05	0.0	0.2854281E 05

PROBLEM NUMBER 1

0.4526443E 00	0.2593460E 02	0.9999998E-02	0.1701700E-02	0.2462251E 02	265
-0.4259935E-03	-0.6600316E-03	0.0	-0.2055238E-03	-0.9550207E-04	0.0
0.0	-0.3105515E 03	0.0	-0.3105515E 03	0.0	0.0
0.4992660E-02	-0.3105515E 03	-0.4115245E 05	-0.5496071E 05	0.0	0.0
0.3424961E-01	0.0	0.4676020E 04	0.7688836E 04	-0.0	0.0
-0.2614831E-02	0.0	-0.1240012E 05	-0.1500543E 05	0.0	0.1388728E 05
0.0	0.0	-0.2247486E 05	-0.3157147E 05	0.0	0.2814805E 05

PROBLEM NUMBER 2

0.4526443E 00	0.2593460E 02	0.9999998E-02	0.1701700E-02	0.2462251E 02	265
-0.4259935E-03	-0.6600316E-03	0.0	-0.2055238E-03	-0.9550207E-04	0.0
0.0	-0.3105515E 03	0.0	-0.3105515E 03	0.0	0.0
0.4992660E-02	-0.3105515E 03	-0.4115245E 05	-0.5496071E 05	0.0	0.0
0.3424961E-01	0.0	0.4676020E 04	0.7688836E 04	-0.0	0.0
-0.2614831E-02	0.0	-0.1240012E 05	-0.1500543E 05	0.0	0.1388728E 05
0.0	0.0	-0.2247486E 05	-0.3157147E 05	0.0	0.2814805E 05

PROBLEM NUMBER 1

0.4628538E 00	0.2651956E 02	0.9999998E-02	0.1701700E-02	0.2513814E 02	289
-0.4037826E-03	-0.6604618E-03	0.0	-0.1968244E-03	-0.9719445E-04	0.0

0.0	-0.4804939E 03	0.0	-0.4804939E 03	0.0	0.0
0.4954774E-02	-0.4804939E 03	-0.3952077E 05	-0.5466484E 05	0.0	0.0
0.3266221E-01	0.0	0.4674395E 04	0.7402645E 04	-0.0	0.0
-0.2730596E-02	0.0	-0.1171048E 05	-0.1518836E 05	0.0	0.1378255E 05
0.0	0.0	-0.2178172E 05	-0.3113779E 05	0.0	0.2767256E 05

PROBLEM NUMBER 2

0.4628538E 00	0.2651956E 02	0.9999998E-02	0.1701700E-02	0.2513814E 02	289
-0.4037826E-03	-0.6604618E-03	0.0	-0.1968244E-03	-0.9719445E-04	0.0
0.0	-0.4804939E 03	0.0	-0.4804939E 03	0.0	0.0
0.4954774E-02	-0.4804939E 03	-0.3952077E 05	-0.5466484E 05	0.0	0.0
0.3266221E-01	0.0	0.4674395E 04	0.7402645E 04	-0.0	0.0
-0.2730596E-02	0.0	-0.1171048E 05	-0.1518836E 05	0.0	0.1378255E 05
0.0	0.0	-0.2178172E 05	-0.3113779E 05	0.0	0.2767256E 05

PROBLEM NUMBER 1

0.4730634E 00	0.2710452E 02	0.9999998E-02	0.1701700E-02	0.2565112E 02	313
-0.3807552E-03	-0.6608106E-03	0.0	-0.1854245E-03	-0.9857783E-04	0.0
0.0	-0.6671321E 03	0.0	-0.6671321E 03	0.0	0.0
0.4900120E-02	-0.6671321E 03	-0.3782764E 05	-0.5435092E 05	0.0	0.0
0.3101031E-01	0.0	0.4643703E 04	0.7021902E 04	-0.0	0.0
-0.2840596E-02	0.0	-0.1102611E 05	-0.1546552E 05	0.0	0.1379249E 05
0.0	0.0	-0.2103123E 05	-0.3059461E 05	0.0	0.2710905E 05

PROBLEM NUMBER 2

0.4730634E 00	0.2710452E 02	0.9999998E-02	0.1701700E-02	0.2565112E 02	313
-0.3807552E-03	-0.6608106E-03	0.0	-0.1854245E-03	-0.9857783E-04	0.0
0.0	-0.6671321E 03	0.0	-0.6671321E 03	0.0	0.0
0.4900120E-02	-0.6671321E 03	-0.3782764E 05	-0.5435092E 05	0.0	0.0
0.3101031E-01	0.0	0.4643703E 04	0.7021902E 04	-0.0	0.0
-0.2840596E-02	0.0	-0.1102611E 05	-0.1546552E 05	0.0	0.1379249E 05
0.0	0.0	-0.2103123E 05	-0.3059461E 05	0.0	0.2710905E 05

PROBLEM NUMBER 1

0.4832730E 00	0.2768950E 02	0.9999998E-02	0.1701700E-02	0.2616145E 02	337
-0.3569731E-03	-0.6610719E-03	0.0	-0.1710737E-03	-0.9961783E-04	0.0
0.0	-0.8710896E 03	0.0	-0.8710896E 03	0.0	0.0
0.4828114E-02	-0.8710896E 03	-0.3607757E 05	-0.5401938E 05	0.0	0.0
0.2929788E-01	0.0	0.4581059E 04	0.6537793E 04	-0.0	0.0
-0.2943207E-02	0.0	-0.1035204E 05	-0.1584655E 05	0.0	0.1393678E 05
0.0	0.0	-0.2022219E 05	-0.2993261E 05	0.0	0.2644986E 05

PROBLEM NUMBER 2

0.4832730E 00	0.2768950E 02	0.9999998E-02	0.1701700E-02	0.2616145E 02	337
-0.3569731E-03	0.6610719E-03	0.0	-0.1710737E-03	-0.9961783E-04	0.0
0.0	-0.8710896E 03	0.0	-0.8710896E 03	0.0	0.0

0.4828114E-02	-0.8710896E 03	-0.3607757E 05	-0.5401938E 05	0.0	0.0
0.2929788E-01	0.0	0.4581059E 04	0.6537793E 04	-0.0	0.0
-0.2943207E-02	0.0	-0.1035204E 05	-0.1584655E 05	0.0	0.1393678E 05
0.0	0.0	-0.2022219E 05	-0.2993261E 05	0.0	0.2644986E 05

PROBLEM NUMBER 1

0.4934825E 00	0.2827446E 02	0.9999998E-02	0.1701700E-02	0.2666905E 02	361
-0.3325155E-03	-0.6612358E-03	0.0	-0.1535126E-03	-0.1002792E-03	0.0
0.0	-0.1092936E 04	0.0	-0.1092936E 04	0.0	0.0
0.4738212E-02	-0.1092936E 04	-0.3427624E 05	-0.5367074E 05	0.0	0.0
0.2752983E-01	0.0	0.4483473E 04	0.5941211E 04	-0.0	0.0
-0.3036659E-02	0.0	-0.9693891E 04	-0.1634151E 05	0.0	0.1423389E 05
0.0	0.0	-0.1935378E 05	-0.2914219E 05	0.0	0.2568705E 05

PROBLEM NUMB R 2

0.4934825E 00	0.2827446E 02	0.9999998E-02	0.1701700E-02	0.2666905E 02	361
-0.3325155E-03	-0.6612358E-03	0.0	-0.1535126E-03	-0.1002792E-03	0.0
0.0	-0.1092936E 04	0.0	-0.1092936E 04	0.0	0.0
0.4738212E-02	-0.1092936E 04	-0.3427624E 05	-0.5367074E 05	0.0	0.0
0.2752983E-01	0.0	0.4483473E 04	0.5941211E 04	-0.0	0.0
-0.3036659E-02	0.0	-0.9693891E 04	-0.1634151E 05	0.0	0.1423389E 05
0.0	0.0	-0.1935378E 05	-0.2914219E 05	0.0	0.2568705E 05

PROBLEM NUMBER 1

0.5036921E 00	0.2885942E 02	0.9999998E-02	0.1701700E-02	0.2717387E 02	385
-0.3074778E-03	-0.6612926E-03	0.0	-0.1324746E-03	-0.1005254E-03	0.0
0.0	-0.1333175E 04	0.0	-0.1333175E 04	0.0	0.0
0.4629932E-02	-0.1333175E 04	-0.3243055E 05	-0.5330561E 05	0.0	0.0
0.2571217E-01	0.0	0.4347875E 04	0.5222770E 04	-0.0	0.0
-0.3119029E-02	0.0	-0.9057895E 04	-0.1696076E 05	0.0	0.1469979E 05
0.0	0.0	-0.1842563E 05	-0.2821351E 05	0.0	0.2481238E 05

PROBLEM NUMBER 2

0.5036921E 00	0.2885942E 02	0.9999998E-02	0.1701700E-02	0.2717387E 02	385
-0.3074778E-03	-0.6612926E-03	0.0	-0.1324746E-03	-0.1005254E-03	0.0
0.0	-0.1333175E 04	0.0	-0.1333175E 04	0.0	0.0
0.4629932E-02	-0.1333175E 04	-0.3243055E 05	-0.5330561E 05	0.0	0.0
0.2571217E-01	0.0	0.4347875E 04	0.5222770E 04	-0.0	0.0
-0.3119029E-02	0.0	-0.9057895E 04	-0.1696076E 05	0.0	0.1469979E 05
0.0	0.0	-0.1842563E 05	-0.2821351E 05	0.0	0.2481238E 05

PROBLEM NUMBER 1

0.5104985E 00	0.2924940E 02	0.9999998E-02	0.1701700E-02	0.2750885E 02	401
-0.2905196E-03	-0.6612644E-03	0.0	-0.1163826E-03	-0.1004407E-03	0.0
0.0	-0.1503767E 04	0.0	-0.1503767E 04	0.0	0.0
0.4547335E-02	-0.1503767E 04	-0.3117945E 05	-0.5305339E 05	0.0	0.0

0.2447630E-01	0.0	0.4234812E 04	0.4671363E 04	-0.0	0.0
-0.3166768E-02	0.0	-0.8649566E 04	-0.1744790E 05	0.0	0.1511050E 05
0.0	0.0	-0.1777371E 05	-0.2751262E 05	0.0	0.2416294E 05

PROBLEM NUMBER 2

0.5104985E 00	0.2924940E 02	0.9999998E-02	0.1701700E-02	0.2750885E 02	401
-0.2905196E-03	-0.6612644E-03	0.0	-0.1163826E-03	-0.1004407E-03	0.0
0.0	-0.1503767E 04	0.0	-0.1503767E 04	0.0	0.0
0.4547335E-02	-0.1503767E 04	-0.3117945E 05	-0.5305339E 05	0.0	0.0
0.2447630E-01	0.0	0.4234812E 04	0.4671363E 04	-0.0	0.0
-0.3166768E-02	0.0	-0.8649566E 04	-0.1744790E 05	0.0	0.1511050E 05
0.0	0.0	-0.1777371E 05	-0.2751262E 05	0.0	0.2416294E 05

```
           SEGMENT NUMBER  2     SEGMENT CODE 11      SECOND PART OF REG. NO.2

                                      TABLE ORDER PHI OR S VS. CROSSECTION PROPERTIES
  0.5105087E 0C    0.6806785E 00
  0.236C000E C1    0.2360000E C1

             PROBLEM  1     TABLE ORDER  PHI OR S VS. DISTRIBUTED LOADS (F THETA, F PHI, F ZETA, M THETA, M PHI)
LOAD ICENTIFICATION CLUES 000100

  0.2CCC000E 04    0.2C00000E C4

             PROBLEM  2     TABLE ORDER  PHI OR S VS. DISTRIBUTED LOADS (F THETA, F PHI, F ZETA, M THETA, M PHI)
LOAD ICENTIFICATION CLUES 000100

  C.20CC000E 04    0.26C0000E C4
```

PHI (RAD. OR IN.)	DEGREES	PRINT INTERVAL	STEP	R ZERO	NUMBER OF CYCLES
EPSILON THETA	EPSILON PHI	GAMMA PHI THETA	K PHI	K THETA	N TEMPERATURE THETA
U	Q PHI	K PHI THETA	J PHI STAR	T PHI THETA	N TEMPERATURE PHI
V	J PHI	N THETA	N PHI	N PHI THETA	M TEMPERATURE THETA
W	Q THETA	M THETA	M PHI	M PHI THETA	M TEMPERATURE PHI
OMEGA THETA	TAU ZETA PHI = Q/T	SIGMA THETA IN	SIGMA PHI IN	TAU PHI THETA IN	SIGMA F IN
OMEGA PHI	TAU ZETA THETA = Q/T	SIGMA THETA OUT	SIGMA PHI OUT	TAU PHI THETA OUT	SIGMA F OUT

PROBLEM NUMBER 1

0.5105086E 00	0.2924998E 02	0.9999998E-02	0.1701700E-02	0.2750935E 02	1
-0.2905244E-03	-0.6612474E-03	0.0	-0.1163621E-03	-0.1004373E-03	0.0
0.C	-0.1503906E 04	0.0	-0.1503906E 04	0.0	0.0
0.4547331E-02	-0.1503906E 04	-0.3117957E 05	-0.5305221E 05	0.0	0.0
0.2447637E-01	0.0	0.4234555E 04	0.4670641E 04	-0.0	0.0
-0.3166736E-02	0.0	-0.8649898E 04	-0.1744818E 05	0.0	0.1511074E 05
0.0	0.0	-0.1777348E 05	-0.2751134E 05	0.0	0.2416191E 05

PROBLEM NUMBER 2

0.5105088E 00	0.2924998E 02	0.9999998E-02	0.1701700E-02	0.2750935E 02	1
-0.2905244E-03	-0.6612474E-03	0.0	-0.1163621E-03	-0.1004373E-03	0.0
0.0	-0.1503906E 04	0.0	-0.1503906E 04	0.0	0.0
0.4547331E-02	-0.1503906E 04	-0.3117957E 05	-0.5305221E 05	0.0	0.0
0.2447637E-01	0.0	0.4234555E 04	0.4670641E 04	-0.0	0.0
-0.3166736E-02	0.0	-0.8649898E 04	-0.1744818E 05	0.0	0.1511074E 05
0.0	0.0	-0.1777348E 05	-0.2751134E 05	0.0	0.2416191E 05

PROBLEM NUMBER 1

0.5207183E 00	0.2983496E 02	0.9999998E-02	0.1701700E-02	0.2800943E 02	25
-0.2647839E-03	-0.6610956E-03	0.0	-0.8891623E-04	-0.9990821E-04	0.0
0.C	-0.1775711E 04	0.0	-0.1775711E 04	0.0	0.0
0.4407577E-02	-0.1775711E 04	-0.2927896E 05	-0.5266135E 05	0.0	0.0
0.2259252E-01	0.0	0.4028553E 04	0.3727553E 04	-0.0	0.0
-0.3225931E-02	0.0	-0.8066473E 04	-0.1829853E 05	0.0	0.1588394E 05
0.0	0.0	-0.1674621E 05	-0.2632975E 05	0.0	0.2308176E 05

PROBLEM NUMBER 2

0.5207183E 00	0.2983496E 02	0.9999998E-02	0.1701700E-02	0.2800943E 02	25
-0.2647839E-03	-0.6610956E-03	0.0	-0.8891623E-04	-0.9990821E-04	0.0
C.C	-0.1775711E 04	0.0	-0.1775711E 04	0.0	0.0
0.4407577E-02	-0.1775711E 04	-0.2927896E 05	-0.5266135E 05	0.0	0.0
0.2259252E-01	0.0	0.4028553E 04	0.3727553E 04	-0.0	0.0
-0.3225931E-02	0.0	-0.8066473E 04	-0.1829853E 05	0.0	0.1588394E 05
0.0	0.0	-0.1674621E 05	-0.2632975E 05	0.0	0.2308176E 05

PROBLEM NUMBER 1

0.5309279E 00	0.3041992E 02	0.9999998E-02	0.1701700E-02	0.2850658E 02	49
-0.2388133E-03	-0.6607971E-03	0.0	-0.5725271E-04	-0.9886314E-04	0.0
0.0	-0.2066832E 04	0.0	-0.2066832E 04	0.0	0.0
0.4248571E-02	-0.2066832E 04	-0.2735923E 05	-0.5225627E 05	0.0	0.0
0.2068094E-01	0.0	0.3776013E 04	0.2636561E 04	-0.0	0.0
-0.3268152E-02	0.0	-0.7525082E 04	-0.1930219E 05	0.0	0.1685082E 05
0.0	0.0	-0.1566071E 05	-0.2498281E 05	0.0	0.2186664E 05

PROBLEM NUMBER 2

0.5309279E 00	0.3041992E 02	0.9999998E-02	0.1701700E-02	0.2850658E 02	49
-0.2388133E-03	-0.6607971E-03	0.0	-0.5725271E-04	-0.9886314E-04	0.0
0.0	-0.2066832E 04	0.0	-0.2066832E 04	0.0	0.0
0.4248571E-02	-0.2066832E 04	-0.2735923E 05	-0.5225627E 05	0.0	0.0
0.2068094E-01	0.0	0.3776013E 04	0.2636561E 04	-0.0	0.0
-0.3268152E-02	0.0	-0.7525082E 04	-0.1930219E 05	0.0	0.1685082E 05
0.0	0.0	-0.1566071E 05	-0.2498281E 05	0.0	0.2186664E 05

PROBLEM NUMBER 1

0.5411375E 00	0.3100488E 02	0.9999998E-02	0.1701700E-02	0.2900075E 02	73
-0.2127831E-03	-0.6603329E-03	0.0	-0.2108731E-04	-0.9726295E-04	0.0
0.0	-0.2377413E 04	0.0	-0.2377413E 04	0.0	0.0
0.4070166E-02	-0.2377413E 04	-0.2543266E 05	-0.5183808E 05	0.0	0.0
0.1875228E-01	0.0	0.3473651E 04	0.1387672E 04	-0.0	0.0
-0.3290890E-02	0.0	-0.7034465E 04	-0.2047039E 05	0.0	0.1801449E 05
0.0	0.0	-0.1451864E 05	-0.2346021E 05	0.0	0.2050761E 05

PROBLEM NUMBER 2

0.5411375E 00	0.3100488E 02	0.9999998E-02	0.1701700E-02	0.2900075E 02	73
-0.2127831E-03	-0.6603329E-03	0.0	-0.2108731E-04	-0.9726295E-04	0.0
0.0	-0.2377413E 04	0.0	-0.2377413E 04	0.0	0.0
0.4070166E-02	-0.2377413E 04	-0.2543266E 05	-0.5183808E 05	0.0	0.0
0.1875228E-01	0.0	0.3473651E 04	0.1387672E 04	-0.0	0.0
-0.3290890E-02	0.0	-0.7034465E 04	-0.2047039E 05	0.0	0.1801449E 05
0.0	0.0	-0.1451864E 05	-0.2346021E 05	0.0	0.2050761E 05

PROBLEM NUMBER 1

0.5513470E 00	0.3158984E 02	0.9999998E-02	0.1701700E-02	0.2949190E 02	97
-0.1868877E-03	-0.6596809E-03	0.0	0.1986464E-04	-0.9506832E-04	0.0
0.0	-0.2707466E 04	0.0	-0.2707466E 04	0.0	0.0
0.3872358E-02	-0.2707466E 04	-0.2351326E 05	-0.5140805E 05	0.0	0.0
0.1681871E-01	0.0	0.3118175E 04	-0.2912959E 02	-0.0	0.0
-0.3291478E-02	0.0	-0.6604105E 04	-0.2181446E 05	0.0	0.1937575E 05
0.0	0.0	-0.1332239E 05	-0.2175170E 05	0.0	0.1899573E 05

PROBLEM NUMBER 2

0.5513470E 00	0.3158984E 02	0.9999998E-02	0.1701700E-02	0.2949190E 02	97
-0.1868877E-03	-0.6596809E-03	0.0	0.1986464E-04	-0.9506832E-04	0.0
0.0	-0.2707466E 04	0.0	-0.2707466E 04	0.0	0.0
0.3872358E-02	-0.2707466E 04	-0.2351326E 05	-0.5140805E 05	0.0	0.0
0.1681871E-01	0.0	0.3118175E 04	-0.2912959E 02	-0.0	0.0
-0.3291478E-02	0.0	-0.6604105E 04	-0.2181446E 05	0.0	0.1937575E 05
0.0	0.0	-0.1332239E 05	-0.2175170E 05	0.0	0.1899573E 05

PROBLEM NUMBER 1

0.5615566E 00	0.3217482E 02	0.9999998E-02	0.1701700E-02	0.2997998E 02	121
-0.1613465E-03	-0.6588169E-03	0.0	0.6588630E-04	-0.9223974E-04	0.0
0.0	-0.3056846E 04	0.0	-0.3056846E 04	0.0	0.0
0.3655271E-02	-0.3056846E 04	-0.2161686E 05	-0.5096760E 05	0.0	0.0
0.1489395E-01	0.0	0.2706291E 04	-0.1623806E 04	-0.0	0.0
-0.3267081E-02	0.0	-0.6244262E 04	-0.2334574E 05	0.0	0.2093411E 05
0.0	0.0	-0.1207512E 05	-0.1984716E 05	0.0	0.1732227E 05

PROBLEM NUMBER 2

0.5615566E 00	0.3217482E 02	0.9999998E-02	0.1701700E-02	0.2997998E 02	121
-0.1613465E-03	-0.6588169E-03	0.0	0.6588630E-04	-0.9223974E-04	0.0
0.0	-0.3056846E 04	0.0	-0.3056846E 04	0.0	0.0
0.3655271E-02	-0.3056846E 04	-0.2161686E 05	-0.5096760E 05	0.0	0.0
0.1489395E-01	0.0	0.2706291E 04	-0.1623806E 04	-0.0	0.0
-0.3267081E-02	0.0	-0.6244262E 04	-0.2334574E 05	0.0	0.2093411E 05
0.0	0.0	-0.1207512E 05	-0.1984716E 05	0.0	0.1732227E 05

PROBLEM NUMBER 1

0.5717661E 00	0.3275978E 02	0.9999998E-02	0.1701700E-02	0.3046494E 02	145
-0.1364062E-03	-0.6577135E-03	0.0	0.1172566E-03	-0.8873793E-04	0.0
0.0	-0.3425241E 04	0.0	-0.3425241E 04	0.0	0.0
0.3419206E-02	-0.3425241E 04	-0.1976123E 05	-0.5051835E 05	0.0	0.0
0.1299343E-01	0.0	0.2234745E 04	-0.3406176E 04	-0.0	0.0
-0.3214706E-02	0.0	-0.5965961E 04	-0.2507549E 05	0.0	0.2268862E 05
0.0	0.0	-0.1078085E 05	-0.1773669E 05	0.0	0.1547903E 05

PROBLEM NUMBER 2

0.5717661E 00	0.3275978E 02	0.9999998E-02	0.1701700E-02	0.3046494E 02	145
-0.1364062E-03	-0.6577135E-03	0.0	0.1172566E-03	-0.8873793E-04	0.0
0.0	-0.3425241E 04	0.0	-0.3425241E 04	0.0	0.0
0.3419206E-02	-0.3425241E 04	-0.1976123E 05	-0.5051835E 05	0.0	0.0
0.1299343E-01	0.0	0.2234745E 04	-0.3406176E 04	-0.0	0.0
-0.3214706E-02	0.0	-0.5965961E 04	-0.2507549E 05	-0.0	0.2268862E 05
0.0	0.0	-0.1078085E 05	-0.1773669E 05	0.0	0.1547903E 05

PROBLEM NUMBER 1

0.5819757E 00	0.3334474E 02	0.9999998E-02	0.1701700E-02	0.3094672E 02	169
-0.1123410E-03	-0.6563400E-03	0.0	0.1742477E-03	-0.8452381E-04	0.0
0.0	-0.3812141E 04	0.0	-0.3812141E 04	0.0	0.0
0.3164643E-02	-0.3812141E 04	-0.1796616E 05	-0.5006209E 05	0.0	0.0
0.1113432E-01	0.0	0.1700339E 04	-0.5385816E 04	-0.0	0.0
-0.3131198E-02	0.0	-0.5781039E 04	-0.2701479E 05	0.0	0.2463829E 05
0.0	0.0	-0.9444520E 04	-0.1541073E 05	0.0	0.1345893E 05

PROBLEM NUMBER 2

0.5819757E 00	0.3334474E 02	0.9999998E-02	0.1701700E-02	0.3094672E 02	169
-0.1123410E-03	-0.6563400E-03	0.0	0.1742477E-03	-0.8452381E-04	0.0
0.0	-0.3812141E 04	0.0	-0.3812141E 04	0.0	0.0
0.3164643E-02	-0.3812141E 04	-0.1796616E 05	-0.5006209E 05	0.0	0.0
0.1113432E-01	0.0	0.1700339E 04	-0.5385816E 04	-0.0	0.0
-0.3131198E-02	0.0	-0.5781039E 04	-0.2701479E 05	0.0	0.2463829E 05
0.0	0.0	-0.9444520E 04	-0.1541073E 05	0.0	0.1345893E 05

PROBLEM NUMBER 1

0.5921853E 00	0.3392970E 02	0.9999998E-02	0.1701700E-02	0.3142526E 02	193
-0.8945487E-04	-0.6546627E-03	0.0	0.2371213E-03	-0.7955903E-04	0.0
0.0	-0.4216824E 04	0.0	-0.4216824E 04	0.0	0.0
0.2892264E-02	-0.4216824E 04	-0.1625356E 05	-0.4960082E 05	0.0	0.0
0.9335633E-02	0.0	0.1099966E 04	-0.7571957E 04	-0.0	0.0
-0.3013251E-02	0.0	-0.5702133E 04	-0.2917441E 05	0.0	0.2678253E 05
0.0	0.0	-0.8072074E 04	-0.1286020E 05	0.0	0.1125764E 05

PROBLEM NUMBER 2

0.5921853E 00	0.3392970E 02	0.9999998E-02	0.1701700E-02	0.3142526E 02	193
-0.8945487E-04	-0.6546627E-03	0.0	0.2371213E-03	-0.7955903E-04	0.0
0.0	-0.4216824E 04	0.0	-0.4216824E 04	0.0	0.0
0.2892264E-02	-0.4216824E 04	-0.1625356E 05	-0.4960082E 05	0.0	0.0
0.9335633E-02	0.0	0.1099966E 04	-0.7571957E 04	-0.0	0.0
-0.3013251E-02	0.0	-0.5702133E 04	-0.2917441E 05	0.0	0.2678253E 05
0.0	0.0	-0.8072074E 04	-0.1286020E 05	0.0	0.1125764E 05

PROBLEM NUMBER 1

0.6023948E 00	0.3451466E 02	0.9999998E-02	0.1701700E-02	0.3190054E 02	217
-0.6808271E-04	-0.6526441E-03	0.0	0.3061257E-03	-0.7380605E-04	0.0
0.0	-0.4638340E 04	0.0	-0.4638340E 04	0.0	0.0
0.2602978E-02	-0.4638340E 04	-0.1464760E 05	-0.4913672E 05	0.0	0.0
0.7618338E-02	0.0	0.4306409E 03	-0.9973352E 04	-0.0	0.0
-0.2857412E-02	0.0	-0.5742691E 04	-0.3156473E 05	0.0	0.2912120E 05
0.0	0.0	-0.6670531E 04	-0.1007657E 05	0.0	0.8877906E 04

PROBLEM NUMBER 2

0.6023948E 00	0.3451466E 02	0.9999998E-02	0.1701700E-02	0.3190054E 02	217

-0.6808271E-04	-0.6526441E-03	0.0	0.3061257E-03	-0.7380605E-04	0.0
0.0	-0.4638340E 04	0.0	-0.4638340E 04	0.0	0.0
0.2602978E-02	-0.4638340E 04	-0.1464760E 05	-0.4913672E 05	0.0	0.0
0.7618338E-02	0.0	0.4306409E 03	-0.9973352E 04	-0.0	0.0
-0.2857412E-02	0.0	-0.5742691E 04	-0.3156473E 05	0.0	0.2912120E 05
0.0	0.0	-0.6670531E 04	-0.1007657E 05	0.0	0.3877906E 04

PROBLEM NUMBER 1

0.6126044E 00	0.3509964E 02	0.9999998E-02	0.1701700E-02	0.3237250E 02	241
-0.4859203E-04	-0.6502438E-03	0.0	0.3814918E-03	-0.6722870E-04	0.0
0.0	-0.5075469E 04	0.0	-0.5075469E 04	0.0	0.0
0.2297939E-02	-0.5075469E 04	-0.1317475E 05	-0.4867220E 05	0.0	0.0
0.6005410E-02	0.0	-0.3104546E 03	-0.1259815E 05	-0.0	0.0
-0.2660090E-02	0.0	-0.5916969E 04	-0.3419554E 05	0.0	0.3165456E 05
0.0	0.0	-0.5248074E 04	-0.7052105E 04	0.0	0.6345430E 04

PROBLEM NUMBER 2

0.6126044E 00	0.3509964E 02	0.9999998E-02	0.1701700E-02	0.3237250E 02	241
-0.4859203E-04	-0.6502438E-03	0.0	0.3814918E-03	-0.6722870E-04	0.0
0.0	-0.5075469E 04	0.0	-0.5075469E 04	0.0	0.0
0.2297939E-02	-0.5075469E 04	-0.1317475E 05	-0.4867220E 05	0.0	0.0
0.6005410E-02	0.0	-0.3104546E 03	-0.1259815E 05	-0.0	0.0
-0.2660090E-02	0.0	-0.5916969E 04	-0.3419554E 05	0.0	0.3165456E 05
0.0	0.0	-0.5248074E 04	-0.7052105E 04	0.0	0.6345430E 04

PROBLEM NUMBER 1

0.6228139E 00	0.3568460E 02	0.9999998E-02	0.1701700E-02	0.3284106E 02	265
-0.3138321E-04	-0.6474166E-03	0.0	0.4634289E-03	-0.5979231E-04	0.0
0.0	-0.5526715E 04	0.0	-0.5526715E 04	0.0	0.0
0.1978569E-02	-0.5526715E 04	-0.1186390E 05	-0.4820987E 05	0.0	0.0
0.4521906E-02	0.0	-0.1125938E 04	-0.1545375E 05	-0.0	0.0
-0.2417564E-02	0.0	-0.6240023E 04	-0.3707591E 05	0.0	0.3438323E 05
0.0	0.0	-0.3814130E 04	-0.3779932E 04	0.0	0.3797146E 04

PROBLEM NUMBER 2

0.6228139E 00	0.3568460E 02	0.9999998E-02	0.1701700E-02	0.3284106E 02	265
-0.3138321E-04	-0.6474166E-03	0.0	0.4634289E-03	-0.5979231E-04	0.0
0.0	-0.5526715E 04	0.0	-0.5526715E 04	0.0	0.0
0.1978569E-02	-0.5526715E 04	-0.1186390E 05	-0.4820987E 05	0.0	0.0
0.4521906E-02	0.0	-0.1125938E 04	-0.1545375E 05	-0.0	0.0
-0.2417564E-02	0.0	-0.6240023E 04	-0.3707591E 05	0.0	0.3438323E 05
0.0	0.0	-0.3814130E 04	-0.3779932E 04	0.0	0.3797146E 04

PROBLEM NUMBER 1

0.6330235E 00	0.3626956E 02	0.9999998E-02	0.1701700E-02	0.3330623E 02	289
-0.1689156E-04	-0.6441143E-03	0.0	0.5521197E-03	-0.5146414E-04	0.0

0.0	-0.5990273E 04	0.0	-0.5990273E 04	0.0	0.0
0.1646588E-02	-0.5990273E 04	-0.1074643E 05	-0.4775257E 05	0.0	0.0
0.3195050E-02	0.0	-0.2018181E 04	-0.1854662E 05	-0.0	0.0
-0.2126006E-02	0.0	-0.6727715E 04	-0.4021404E 05	0.0	0.3730793E 05
0.0	0.0	-0.2379431E 04	-0.2542724E 03	0.0	0.2263034E 04

PROBLEM NUMBER 2

0.6330235E 00	0.3626956E 02	0.9999998E-02	0.1701700E-02	0.3330623E 02	289
-0.1689156E-04	-0.6441143E-03	0.0	0.5521197E-03	-0.5146414E-04	0.0
0.0	-0.5990273E 04	0.0	-0.5990273E 04	0.0	0.0
0.1646588E-02	-0.5990273E 04	-0.1074643E 05	-0.4775257E 05	0.0	0.0
0.3195050E-02	0.0	-0.2018181E 04	-0.1854662E 05	-0.0	0.0
-0.2126006E-02	0.0	-0.6727715E 04	-0.4021404E 05	0.0	0.3730793E 05
0.0	0.0	-0.2379431E 04	-0.2542724E 03	0.0	0.2263034E 04

PROBLEM NUMBER 1

0.6432331E 00	0.3685452E 02	0.9999998E-02	0.1701700E-02	0.3376791E 02	313
-0.5587714E-05	-0.6402843E-03	0.0	0.6477155E-03	-0.4221391E-04	0.0
0.0	-0.6463996E 04	0.0	-0.6463996E 04	0.0	0.0
0.1304030E-02	-0.6463996E 04	-0.9856281E 04	-0.4730337E 05	0.0	0.0
0.2054267E-02	0.0	-0.2989259E 04	-0.2188218E 05	-0.0	0.0
-0.1781487E-02	0.0	-0.7396652E 04	-0.4361701E 05	0.0	0.4042937E 05
0.0	0.0	-0.9561265E 03	0.3529384E 04	0.0	0.4092098E 04

PROBLEM NUMBER 2

0.6432331E 00	0.3685452E 02	0.9999998E-02	0.1701700E-02	0.3376791E 02	313
-0.5587714E-05	-0.6402843E-03	0.0	0.6477155E-03	-0.4221391E-04	0.0
0.0	-0.6463996E 04	0.0	-0.6463996E 04	0.0	0.0
0.1304030E-02	-0.6463996E 04	-0.9856281E 04	-0.4730337E 05	0.0	0.0
0.2054267E-02	0.0	-0.2989259E 04	-0.2188218E 05	-0.0	0.0
-0.1781487E-02	0.0	-0.7396652E 04	-0.4361701E 05	0.0	0.4042937E 05
0.0	0.0	-0.9561265E 03	0.3529384E 04	0.0	0.4092098E 04

PROBLEM NUMBER 1

0.6534426E 00	0.3743950E 02	0.9999998E-02	0.1701700E-02	0.3422607E 02	337
0.2021444E-05	-0.6358696E-03	0.0	0.7503312E-03	-0.3201410E-04	0.0
0.0	-0.6945395E 04	0.0	-0.6945395E 04	0.0	0.0
0.9532759E-03	-0.6945395E 04	-0.9229988E 04	-0.4686556E 05	0.0	0.0
0.1131246E-02	0.0	-0.4040900E 04	-0.2546452E 05	-0.0	0.0
-0.1380004E-02	0.0	-0.8264184E 04	-0.4729068E 05	0.0	0.4374799E 05
0.0	0.0	0.4421580E 03	0.7574078E 04	0.0	0.7362961E 04

PROBLEM NUMBER 2

0.6534426E 00	0.3743950E 02	0.9999998E-02	0.1701700E-02	0.3422607E 02	337
0.2021444E-05	-0.6358696E-03	0.0	0.7503312E-03	-0.3201410E-04	0.0
0.0	-0.6945395E 04	0.0	-0.6945395E 04	0.0	0.0

0.9532759E-03	-0.6945395E 04	-0.9229988E 04	-0.4686556E 05	0.0	0.0
0.1131246E-02	0.0	-0.4040900E 04	-0.2546452E 05	-0.0	0.0
-0.1380004E-02	0.0	-0.8264184E 04	-0.4729068E 05	0.0	0.4374799E 05
0.0	0.0	0.4421580E 03	0.7574078E 04	0.0	0.7362961E 04

PROBLEM NUMBER 1

0.6636522E 00	0.3802446E 02	0.9999998E-02	0.1701700E-02	0.3468066E 02	361
0.5392175E-05	-0.6308095E-03	0.0	0.8600391E-03	-0.2084031E-04	0.0
0.0	-0.7431570E 04	0.0	-0.7431570E 04	0.0	0.0
0.5970728E-03	-0.7431570E 04	-0.8906758E 04	-0.4644265E 05	0.0	0.0
0.4599667E-03	0.0	-0.5174430E 04	-0.2929629E 05	-0.0	0.0
-0.9174971E-03	0.0	-0.9348348E 04	-0.5123937E 05	0.0	0.4726374E 05
0.0	0.0	0.1800245E 04	0.1188117E 05	0.0	0.1109117E 05

PROBLEM NUMBER 2

0.6636522E 00	0.3802446E 02	0.9999998E-02	0.1701700E-02	0.3468066E 02	361
0.5392175E-05	-0.6308095E-03	0.0	0.8600391E-03	-0.2084031E-04	0.0
0.0	-0.7431570E 04	0.0	-0.7431570E 04	0.0	0.0
0.5970728E-03	-0.7431570E 04	-0.8906758E 04	-0.4644265E 05	0.0	0.0
0.4599667E-03	0.0	-0.5174430E 04	-0.2929629E 05	-0.0	0.0
-0.9174971E-03	0.0	-0.9348348E 04	-0.5123937E 05	0.0	0.4726374E 05
0.0	0.0	0.1800245E 04	0.1188117E 05	0.0	0.1109117E 05

PROBLEM NUMBER 1

0.6738617E 00	0.3860942E 02	0.9999998E-02	0.1701700E-02	0.3513165E 02	385
0.3943557E-05	-0.6250383E-03	0.0	0.9768626E-03	-0.8671953E-05	0.0
0.0	-0.7919230E 04	0.0	-0.7919230E 04	0.0	0.0
0.2385642E-03	-0.7919230E 04	-0.8928469E 04	-0.4603839E 05	0.0	0.0
0.7672112E-04	0.0	-0.6390719E 04	-0.3337844E 05	-0.0	0.0
-0.3898812E-03	0.0	-0.1066783E 05	-0.5546568E 05	0.0	0.5097594E 05
0.0	0.0	0.3101331E 04	0.1645007E 05	0.0	0.1513955E 05

PROBLEM NUMBER 2

0.6738617E 00	0.3860942E 02	0.9999998E-02	0.1701700E-02	0.3513165E 02	385
0.3943557E-05	-0.6250383E-03	0.0	0.9768626E-03	-0.8671953E-05	0.0
0.0	-0.7919230E 04	0.0	-0.7919230E 04	0.0	0.0
0.2385642E-03	-0.7919230E 04	-0.8928469E 04	-0.4603839E 05	0.0	0.0
0.7672112E-04	0.0	-0.6390719E 04	-0.3337844E 05	-0.0	0.0
-0.3898812E-03	0.0	-0.1066783E 05	-0.5546568E 05	0.0	0.5097594E 05
0.0	0.0	0.3101331E 04	0.1645007E 05	0.0	0.1513955E 05

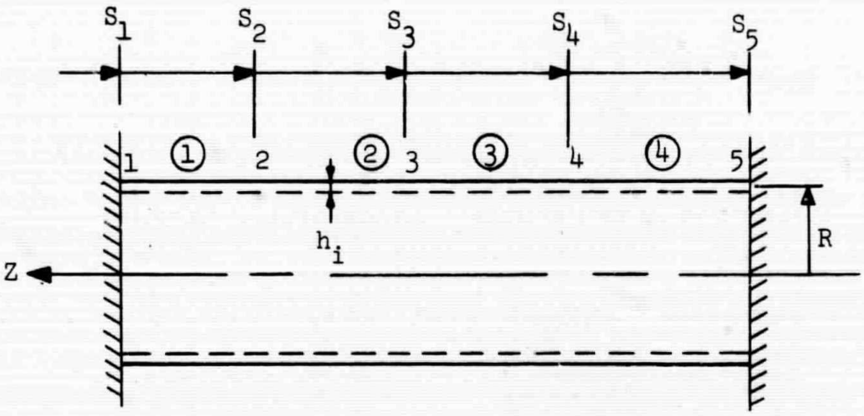
PROBLEM NUMBER 1

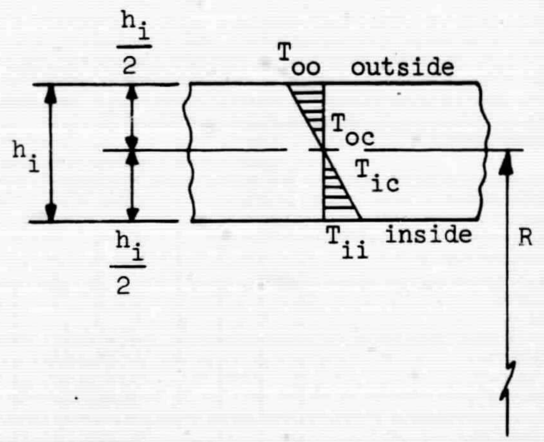
0.6806681E 00	0.3899940E 02	0.9999998E-02	0.1701700E-02	0.3543027E 02	401
-0.3343953E-08	-0.6207617E-03	0.0	0.1058685E-02	0.1143162E-08	0.0
0.0	-0.8243332E 04	0.0	-0.8243332E 04	0.0	0.0
0.1984881E-07	-0.8243332E 04	-0.9156473E 04	-0.4578121E 05	0.0	0.0

0.2127763E-06	0.0	-0.7247746E 04	-0.3623857E 05	-0.0	0.0
0.5211660E-07	0.0	-0.1168770E 05	-0.5843786E 05	0.0	0.5355914E 05
0.0	0.0	0.3927973E 04	0.1964020E 05	0.0	0.1800056E 05

PROBLEM NUMBER 2

0.6806681E 00	0.3899940E 02	0.9999998E-02	0.1701700E-02	0.3543027E 02	401
-0.3343953E-08	-0.6207617E-03	0.0	0.1058685E-02	0.1143162E-08	0.0
0.0	-0.8243332E 04	0.0	-0.8243332E 04	0.0	0.0
0.1984881E-07	-0.8243332E 04	-0.9156473E 04	-0.4578121E 05	0.0	0.0
0.2127763E-06	0.0	-0.7247746E 04	-0.3623857E 05	-0.0	0.0
0.5211660E-07	0.0	-0.1168770E 05	-0.5843786E 05	0.0	0.5355914E 05
0.0	0.0	0.3927973E 04	0.1964020E 05	0.0	0.1800056E 05





Temperature Distribution

Shell Constants

$R = 25.0''$

$h_i = 0.25''$

$\nu = 0.3$

$E = 3.0 \times 10^7$ psi

$T_{oo} = -100^\circ F$

$T_{oc} = T_{ic} = 0$

$T_{ii} = +100^\circ F$

α = coef. thermal expan. = 6.5×10^{-5} in. per $^\circ F$

$S_5 - S_1 = 26.2646''$

Figure 4-2. Test Problem Two

```
H.$.F.C. FØUR REGIØN$ EQUAL FØUR $EGMENT$
 4 4 1 0.0       11
MAT1     I$ØT
0.0           0.0           0.0
BLANK CARD
0.3      E+080.3        E+080.3       E+08
 BLANK CARD
0.3           0.3           0.3
 BLANK CARD
6.5      E-066.5        E-066.5       E-06
 BLANK CARD
 1.0 1 REGIØN EQUAL$ 1 $EGMENT
    1   1   2
31   FIR$T REGIØN, FIR$T $EGMENT
 1.0           6.8366          0.5           1.0     E-04 5.8366   E-020.0
 25.0
I$ØT     MAT1      $ING      THIC      TH$T      0.0       LINE      2
 0.99999       6.83661
 0.25          0.25
400000  THERMAL LØAD ØNLY
 100.0         100.0
 0.0           0.0
 0.0           0.0
-100.0        -100.0
    1   1   2
 1.0 1 REGIØN EQUAL$ 1 $EGMENT
    2   2   3
31   $ECØND REGIØN, FIR$T $EGMENT
 6.8366        13.1596         0.5           1.0     E-04 6.3230   E-020.0
 25.0
```

CODING INSTRUCTIONS:

1. Alphabetical characters are written as follows
   A B C D E F G H I J K L M N Ø P Q R $ T U V W X Y Z
2. Numerical characters are written as follows
   1 2 3 4 5 6 7 8 9 0

ENG 100.1 2-64

GRUMMAN AIRCRAFT ENGINEERING CORPORATION - ENGINEERING DEPARTMENT

```
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80
ISØT     MATI      $ING      THIC      TH$T      0.0       LINE          2
 6.83659       13.15961
 0.25             0.25
400000  THERMAL LØAD ØNLY
 100.0         100.0
 0.0           0.0
 0.0           0.0
-100.0        -100.0
     1    1    2
 1.0  1 REGIØN EQUAL$ 1 $EGMENT
     3    3    4
31    THIRD REGIØN, FIR$T $EGMENT
 13.1596       19.9689        0.5            1.0      E-04    6.8093   E-020.0
 25.0
ISØT     MATI      $ING      THIC      TH$T      0.0       LINE          2
 13.15959      19.96891
 0.25          0.25
400000  THERMAL LØAD ØNLY
 100.0         100.0
 0.0           0.0
 0.0           0.0
-100.0        -100.0
     1    1    2
 1.0  1 REGIØN EQUAL$ 1 $EGMENT
     4    4    5
31    FØURTA REGTØN, FIR$T $EGMENT
 19.9689       27.2646        0.5            1.0      E-04    7.2957   E-020.0
 25.0
ISØT     MATI      $ING      THIC      TH$T      0.0       LINE          2
 19.96889      27.26461
01 02 03 04 05 06 07 08 09 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 7. 78 79 80
```

CODING INSTRUCTIONS:

1. Alphabetical characters are written as follows
   A B C D E F G H I J K L M N Ø P Q R $ T U V W X Y Z
2. Numerical characters are written as follows
   1 2 3 4 5 6 7 8 9 0

ENG 100.1 2-64

GRUMMAN AIRCRAFT ENGINEERING CORPORATION - ENGINEERING DEPARTMENT

```
0.25           0.25
40000.0 THERMAL LOAD ONLY
 100.0         100.0
 0.0           0.0
 0.0           0.0
-100.0        -100.0
    1    1    2
    5    0
1 0 0 0 0
2 1 1 1 1
3 1 1 1 1
4 1 1 1 1
5 0 0 0 0
BLANK    CARD
```

CODING INSTRUCTIONS:

1. Alphabetical characters are written as follows
A B C D E F G H I J K L M N Ø P Q R S T U V W X Y Z

2. Numerical characters are written as follows
1 2 3 4 5 6 7 8 9 0

ENG 100.1 2-64

GRUMMAN AIRCRAFT ENGINEERING CORPORATION - ENGINEERING DEPARTMENT

UNSYMMETRIC, ORTHOTROPIC, REINFORCED SHELL ANALYSIS WITH COUPLING OF AT MOST 29 SHELL REGIONS

USING

LOVE-REISSNER ACCURACY THEORY

DECK NUMBER 45218

AS OF MAY 5, 1968

NUMBER OF SEGMENTS = 4 NUMBER OF REGIONS = 4 NUMBER OF MATERIAL PROPERTY TABLES USED = 1 NUMBER OF PROBLEMS = 1

HARMONIC (N) = 0.0

THE GIVEN INPUT DATA INDICATES THAT THE SHELL SEGMENTS ARE TO BE COUPLED

M.S.F.C. FOUR REGIONS EQUAL FOUR SEGMENTS

REGION NUMBER 1

THERE ARE 1 SEGMENTS AND 0 KINEMATIC LINKS WITHIN THIS REGION

SEGMENT NUMBER 1 SEGMENT CODE 31 FIRST REGION, FIRST SEGMENT

TIC	STOP	DTAU	DIFF	STEP	DELTA
0.1000000E 01	0.6836599E 01	0.5000000E 00	0.9999999E-04	0.5836600E-01	.0

GEOMETRY INPUT VARIABLES

0.2500000E 02 0.0 0.0

ISOT MAT1 SING THIC THST T FREE = 0.0 LINE NUMBER OF TABLE COLUMNS = 2

MATERIAL PROPERTY TABLE USED

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.30000E 08	0.30000E 08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.30000E 00	0.30000E 00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.65000E-05	0.65000E-05	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE ORDER PHI OR S VS. CROSSECTION PROPERTIES

0.9999900E 00	0.6836610E 01
0.2500000E 00	0.2500000E 00

TABLE ORDER PHI OR S VS. TEMPERATURE LOADS

0.1000000E 03	0.1000000E 03
0.0	0.0
0.0	0.0
-0.1000000E 03	-0.1000000E 03

MATRIX X AND Y (TRANSPOSED) .MAGIC OUTPUT

0.0	0.0	0.0	0.0	0.1000000E 01	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.1000000E 01	0.0	0.0
0.0	0.0	-0.9939062E 05	0.3188943E 05	0.0	-0.9939063E-01	-0.9978444E 01	-0.5831242E 01
0.0	0.0	0.3188940E 05	0.2503109E 06	0.0	0.3188939E-01	-0.8282563E 01	-0.9978449E 01
0.1000000E 01	0.0	0.0	0.0	0.2023373E-05	0.0	0.0	0.0
0.0	0.1000000E 01	0.9939063E-01	-0.3188943E-01	0.0	0.8776184E-06	0.1097845E-04	0.5831242E-05
0.0	0.0	-0.9978448E 01	-0.8282562E 01	0.0	-0.1097845E-04	-0.4859369E-03	-0.6190784E-04
0.0	0.0	-0.5831241E 01	-0.9978446E 01	0.0	-0.5831241E-05	-0.6190795E-04	0.1929505E-03
0.0	0.0	-0.1692099E 04	-0.3185706E 04	0.0	-0.1692099E-02	-0.1796434E-01	0.5599003E-01

STIFFNESS COEFFICIENTS

	DELTA T1	DELTA Z1	DELTA R1	THETA 1	DELTA T2	DELTA Z2	DELTA R2	THETA 2
FORCE T1	0.7763253E 08	0.0	0.0	0.0	-0.7763253E 08	0.0	0.0	0.0
FORCE Z1	0.0	0.2159409E 09	0.5485621E 07	-0.4765627E 07	0.0	-0.2159409E 09	0.5485790E 07	0.4765971E 07
FORCE R1	0.0	0.5485788E 07	0.3819266E 07	-0.3687544E 07	0.0	-0.5485788E 07	0.4499185E 06	0.2143339E 05
MOMENT 1	0.0	-0.4765940E 07	-0.3687550E 07	0.7084268E 07	0.0	0.4765940E 07	-0.2143268E 05	0.6769357E 06
FORCE T2	-0.7763253E 08	0.0	0.0	0.0	0.7763253E 08	0.0	0.0	0.0
FORCE Z2	0.0	-0.2159409E 09	-0.5485621E 07	0.4765627E 07	0.0	0.2159409E 09	-0.5485790E 07	-0.4765971E 07
FORCE R2	0.0	0.5485808E 07	0.4499054E 06	-0.2140209E 05	0.0	-0.5485808E 07	0.3819272E 07	0.3687553E 07
MOMENT 2	0.0	0.4765932E 07	0.2140209E 05	0.6769737E 06	0.0	-0.4765932E 07	0.3687550E 07	0.7084272E 07

SEGMENT SYMMETRY CHECK

0.7763253E 08	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.2159409E 09	0.0	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.1000030E 01	0.3819266E 07	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.1000065E 01	0.1000001E 01	0.7084268E 07	0.0	0.0	0.0	0.0
0.1000000E 01	0.1000000E 01	0.1000000E 01	0.1000000E 01	0.7763253E 08	0.0	0.0	0.0
0.1000000E 01	0.1000000E 01	0.1000030E 01	0.1000065E 01	0.1000000E 01	0.2159409E 09	0.0	0.0
0.1000000E 01	0.1000003E 01	0.1000029E 01	0.1001429E 01	0.1000000E 01	0.1000003E 01	0.3819272E 07	0.0
0.1000000E 01	0.1000008E 01	0.1001462E 01	0.1000055E 01	0.1000000E 01	0.1000008E 01	0.1000000E 01	0.7084272E 07

SEGMENT LOAD MATRICES

0.0
-0.2032523E 01
-0.4658827E-01
-0.4558104E 05
0.0
0.2032523E 01
0.3834951E-01
0.4558107E 05

REGION NUMBER 2

THERE ARE 1 SEGMENTS AND 0 KINEMATIC LINKS WITHIN THIS REGION

SEGMENT NUMBER 1 SEGMENT CODE 31 SECOND REGION, FIRST SEGMENT

TIC	STOP	DTAU	DIFF	STEP	DELTA
0.6836599E 01	0.1315960E 02	0.5000000E 00	0.9999999E-04	0.6322998E-01	.0

GEOMETRY INPUT VARIABLES

0.2500000E 02 0.0 0.0

ISCT MAT1 SING THIC THST T FREE = 0.0 LINE NUMBER OF TABLE COLUMNS = 2

MATERIAL PROPERTY TABLE USED

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.30000E 08	0.30000E 08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.30000E 00	0.30000E 00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.65000E-05	0.65000E-05	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE ORDER PHI OR S VS. CROSSECTION PROPERTIES

0.6836590E 01	0.1315961E 02
0.2500000E 00	0.2500000E 00

TABLE ORDER PHI OR S VS. TEMPERATURE LOADS

0.1000000E 03	0.1000000E 03
0.0	0.0
0.0	0.0
-0.1000000E 03	-0.1000000E 03

MATRIX X AND Y (TRANSPOSED) MAGIC OUTPUT

0.0	0.0	0.0	0.0	0.1000000E 01	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.1000000E 01	0.0	0.0
0.0	0.0	-0.1660123E 06	-0.3197864E 05	0.0	-0.1660123E 00	-0.1285150E 02	-0.5861337E 01
0.0	0.0	-0.3197868E 05	0.2516027E 06	0.0	-0.3197868E-01	-0.1383437E 02	-0.1285150E 02
0.1000000E 01	0.0	0.0	0.0	0.2191999E-05	0.0	0.0	0.0
0.0	0.1000000E 01	0.1660123E 00	0.3197868E-01	0.0	0.1009096E-05	0.1385150E-04	0.5861337E-05
0.0	0.0	-0.1285150E 02	-0.1383437E 02	0.0	-0.1385149E-04	-0.4884447E-03	0.6208122E-04
0.0	0.0	-0.5861336E 01	-0.1285150E 02	0.0	-0.5861335E-05	0.6708137E-04	0.3222853E-02
0.0	0.0	-0.1700832E 04	-0.4019404E 04	0.0	-0.1700832E-02	0.1801467E-01	0.9352016E-01

STIFFNESS COEFFICIENTS

	DELTA T1	DELTA Z1	DELTA R1	THETA 1	DELTA T2	DELTA Z2	DELTA R2	THETA 2
FORCE T1	0.7166043E 08	0.0	0.0	0.0	-0.7166043E 08	0.0	0.0	0.0
FORCE Z1	0.0	0.1982740E 09	0.5041057E 07	-0.4577073E 07	0.0	-0.1982740E 09	0.5040995E 07	0.4577004E 07
FORCE R1	0.0	0.5040996E 07	0.3807907E 07	-0.3681963E 07	0.0	-0.5040996E 07	0.4420701E 06	0.1768347E 06
MOMENT 1	0.0	-0.4577008E 07	-0.3681964E 07	0.7056224E 07	0.0	0.4577008E 07	-0.1768346E 06	0.3700888E 06
FORCE T2	-0.7166043E 08	0.0	0.0	0.0	0.7166043E 08	0.0	0.0	0.0
FORCE Z2	0.0	-0.1982740E 09	-0.5041057E 07	0.4577073E 07	0.0	0.1982740E 09	-0.5040995E 07	-0.4577004E 07
FORCE R2	0.0	0.5041037E 07	0.4420710E 06	-0.1767931E 06	0.0	-0.5041037E 07	0.3807909E 07	0.3681967E 07
MOMENT 2	0.0	0.4577014E 07	0.1768127E 06	0.3701384E 06	0.0	-0.4577014E 07	0.3681965E 07	0.7056226E 07

SEGMENT SYMMETRY CHECK

0.7166043E 08	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.1982740E 09	0.0	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.1000011E 01	0.3807907E 07	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.1000013E 01	0.1000000E 01	0.7056224E 07	0.0	0.0	0.0	0.0
0.1000000E 01	0.1000000E 01	0.1000000E 01	0.1000000E 01	0.7166043E 08	0.0	0.0	0.0
0.1000000E 01	0.1000000E 01	0.1000011E 01	0.1000013E 01	0.1000000E 01	0.1982740E 09	0.0	0.0
0.1000000E 01	0.1000008E 01	0.1000002E 01	0.1000235E 01	0.1000000E 01	0.1000008E 01	0.3807909E 07	0.0
0.1000000E 01	0.1000002E 01	0.1000124E 01	0.1000134E 01	0.1000000E 01	0.1000002E 01	0.1000000E 01	0.7056226E 07

SEGMENT LOAD MATRICES

```
 0.0
 0.3451456E 00
 0.9567377E-02
-0.4558107E 05
 0.0
-0.3451456E 00
 0.1150485E 00
 0.4558127E 05
```

REGION NUMBER 3

THERE ARE 1 SEGMENTS AND 0 KINEMATIC LINKS WITHIN THIS REGION

SEGMENT NUMBER 1 SEGMENT CODE 31 THIRD REGION, FIRST SEGMENT

TIC	STOP	DTAU	DIFF	STEP	DELTA
0.1315960E 02	0.1996889E 02	0.5000000E 00	0.9999999E-04	0.6809294E-01	.0

GEOMETRY INPUT VARIABLES

0.2500000E 02	0.0	0.0

ISCT MAT1 SING THIC THST T FREE = 0.0 LINF NUMBER OF TABLE COLUMNS = 2

MATERIAL PROPERTY TABLE USED

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.30000E 08	0.30000E 08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.30000E 00	0.30000E 00	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.65000E-05	0.65000E-05	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE ORDER PHI OR S VS. CROSSECTION PROPERTIES

0.1315959E 02	0.1996890E 02
0.2500000E 00	0.2500000E 00

TABLE ORDER PHI OR S VS. TEMPERATURE LOADS

0.1000000E 03	0.1000000E 03
0.0	0.0
0.0	0.0
-0.1000000E 03	-0.1000000E 03

MATRIX X AND Y (TRANSPOSED) MAGIC OUTPUT

0.0	0.0	0.0	0.0	0.1000000E 01	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.1000000E 01	0.0	0.0
0.0	0.0	-0.2491029E 06	-0.1323515E 06	0.0	-0.2491028E 00	-0.1553270E 02	-0.4968034E 01
0.0	0.0	-0.1323516E 06	0.2132569E 06	0.0	-0.1323515E 00	-0.2075859E 02	-0.1553270E 02
0.1000000E 01	0.0	0.0	0.0	0.2360705E-05	0.0	0.0	0.0
0.0	0.1000000E 01	0.2491029E 00	0.1323515E 00	0.0	0.1157075E-05	0.1653269E-04	0.4968033E-05
0.0	0.0	-0.1553270E 02	-0.2075858E 02	0.0	-0.1653269E-04	-0.4140027E-03	0.2569384E-03
0.0	0.0	-0.4968032E 01	-0.1553270E 02	0.0	-0.4968032E-05	0.2569386E-03	0.4835918E-03
0.0	0.0	-0.1441615E 04	-0.4797430E 04	0.0	-0.1441615E-02	0.7455796E-01	0.1403278E 00

STIFFNESS COEFFICIENTS

	DELTA T1	DELTA Z1	DELTA R1	THETA 1	DELTA T2	DELTA Z2	DELTA R2	THETA 2
FORCE T1	0.6653925E 08	0.0	0.0	0.0	-0.6653925E 08	0.0	0.0	0.0
FORCE Z1	0.0	0.1831835E 09	0.4622970E 07	-0.4338253E 07	0.0	-0.1831835E 09	0.4622906E 07	0.4338079E 07
FORCE R1	0.0	0.4622906E 07	0.3795474E 07	-0.3677784E 07	0.0	-0.4622906E 07	0.4019969E 06	0.2610782E 06
MOMENT 1	0.0	-0.4338090E 07	-0.3677787E 07	0.7043935E 07	0.0	0.4338090E 07	-0.2610782E 06	0.1415386E 06
FORCE T2	-0.6653925E 08	0.0	0.0	0.0	0.6653925E 08	0.0	0.0	0.0
FORCE Z2	0.0	-0.1831835E 09	-0.4622970E 07	0.4338253E 07	0.0	0.1831835E 09	-0.4622906E 07	-0.4338079E 07
FORCE R2	0.0	0.4622911E 07	0.4020354E 06	-0.2610368E 06	0.0	-0.4622911E 07	0.3795473E 07	0.3677799E 07
MOMENT 2	0.0	0.4338067E 07	0.2610957E 06	0.1416367E 06	0.0	-0.4338067E 07	0.3677784E 07	0.7043936E 07

SEGMENT SYMMETRY CHECK

0.6653925E 08	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.1831835E 09	0.0	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.1000013E 01	0.3795474E 07	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.1000037E 01	0.1000000E 01	0.7043935E 07	0.0	0.0	0.0	0.0
0.1000000E 01	0.1000000E 01	0.1000000E 01	0.1000000E 01	0.6653925E 08	0.0	0.0	0.0
0.1000000E 01	0.1000000E 01	0.1000013E 01	0.1000037E 01	0.1000000E 01	0.1831835E 09	0.0	0.0
0.1000000E 01	0.1000001E 01	0.1000095E 01	0.1000158E 01	0.1000000E 01	0.1000001E 01	0.3795473E 07	0.0
0.1000000E 01	0.1000002E 01	0.1000067E 01	0.1000692E 01	0.1000000E 01	0.1000002E 01	0.1000001E 01	0.7043936E 07

SEGMENT LOAD MATRICES

0.0
0.1418931E 01
-0.1438107E-01
-0.4558107E 05
0.0
-0.1418931E 01
-0.5368931E 00
0.4558130E 05

REGION NUMBER 4

THERE ARE 1 SEGMENTS AND 0 KINEMATIC LINKS WITHIN THIS REGION

SEGMENT NUMBER 1 SEGMENT CODE 31 FOURTH REGION, FIRST SEGMENT

TIC	STOP	DTAU	DIFF	STEP	DELTA
C.1956889E 02	0.2726459E 02	0.5000000E 00	0.9999999E-04	0.7295698E-01	.0

GEOMETRY INPUT VARIABLES

0.2500000E 02 0.0 0.0

ISCT MATI SING THIC THST T FREE = 0.0 LINE NUMBER OF TABLE COLUMNS = 2

MATERIAL PROPERTY TABLE USED

0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C.30000E C8	C.30000E 08	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
C.30000E CC	0.30000E CC	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.65000E-C5	C.65000E-05	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

TABLE ORDER PHI OR S VS. CROSSECTION PROPERTIES

0.1956889E 02	0.2726460E 02
0.2500000E 0C	0.2500000E 00

TABLE ORDER PHI OR S VS. TEMPERATURE LOADS

C.1000000E C3	0.1000000E C3
C.0	0.0
0.0	0.0
-C.1000000E C3	-C.1000000E 03

MATRIX X AND Y (TRANSPOSED) MAGIC OUTPUT

C.0	0.0	0.0	0.0	0.1000000E 01	0.0	0.0	0.0
C.0	0.0	0.0	0.0	0.0	0.1000000E 01	0.0	0.0
C.0	0.0	-0.3462463E 06	-0.2771230E 06	0.0	-0.3462462E 00	-0.1746674E 02	-0.2685916E 01
C.0	0.0	-0.2771229E 06	0.1152952E 06	0.0	-0.2771229E 00	-0.2885387E 02	-0.1746674E 02
C.1000000E C1	C.0	0.0	0.0	0.2529842E-05	0.0	0.0	0.0
C.0	0.1000000E 01	0.3462463E 00	0.2771231E 00	0.0	0.1319271E-05	0.1846673E-04	0.2685913E-05
C.0	0.0	-0.1746674E 02	-0.2885387E 02	0.0	-0.1846673E-04	-0.2238261E-03	0.5379883E-03
C.0	0.0	-0.2685913E 01	-0.1746674E 02	0.0	-0.2685913E-05	0.5379885E-03	0.6721795E-03
0.0	0.0	-0.7793933E 03	-0.5358645E 04	0.0	-0.7793929E-03	0.1561125E 00	0.1950518E 00

STIFFNESS COEFFICIENTS

	DELTA T1	DELTA Z1	DELTA R1	THETA 1	DELTA T2	DELTA Z2	DELTA R2	THETA 2
FORCE T1	0.6209064E 08	0.0	0.0	0.0	-0.6209064E 08	0.0	0.0	0.0
FORCE Z1	0.0	0.1701547E 09	0.4242287E 07	-0.4075056E 07	0.0	-0.1701547E 09	0.4242595E 07	0.4075544E 07
FORCE R1	0.0	0.4242612E 07	0.3782345E 07	-0.3671865E 07	0.0	-0.4242612E 07	0.3458157E 06	0.2937215E 06
MOMENT 1	0.0	-0.4075544E 07	-0.3671870E 07	0.7036864E 07	0.0	0.4075544E 07	-0.2937313E 06	-0.1769034E 05
FORCE T2	-0.6209064E 08	0.0	0.0	0.0	0.6209064E 08	0.0	0.0	0.0
FORCE Z2	0.0	-0.1701547E 09	-0.4242287E 07	0.4075056E 07	0.0	0.1701547E 09	-0.4242595E 07	-0.4075544E 07
FORCE R2	0.0	0.4242592E 07	0.3458070E 06	-0.2937682E 06	0.0	-0.4242592E 07	0.3782352E 07	0.3671874E 07
MOMENT 2	0.0	0.4075508E 07	0.2937094E 06	-0.1768127E 05	0.0	-0.4075508E 07	0.3671872E 07	0.7036869E 07

SEGMENT SYMMETRY CHECK

0.6209064E 08	0.0	0.0	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.1701547E 09	0.0	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.1000076E 01	0.3782345E 07	0.0	0.0	0.0	0.0	0.0
0.1000000E 01	0.1000119E 01	0.1000001E 01	0.7036864E 07	0.0	0.0	0.0	0.0
0.1000000E 01	0.1000000E 01	0.1000000E 01	0.1000000E 01	0.6209064E 08	0.0	0.0	0.0
0.1000000E 01	0.1000000E 01	0.1000076E 01	0.1000119E 01	0.1000000E 01	0.1701547E 09	0.0	0.0
0.1000000E 01	0.1000000E 01	0.1000025E 01	0.1000125E 01	0.1000000E 01	0.1000000E 01	0.3782352E 07	0.0
0.1000000E 01	0.1000009E 01	0.1000074E 01	0.1000512E 01	0.1000000E 01	0.1000009E 01	0.1000000E 01	0.7036869E 07

SEGMENT LOAD MATRICES

0.0
-0.3681553E 01
-0.7659902E-01
-0.4558100E 05
0.0
0.3681553E 01
0.1533980E 00
0.4558192E 05

INPUT DATA FOR REGION COUPLING

NUMBER OF REGION JOINTS 5 NUMBER OF KINEMATIC LINKS 0

REGION	JOINT(I)	JOINT(J)	RZERO(I)	RZERO(J)
1	1	2	0.2500000E 02	0.2500000E 02
2	2	3	0.2500000E 02	0.2500000E 02
3	3	4	0.2500000E 02	0.2500000E 02
4	4	5	0.2500000E 02	0.2500000E 02

BOUNDARY CONDITIONS

JOINT	DELTA T	DELTA Z	DELTA R	THETA	ANGLE ALPHA
1	0	0	0	0	0.0
2	1	1	1	1	0.0
3	1	1	1	1	0.0
4	1	1	1	1	0.0
5	0	0	0	0	0.0

THE REDUCED FLEXIBILITY MATRIX

ROW	COLUMN 1	COLUMN 2	COLUMN 3	COLUMN 4	COLUMN 5	COLUMN 6	COLUMN 7	COLUMN 8
1	0.1001893E-07	0.0	0.0	0.0	0.6918143E-08	0.0	0.0	0.0
2	0.0	0.3707111E-08	0.2010579E-08	0.1595999E-08	0.0	0.2581047E-08	-0.1519344E-08	-0.7029619E-10
3	0.0	0.2010597E-08	0.1341273E-06	0.1761402E-12	0.0	0.3689155E-08	-0.7731963E-08	-0.5934111E-09
4	0.0	0.1595980E-08	0.1670965E-12	0.7187577E-07	0.0	-0.9417481E-10	0.6056069E-09	-0.2462776E-08
5	0.6918143E-08	0.0	0.0	0.0	0.1441284E-07	0.0	0.0	0.0
6	0.0	0.2581048E-08	0.3689177E-08	-0.9418916E-10	0.0	0.5431975E-08	0.2356502E-09	0.1635113E-08
7	0.0	-0.1519356E-08	-0.7731948E-08	0.6051841E-09	0.0	0.2356766E-09	0.1345533E-06	-0.1108058E-11
8	0.0	-0.7031938E-10	-0.5932126E-09	-0.2463040E-08	0.0	0.1635079E-08	-0.1131206E-11	0.7211048E-07
9	0.3578702E-08	0.0	0.0	0.0	0.7455650E-08	0.0	0.0	0.0
10	0.0	0.1316075E-08	0.1819214E-08	-0.9862831E-11	0.0	0.2795231E-08	0.1840012E-08	-0.6630205E-10
11	0.0	-0.1430271E-08	-0.1769614E-08	-0.6001590E-10	0.0	-0.3129702E-08	-0.7188941E-08	0.1494236E-08
12	0.0	0.2188282E-10	0.1005288E-09	0.3670368E-10	0.0	-0.2278980E-10	-0.1465099E-08	-0.1269321E-08

ROW	COLUMN 9	COLUMN 10	COLUMN 11	COLUMN 12
1	0.3578704E-08	0.0	0.0	0.0
2	0.0	0.1318075E-08	-0.1430221E-08	0.2183442E-10
3	0.0	0.1819205E-08	-0.1769569E-08	0.1004562E-09
4	0.0	-0.9854902E-11	-0.6004836E-10	0.3667751E-10
5	0.7455654E-08	0.0	0.0	0.0
6	0.0	0.2795232E-08	-0.3129567E-08	-0.2287449E-10
7	0.0	0.1840009E-08	-0.7188191E-08	-0.1464999E-08
8	0.0	-0.6627691E-10	0.1484649E-08	-0.1268792E-08
9	0.1163099E-07	0.0	0.0	0.0
10	0.0	0.4342979E-08	-0.1588334E-08	0.1700937E-08
11	0.0	-0.1588531E-08	0.1342260E-06	0.7698457E-10
12	0.0	0.1701084E-08	0.7707973E-10	0.7208195E-07

THE EXPANDED REGION JOINT DISPLACEMENT MATRIX (REGION END DEFLECTIONS)

JOINT	PROBLEM	DELTA T	DELTA Z	DELTA R	OMEGA-THETA
1	1	0.0	0.0	0.0	0.0
2	1	0.0	-0.5677222E-08	-0.6117556E-08	-0.3381595E-08
3	1	0.0	-0.1393664E-09	-0.4388411E-08	-0.1439790E-07
4	1	0.0	0.1425664E-07	0.8151966E-07	-0.1316233E-07
5	1	0.0	0.0	0.0	0.0

```
                                    REGION NUMBER  1

                  THERE ARE  1 SEGMENTS AND  0 KINEMATIC LINKS WITHIN THIS REGION

SEGMENT NUMBER  1      SEGMENT CODE 31          FIRST REGION, FIRST SEGMENT

                                 TABLE ORDER PHI OR S VS. CROSSECTION PROPERTIES
0.9999900E 00   0.6836610E 01
0.2500000E 00   0.2500000E 00

                                 TABLE ORDER PHI OR S VS. TEMPERATURE LOADS
0.1000000E 03   0.1000000E 03
0.0             0.0
0.0             0.0
-0.1000000E 03  -0.1000000E 03
```

PHI (RAD. OR IN.)	DEGREES	PRINT INTERVAL	STEP	R ZERO	NUMBER OF CYCLES
EPSILON THETA	EPSILON PHI	GAMMA PHI THETA	K PHI	K THETA	N TEMPERATURE THETA
U	Q PHI	K PHI THETA	J PHI STAR	T PHI THETA	N TEMPERATURE PHI
V	J PHI	N THETA	N PHI	N PHI THETA	M TEMPERATURE THETA
W	J THETA	M THETA	M PHI	M PHI THETA	M TEMPERATURE PHI
OMEGA THETA	TAU ZETA PHI = Q/T	SIGMA THETA IN	SIGMA PHI IN	TAU PHI THETA IN	SIGMA F IN
OMEGA PHI	TAU ZETA THETA = Q/T	SIGMA THETA OUT	SIGMA PHI OUT	TAU PHI THETA OUT	SIGMA F OUT

PROBLEM NUMBER 1

0.1000000E 01	0.0	0.5000000E 00	0.5836600E-01	0.2500000E 02	1
0.0	-0.6613998E-09	0.0	-0.4296872E-08	0.0	0.0
0.0	-0.1182146E-03	0.0	-0.1182146E-03	0.0	0.0
0.0	-0.1182146E-03	-0.1635329E-02	-0.5451098E-02	0.0	0.2901782E 03
0.0	0.0	-0.2901780E 03	-0.2901780E 03	-0.0	0.2901782E 03
0.0	0.0	-0.2785709E 05	-0.2785711E 05	0.0	0.2785710E 05
0.0	0.0	0.2785708E 05	0.2785707E 05	0.0	0.2785707E 05

PROBLEM NUMBER 1

0.1525284E 01	0.0	0.5000000E 00	0.5836600E-01	0.2500000E 02	37
0.2099972E-10	-0.6676999E-09	0.0	-0.2934323E-08	0.0	0.0
0.0	-0.8499061E-04	0.0	-0.8499061E-04	0.0	0.0
-0.3485661E-09	-0.8499061E-04	-0.1477831E-02	-0.5451098E-02	0.0	0.2901782E 03
-0.5249929E-09	0.0	-0.2901780E 03	-0.2901780E 03	-0.0	0.2901782E 03
-0.1679632E-08	0.0	-0.2785709E 05	-0.2785712E 05	0.0	0.2785711E 05
0.0	0.0	0.2785708E 05	0.2785707E 05	0.0	0.2785707E 05

PROBLEM NUMBER 1

0.2050568E 01	0.0	0.5000000E 00	0.5836600E-01	0.2500000E 02	73
0.7476852E-10	-0.6838305E-09	0.0	-0.1983597E-08	0.0	0.0
0.0	-0.5782436E-04	0.0	-0.5782436E-04	0.0	0.0
-0.7031900E-09	-0.5782436E-04	-0.1074565E-02	-0.5451098E-02	0.0	0.2901782E 03
-0.1869213E-08	0.0	-0.2901780E 03	-0.2901780E 03	-0.0	0.2901782E 03
-0.3155276E-08	0.0	-0.2785709E 05	-0.2785712E 05	0.0	0.2785710E 05
0.0	0.0	0.2785708E 05	0.2785708E 05	0.0	0.2785707E 05

PROBLEM NUMBER 1

0.2575851E 01	0.0	0.5000000E 00	0.5836600E-01	0.2500000E 02	109
0.1507088E-09	-0.7066125E-09	0.0	-0.1332609E-08	0.0	0.0
0.0	-0.4099248E-04	0.0	-0.4099248E-04	0.0	0.0
-0.1068148E-08	-0.4099248E-04	-0.5050129E-03	-0.5451098E-02	0.0	0.2901782E 03
-0.3767720E-08	0.0	-0.2901780E 03	-0.2901780E 03	-0.0	0.2901782E 03
-0.4016329E-08	0.0	-0.2785709E 05	-0.2785712E 05	0.0	0.2785710E 05
0.0	0.0	0.2785709E 05	0.2785708E 05	0.0	0.2785708E 05

PROBLEM NUMBER 1

0.3101135E 01	0.0	0.5000000E 00	0.5836600E-01	0.2500000E 02	145
0.2414877E-09	-0.7338461E-09	0.0	-0.8217076E-09	0.0	0.0
0.0	-0.3737869E-04	0.0	-0.3737869E-04	0.0	0.0
-0.1446325E-08	-0.3737869E-04	0.1758292E-03	-0.5451098E-02	0.0	0.2901782E 03
-0.6037194E-08	0.0	-0.2901780E 03	-0.2901780E 03	-0.0	0.2901782E 03
-0.4580006E-08	0.0	-0.2785709E 05	-0.2785712E 05	0.0	0.2785710E 05
0.0	0.0	0.2785709E 05	0.2785708E 05	0.0	0.2785708E 05

PROBLEM NUMBER 1

0.3626419E 01	0.0	0.5000000E 00	0.5836600E-01	0.2500000E 02	181
0.3412897E-09	-0.7637868E-09	0.0	-0.2595268E-09	0.0	0.0
0.0	-0.4885640E-04	0.0	-0.4885640E-04	0.0	0.0
-0.1839592E-08	-0.4885640E-04	0.9243453E-03	-0.5451098E-02	0.0	0.2901782E 03
-0.8532247E-08	0.0	-0.2901780E 03	-0.2901780E 03	-0.0	0.2901782E 03
-0.4870738E-08	0.0	-0.2785709E 05	-0.2785713E 05	0.0	0.2785710E 05
0.0	0.0	0.2785709E 05	0.2785708E 05	0.0	0.2785708E 05

PROBLEM NUMBER 1

0.4151703E 01	0.0	0.5000000E 00	0.5836600E-01	0.2500000E 02	217
0.4437160E-09	-0.7945147E-09	0.0	0.5643215E-09	0.0	0.0
0.0	-0.7636580E-04	0.0	-0.7636580E-04	0.0	0.0
-0.2248892E-08	-0.7636580E-04	0.1692542E-02	-0.5451098E-02	0.0	0.2901782E 03
-0.1109290E-07	0.0	-0.2901780E 03	-0.2901780E 03	-0.0	0.2901782E 03
-0.4806878E-08	0.0	-0.2785708E 05	-0.2785713E 05	0.0	0.2785710E 05
0.0	0.0	0.2785709E 05	0.2785709E 05	0.0	0.2785709E 05

PROBLEM NUMBER 1

0.4676987E 01	0.0	0.5000000E 00	0.5836600E-01	0.2500000E 02	253
0.5394742E-09	-0.8232421E-09	0.0	-0.8784817E-10	0.0	0.0
0.0	-0.1196419E-03	0.0	-0.1196419E-03	0.0	0.0
-0.2673958E-08	-0.1196419E-03	0.2410728E-02	-0.5451098E-02	0.0	0.2901782E 03
-0.1348686E-07	0.0	-0.2901782E 03	-0.2901780E 03	-0.0	0.2901782E 03
-0.4213248E-08	0.0	-0.2785710E 05	-0.2785714E 05	0.0	0.2785711E 05
0.0	0.0	0.2785712E 05	0.2785709E 05	0.0	0.2785710E 05

PROBLEM NUMBER 1

0.5202271E 01	0.0	0.5000000E 00	0.5836600E-01	0.2500000E 02	289
0.6251966E-09	-0.8489589E-09	0.0	0.1892636E-08	0.0	0.0
0.0	-0.1771695E-03	0.0	-0.1771695E-03	0.0	0.0
-0.3113275E-08	-0.1771695E-03	0.3053646E-02	-0.5451098E-02	0.0	0.2901782E 03
-0.1562992E-07	0.0	-0.2901782E 03	-0.2901782E 03	-0.0	0.2901782E 03
-0.3773103E-08	0.0	-0.2785710E 05	-0.2785714E 05	0.0	0.2785712E 05
0.0	0.0	0.2785712E 05	0.2785710E 05	0.0	0.2785711E 05

PROBLEM NUMBER 1

0.5727554E 01	0.0	0.5000000E 00	0.5836600E-01	0.2500000E 02	325
0.6892371E-09	-0.8681711E-09	0.0	0.4732200E-08	0.0	0.0
0.0	-0.2468443E-03	0.0	-0.2468443E-03	0.0	0.0
-0.3564741E-08	-0.2468443E-03	0.3533950E-02	-0.5451098E-02	0.0	0.2901782E 03
-0.1723093E-07	0.0	-0.2901782E 03	-0.2901782E 03	-0.0	0.2901782E 03
-0.2074182E-08	0.0	-0.2785710E 05	-0.2785715E 05	0.0	0.2785712E 05
0.0	0.0	0.2785712E 05	0.2785711E 05	0.0	0.2785711E 05

PROBLEM NUMBER 1

0.6252838E 01	0.0	0.5000000E 00	0.5836600E-01	0.2500000E 02	361
0.7001317E-09	-0.8714394E-09	0.0	0.8561013E-08	0.0	0.0
0.0	-0.3229058E-03	0.0	-0.3229058E-03	0.0	0.0
-0.4022592E-08	-0.3229058E-03	0.3615660E-02	-0.5451098E-02	0.0	0.2901782E 03
-0.1750330E-07	0.0	-0.2901782E 03	-0.2901785E 03	-0.0	0.2901782E 03
0.1372353E-08	0.0	-0.2785710E 05	-0.2785717E 05	0.0	0.2785713E 05
0.0	0.0	0.2785712E 05	0.2785712E 05	0.0	0.2785712E 05

PROBLEM NUMBER 1

0.6778122E 01	0.0	0.5000000E 00	0.5836600E-01	0.2500000E 02	397
0.6156020E-09	-0.8460805E-09	0.0	0.1339470E-07	0.0	0.0
0.0	-0.3937939E-03	0.0	-0.3937939E-03	0.0	0.0
-0.4475268E-08	-0.3937939E-03	0.2981687E-02	-0.5451098E-02	0.0	0.2901782E 03
-0.1539005E-07	0.0	-0.2901782E 03	-0.2901787E 03	-0.0	0.2901782E 03
0.7097032E-08	0.0	-0.2785710E 05	-0.2785719E 05	0.0	0.2785714E 05
0.0	0.0	0.2785712E 05	0.2785714E 05	0.0	0.2785713E 05

PROBLEM NUMBER 1

0.6836487E 01	0.0	0.5000000E 00	0.5836600E-01	0.2500000E 02	401
0.5981071E-09	-0.8408321E-09	0.0	0.1398822E-07	0.0	0.0
0.0	-0.4006047E-03	0.0	-0.4006047E-03	0.0	0.0
-0.4524502E-08	-0.4006047E-03	0.2850474E-02	-0.5451098E-02	0.0	0.2901782E 03
-0.1495268E-07	0.0	-0.2901782E 03	-0.2901787E 03	-0.0	0.2901782E 03
0.7896098E-08	0.0	-0.2785710E 05	-0.2785719E 05	0.0	0.2785714E 05
0.0	0.0	0.2785712E 05	0.2785714E 05	0.0	0.2785713E 05

PROBLEM NUMBER 1

0.6836599[illegible] 01	0.0	0.5000000E 00	0.5836600E-01	0.2500000E 02	405
0.5980716E-09	-0.8408214E-09	0.0	0.1398937E-07	0.0	0.0
0.0	-0.4006175E-03	0.0	-0.4006175E-03	0.0	0.0
-0.4524594E-08	-0.4006175E-03	0.2850208E-02	-0.5451098E-02	0.0	0.2901782E 03
-0.1495179E-07	0.0	-0.2901782E 03	-0.2901787E 03	-0.0	0.2901782E 03
0.7897672E-08	0.0	-0.2785710E 05	-0.2785719E 05	0.0	0.2785714E 05
0.0	0.0	0.2785712E 05	0.2785714E 05	0.0	0.2785713E 05

```
                                        REGION NUMBER  2

                          THERE ARE  1 SEGMENTS AND  0 KINEMATIC LINKS WITHIN THIS REGION

         SEGMENT NUMBER  1       SEGMENT CODE 31          SECOND REGION, FIRST SEGMENT

                                     TABLE ORDER PHI OR S VS. CROSSECTION PROPERTIES
 0.6836590E 01   0.1315961E 02
 0.2500000E 00   0.2500000E 00

                                      TABLE ORDER PHI OR S VS. TEMPERATURE LOADS
 0.1000000E 03   0.1000000E 03
 0.0             0.0
 0.0             0.0
-0.1000000E 03  -0.1000000E 03
```

PHI (RAD. OR IN.)	DEGREES	PRINT INTERVAL	STEP	R ZERO	NUMBER OF CYCLES
EPSILON THETA	EPSILON PHI	GAMMA PHI THETA	K PHI	K THETA	N TEMPERATURE THETA
U	Q PHI	K PHI THETA	J PHI STAR	T PHI THETA	N TEMPERATURE PHI
V	J PHI	N THETA	N PHI	N PHI THETA	M TEMPERATURE THETA
W	Q THETA	M THETA	M PHI	M PHI THETA	M TEMPERATURE PHI
OMEGA THETA	TAU ZETA PHI = Q/T	SIGMA THETA IN	SIGMA PHI IN	TAU PHI THETA IN	SIGMA F IN
OMEGA PHI	TAU ZETA THETA = Q/T	SIGMA THETA OUT	SIGMA PHI OUT	TAU PHI THETA OUT	SIGMA F OUT

PROBLEM NUMBER 1

0.6836599E 01	0.0	0.5000000E 00	0.6322998E-01	0.2500000E 02	1
-0.2447020E-09	-0.5879834E-09	0.0	-0.4296872E-08	0.0	0.0
0.0	-0.2142803E-03	0.0	-0.2142803E-03	0.0	0.0
0.5677222E-08	-0.2142803E-03	-0.3470581E-02	-0.5451050E-02	0.0	0.2901782E 03
0.6117556E-08	0.0	-0.2901780E 03	-0.2901780E 03	-0.0	0.2901782E 03
-0.3381595E-08	0.0	-0.2785710E 05	-0.2785711E 05	0.0	0.2785710E 05
0.0	0.0	0.2785707E 05	0.2785707E 05	0.0	0.2785707E 05

PROBLEM NUMBER 1

0.7342428E 01	0.0	0.5000000E 00	0.6322998E-01	0.2500000E 02	33
-0.1586494E-09	-0.5137992E-09	0.0	-0.1951154E-08	0.0	0.0
0.0	-0.1501938E-03	0.0	-0.1501938E-03	0.0	0.0
0.5373661E-08	-0.1501938E-03	-0.2825186E-02	-0.5451050E-02	0.0	0.2901782E 03
0.3966235E-08	0.0	-0.2901780E 03	-0.2901780E 03	-0.0	0.2901782E 03
-0.4926618E-08	0.0	-0.2785710E 05	-0.2785712E 05	0.0	0.2785710E 05
0.0	0.0	0.2785708E 05	0.2785708E 05	0.0	0.2785707E 05

PROBLEM NUMBER 1

0.7848257E 01	0.0	0.5000000E 00	0.6322998E-01	0.2500000E 02	65
-0.5199653E-10	-0.6457550E-09	0.0	-0.3423635E-09	0.0	0.0
0.0	-0.1009824E-03	0.0	-0.1009824E-03	0.0	0.0
0.5055224E-08	-0.1009824E-03	-0.2025289E-02	-0.5451050E-02	0.0	0.2901782E 03
0.1299914E-08	0.0	-0.2901780E 03	-0.2901780E 03	-0.0	0.2901782E 03
-0.5460015E-08	0.0	-0.2785710E 05	-0.2785713E 05	0.0	0.2785711E 05
0.0	0.0	0.2785708E 05	0.2785708E 05	0.0	0.2785707E 05

PROBLEM NUMBER 1

0.8354086E 01	0.0	0.5000000E 00	0.6322998E-01	0.2500000E 02	97
0.5861288E-10	-0.6789780E-09	0.0	0.7363758E-09	0.0	0.0
0.0	-0.6842712E-04	0.0	-0.6842712E-04	0.0	0.0
0.4720132E-08	-0.6842712E-04	-0.1195718E-02	-0.5451050E-02	0.0	0.2901782E 03
-0.1465322E-08	0.0	-0.2901780E 03	-0.2901780E 03	-0.0	0.2901782E 03
-0.5362594E-08	0.0	-0.2785709E 05	-0.2785713E 05	0.0	0.2785711E 05
0.0	0.0	0.2785708E 05	0.2785709E 05	0.0	0.2785708E 05

PROBLEM NUMBER 1

0.8859915E 01	0.0	0.5000000E 00	0.6322998E-01	0.2500000E 02	129
0.1619531E-09	-0.7099799E-09	0.0	0.1500603E-08	0.0	0.0
0.0	-0.5222199E-04	0.0	-0.5222199E-04	0.0	0.0
0.4368650E-08	-0.5222199E-04	-0.4206661E-03	-0.5451050E-02	0.0	0.2901782E 03
-0.4048829E-08	0.0	-0.2901780E 03	-0.2901780E 03	-0.0	0.2901782E 03
-0.4787989E-08	0.0	-0.2785709E 05	-0.2785713E 05	0.0	0.2785711E 05
0.0	0.0	0.2785709E 05	0.2785709E 05	0.0	0.2785709E 05

PROBLEM NUMBER 1

0.9365744E 01	0.0	0.5000000E 00	0.6322998E-01	0.2500000E 02	161
0.2523199E-09	-0.7370899E-09	0.0	0.1990622E-09	0.0	0.0
0.0	-0.5068524E-04	0.0	-0.5068524E-04	0.0	0.0
0.4002580E-08	-0.5068524E-04	0.2570867E-03	-0.5451050E-02	0.0	0.2901782E 03
-0.6308003E-08	0.0	-0.2901782E 03	-0.2901782E 03	-0.0	0.2901782E 03
-0.4336702E-08	0.0	-0.2785711E 05	-0.2785714E 05	0.0	0.2785712E 05
0.0	0.0	0.2785711E 05	0.2785709E 05	0.0	0.2785710E 05

PROBLEM NUMBER 1

0.9871572E 01	0.0	0.5000000E 00	0.6322998E-01	0.2500000E 02	193
0.3378855E-09	-0.7627596E-09	0.0	0.9175491E-09	0.0	0.0
0.0	-0.6244966E-04	0.0	-0.6244966E-04	0.0	0.0
0.3623168E-08	-0.6244966E-04	0.8988269E-03	-0.5451050E-02	0.0	0.2901782E 03
-0.8447138E-08	0.0	-0.2901782E 03	-0.2901782E 03	-0.0	0.2901782E 03
-0.4060720E-08	0.0	-0.2785711E 05	-0.2785714E 05	0.0	0.2785712E 05
0.0	0.0	0.2785711E 05	0.2785709E 05	0.0	0.2785710E 05

PROBLEM NUMBER 1

0.1037740E 02	0.0	0.5000000E 00	0.6322998E-01	0.2500000E 02	225
0.4138594E-09	-0.7855518E-09	0.0	0.1869991E-08	0.0	0.0
0.0	-0.8657709E-04	0.0	-0.8657709E-04	0.0	0.0
0.3231394E-08	-0.8657709E-04	0.1468632E-02	-0.5451050E-02	0.0	0.2901782E 03
-0.1034649E-07	0.0	-0.2901782E 03	-0.2901782E 03	-0.0	0.2901782E 03
-0.3368885E-08	0.0	-0.2785711E 05	-0.2785714E 05	0.0	0.2785712E 05
0.0	0.0	0.2785712E 05	0.2785710E 05	0.0	0.2785710E 05

PROBLEM NUMBER 1

0.1088323E 02	0.0	0.5000000E 00	0.6322998E-01	0.2500000E 02	257
0.4703665E-09	-0.8025041E-09	0.0	0.3204080E-08	0.0	0.0
0.0	-0.1209029E-03	0.0	-0.1209029E-03	0.0	0.0
0.2829420E-08	-0.1209029E-03	0.1892438E-02	-0.5451050E-02	0.0	0.2901782E 03
-0.1175918E-07	0.0	-0.2901782E 03	-0.2901782E 03	-0.0	0.2901782E 03
-0.2104325E-08	0.0	-0.2785711E 05	-0.2785715E 05	0.0	0.2785712E 05
0.0	0.0	0.2785712E 05	0.2785711E 05	0.0	0.2785711E 05

PROBLEM NUMBER 1

0.1138506E 02	0.0	0.5000000E 00	0.6322998E-01	0.2500000E 02	289
0.4933860CE-09	-0.8094920E-09	0.0	0.5028614E-08	0.0	0.0
0.0	-0.1614870E-03	0.0	-0.1614870E-03	0.0	0.0
0.2421189E-08	-0.1614870E-03	0.2067135E-02	-0.5451050E-02	0.0	0.2901782E 03
-0.1234150E-07	0.0	-0.2901782E 03	-0.2901782E 03	-0.0	0.2901782E 03
-0.4432414E-10	0.0	-0.2785710E 05	-0.2785716E 05	0.0	0.2785712E 05
0.0	0.0	0.2785712E 05	0.2785711E 05	0.0	0.2785711E 05

PROBLEM NUMBER 1

0.1189489E 02	0.0	0.5000000E 00	0.6322998E-01	0.2500000E 02	321
0.4650262E-09	-0.8009018E-09	0.0	0.7386312E-08	0.0	0.0
0.0	-0.2019366E-03	0.0	-0.2019366E-03	0.0	0.0
0.2013092E-08	-0.2019366E-03	0.1852382E-02	-0.5451050E-02	0.0	0.2901782E 03
-0.1162566E-07	0.0	-0.2901782E 03	-0.2901785E 03	-0.0	0.2901782E 03
0.3073491E-08	0.0	-0.2785711E 05	-0.2785716E 05	0.0	0.2785713E 05
0.0	0.0	0.2785712E 05	0.2785712E 05	0.0	0.2785711E 05

PROBLEM NUMBER 1

0.1240072E 02	0.0	0.5000000E 00	0.6322998E-01	0.2500000E 02	353
0.3603842E-09	-0.7695093E-09	0.0	0.1021695E-07	0.0	0.0
0.0	-0.2326111E-03	0.0	-0.2326111E-03	0.0	0.0
0.1614771E-08	-0.2326111E-03	0.1067567E-02	-0.5451050E-02	0.0	0.2901782E 03
-0.9009607E-08	0.0	-0.2901782E 03	-0.2901785E 03	-0.0	0.2901782E 03
0.7508838E-08	0.0	-0.2785711E 05	-0.2785718E 05	0.0	0.2785713E 05
0.0	0.0	0.2785712E 05	0.2785713E 05	0.0	0.2785712E 05

PROBLEM NUMBER 1

0.1290655E 02	0.0	0.5000000E 00	0.6322998E-01	0.2500000E 02	385
0.1509396E-09	-0.7066758E-09	0.0	0.1331018E-07	0.0	0.0
0.0	-0.2398413E-03	0.0	-0.2398413E-03	0.0	0.0
0.1239893E-08	-0.2398413E-03	-0.5032674E-03	-0.5451050E-02	0.0	0.2901782E 03
-0.3773490E-08	0.0	-0.2901782E 03	-0.2901787E 03	-0.0	0.2901782E 03
0.1345520E-07	0.0	-0.2785711E 05	-0.2785719E 05	0.0	0.2785715E 05
0.0	0.0	0.2785711E 05	0.2785714E 05	0.0	0.2785712E 05

PROBLEM NUMBER 1

0.1315946E 02	0.0	0.5000000E 00	0.6322998E-01	0.2500000E 02	401
-0.2869565E-11	-0.6605332E-09	0.0	0.1483475E-07	0.0	0.0
0.0	-0.2291424E-03	0.0	-0.2291424E-03	0.0	0.0
0.1066768E-08	-0.2291424E-03	-0.1656836E-02	-0.5451050E-02	0.0	0.2901782E 03
0.7173913E-10	0.0	-0.2901782E 03	-0.2901787E 03	-0.0	0.2901782E 03
0.1701586E-07	0.0	-0.2785712E 05	-0.2785719E 05	0.0	0.2785715E 05
0.0	0.0	0.2785711E 05	0.2785715E 05	0.0	0.2785712E 05

PROBLEM NUMBER 1

0.1315986OE 02	0.0	0.5000000E 00	0.6322998E-01	0.2500000E 02	405
-0.2964340E-11	-0.6605048E-09	0.0	0.1483556E-07	0.0	0.0
0.0	-0.2291332E-03	0.0	-0.2291332E-03	0.0	0.0
0.1066676E-08	-0.2291332E-03	-0.1657547E-02	-0.5451050E-02	0.0	0.2901782E 03
0.7410850E-10	0.0	-0.2901782E 03	-0.2901787E 03	-0.0	0.2901782E 03
0.1701792E-07	0.0	-0.2785712E 05	-0.2785719E 05	0.0	0.2785715E 05
0.0	0.0	0.2785711E 05	0.2785715E 05	0.0	0.2785712E 05

```
                                        REGION NUMBER  3

                   THERE ARE  1 SEGMENTS AND  0 KINEMATIC LINKS WITHIN THIS REGION

        SEGMENT NUMBER  1     SEGMENT CODE 31         THIRD REGION, FIRST SEGMENT

                              TABLE ORDER PHI OR S VS. CROSSECTION PROPERTIES
 0.1315959E 02   0.1996890E 02
 0.2500000E 00   0.2500000E 00

                                TABLE ORDER PHI OR S VS. TEMPERATURE LOADS
 0.1000000E 03   0.1000000E 03
 0.0             0.0
 0.0             0.0
-0.1000000E 03  -0.1000000E 03
```

PHI (RAD. OR IN.)	DEGREES	PRINT INTERVAL	STEP	R ZERO	NUMBER OF CYCLES
EPSILON THETA	EPSILON PHI	GAMMA PHI THETA	K PHI	K THETA	N TEMPERATURE THETA
U	Q PHI	K PHI THETA	J PHI STAR	T PHI THETA	N TEMPERATURE PHI
V	J PHI	N THETA	N PHI	N PHI THETA	M TEMPERATURE THETA
W	Q THETA	M THETA	M PHI	M PHI THETA	M TEMPERATURE PHI
OMEGA THETA	TAU ZETA PHI = Q/T	SIGMA THETA IN	SIGMA PHI IN	TAU PHI THETA IN	SIGMA F IN
OMEGA PHI	TAU ZETA THETA = Q/T	SIGMA THETA OUT	SIGMA PHI OUT	TAU PHI THETA OUT	SIGMA F OUT
		PROBLEM NUMBER 1			
0.1315960E 02	0.0	0.5000000E 00	0.6809294E-01	0.2500000E 02	1
-0.1755364E-09	-0.6097308E-09	0.0	0.6249998E-08	0.0	0.0
0.0	-0.9741524E-04	0.0	-0.9741524E-04	0.0	0.0
0.1393664E-09	-0.9741524E-04	-0.2951832E-02	-0.5451031E-02	0.0	0.2901782E 03
0.4388411E-08	0.0	-0.2901782E 03	-0.2901785E 03	-0.0	0.2901782E 03
-0.1439790E-07	0.0	-0.2785712E 05	-0.2785716E 05	0.0	0.2785714E 05
0.0	0.0	0.2785710E 05	0.2785712E 05	0.0	0.2785711E 05
		PROBLEM NUMBER 1			
0.1370434E 02	0.0	0.5000000E 00	0.6809294E-01	0.2500000E 02	33
0.9678488E-10	-0.6910272E-09	0.0	0.7271854E-08	0.0	0.0
0.0	-0.5661287E-04	0.0	-0.5661287E-04	0.0	0.0
-0.2157527E-09	-0.5661287E-04	-0.8944224E-03	-0.5451031E-02	0.0	0.2901782E 03
-0.2469622E-08	0.0	-0.2901782E 03	-0.2901785E 03	-0.0	0.2901782E 03
-0.1068924E-07	0.0	-0.2785711E 05	-0.2785716E 05	0.0	0.2785714E 05
0.0	0.0	0.2785711E 05	0.278[illegible]2E 05	0.0	0.2785711E 05
		PROBLEM NUMBER 1			
0.1424908E 02	0.0	0.5000000E 00	0.6809294E-01	0.2500000E 02	65
0.2870659E-09	-0.7475116E-09	0.0	0.8005554E-08	0.0	0.0
0.0	-0.5374377E-04	0.0	-0.5374377E-04	0.0	0.0
-0.6088050E-09	-0.5374377E-04	0.5176866E-03	-0.5451031E-02	0.0	0.2901782E 03
-0.7176652E-08	0.0	-0.2901782E 03	-0.2901785E 03	-0.0	0.2901782E 03
-0.6526449E-08	0.0	-0.2785711E 05	-0.2785716E 05	0.0	0.2785713E 05
0.0	0.0	0.2785711E 05	0.2785712E 05	0.0	0.2785711E 05
		PROBLEM NUMBER 1			
0.1479382E 02	0.0	0.5000000E 00	0.6809294E-01	0.2500000E 02	97
0.3801743E-09	-0.7754442E-09	0.0	0.8878501E-03	0.0	0.0
0.0	-0.7399207E-04	0.0	-0.7399207E-04	0.0	0.0
-0.1024975E-08	-0.7399207E-04	0.1215999E-02	-0.5451031E-02	0.0	0.2901782E 03
-0.9504362E-08	0.0	-0.2901782E 03	-0.2901785E 03	-0.0	0.2901782E 03
-0.1940659E-08	0.0	-0.2785711E 05	-0.2785717E 05	0.0	0.2785713E 05
0.0	0.0	0.2785712E 05	0.2785712E 05	0.0	0.2785712E 05
		PROBLEM NUMBER 1			

0.1533855E 02	0.0	0.5000000E 00	0.6809294E-01	0.2500000E 02	129
0.3675351E-09	-0.7716534E-09	0.0	0.1010091E-07	0.0	0.0
0.0	-0.1009837E-03	0.0	-0.1009837E-03	0.0	0.0
-0.1447888E-08	-0.1009837E-03	0.1121235E-02	-0.5451031E-02	0.0	0.2901782E 03
-0.9188479E-08	0.0	-0.2901782E 03	-0.2901785E 03	-0.0	0.2901782E 03
0.3211474E-08	0.0	-0.2785711E 05	-0.2785717E 05	0.0	0.2785714E 05
0.0	0.0	0.2785712E 05	0.2785713E 05	0.0	0.2785712E 05

PROBLEM NUMBER 1

0.1568329E 02	0.0	0.5000000E 00	0.6809294E-01	0.2500000E 02	161
0.2346799E-09	-0.7317957E-09	0.0	0.1164123E-07	0.0	0.0
0.0	-0.1163128E-03	0.0	-0.1163128E-03	0.0	0.0
-0.1859138E-08	-0.1163128E-03	0.1247910E-03	-0.5451031E-02	0.0	0.2901782E 03
-0.5366998E-08	0.0	-0.2901782E 03	-0.2901785E 03	-0.0	0.2901782E 03
0.9123486E-08	0.0	-0.2785711E 05	-0.2785718E 05	0.0	0.2785714E 05
0.0	0.0	0.2785711E 05	0.2785714E 05	0.0	0.2785712E 05

PROBLEM NUMBER 1

0.1642798E 02	0.0	0.5000000E 00	0.6809294E-01	0.2500000E 02	193
-0.3638526E-10	-0.6504761E-09	0.0	0.1319323E-07	0.0	0.0
0.0	-0.9889388E-04	0.0	-0.9889388E-04	0.0	0.0
-0.2237641E-08	-0.9889388E-04	-0.1908198E-02	-0.5451031E-02	0.0	0.2901782E 03
0.9096315E-09	0.0	-0.2901782E 03	-0.2901787E 03	-0.0	0.2901782E 03
0.1569846E-07	0.0	-0.2785712E 05	-0.2785718E 05	0.0	0.2785715E 05
0.0	0.0	0.2785711E 05	0.2785714E 05	0.0	0.2785712E 05

PROBLEM NUMBER 1

0.1597266E 02	0.0	0.5000000E 00	0.6809294E-01	0.2500000E 02	225
-0.4634659E-09	-0.5223519E-09	0.0	0.1413569E-07	0.0	0.0
0.0	-0.2464285E-04	0.0	-0.2464285E-04	0.0	0.0
-0.2559311E-08	-0.2464285E-04	-0.5111303E-02	-0.5451031E-02	0.0	0.2901782E 03
0.1158665E-07	0.0	-0.2901782E 03	-0.2901787E 03	-0.0	0.2901782E 03
0.2338880E-07	0.0	-0.2785713E 05	-0.2785719E 05	0.0	0.2785716E 05
0.0	0.0	0.2785709E 05	0.2785714E 05	0.0	0.2785711E 05

PROBLEM NUMBER 1

0.1751733E 02	0.0	0.5000000E 00	0.6809294E-01	0.2500000E 02	257
-0.1056786E-08	-0.3443561E-09	0.0	0.1349324E-07	0.0	0.0
0.0	0.1329436E-03	0.0	0.1329436E-03	0.0	0.0
-0.2797647E-08	0.1329436E-03	-0.9561200E-02	-0.5451031E-02	0.0	0.2901782E 03
0.2641965E-07	0.0	-0.2901782E 03	-0.2901787E 03	-0.0	0.2901782E 03
0.3101360E-07	0.0	-0.2785715E 05	-0.2785719E 05	0.0	0.2785716E 05
0.0	0.0	0.2785707E 05	0.2785714E 05	0.0	0.2785711E 05

PROBLEM NUMBER 1

0.1806201E 02	0.0	0.5000000E 00	0.6809294E-01	0.2500000E 02	289
-0.1807382E-08	-0.1191775E-09	0.0	0.9915265E-08	0.0	0.0
0.0	0.4006596E-03	0.0	0.4006596E-03	0.0	0.0
-0.2925852E-08	0.4006596E-03	-0.1519067E-01	-0.5451031E-02	0.0	0.2901782E 03
0.4518455E-07	0.0	-0.2901782E 03	-0.2901785E 03	-0.0	0.2901782E 03
0.3755864E-07	0.0	-0.2785717E 05	-0.2785717E 05	0.0	0.2785717E 05
0.0	0.0	0.2785705E 05	0.2785713E 05	0.0	0.2785708E 05

PROBLEM NUMBER 1

0.1860669E 02	0.0	0.5000000E 00	0.6809294E-01	0.2500000E 02	321
-0.2671095E-08	0.1399363E-09	0.0	0.1699343E-08	0.0	0.0
0.0	0.8012063E-03	0.0	0.8012063E-03	0.0	0.0
-0.2921227E-08	0.8012063E-03	-0.2166852E-01	-0.5451031E-02	0.0	0.2901782E 03
0.6677737E-07	0.0	-0.2901782E 03	-0.2901782E 03	-0.0	0.2901782E 03
0.4097557E-07	0.0	-0.2785720E 05	-0.2785714E 05	0.0	0.2785716E 05
0.0	0.0	0.2785702E 05	0.2785710E 05	0.0	0.2785705E 05

PROBLEM NUMBER 1

0.1915137E 02	0.0	0.5000000E 00	0.6809294E-01	0.2500000E 02	353
-0.3556918E-08	0.4056830E-09	0.0	-0.1115230E-07	0.0	0.0
0.0	0.1346240E-02	0.0	0.1346240E-02	0.0	0.0
-0.2772115E-08	0.1346240E-02	-0.2831219E-01	-0.5451031E-02	0.0	0.2901782E 03
0.8892295E-07	0.0	-0.2901780E 03	-0.2901775E 03	-0.0	0.2901782E 03
0.3912277E-07	0.0	-0.2785720E 05	-0.2785709E 05	0.0	0.2785714E 05
0.0	0.0	0.2785698E 05	0.2785704E 05	0.0	0.2785700E 05

PROBLEM NUMBER 1

0.1969604E 02	0.0	0.5000000E 00	0.6809294E-01	0.2500000E 02	385
-0.4305846E-08	0.6303622E-09	0.0	-0.3258158E-07	0.0	0.0
0.0	0.2027683E-02	0.0	0.2027683E-02	0.0	0.0
-0.2486593E-08	0.2027683E-02	-0.3392918E-01	-0.5451031E-02	0.0	0.2901782E 03
0.1076462E-06	0.0	-0.2901777E 03	-0.2901768E 03	-0.0	0.2901782E 03
0.2775354E-07	0.0	-0.2785720E 05	-0.2785700E 05	0.0	0.2785709E 05
0.0	0.0	0.2785693E 05	0.2785696E 05	0.0	0.2785694E 05

PROBLEM NUMBER 1

0.1996838E 02	0.0	0.5000000E 00	0.6809294E-01	0.2500000E 02	401
-0.4554007E-08	0.7048109E-09	0.0	-0.4608189E-07	0.0	0.0
0.0	0.2408254E-02	0.0	0.2408254E-02	0.0	0.0
-0.2303983E-08	0.2408254E-02	-0.3579039E-01	-0.5451031E-02	0.0	0.2901782E 03
0.1138503E-06	0.0	-0.2901775E 03	-0.2901760E 03	-0.0	0.2901782E 03
0.1721178E-07	0.0	-0.2785718E 05	-0.2785694E 05	0.0	0.2785705E 05
0.0	0.0	0.2785690E 05	0.2785690E 05	0.0	0.2785689E 05

PROBLEM NUMBER 1

0.1996887E 02	0.0	0.5000000E 00	0.6809294E-01	0.2500000E 02	405
-0.4554355E-08	0.7049152E-09	0.0	-0.4611294E-07	0.0	0.0
0.0	0.2408975E-02	0.0	0.2408975E-02	0.0	0.0
-0.2303628E-08	0.2408975E-02	-0.3579300E-01	-0.5451031E-02	0.0	0.2901782E 03
0.1138590E-06	0.0	-0.2901775E 03	-0.2901760E 03	-0.0	0.2901782E 03
0.1718857E-07	0.0	-0.2785718E 05	-0.2785694E 05	0.0	0.2785705E 05
0.0	0.0	0.2785690E 05	0.2785690E 05	0.0	0.2785689E 05

```
                                        REGION NUMBER  4

                     THERE ARE  1 SEGMENTS AND  0 KINEMATIC LINKS WITHIN THIS REGION

         SEGMENT NUMBER  1      SEGMENT CODE 31         FOURTH REGION, FIRST SEGMENT

                                  TABLE ORDER PHI OR S VS. CROSSECTION PROPERTIES
 0.1996389E 02   0.2726460E 02
 0.2500000E 00   0.2500000E 00

                                   TABLE ORDER PHI OR S VS. TEMPERATURE LOADS
 0.1000000E 03   0.1000000E 03
 0.0             0.0
 0.0             0.0
-0.1000000E 03  -0.1000000E 03
```

PHI (RAD. OR IN.)	DEGREES	PRINT INTERVAL	STEP	R ZERO	NUMBER OF CYCLES
EPSILON THETA	EPSILON PHI	GAMMA PHI THETA	K PHI	K THETA	N TEMPERATURE THETA
U	Q PHI	K PHI THETA	J PHI STAR	T PHI THETA	N TEMPERATURE PHI
V	J PHI	N THETA	N PHI	N PHI THETA	M TEMPERATURE THETA
W	Q THETA	M THETA	M PHI	M PHI THETA	M TEMPERATURE PHI
OMEGA THETA	TAU ZETA PHI = Q/T	SIGMA THETA IN	SIGMA PHI IN	TAU PHI THETA IN	SIGMA F IN
OMEGA PHI	TAU ZETA THETA = Q/T	SIGMA THETA OUT	SIGMA PHI OUT	TAU PHI THETA OUT	SIGMA F OUT

PROBLEM NUMBER 1

0.1996889E 02	0.0	0.5000000E 00	0.7295698E-01	0.2500000E 02	1
0.3260786E-08	-0.1639632E-08	0.0	0.5273435E-07	0.0	0.0
0.0	0.2167387E-02	0.0	0.2167387E-02	0.0	0.0
-0.1425664E-07	0.2167387E-02	0.2282057E-01	-0.5451068E-02	0.0	0.2901782E 03
-0.8151966E-07	0.0	-0.2901787E 03	-0.2901804E 03	-0.0	0.2901782E 03
-0.1316233E-07	0.0	-0.2785707E 05	-0.2785735E 05	0.0	0.2785721E 05
0.0	0.0	0.2785725E 05	0.2785730E 05	0.0	0.2785728E 05

PROBLEM NUMBER 1

0.2047945E 02	0.0	0.5000000E 00	0.7295698E-01	0.2500000E 02	29
0.3299056E-08	-0.1651125E-08	0.0	0.2944724E-07	0.0	0.0
0.0	0.1692903E-02	0.0	0.1692903E-02	0.0	0.0
-0.1510231E-07	0.1692903E-02	0.2310791E-01	-0.5451068E-02	0.0	0.2901782E 03
-0.8247741E-07	0.0	-0.2901785E 03	-0.2901792E 03	-0.0	0.2901782E 03
0.7510579E-08	0.0	-0.2785704E 05	-0.2785725E 05	0.0	0.2785714E 05
0.0	0.0	0.2785723E 05	0.2785721E 05	0.0	0.2785721E 05

PROBLEM NUMBER 1

0.2099001E 02	0.0	0.5000000E 00	0.7295698E-01	0.2500000E 02	57
0.3025852E-08	-0.1569151E-08	0.0	0.1188941E-07	0.0	0.0
0.0	0.1239114E-02	0.0	0.1239114E-02	0.0	0.0
-0.1592727E-07	0.1239114E-02	0.2105857E-01	-0.5451068E-02	0.0	0.2901782E 03
-0.7564631E-07	0.0	-0.2901782E 03	-0.2901785E 03	-0.0	0.2901782E 03
0.1781307E-07	0.0	-0.2785703E 05	-0.2785718E 05	0.0	0.2785710E 05
0.0	0.0	0.2785720E 05	0.2785714E 05	0.0	0.2785716E 05

PROBLEM NUMBER 1

0.2150056E 02	0.0	0.5000000E 00	0.7295698E-01	0.2500000E 02	85
0.2625600E-08	-0.1449076E-08	0.0	0.3254161E-09	0.0	0.0
0.0	0.8389687E-03	0.0	0.8389687E-03	0.0	0.0
-0.1669860E-07	0.8389687E-03	0.1805668E-01	-0.5451068E-02	0.0	0.2901782E 03
-0.6563999E-07	0.0	-0.2901780E 03	-0.2901780E 03	-0.0	0.2901782E 03
0.2032942E-07	0.0	-0.2785702E 05	-0.2785713E 05	0.0	0.2785707E 05
0.0	0.0	0.2785716E 05	0.2785709E 05	0.0	0.2785712E 05

PROBLEM NUMBER 1

0.2201112E 02	0.0	0.5000000E 00	0.7295698E-01	0.2500000E 02	113
0.2225662E-08	-0.1329095E-08	0.0	-0.8369085E-08	0.0	0.0
0.0	0.5013396E-03	0.0	0.5013396E-03	0.0	0.0
-0.1740741E-07	0.5013396E-03	0.1505714E-01	-0.5451068E-02	0.0	0.2901782E 03
-0.5564156E-07	0.0	-0.2901780E 03	-0.2901777E 03	-0.0	0.2901782E 03
0.1808769E-07	0.0	-0.2785703E 05	-0.2785710E 05	0.0	0.2785705E 05
0.0	0.0	0.2785715E 05	0.2785705E 05	0.0	0.2785710E 05

PROBLEM NUMBER 1

0.2252168E 02	0.0	0.5000000E 00	0.7295698E-01	0.2500000E 02	141
0.1909534E-08	-0.1234256E-08	0.0	-0.1302790E-07	0.0	0.0
0.0	0.2194443E-03	0.0	0.2194443E-03	0.0	0.0
-0.1806048E-07	0.2194443E-03	0.1268618E-01	-0.5451068E-02	0.0	0.2901782E 03
-0.4773834E-07	0.0	-0.2901780E 03	-0.2901775E 03	-0.0	0.2901782E 03
0.1246730E-07	0.0	-0.2785704E 05	-0.2785708E 05	0.0	0.2785705E 05
0.0	0.0	0.2785714E 05	0.2785704E 05	0.0	0.2785708E 05

PROBLEM NUMBER 1

0.2303224E 02	0.0	0.5000000E 00	0.7295698E-01	0.2500000E 02	169
0.1726365E-08	-0.1179306E-08	0.0	-0.1427610E-07	0.0	0.0
0.0	-0.2381603E-04	0.0	-0.2381603E-04	0.0	0.0
-0.1867492E-07	-0.2381603E-04	0.1131242E-01	-0.5451068E-02	0.0	0.2901782E 03
-0.4315913E-07	0.0	-0.2901780E 03	-0.2901775E 03	-0.0	0.2901782E 03
0.5360103E-08	0.0	-0.2785704E 05	-0.2785707E 05	0.0	0.2785705E 05
0.0	0.0	0.2785713E 05	0.2785703E 05	0.0	0.2785708E 05

PROBLEM NUMBER 1

0.2354280E 02	0.0	0.5000000E 00	0.7295698E-01	0.2500000E 02	197
0.1689497E-08	-0.1168245E-08	0.0	-0.1247838E-07	0.0	0.0
0.0	-0.2502599E-03	0.0	-0.2502599E-03	0.0	0.0
-0.1927255E-07	-0.2502599E-03	0.1103591E-01	-0.5451068E-02	0.0	0.2901782E 03
-0.4223743E-07	0.0	-0.2901780E 03	-0.2901775E 03	-0.0	0.2901782E 03
-0.1597422E-08	0.0	-0.2785704E 05	-0.2785708E 05	0.0	0.2785705E 05
0.0	0.0	0.2785713E 05	0.2785704E 05	0.0	0.2785708E 05

PROBLEM NUMBER 1

0.2405336E 02	0.0	0.5000000E 00	0.7295698E-01	0.2500000E 02	225
0.1780240E-08	-0.1195468E-08	0.0	-0.7711716E-08	0.0	0.0
0.0	-0.4812675E-03	0.0	-0.4812675E-03	0.0	0.0
-0.15[illegible]7474E-07	-0.4812675E-03	0.1171648E-01	-0.5451068E-02	0.0	0.2901782E 03
-0.4450601E-07	0.0	-0.2901780E 03	-0.2901777E 03	-0.0	0.2901782E 03
-0.6881326E-08	0.0	-0.2785704E 05	-0.2785710E 05	0.0	0.2785707E 05
0.0	0.0	0.2785713E 05	0.2785705E 05	0.0	0.2785709E 05

PROBLEM NUMBER 1

0.2456392E 02	0.0	0.5000000E 00	0.7295698E-01	0.2500000E 02	253
0.1948711E-08	-0.1246010E-08	0.0	0.1973426E-09	0.0	0.0
0.0	-0.7329723E-03	0.0	-0.7329723E-03	0.0	0.0
-0.2049762E-07	-0.7329723E-03	0.1298001E-01	-0.5451068E-02	0.0	0.2901782E 03
-0.4871778E-07	0.0	-0.2901780E 03	-0.2901780E 03	-0.0	0.2901782E 03
-0.8940106E-08	0.0	-0.2785704E 05	-0.2785713E 05	0.0	0.2785708E 05
0.0	0.0	0.2785714E 05	0.2785709E 05	0.0	0.2785711E 05

PROBLEM NUMBER 1

0.2507448E 02	0.0	0.5000000E 00	0.7295698E-01	0.2500000E 02	281
0.2119178E-08	-0.1297149E-08	0.0	0.9620148E-08	0.0	0.0
0.0	-0.1011680E-02	0.0	-0.1011680E-02	0.0	0.0
-0.2114751E-07	-0.1011680E-02	0.1425852E-01	-0.5451068E-02	0.0	0.2901782E 03
-0.5297946E-07	0.0	-0.2901782E 03	-0.2901785E 03	-0.0	0.2901782E 03
-0.6920828E-08	0.0	-0.2785705E 05	-0.2785717E 05	0.0	0.2785711E 05
0.0	0.0	0.2785717E 05	0.2785713E 05	0.0	0.2785715E 05

PROBLEM NUMBER 1

0.2558504E 02	0.0	0.5000000E 00	0.7295698E-01	0.2500000E 02	309
0.2186256E-08	-0.1317273E-08	0.0	0.2322466E-07	0.0	0.0
0.0	-0.1310295E-02	0.0	-0.1310295E-02	0.0	0.0
-0.2181730E-07	-0.1310295E-02	0.1476159E-01	-0.5451068E-02	0.0	0.2901782E 03
-0.5465639E-07	0.0	-0.2901785E 03	-0.2901790E 03	-0.0	0.2901782E 03
0.1439665E-08	0.0	-0.2785707E 05	-0.2785723E 05	0.0	0.2785715E 05
0.0	0.0	0.2785720E 05	0.2785718E 05	0.0	0.2785719E 05

PROBLEM NUMBER 1

0.2609560E 02	0.0	0.5000000E 00	0.7295698E-01	0.2500000E 02	337
0.2003331E-08	-0.1262395E-08	0.0	0.4033990E-07	0.0	0.0
0.0	-0.1602134E-02	0.0	-0.1602134E-02	0.0	0.0
-0.2248032E-07	-0.1602134E-02	0.1338965E-01	-0.5451068E-02	0.0	0.2901782E 03
-0.5008328E-07	0.0	-0.2901787E 03	-0.2901799E 03	-0.0	0.2901782E 03
0.1793795E-07	0.0	-0.2785711E 05	-0.2785730E 05	0.0	0.2785720E 05
0.0	0.0	0.2785721E 05	0.2785726E 05	0.0	0.2785723E 05

PROBLEM NUMBER 1

0.2660616E 02	0.0	0.5000000E 00	0.7295698E-01	0.2500000E 02	365
0.1388851E-08	-0.1078052E-08	0.0	0.6095968E-07	0.0	0.0
0.0	-0.1835401E-02	0.0	-0.1835401E-02	0.0	0.0
-0.2308477E-07	-0.1835401E-02	0.8781064E-02	-0.5451068E-02	0.0	0.2901782E 03
-0.3472129E-07	0.0	-0.2901790E 03	-0.2901807E 03	-0.0	0.2901782E 03
0.4400667E-07	0.0	-0.2785715E 05	-0.2785739E 05	0.0	0.2785726E 05
0.0	0.0	0.2785721E 05	0.2785734E 05	0.0	0.2785728E 05

PROBLEM NUMBER 1

0.2711671E 02	0.0	0.5000000E 00	0.7295698E-01	0.2500000E 02	393
0.1303086E-09	-0.7004888E-09	0.0	0.8381750E-07	0.0	0.0
0.0	-0.1928066E-02	0.0	-0.1928066E-02	0.0	0.0
-0.2354362E-07	-0.1928066E-02	-0.6580059E-03	-0.5451068E-02	0.0	0.2901782E 03
-0.3257715E-08	0.0	-0.2901792E 03	-0.2901816E 03	-0.0	0.2901782E 03
0.8111277E-07	0.0	-0.2785721E 05	-0.2785748E 05	0.0	0.2785734E 05
0.0	0.0	0.2785720E 05	0.2785743E 05	0.0	0.2785731E 05

PROBLEM NUMBER 1

0.2726259E 02	0.0	0.5000000E 00	0.7295698E-01	0.2500000E 02	401
-0.3798226E-09	-0.5474494E-09	0.0	0.9099904E-07	0.0	0.0
0.0	-0.1913332E-02	0.0	-0.1913332E-02	0.0	0.0
-0.2363953E-07	-0.1913332E-02	-0.4483990E-02	-0.5451068E-02	0.0	0.2901782E 03
0.9495569E-08	0.0	-0.2901792E 03	-0.2901819E 03	-0.0	0.2901782E 03
0.9386753E-07	0.0	-0.2785722E 05	-0.2785750E 05	0.0	0.2785736E 05
0.0	0.0	0.2785719E 05	0.2785746E 05	0.0	0.2785732E 05

PROBLEM NUMBER 1

0.2726457E 02	0.0	0.5000000E 00	0.7295698E-01	0.2500000E 02	405
-0.3873353E-09	-0.5451957E-09	0.0	0.9109692E-07	0.0	0.0
0.0	-0.1912971E-02	0.0	-0.1912971E-02	0.0	0.0
-0.2364103E-07	-0.1912971E-02	-0.4540335E-02	-0.5451068E-02	0.0	0.2901782E 03
0.9683383E-08	0.0	-0.2901792E 03	-0.2901819E 03	-0.0	0.2901782E 03
0.9404948E-07	0.0	-0.2785722E 05	-0.2785750E 05	0.0	0.2785736E 05
0.0	0.0	0.2785719E 05	0.2785746E 05	0.0	0.2785732E 05

SECTION 5

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APPENDIX A

HIGHER HARMONIC LOADINGS

The representation of unsymmetric loads by the use of Fourier Harmonic coefficients is a mathematical simplification which allows the elimination of partial differential equations from the derivations of particular shell theories. Since there is no physical reasoning behind these simplifications, the use of harmonics for load representation may present some difficulties for the user. These difficulties may perhaps be best eliminated by the discussion of a general physical problem involving unsymmetric loading.

Suppose that some general shell of revolution surface is loaded by an arbitrary unsymmetric loading such as may occur in aerodynamic problems. If any circular crossection of this surface is unwrapped for plotting purposes, the intensity of the loading (normal or shear) along the crossection can be plotted as a function of circumferential location from 0 to $2\pi r_0$ (see Figure A-1). Since the location of the origin for θ (circumferential angle) is arbitrary, a significant simplification is gained by locating it on a line of symmetry of the external loads, as shown in the figure. In the STARS II program, one line of symmetry must exist in the loading if it is to be amenable to solution. This requirement is due to the fact that only one-half of the Fourier Series was used in the derivations (see Reference 1 Section 2). Once the origin for θ is set for one crossection, it becomes fixed for all crossections.

On a typical crossection, the aerodynamic load will most likely be given in tabular form (the points shown in Figure A-1). Thus the problem becomes: How to represent an approximate curve drawn through the points (analytical equation unknown) in terms of a Fourier Series? One solution is as follows:

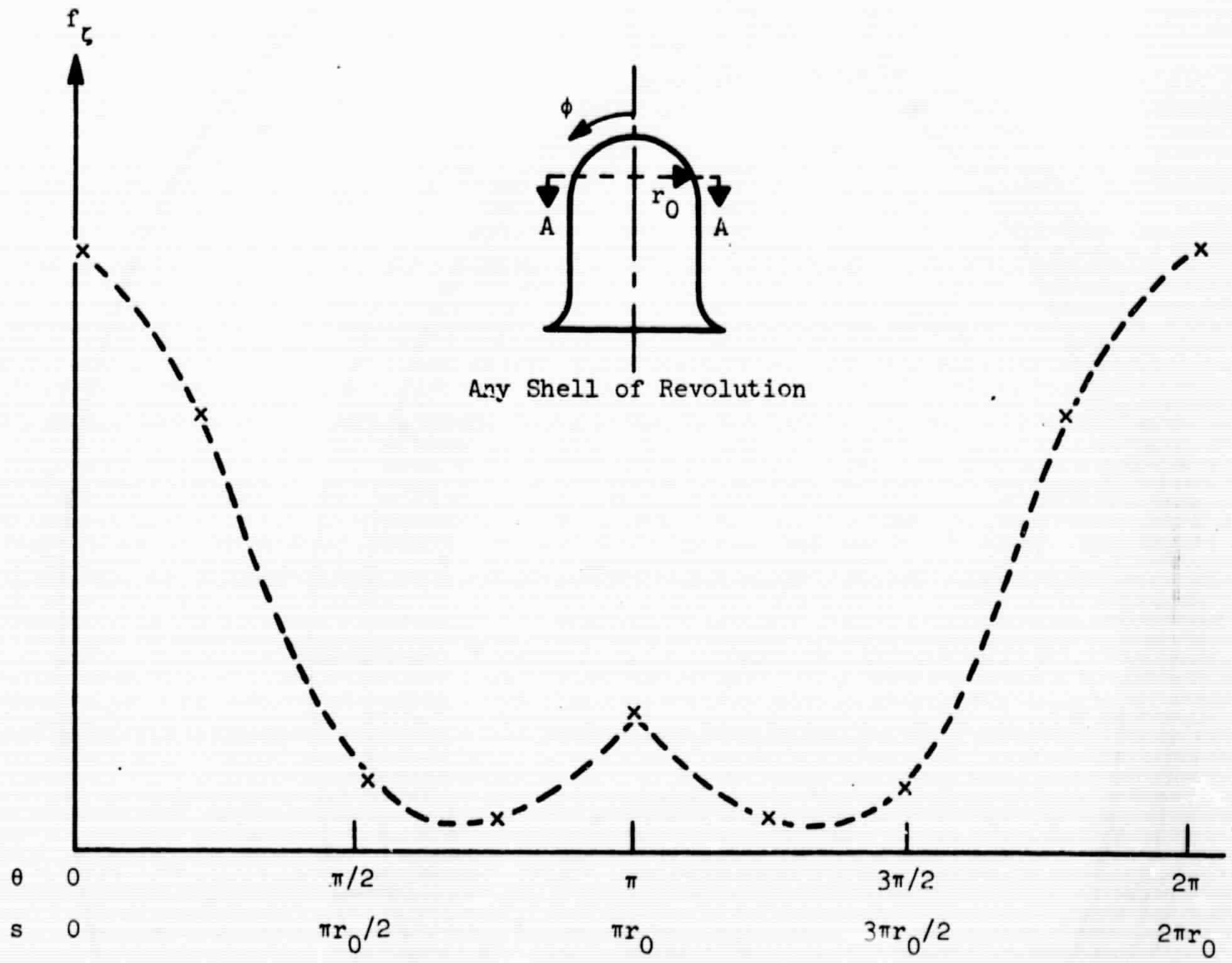
Step 1. Utilize the point plot to obtain a smooth analytical function (recommended = a polynomial).

Step 2. Obtain a Fourier series representation, cosine only or sine only as appropriate, of the analytical function found in Step 1.

The manipulations involved in these steps are discussed in most calculus and differential equation texts and won't be belabored here. The Fourier coefficients thus found quickly decrease in magnitude for most smooth loadings, and only a few are necessary. (See Figures A-2 through A-4 for sample shapes.)

This procedure is repeated at as many crossections as necessary, since the loading to be presented is not a planar area, but a space volume, using a Fourier Series variation in the θ direction, and linear interpolation, at up to 30 points per segment, in the ϕ direction. The Fourier Harmonic coefficients thus obtained, are the necessary load inputs to the STARS II program.

The output for a problem, in terms of stress resultants and stresses, will also be Fourier Series coefficients. Thus the final answer is obtained by summing the appropriate series at various values of θ. Algebraically summing the coefficients will give the correct value at $\theta = 0$, but other values should also be calculated. For instance, if the highest harmonic considered in a problem is the fourth, the coefficient $A^{(4)}$ will pass through the values $+ |A|$ and 0 twice, and $- |A|$ once, all between the values $\theta = 0$ and $\theta = \pi/2$. Strictly speaking, therefore, for an accurate picture of the results in a solution where the highest harmonic is "n", one should consider θ increments of the form $\pi/2n$.



Load Distribution at Crossection "A-A"

Figure A-1. Arbitrary Load Plot

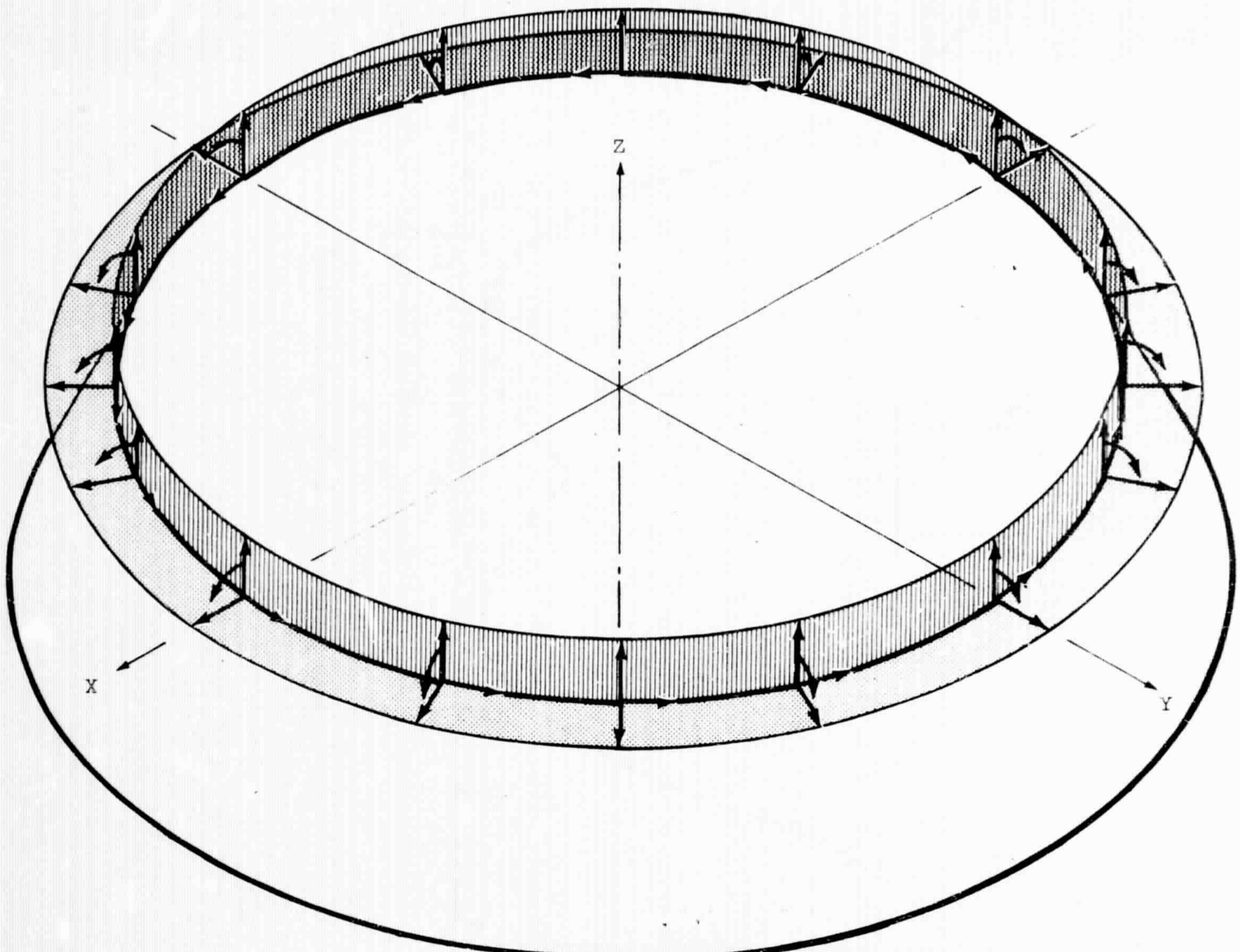


Figure A-2. n = 0 Axisymmetric Loading on Joint

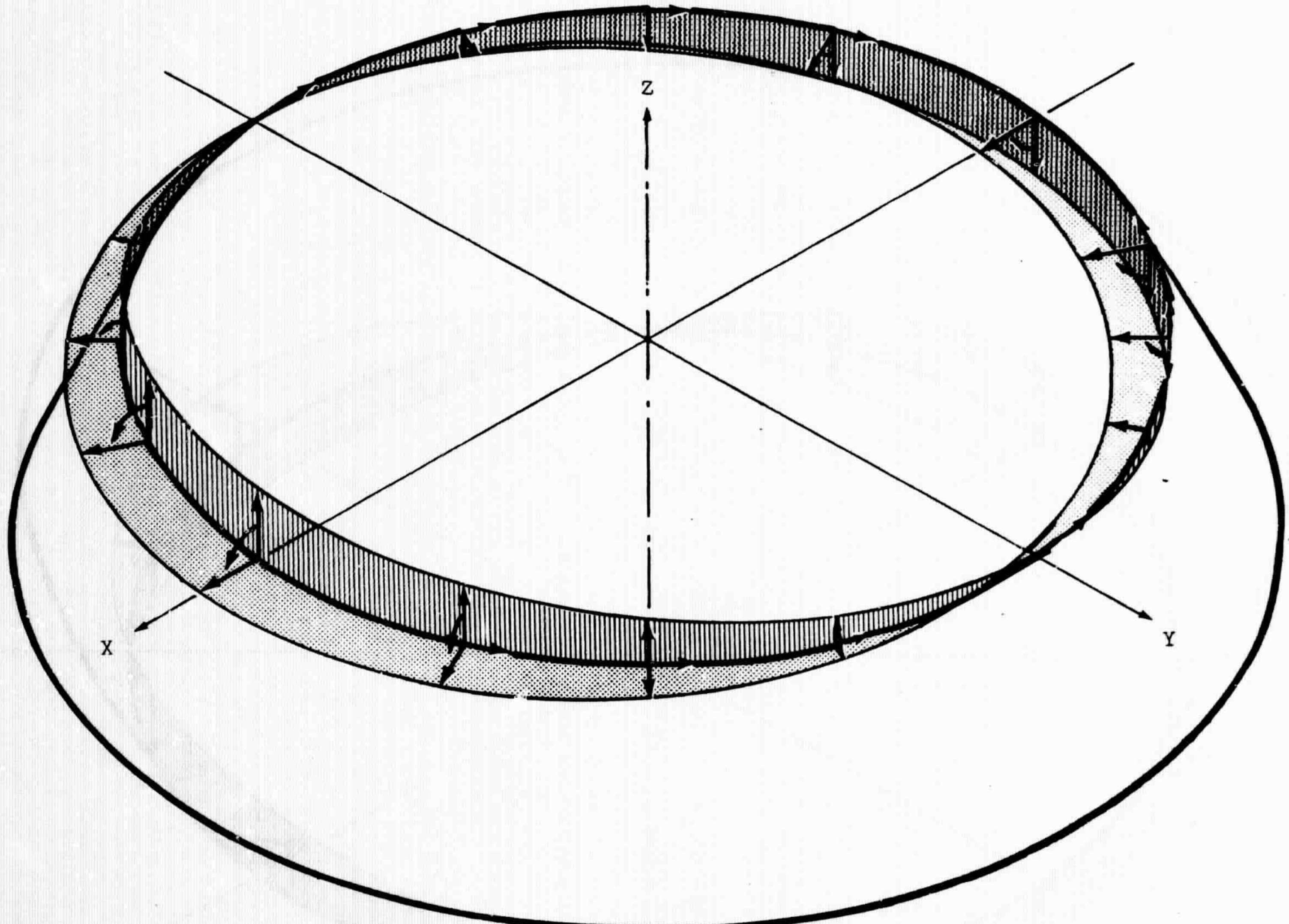


Figure A-3. n = 1 Antisymmetric Loading on Joint

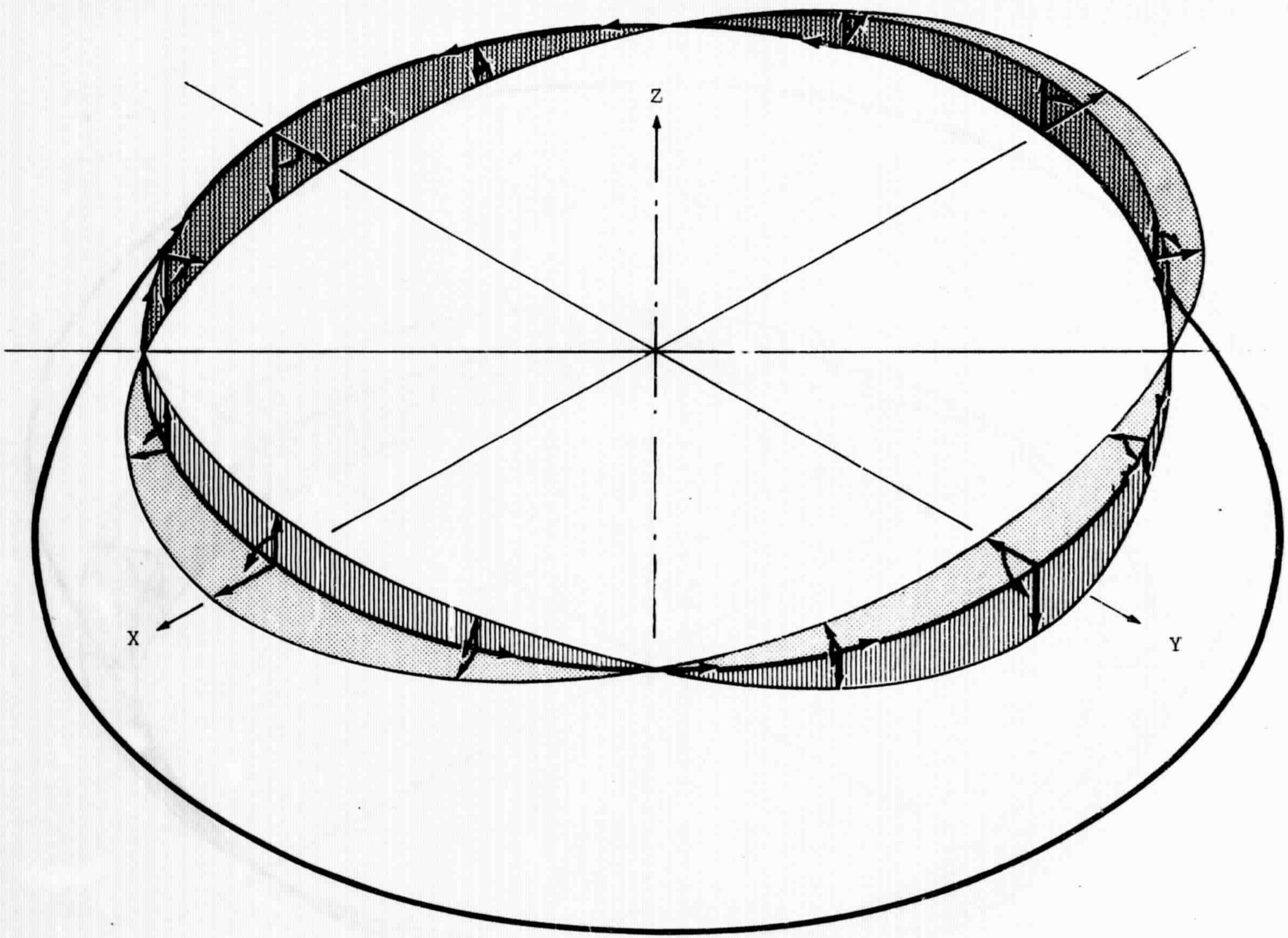


Figure A-4. n = 2 Typical Self-Equilibrating Loading on Joint

APPENDIX B

STRESS CALCULATIONS FOR REINFORCED CASES

Several items must be noted when a stress analysis is performed upon a reinforced construction by use of the current program. Some of these items can be treated as rules and some require engineering judgement. The rules to remember are as follows:

1. The hoop and meridional stresses output in a waffle reinforcement are rotated 45° from the θ and ϕ coordinates, and are actually in the waffle rib directions.
2. For a reinforced section, the in-plane shear stress is calculated for the meridional face only. This means that for a construction such as that shown in Figure B-1, $\tau_{\phi\theta}$ outer is calculated at point 1, and $\tau_{\phi\theta}$ inner is calculated at point 4.

Items requiring engineering consideration in the stress analysis, are the following:

3. If a shell crossection contains materials of different properties, either actually or due to differential thermal loading, there is no guarantee that the stress at the extreme point is the most critical. The analyst should decide whether a check of stresses at each location where material properties change is necessary.
4. For a structure such as that shown in Figure B-1, the program will calculate direct stresses at points 1, 4, 3 and the bottom point below 3, and in-plane shear stresses at points 1 and 4. While strain is linear from point 1 to point 4, there is a stress discontinuity at point 2. This will occur even if the material properties of shell and ribs are the same, since the governing Hooke's Laws differ (see Reference 6). The analyst must again decide whether the stresses at point 2 could be more critical than those at the extreme points.

Any additional stress calculations that the analyst decides to make on the basis of items 3 and 4, should be always made using the program strain and curvature output, and Hooke's Laws for ring, stringer or shell (Ref. 6). This can be done automatically in the program by providing the correct ζ distance (instead of the extreme) and by setting the stress clues for the appropriate Hooke's Laws (segment card data sets 10 and 11).

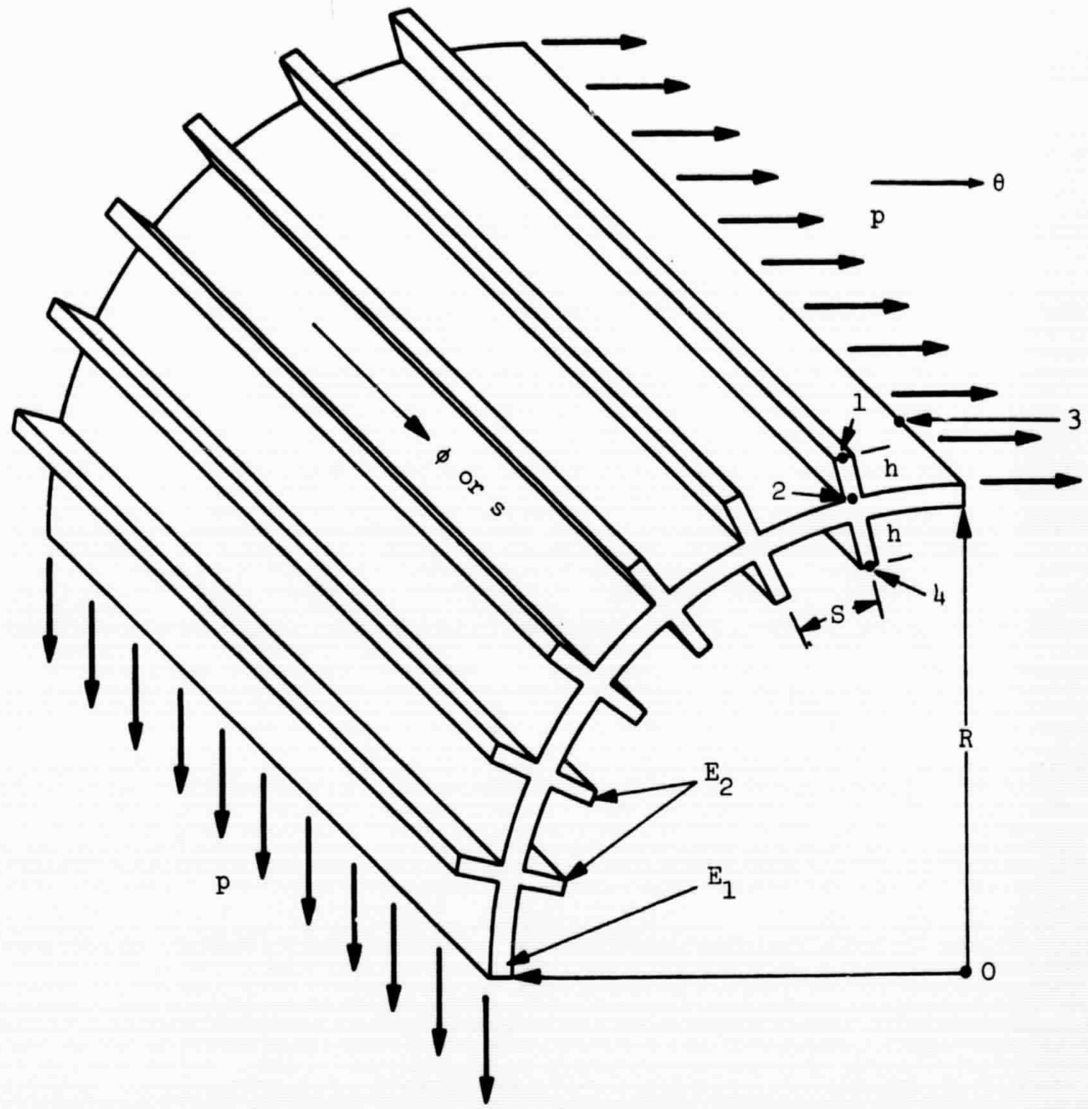


Figure B-1. Special Stress Case