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COLLOCATION FLUTTER ANALYSIS STUDY

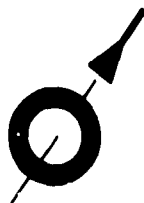
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VOLUME III (Continued)

AICs - COMPUTER PROGRAM TO CALCULATE UNSTEADY AERODYNAMIC
INFLUENCE COEFFICIENTS FOR SUBSONIC, TRANSONIC AND SUPERSONIC FLIGHT

APRIL 1969



MISSILE SYSTEMS DIVISION

HUGHES

HUGHES AIRCRAFT COMPANY

COFA

COLLOCATION FLUTTER ANALYSIS STUDY

VOLUME III (CONT'D)

AICs - COMPUTER PROGRAM TO CALCULATE
UNSTEADY AERODYNAMIC INFLUENCE COEFFICIENTS FOR
SUBSONIC, TRANSONIC, AND SUPERSONIC FLIGHT

Prepared by Dynamics & Environments Section Personnel
Hughes Aircraft Company, Missile Systems Division
Contract No.00019-68-C-0247

APRIL 1969

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ABSTRACT

Subsonic Kernel function, transonic box, and supersonic box methods for computing unsteady aerodynamics are applied to the problem of interaction of a general trapezoidal wing with a downstream rectangular control surface lying in the wake of the wing. The unsteady aerodynamic forces are related to a set of collocation stations through a series of matrix transformations, interpolations, and differentiations. The resulting matrix is a set of aerodynamic influence coefficients (AICs) that are directly applicable to flutter analysis.

The transformation of the unsteady aerodynamics into AICs is presented as a separate discussion; followed by discussions for the developments of analytical techniques for each flight regime. The analytical developments and a discussion of the basic single-planar-surface are presented, followed by the complete two-surface solutions for the general aerodynamic forces. Each of the three numerical methods is developed by detailing the complete set of equations necessary to compute airloads on the configurations considered. A computer program to determine the AIC matrix for each flight regime is presented with a complete discussion of usage and logical flow. Also included are program listings, flow charts and sample input and output problems.

PART V - SECTION A

TECHNICAL DISCUSSION OF THE TRANSONIC BOX METHOD

When the flight speed approaches the acoustic speed (i.e., transonic flow), the Mach number is near unity and Equation 4.1 can be rewritten

$$\phi_{yy} + \phi_{zz} = M^2 (2ik\phi_x - k^2\phi) \quad (5.1)$$

which is valid according to Reference 6 if $k \gg |M-1|$. Using this version of the linearized flow equation leads to a similarity rule in transonic flow. Air loads for Mach numbers near unity may be computed by a transformation of the geometry and flow field to the equivalent problem at $M=1$. The absence of the ϕ_{xx} term because of β^2 being of small order restricts the flow to one that has no variation in local Mach number along the surface. This restriction supplements the thin airfoil assumptions previously used in linearization. The condition can be simply stated as

$$k \gg |1 - M_L|$$

where M_L is the local Mach number over the surface.

A pulsating doublet placed in the $M=1$ free stream with the axis parallel to the z axis is a solution to Equation 5.1 and produces a velocity potential at (x, y, z) given by

$$\phi_D = \frac{ik(z-\xi)}{2\pi(x-\xi)^2} \exp \left\{ -1/2 ik \left[(x-\xi) + \frac{(y-\eta)^2 + (z-\xi)^2}{(x-\xi)} \right] \right\} \quad (5.2)$$

where the doublet is positioned at the point (ξ, η, ζ) . The doublet in transonic flow has no influence at points upstream of the line $x=\xi$. Consequently, the potential is zero in that region. The velocity potential due to a doublet is discontinuous at the point (ξ, η, ζ) .

That Equation 5.2 satisfies equation 5.1 may be checked by substitution. Furthermore, a solution to 5.1 may be obtained by superposition. This solution will be represented in the form

$$\phi(x, y, z) = \iint \phi(\xi, \eta) \phi_D(x, y, z, \xi, \eta, 0) d\xi d\eta \quad (5.3)$$

and it may be further shown that in the limit as $z \rightarrow 0$

$$\left[\phi(x, y, z)_{z+} - \phi(x, y, z)_{z-} \right] = \phi(x, y)$$

A sheet of these doublets covering the wing, wake, and tail will then provide the required lifting antisymmetry and jump in potential between upper and lower sides when the doublet strength function is determined by the appropriate boundary conditions. The velocity potential required to produce the necessary vertical velocity at a point (x,y) on the wing can be determined by application of the tangential flow boundary condition

$$w_W = \iint_W \psi(\xi, \eta) \psi(x-\xi, y-\eta) d\xi d\eta \quad (5.4)$$

where

$$\psi(x-\xi, y-\eta) = \lim_{z \rightarrow 0} \frac{1}{z} \phi_D = \frac{ik}{2\pi} \frac{1}{(x-\xi)^2} \exp \left[-\frac{1}{2} ik \left((x-\xi) + \frac{(y-\eta)^2}{(x-\xi)} \right) \right]$$

The function ψ is in effect the limit as $z \rightarrow 0$ of $\frac{\partial \phi_D}{\partial z}$ when $\xi = 0$. It is, consequently, the doublet downwash influence function when $\xi \leq x$. The zero pressure jump condition is written here for the wake velocity potential in terms of the wing trailing edge quantities.

$$\phi_{Wake} = \phi_{W_{TE}} \exp \left[-ik(x - x_{W_{TE}}) \right] \quad (5.5)$$

and further matching of the tangential flow condition gives the velocity potential required to produce downwash at a similar point on the tail as

$$w_T = \iint_{T + Wake + W} \phi(\xi, \eta) \psi(x-\xi, y-\eta) d\xi d\eta \quad (5.6)$$

where the region of integration is over the entire doublet sheet forward of the line $\xi = x$ (see Reference 12).

Equations 5.4, 5.5, and 5.6 then constitute a system of equations whereby the potential jump may be determined.

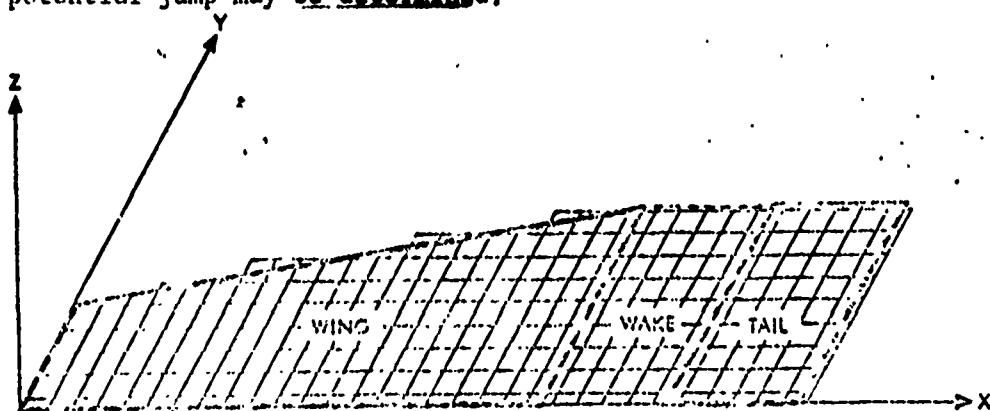


Figure 5.1 Transonic Box Overlay for a Typical Configuration at Sonic Mach Number

To compute the velocity potential distribution for each Mach number near unity and reduced frequency greater than zero, following the approach developed in Reference 1, we overlay the two surfaces and intervening wake with a system of square boxes of relative length Δ adjusted so that box centers lie along the x axis and the wing trailing edge and so that box edges lie along the y axis. A typical box overlay on a trapezoidal wing, wake, and downstream control surface is shown in Figure 5.1. Only boxes that have their centers within the respective regions are considered in this development.

If the potential function $\phi(x,y)$ is approximated by a function which is constant in each of the boxes and equal to the value at its center in the wake region, the downwash condition on the wing and control surfaces is matched at the center of each box.

The boxes will be designated by n and v in the chordwise direction and by m and μ in the spanwise direction. Then for (n, m) on the wing

$$w_{n,m} = \sum_v \sum_\mu \phi_{v,\mu} A(n-v, |m-\mu|) \quad (5.7)$$

for (n,m) on wake,

$$\phi_{n,m} = \phi_{W_{TE_m}} \exp \left[-ik(n-n_{W_{TE_m}}) \right] \quad (5.8)$$

and for (n,m) on T, (v,μ) on W, T, and wake,

$$w_{n,m} = \sum_v \sum_\mu \phi_{v,\mu} A(n-v, |m-\mu|) \quad (5.9)$$

where $n = x/\Delta$, $m = y/\Delta$, $v = \xi/\Delta$, and $\mu = \eta/\Delta$ are coordinates of the box centers and $v \leq n$. The aerodynamic influence coefficients (AIC's) are given by

$$A(n-v, |m-\mu|) = \iint_{\text{BOX AREA}} \psi(x-\xi, y-\eta) d\xi d\eta \quad (5.10)$$

and are computed for each pair of relative box locations by integration of the doublet influence function, ψ , over that portion of the sending box centered at (v,μ) that influences the receiving point (n,m) . Approximation formulas and integration techniques for evaluation of the transonic AIC's are developed in Reference 12.

Solutions to Equation 5.9 at each box center can be obtained most efficiently by the separation of the terms in the n th row from the remainder of the sum to

obtain the smaller system of equations for the wing, W,

$$\sum_{\mu} A(o, |m-\mu|) \phi_{n,\mu} = w_{n,m} - \sum_{\nu < n} \sum_{\mu} A(n-\nu, |m-\mu|) \phi_{\nu,\mu} \quad (5.11)$$

where the AIC's $A(o, |m-\mu|)$ represent the effect of every other box in the nth row on the mth box, and the double summation gives the contribution to the downwash at the box center of all the boxes located in all the upstream rows. Since the downwash is directly calculable from tangential flow considerations (Equation 5.4), and since the velocity potential to be computed at the box center is contained in a sum, Equation 5.11 has to be applied to the entire nth row to solve for the velocity potentials at all box centers in that row simultaneously. The procedure would build up the velocity potential distribution over the wing one row at a time until the trailing edge row was completed. The numerical complexity is not increased, however, by a large number of box rows over the configuration because the influence coming from more than 15 rows away is negligible. Therefore, the AIC's for $n-\nu > 15$ are not needed.

With the wing trailing edge velocity potential values now available, the distribution is continued downstream in the wake region for all boxes by simply employing Equation 5.8 for each box. This method adequately determines the velocity potential distribution between the wing trailing edge and tail leading edge under the assumptions that no rolling up of wing tip vortices occurs. The downwash in this region is not readily computed, but fortunately is not required in subsequent computations.

To compute the velocity potential distribution on the tail, rewrite Equation 5.9 in the smaller system of equations with the velocity potentials in the nth row segregated from the upstream influence. For (n,m) on the tail, T,

$$\sum_{\mu} A(o, |m-\mu|) \phi_{n,\mu} = w_{n,m} - \sum_{\nu < n} \sum_{\mu} A(n-\nu, |m-\mu|) \phi_{\nu,\mu} \quad (5.12)$$

where the terms are defined as above. Here again the velocity potentials for the entire nth row on the tail are computed at once, but with the double summation now extending at most 15 rows upstream. This upstream influence includes contributions not only from the tail itself, but also from the wake and wing regions included in the fifteen rows.

PART V - SECTION B
TRANSONIC AIC COMPUTER PROGRAM DESCRIPTION

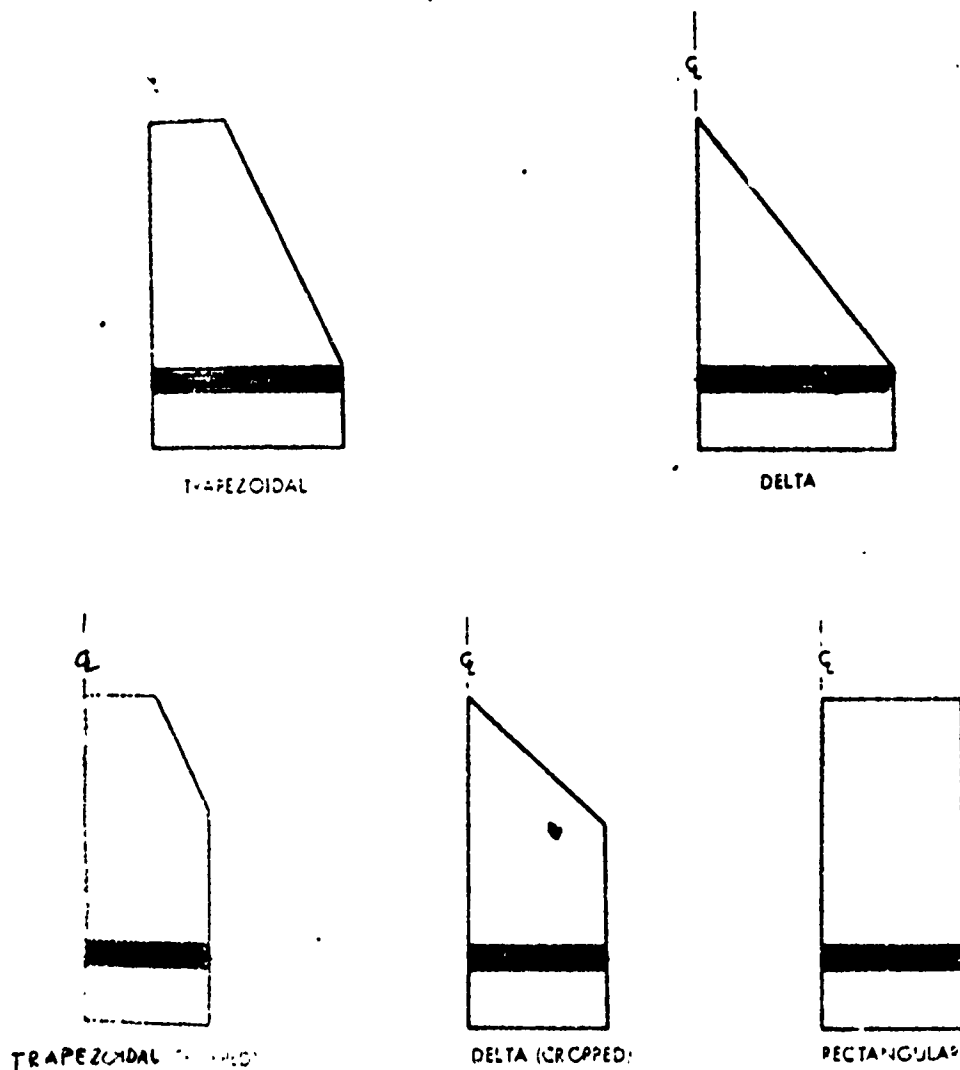
A FORTRAN IV computer program is presented which calculates transonic unsteady aerodynamic influence coefficients for a variety of single or tandem lifting surfaces. The computer solution is based on a doublet superposition approach, and a square box approximation is employed to reduce the integral equations to sums of constant values times doublet strengths at box centers times integrals dependent upon relative position, Mach number, and reduced frequency.

The various tandem configurations which can be analyzed are shown in Figure 5.2. Also it is possible to analyze a single surface (the wing). The aerodynamic surfaces are assumed to have a plane of symmetry parallel to the free stream flow. The upstream surface must have an unswept trailing edge and the rectangular trailing surface must have the same spanwise dimension as the trailing edge of the wing.

The program allows up to 40 AIC control points. The AIC stations must satisfy the following requirements:

- (1) The chordwise rows must be parallel to the flow stream.
- (2) The chordwise rows on a surface must have the same number of control points.
- (3) The control points in each spanwise row must have the same fractional chordwise location.
- (4) The origin for the AIC station coordinates and the wing and control surface coordinates must be at the leading edge root of the wing.

Examples of acceptable AIC control point patterns for the transonic program are illustrated in Figure 5.3.



 Diaphragm Region

FIGURE 5.2 TANDEM COPLANAR CONFIGURATIONS AT TRANSONIC MACH NUMBERS

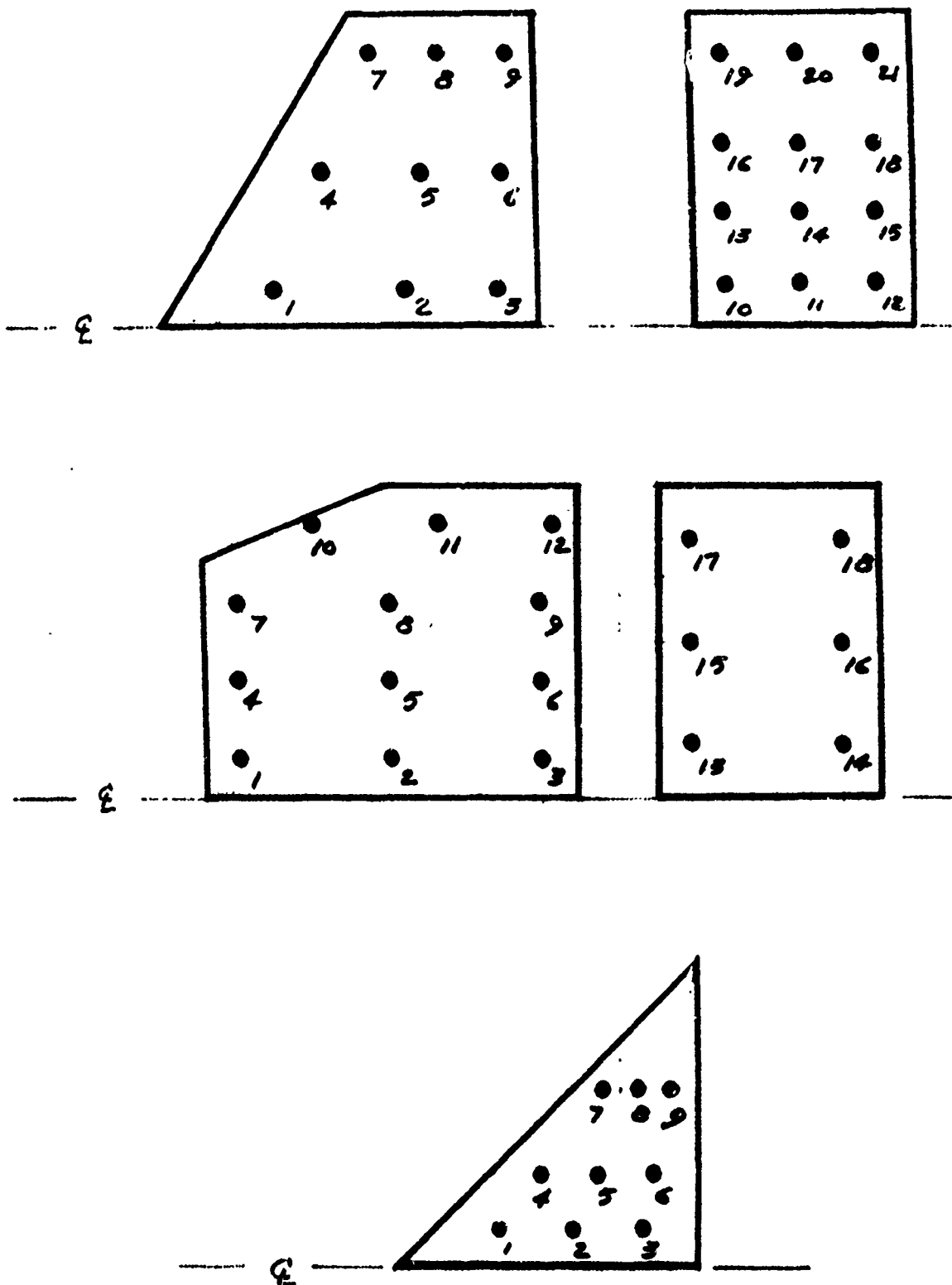


FIGURE 5.3. EXAMPLES OF ACCEPTABLE AIC CONTROL POINT PATTERNS FOR THE TRANSONIC PROGRAM

The transonic program is presently limited to 45 boxes on the aerodynamic surfaces. This limitation does not include the diaphragm boxes in the gap region. The restriction results from performing all operations on the computer in core without utilizing peripheral tape and disc units.

The user specifies the number of boxes along the wing root and the computer program determines the size of the boxes and overlay pattern which will cover the planform. The box centers of the first chordwise row will lie along the root of the surfaces. The last spanwise row of boxes on the wing will have their centers on the trailing edge. If NBW is selected by the user as the number of boxes along the wing root and if the wing root dimension is $2b_r$, then the box size will be $\Delta \times \Delta$ where $\Delta = 2b_r / (NBW - .5)$. Knowing the size of the boxes and the planform geometry, the user can estimate if the 45 box restriction is satisfied. An example of a typical box overlay is shown in Figure 5.4.

The transonic AIC computer program consists of a main program (MAIN) and 20 subroutines and function subprogram. Execution begins with MAIN calling subroutine DAIN which reads the input data. Control then passes into a Mach number loop where a test is made to determine if the Mach number satisfies the criterion $|M - 1.0| < 0.05$. Subroutine CODE is called to approximate the surface and gap regions with a sonic box overlay. The output subroutine POUT is called and the input flight conditions, geometry, and map of the sonic box overlay are printed. The AIC station locations are also printed if the option is exercised. A check is made in MAIN to determine if the number of boxes on the wing and control surface does not exceed 45.

The subroutine TRAMP is called by MAIN to generate the substantial derivative matrix $[w]$. The $[W]$ matrix relates the Mach boxes on the surfaces to the AIC stations and serves as a substantial derivative operator. Subroutines called by TRAMP are CMAT, SMAT, TMAT, EMAT, RMAT, and MINV.

Control passes into the frequency loop and a test is made to determine that a non-zero frequency or reduced frequency is being considered. Subroutine POT2H is called to compute in-plane velocity potential influence coefficients for the reduced frequency. These coefficients are dependent only on the relative position of the boxes, the Mach number and reduced frequency.

The main program now passes into a loop which examines each box and for boxes on the surfaces, the subroutine PHIB is called to form the product of velocity potentials computed for boxes within the zone of influences times the appropriate velocity potential influence coefficient.

The influence of each box on the other boxes is constructed and the resulting system of simultaneous complex equations is solved by the subroutine MSINEC to determine the velocity potential at box centers. The velocity potentials are converted to pressure through a substantial derivative operator constructed by subroutine SD2. Multiplying pressure by the box area yields the force at each box center on the surfaces. These forces are transferred to the AIC stations through static considerations thereby forming the AIC matrix. This operation is performed by subroutine FORCE. The output subroutine POUT is called to print the AIC matrix.

1.0 PROCESSING REQUIREMENTS

The input and output files used by the program are 05 and 06, respectively. All read and write statements are contained in MAIN, POUT, and DAIN. Peripheral tape and disc inputs are not used by the program. Approximately 40,000 cells of core storage is required.

A standard input form of six 12-column fields per card is used by the program. Floating point numbers (6E12.5 format) may lie anywhere within the appropriate field but fixed point numbers (6I12 format) must be right adjusted. Detailed instructions for data input are given and listings of data cards for sample problems are provided.

2.0 INPUT INSTRUCTIONS

Instructions for preparing input data for the transonic AIC computer program are presented here. The field location and format for each quantity is specified. Any set of units may be used for geometric dimensions and acoustic velocity as long as they are consistent, e.g., if inches is used for length, then the acoustic velocity must have dimensions of inches per second. The required data and the sequence in which the information is entered is as follows:

1. Streamwise Coordinates (6E12.5 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	X(1)	X(2)	X(3)	X(4)	X(5)	
Item	(1)	(2)	(3)	(4)	(5)	

- (1) X(1) Wing root leading edge coordinate
- (2) X(2) Wing tip leading edge coordinate
- (3) X(3) Wing trailing edge coordinate
- (4) X(4) Control surface leading edge coordinate
- (5) X(5) Control surface trailing edge coordinate

A single surface, the wing, may be analyzed by setting X(4) and X(5) equal to X(3). The various configurations are generated as shown in Table 5.1. The origin for the planform and AIC station coordinates must be at the leading edge root of the wing, therefore X(1) and Y(1), described below, must always be zero.

2. Spanwise Coordinates and Acoustic Velocity (6E12.5 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	Y(1)	Y(2)	Y(3)	SOUND		
Item	(1)	(2)	(3)	(4)		

- (1) Y(1) Wing root spanwise coordinate
- (2) Y(2) Wing leading edge spanwise coordinate
- (3) Y(3) Wing (and control surface) tip spanwise coordinate
- (4) SOUND Speed of sound at altitude for which analysis is performed

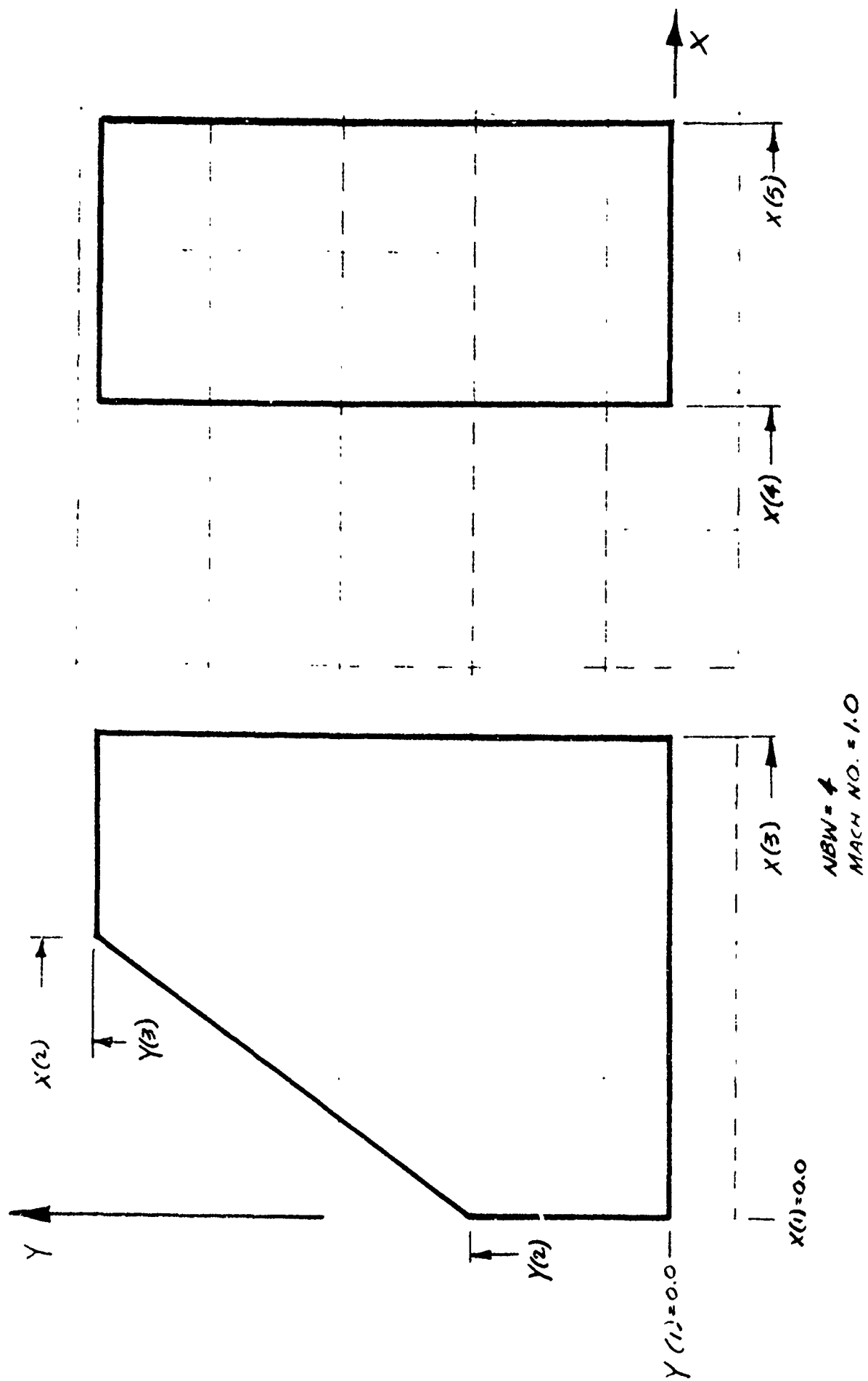


FIGURE 5.4 GEOMETRIC DESCRIPTION AND SONIC BOX OVERLAY

TABLE 5.1 OPTIONAL CONFIGURATIONS

CONFIGURATION	CHORDWISE COORDINATE	SPANWISE COORDINATE
RECTANGULAR	$X(1) = 0.0$	$Y(1) = 0.0$
	$X(2) = 0.0$	$Y(2) = 0.0$
	$X(3) > 0.0$	$Y(3) > 0.0$
	$X(4) \geq X(3)$	
	$X(5) \geq X(4)$	
DELTA	$X(1) = 0.0$	$Y(1) = 0.0$
	$X(2) > 0.0$	$Y(2) = 0.0$
	$X(3) = X(2)$	$Y(3) > 0.0$
	$X(4) \geq X(3)$	
	$X(5) \geq X(4)$	
TRAPEZOIDAL	$X(1) = 0.0$	$Y(1) = 0.0$
	$X(2) > 0.0$	$Y(2) > 0.0$
	$X(3) = X(2)$	$Y(3) > Y(2)$
	$X(4) \geq X(3)$	
	$X(5) \geq X(4)$	
TRAPEZOIDAL (CROPPED)	$X(1) = 0.0$	$Y(1) = 0.0$
	$X(2) > X(1)$	$Y(2) > 0.0$
	$X(3) > X(2)$	$Y(3) > Y(2)$
	$X(4) \geq X(3)$	
	$X(5) \geq X(4)$	
DELTA (CROPPED)	$X(1) = 0.0$	$Y(1) = 0.0$
	$X(2) > 0.0$	$Y(2) = 0.0$
	$X(3) > X(2)$	$Y(3) > Y(2)$
	$X(4) \geq X(3)$	
	$X(5) \geq X(4)$	

3. General Information (6I12 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	NMACH	KF	NFREQ	NBW	LPUNCH	
Item	(1)	(2)	(3)	(4)	(5)	

- (1) NMACH Number of Mach numbers: (Maximum 6)
- (2) KF Option to input frequencies or reduced frequencies:
 KF = 0 frequencies
 KF = 1 reduced frequencies
- (3) NFREQ Number of frequencies or reduced frequencies at each
 Mach number (maximum 10)
- (4) NBW Number of chordwise boxes on wing
- (5) LPUNCH Option to punch AICs on cards:
 LPUNCH = 0 no punched output
 LPUNCH = 1 punch AICs for wing only
 LPUNCH = 2 punch AICs for control surface only
 LPUNCH = 3 punch individual AIC matrix for wing
 and control surface
 LPUNCH = 4 punch total AIC matrix for wing-control
 surface combination

The AIC matrices are punched by rows with a 1P6E12.5 format. Each row of an AIC matrix begins on a new card.

4. Mach Numbers (6E12.5 format)

Column	1-12	13-24	24-36	37-48	49-60	61-72
Name	FMACH(1)	FMACH(2)	FMACH(3)	FMACH(4)	FMACH(5)	FMACH(6)
Item	(1)	(2)	(3)	(4)	(5)	(6)

(1) FMACH (1) Mach number

(2) FMACH (2) Mach number

.

(NMACH) FMACH (NMACH) Mach number

Enter NMACH values of Mach number (see Part 3, Item 1). Mach numbers must be in the range 0.95 to 1.05.

5. Frequencies (or Reduced Frequencies) (6E12.5 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	FREQ(1)	FREQ(2)	FREQ(3)	FREQ(4)	FREQ(5)	FREQ(6)
Item	(1)	(2)	(3)	(4)	(5)	(6)

Input NFREQ values of frequency or reduced frequency (see Part 3, Items 2 and 3). Reduced frequency is defined as $k_r = \frac{\omega b_r}{U}$ where b_r is the semi-chord of the wing root, U is the free stream velocity and ω is the oscillatory angular frequency in radians/sec

(1) FREQ (1) frequency (CPS) or k_r

(2) FREQ (2) frequency (CPS) or k_r

.

(NFREQ) FREQ (NFREQ) frequency (CPS) or k_r

If NFREQ > 6, continue input of FREQ (7) to FREQ (NFREQ) on new card.

6. Number of AIC Stations (6I12 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	NXWING	NYWING	NXCS	NYCS		
Item	(1)	(2)	(3)	(4)		

- (1) NXWING Number of chordwise AIC collocation stations on wing
- (2) NYWING Number of spanwise AIC collocation stations on wing
- (3) NXCS Number of chordwise AIC collocation stations on control surface. Set equal to zero if analysis is for wing only
- (4) NYCS Number of spanwise AIC collocation stations on control surface. Set equal to zero if analysis is for wing only.

7. Spanwise Location of AIC Stations on Wing (6E12.5 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	YAIC(1,W)	YAIC(2,W)	YAIC(3,W)	YAIC(4,W)	YAIC(5,W)	YAIC(6,W)
Item	(1)	(2)	(3)	(4)	(5)	(6)

- (1) YAIC(1,W) Spanwise coordinate of first row of AIC collocation stations on wing
- (2) YAIC(2,W) Spanwise coordinate of second row of AIC collocation stations on wing

· · ·
· · ·
· · ·

- (NYWING) YAIC(NYWING, W) Spanwise coordinate of last row of AIC collocation stations on wing

AIC station rows are numbered from root to tip of surface. If NYWING > 6, continue input on new card(s).

8. Spanwise Location of AIC Stations on Control Surface (6E12.5 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	YAIC(1,CS)	YAIC(2,CS)	YAIC(3,CS)	YAIC(4,CS)	YAIC(5,CS)	YAIC(6,CS)
Item	(1)	(2)	(3)	(4)	(5)	(6)

(1) YAIC(1,CS) Spanwise coordinate of first row of AIC collocation stations on control surface

(2) YAIC(2,CS) Spanwise coordinate of second row of AIC collocation stations on control surface

. . .
. . .
. . .

(NYCS) YAIC(NYCS,CS) Spanwise coordinate of last row of AIC collocation stations on control surface

Omit this input if only the wing is analyzed. For NYCS 6, continue input on new card(s). AIC station rows are numbered from root to tip of surface.

9. Chordwise Location of AIC Stations on Wing (6E12.5 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	XAIC(W,1,1)	XAIC(W,1,2)	XAIC(W,1,3)	...	...	...
Item	(1)	(2)	(3)	(4)	(5)	(6)

(1) XAIC(W,1,1) Streamwise coordinate of first AIC collocation station in first row on wing

(2) XAIC(W,1,2) Streamwise coordinate of second AIC collocation station in first row on wing

. . .
. . .
. . .

(NXWING*NYWING) XAIC (W, NYWING, NXWING) Streamwise coordinate of last AIC collocation station in last row on wing

9. continued

Streamwise numbering sequence is from leading edge to trailing edge (see Figure 5.3). Continue input of values for each row immediately after the last value of the preceeding row; do not begin input of each row on new card.

10. Chordwise Location of AIC Stations on Control Surface (6E12.5 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	XAIC(CS,1,1)	XAIC(CS,1,2)	XAIC(CS,1,3)	...	...	...
Item	(1)	(2)	(3)	(4)	(5)	(6)

Procedure to input streamwise coordinate location of AIC stations on control surface is the same as wing above. Omit this input if only wing is analyzed.

3.0 SAMPLE PROBLEMS

The operation of the transonic AIC program is demonstrated with three sample problems. A trapezoidal wing-rectangular control surface combination, a cropped trapezoidal and a delta configuration are analyzed. Explanation of input parameters and complete listings of input cards and computer output are given for each sample problem.

Sample Problem 1.

Transonic AIC's are obtained for a trapezoidal wing and rectangular control surface. The planform geometry and AIC stations are shown in Figure 5.5. The dimensional unit used for length is feet, therefore the acoustic velocity is entered as feet/sec. Five boxes were specified for NBW. The box overlay, which is included with the output, has 21 boxes on the wing and 10 on the control surface, thereby satisfying the 45 box limitation. There are 10 diaphragm boxes in the gap area. The analysis is performed for $M = 1.0$, $k_r = 0.10$ and $a = 1116.87$ ft/sec (sea level). Input parameters are summarized below and a listing of the input data cards and computer output follows.

$X(1) = 0.0'$	$X(2) = 1.0'$	$X(3) = 2.0'$	$X(4) = 3.0'$	$X(5) = 4.0'$
$Y(1) = 0.0'$	$Y(2) = 0.0'$	$Y(3) = 2.0'$		
SOUND = 116.87 ft/sec	acoustic velocity (sea level)			
NMACH = 1	number of Mach numbers			
KF = 1	input reduced frequency			
NFREQ = 1	number of reduced frequencies			
NBW = 5	number of chordwise boxes on wing			
LPUNCH = 4	punch combined wing-control surface AIC matrix on cards			
PMACH (1) = 1.0	Mach number			
FREQ (1) = 0.10	reduced frequency			
NXWING = 3	number of chordwise AIC stations on wing			
NYWING = 5	number of spanwise AIC stations on wing			
NXCS = 2	number of chordwise AIC stations on control surface			
NYCS = 3	number of spanwise AIC stations on control surface			

$$YAIC(1,W) = 0.2'$$

$$YAIC(4,W) = 1.4'$$

$$YAIC(2,W) = 0.6'$$

$$YAIC(5,W) = 1.8'$$

$$YAIC(3,W) = 1.0'$$

$$YAIC(1,CS) = 0.4'$$

$$YAIC(2,CS) = 1.0'$$

$$YAIC(3,CS) = 1.6'$$

$$XAIC(1,1,W) = 0.575'$$

$$XAIC(2,1,W) = 0.725'$$

$$XAIC(3,1,W) = 0.875'$$

$$XAIC(4,1,W) = 1.025'$$

$$XAIC(5,1,W) = 1.175'$$

$$XAIC(1,2,W) = 1.050'$$

$$XAIC(2,2,W) = 1.150'$$

$$XAIC(3,2,W) = 1.250'$$

$$XAIC(4,2,W) = 1.350'$$

$$XAIC(5,2,W) = 1.450'$$

$$XAIC(1,3,W) = 1.525'$$

$$XAIC(2,3,W) = 1.575'$$

$$XAIC(3,3,W) = 1.625'$$

$$XAIC(4,3,W) = 1.675'$$

$$XAIC(5,3,W) = 1.725'$$

$$XAIC(1,1,CS) = 3.25'$$

$$XAIC(2,1,CS) = 3.25'$$

$$XAIC(3,1,CS) = 3.25'$$

$$XAIC(1,2,CS) = 3.75'$$

$$XAIC(2,2,CS) = 3.75'$$

$$XAIC(3,2,CS) = 3.75'$$

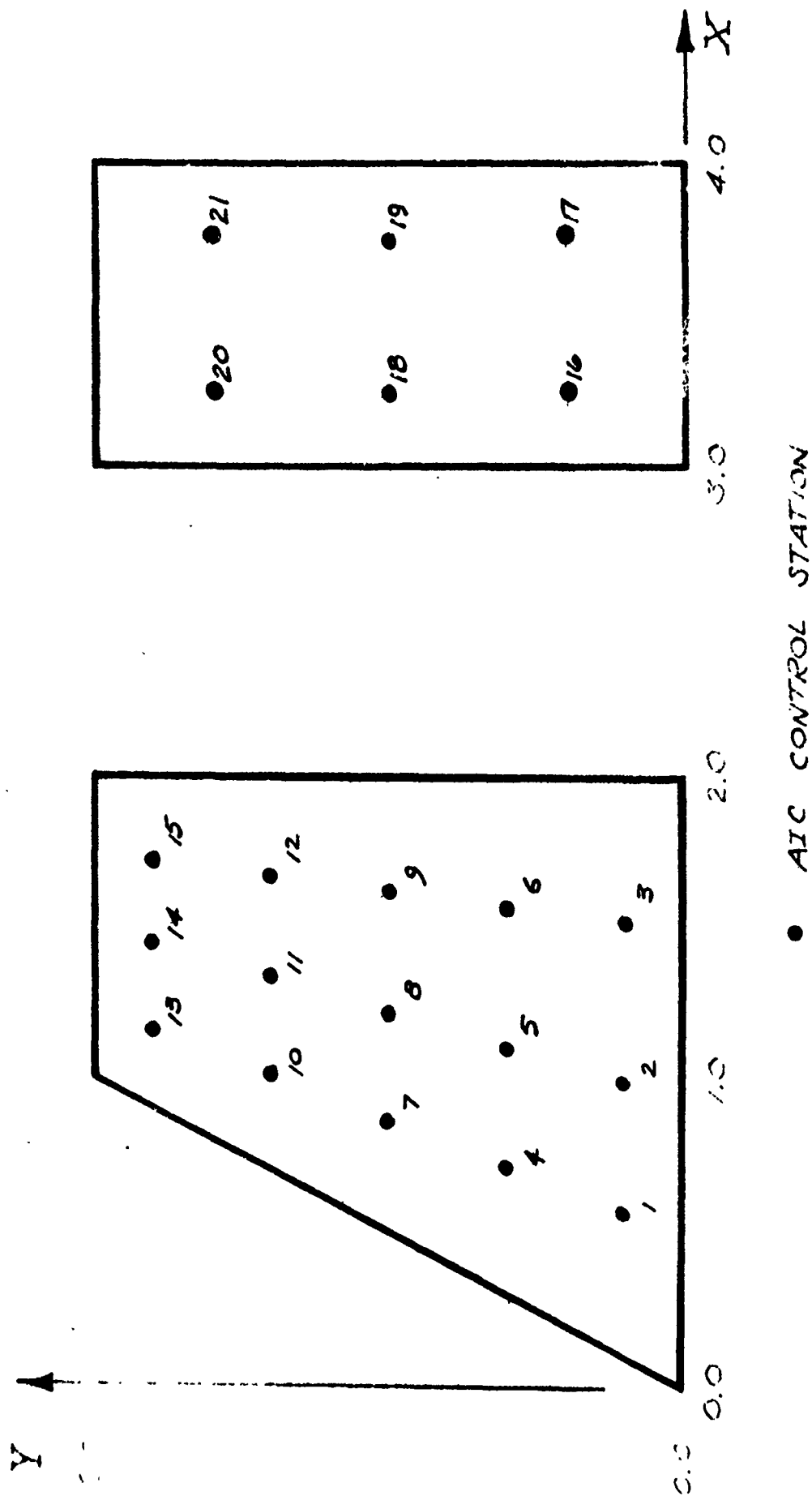


FIGURE 5.5. TRANSONIC SAMPLE PROBLEM 1.

HUGHES AIRCRAFT CO. TRANSONIC AIC PROGRAM

FLIGHT CONDITIONS AND GEOMETRY

MACH NUMBER = 1.00000 SPEED OF SOUND = 1116.870 L/T RHO = 1.700

	WING	TAIL
L.E. STATION (L)	0.	3.000
ROOT CHORD (L)	2.000	1.000
L.E. SPAN (L)	0.	2.000
T.E. SPAN (L)	2.000	2.000
TIP CHORD (L)	1.000	1.000
TOTAL AREA (L*L)	6.000	4.000
CHORDWISE BOXES	5	2
SPANWISE BOXES	5	5

TOTAL CHORDWISE BOXES = 9 BOX CHORD = 4.44444E-01 L BOX SPAN = 4.44444E-01 L

HUGHES AIRCRAFT CO. TRANSONIC ATC PROGRAM (CONT-D)

ATC COLLOCATION STATION COORDINATES ON THE WING

YAIC	XAIC VALUES--		
0.200000E 00	0.575000E 00	0.105000E 01	0.152500E 01
0.600000E 00	0.725000E 00	0.115000E 01	0.157500E 01
0.100000E 01	0.875000E 00	0.125000E 01	0.162500E 01
0.140000E 01	0.102500E 01	0.135000E 01	0.167500E 01
0.180000E 01	0.117500E 01	0.145000E 01	0.172500E 01

HUGHES AIRCRAFT CO. TRANSONIC AIC PROGRAM (CONT-D)

AIC COLLIGATION STATION COORDINATES ON THE TAIL

YAIC	XAIC VALUES--	
0.400000E 00	0.325000E 01	0.375000E 01
0.100000E 01	0.325000E 01	0.375000E 01
0.160000E 01	0.325000E 01	0.375000E 01

232

DYNAMIC PRESSURE (1/2 * RH0 * VEL^2) 6.23699E 05

X
 4[illegible]

ROW = 6
 -7.2190E 01 2.5877E 01 1.5418E 02 -3.8275E 01 -8.1494E 01 1.1992E 01 -6.4230E 00 -3.7299E 00 1.1587E 01 4.8347E 00
 -5.1906E 00 -3.0514E 00 -1.8006E 02 8.4292E 01 3.8531E 02 -1.3665E 02 -7.0425E 02 5.1503E 01 5.9870E 01 5.3195E 00
 -1.2143E 02 -1.2098E 01 6.1369E 01 8.9079E 00 -3.4439E 01 7.7505E 01 8.9151E 01 -1.3609E 02 -5.4172E 01 9.8049E 01
 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.
 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.

ROW = 7
 -1.0859E 01 2.8843E 01 5.3949E 01 -4.4908E 01 -3.5081E 01 2.2333E 01 1.1622E 01 -5.1668E 00 -2.6339E 01 9.4622E 00
 -1.4700E 01 -4.1576E 00 -1.1105E 02 7.9261E 01 2.6701E 02 -1.5167E 02 -1.5583E 02 7.0748E 01 6.0418E 01 -3.1014E 01
 -1.2357E 02 5.1695E 01 6.2894E 01 -2.0471E 01 4.0997E 01 -2.9354E 01 -4.7209E 01 3.8246E 01 5.6918E 00 -9.9596E 00
 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.
 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.

ROW = 8
 -2.4696E 01 1.2548E 01 5.4599E 01 -2.1331E 01 -2.9758E 01 4.2635E 00 9.4244E 00 -2.3915E 00 -2.0198E 01 1.6626E 00
 -1.3540E 01 -1.2309E 00 -1.1382E 02 4.2435E 01 2.4173E 02 -7.1149E 01 -1.2754E 02 2.8227E 01 3.4525E 01 -4.1095E 00
 -6.9782E 01 7.8688E 00 3.5124E 01 -1.5007E 00 -1.9936E 01 7.797E 01 5.1102E 01 -2.8764E 01 -3.1120E 01 1.3237E 01
 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.
 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.

ROW = 9
 -5.4314E 01 1.0533E 01 1.1139E 02 -1.2962E 01 -5.6801E 01 2.3107E 00 1.6370E 01 -1.2727E 00 -3.7192E 01 5.0285E 01
 -1.0763E 01 7.8671E 01 -2.3510E 02 3.3348E 01 4.7732E 02 -4.0386E 01 -2.4153E 02 6.8311E 00 5.2674E 01 2.7724E 00
 -1.0568E 02 -1.1425E 01 5.2838E 01 8.8764E 00 -8.4432E 01 2.9760E 01 1.7448E 02 -4.8677E 01 -8.9792E 01 1.8780E 01
 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.
 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.

ROW = 10
 -8.9328E 00 2.0579E 01 3.6195E 01 -4.2341E 01 -2.7322E 01 2.0922E 01 4.6229E 00 -3.5919E 00 -1.2637E 01 7.0787E 00
 8.0170E 00 -3.3313E 00 -3.8800E 01 6.0588E 01 1.2025E 02 -1.2260E 02 -8.8257E 01 6.0146E 01 -3.8896E 01 -1.3026E 01
 7.1893E 01 2.4974E 01 -3.5854E 01 -1.1773E 01 6.5899E 01 -1.9408E 01 -8.4768E 01 -2.1026E 01 -1.8440E 01 -3.0266E 00
 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.
 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.

ROW = 11
 -1.4234E 01 7.2227E 00 3.1209E 01 -1.1878E 01 -1.6881E 01 4.5424E 00 3.8107E 00 -1.2380E 00 -8.1068E 00 1.9303E 00
 4.276E 00 -6.7195E 01 -5.2635E 01 2.3851E 01 1.1259E 02 -3.9872E 01 -5.9736E 01 1.5972E 01 -1.7715E 01 -1.2582E 00
 3.5187E 01 2.7100E 00 -1.7499E 01 -1.4244E 00 -2.4284E 01 1.2847E 01 5.4730E 01 -2.2917E 01 -3.0378E 01 9.8995E 00
 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.
 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.

ROW = 12
 -3.2628E 01 7.9547E 00 6.7180E 01 -1.0721E 01 -3.4373E 01 2.6999E 00 8.2603E 00 -1.1788E 00 -1.6717E 01 1.2974E 00
 8.4826E 00 -1.0892E 01 -1.1945E 02 2.6290E 01 -2.4426E 02 -3.7737E 01 -1.2420E 02 1.1305E 01 -3.3947E 01 -2.0261E 00
 6.7602E 01 4.9954E 00 -3.3687E 01 -2.9217E 00 -7.1962E 01 2.0501E 01 1.4772E 02 -3.3040E 01 -7.5579E 01 1.2448E 01
 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.
 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.

ROW = 13
 -1.1542E 01 1.0860E 01 2.6863E 01 -1.8768E 01 -1.5201E 01 7.7533E 00 2.0215E 00 -1.8392E 00 -4.7147E 00 4.1403E 00
 2.697E 00 -1.2731E 00 -3.4483E 01 3.4981E 01 7.9023E 01 -4.2110E 01 -4.4280E 01 2.6789E 01 -1.2892E 01 -1.3978E 00
 2.5291E 01 2.3348E 00 -1.2448E 01 -8.9493E 01 -7.7806E 01 2.5125E 01 1.6369E 02 -4.3888E 01 -8.5793E 01 1.8544E 01
 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.
 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.

ROW = 14
 -4.7113E 00 4.3832E 00 2.0694E 01 -6.9289E 00 -1.0915E 01 2.4964E 00 1.7446E 00 -7.2361E 01 -3.7079E 00 1.1201E 00
 -1.9511E 00 -3.8773E 01 -3.0429E 01 1.4385E 01 6.4188E 01 -2.3882E 01 -3.3622E 01 9.404E 00 -8.5080E 00 -7.1977E 01
 1.638E 01 1.3806E 00 -8.3529E 00 -6.4769E 01 -5.7309E 01 9.5170E 00 1.1725E 02 -1.4433E 01 -3.9594E 01 4.8477E 00
 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.
 0. 0. 0. 0. 0. 0. 0. 0. 0. 0.

0. 0;
 ROW =15
 -1.5962E 01 4.3294E 00 3.2930E 01 -6.0433E 00 -1.0846E 01 1.6806E 00 2.8943E 00 -6.8904E-01 -5.9461E 00 9.1897E-01
 -3.0357E 00 -2.2424E-01 -9.0802E 01 1.4519E 01 -8.2926E 01 -2.2095E 01 -5.3163E 01 7.5133E 00 -1.2676E 01 -9.3945E-01
 2.5199E 01 1.9014E 00 -1.2545E 01 -1.0330E 00 -8.9675E 01 8.4918E 00 1.8121E 02 -9.9119E 00 -9.1482E 01 1.3737E 00
 0. 0;
 0. 0;

ROW =16
 7.0249E 01 -3.7038E 01 -1.9830E 02 9.3515E 01 1.2894E 02 -5.2333E 01 -2.9616E 00 4.0124E 00 9.3609E 00 -9.7884E 00
 -6.0110E 00 5.5236E 00 8.9737E 01 -8.2926E 01 -2.6983E 02 2.0049E 02 -1.8153E 02 -1.1407E 02 3.0335E 01 1.4499E 01
 8.3794E 01 -3.5094E 01 -5.3804E 01 1.9502E 01 2.2423E 01 -3.4946E 01 -7.6103E 01 8.5997E 01 5.4136E 01 -9.0030E 01
 9.5821E 01 -1.4562E-01 -9.6016E 01 -4.5234E 00 -2.1785E 00 -2.3872E 00 2.0875E 00 2.5089E 00 3.6417E 01 -4.1735E 00
 -3.6658E 01 2.4183E 00

ROW =17
 8.2945E 01 -4.1507E 01 -2.3352E 02 9.9984E 01 1.5151E 02 -5.5273E 01 -3.5944E 00 4.5264E 00 1.1337E 01 -1.0951E 01
 -7.8816E 00 6.1276E 00 1.0735E 02 -9.2294E 01 -3.2075E 02 2.2095E 02 2.1492E 02 -1.2456E 02 -3.5744E 01 1.5918E 01
 9.8493E 01 -3.7084E 01 -6.3117E 01 2.8333E 01 2.7409E 01 -3.9568E 01 -9.1665E 01 9.6453E 01 6.4816E 01 -5.5704E 01
 1.1139E 02 3.8351E 00 -1.1142E 02 -9.2712E 00 -2.4445E 00 -2.8707E 00 2.3331E 00 3.0089E 00 4.2488E 01 -3.3337E 00
 -4.2695E 01 1.2639E 00

ROW =18
 2.7990E 01 -2.5225E 01 -8.3062E 01 6.1137E 01 5.5620E 01 -3.4657E 01 -9.1882E 00 4.1301E 00 2.5706E 01 -1.0330E 01
 -1.6626E 01 5.8851E 00 1.0240E 02 -6.7477E 01 -2.9658E 02 1.6492E 02 1.9545E 02 -9.3934E 01 -2.8588E 01 1.1803E 01
 7.8477E 01 -2.8722E 01 -5.0219E 01 1.5919E 01 2.8309E 01 -2.7788E 01 -8.7884E 01 6.9025E 01 6.0032E 01 4.0239E 01
 4.6925E 01 -4.1271E 00 -4.7184E 01 1.8646E 00 2.1083E 01 1.4830E 00 -2.1064E 01 -2.5235E 00 2.9943E 01 -2.9912E 00
 -3.0126E 01 1.5413E 00

ROW =19
 3.3455E 01 -2.8092E 01 -9.8706E 01 6.7360E 01 6.9835E 01 -3.7832E 01 -1.0812E 01 4.3960E 00 3.0139E 01 -1.0882E 01
 -1.2498E 01 6.1144E 00 1.2138E 02 -7.3842E 01 -3.5028E 02 1.7855E 02 2.3023E 02 -1.0060E 02 -3.3575E 01 1.2467E 01
 9.2077E 01 -2.9963E 01 -5.6817E 01 1.6325E 01 3.3931E 01 -3.0973E 01 -1.0462E 02 7.6261E 01 7.1155E 01 -4.407E 01
 5.4700E 01 -2.8431E 00 -5.4906E 01 2.0283E-01 2.4454E 01 2.6094E 00 -2.4390E 01 -3.8190E 00 3.4919E 01 -2.2242E 00
 -3.5071E 01 5.3360E-01

ROW =20
 1.6014E 01 -2.0091E 01 -5.0055E 01 4.8846E 01 3.4475E 01 -2.7924E 01 -3.6424E 00 2.8403E 00 1.0745E 01 -7.0930E 00
 -7.1760E 00 4.0951E 00 4.4500E 01 -5.0033E 01 -1.3903E 02 1.2221E 02 9.5427E 01 -7.0273E 01 1.0879E 01 4.6350E 00
 -2.5961E 01 -1.3383E 01 1.5968E 01 5.7509E 00 4.4848E 01 -2.6380E 01 -1.3016E 02 6.6657E 01 8.5735E 01 -3.9089E 01
 3.3239E 01 -4.36297E 00 -3.3501E 01 3.2328E 00 5.3395E 00 -4.4594E-01 -5.3770E 00 3.8710E-01 4.4192E 01 -7.3781E-03
 -4.4286E 01 -2.1619E 00

ROW =21
 1.0371E 01 -2.2609E 01 -5.9968E 01 5.4513E 01 4.1067E 01 -3.0923E 01 -4.3351E 00 3.1376E 00 1.2734E 01 -7.7673E 00
 -8.4782E 00 4.4441E 00 5.3595E 01 5.6093E 01 -1.6602E 02 1.3578E 02 1.1339E 02 -7.7429E 01 1.2433E 01 5.8425E 00
 -3.6811E 01 -1.3207E 01 1.8266E 01 7.3632E 00 5.3031E 01 -2.8656E 01 -1.5349E 02 7.1710E 01 1.0092E 02 -4.1659E 01
 3.5818E 01 -4.2300E 00 -3.9056E 01 2.3636E 00 6.2314E 00 -5.2750E-01 -6.2641E 00 2.2513E-01 5.1375E 01 1.8464E 00
 -5.1393E 01 -4.3724E 00

Sample Problem 2.

A cropped trapezoidal wing is analyzed for $M = 1.0$, $k_r = 0.10$ and 116.87 ft/sec (sea level). The trailing surface is removed from the analysis by setting $X(5) = X(4) = X(3)$. The wing geometry and AIC stations are shown in Figure 5.7. Six chordwise boxes were specified for the wing. The resulting box overlay has 33 boxes. Input information is summarized below and a listing of the data input cards and computer output follows.

$X(1) = 0.0'$ $X(2) = 1.0'$ $X(3) = 2.0'$ $X(4) = 2.0'$ $X(5) = 2.0'$
 $Y(1) = 0.0'$ $Y(2) = 1.0'$ $Y(3) = 2.0'$

SOUND = 116.87 ft/sec acoustic velocity (sea level)
 NMACH = 1 number of Mach numbers
 FK = 1 input reduced frequency
 NFREQ = 1 number of reduced frequencies
 NBW = 6 number of chordwise boxes on wing
 LPUNCH = 1 punch wing AIC matrix on cards
 FMACH (1) = 1.0 reduced frequency
 NMWING = 4 number of chordwise AIC stations on wing
 NYWING = 4 number of spanwise AIC stations on wing
 NXCS = 0 number of chordwise AIC stations on control surface
 NYCS = 0 number of spanwise AIC stations on control surface

$YAIC(1,W) = 0.2'$ $YAIC(2,W) = 0.7'$ $YAIC(3,W) = 1.3'$
 $YAIC(4,W) = 1.8'$

$XAIC(1,1,W) = 0.100'$ $XAIC(1,2,W) = 0.700'$ $XAIC(1,3,W) = 1.300'$
 $XAIC(1,4,W) = 1.900'$
 $XAIC(2,1,W) = 0.100'$ $XAIC(2,2,W) = 0.700'$ $XAIC(2,3,W) = 1.300'$
 $XAIC(2,4,W) = 1.900'$
 $XAIC(3,1,W) = 0.380'$ $XAIC(3,2,W) = 0.900'$ $XAIC(3,3,W) = 1.405'$
 $XAIC(3,4,W) = 1.915'$
 $XAIC(4,1,W) = 0.860'$ $XAIC(4,2,W) = 1.220'$ $XAIC(4,3,W) = 1.580'$
 $XAIC(4,4,W) = 1.940'$

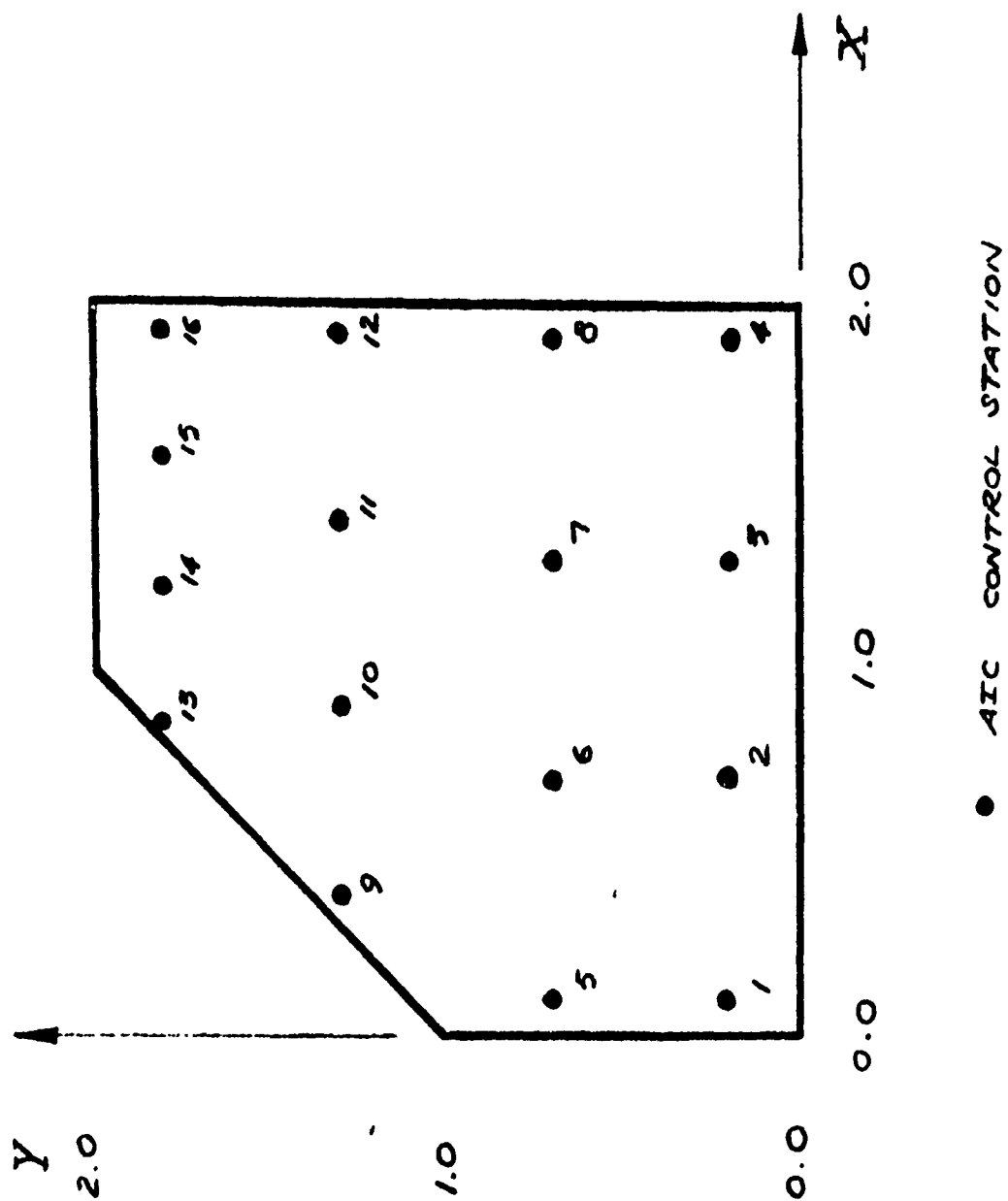


FIGURE 5.1. TRANSONIC SAMPLE PROBLEM 2.

HUGHES AIRCRAFT CO. TRANSONIC AIC PROGRAM

FLIGHT CONDITIONS AND GEOMETRY

MACH NUMBER = 1.00000 SPEED OF SOUND = 1116.870 L/T RMS = 1.00

	WING	TAIL
L.E. STATION (I)	0.	2.000
ROOT CHORD (L)	2.000	0.
L.F. SPAN (I)	1.000	2.000
T.E. SPAN (L)	2.000	2.000
TIP CHORD (L)	1.000	0.
TOTAL AREA (L ²)	7.000	0.
CHORDWISE BOXES	6	n
SPANWISE BOXES	6	6

TOTAL CHORDWISE BOXES = 6 BOX CHORD = 3.63434E-01 L BOX SPAN = 3.63636E-01 L

HUGHES AIRCRAFT CO. TRANSONIC AIC PROGRAM (CONT-D)

MAP OF SONIC HOX OVERLAY
ON WING, TAIL AND WAKE
(S) - WING
(S) - TAIL
(.) - WAKE

SSSS
SSSS
SSSSSS
SSSSSS
SSSSSS
SSSSSS
SSSSSS

HUGHES AIRCRAFT CO. TRANSONIC AIC PROGRAM (CONT-D)

AIC COLLOCATION STATION COORDINATES ON THE AING				
V4IC	X4IC VAL UFS--			
0.200000E 00	0.100000E 00	0.700000E 00	0.130000E 01	0.190000E 01
0.700000E 00	0.100000E 00	0.700000E 00	0.130000E 01	0.190000E 01
0.130000E 01	0.387000E 00	0.900000E 00	0.140500E 01	0.191500E 01
0.180000E 01	0.800000E 00	0.122000E 01	0.158000E 01	0.194000E 01

HUGHES AIRCRAFT CO. TRANSONIC AIC PROGRAM (CONT-D)

OSCILLATORY FREQUENCY (CPS) 1.77755E 01
REFERENCE CHORD 1.00000E 00
REDUCED FREQUENCY (REF. CHORD) 1.00000E-01
REDUCED VELOCITY (REF. CHORD) 1.00000E 01
FREE STREAM MACH NUMBER 1.00000E 00
FREE STREAM VELOCITY 1.11687E 03
DENSITY 1.00
DYNAMIC PRESSURE (1/2* ρ *V²) 6.23699E 05

AERODYNAMIC INFLUENCE COEFFICIENTS

RL	IM	RL	IM	RL	IM	RL	IM
ROW = 1							
2.9104E 01	2.3762E-01	-1.2264E 01	-1.0361E 01	-1.5762E 01	7.0967E 00	-1.4645E 00	1.7125E-01
-1.2048E 01	-6.9629E 00	-1.5707E 00	5.9211E 00	-9.2102E-01	2.2773E-01	3.4597E 01	-3.1868E 01
1.9211E 01	-1.8351E 01	-2.7950E 00	2.4833E 00	-7.6487E 00	1.2229E 01	1.0147E 01	-1.6434E 01
4.8418E-01	-7.7325E-01						
ROW = 2							
-4.7330E 01	2.3197E 01	1.5981E 02	-5.6834E 01	-1.4525E 02	4.0923E 01	3.2615E 01	-9.2195E 01
5.9559E 01	-4.8527E 01	-5.9686E 01	3.8015E 01	1.3524E 01	-4.5277E 00	1.5039E 01	2.9933E 00
-2.5165E 01	2.6321E 01	4.8522E 00	-5.6111E 00	1.9204E 01	-3.2240E 01	-3.5121E 01	5.1333E 01
-2.5335E 00	2.9051E 00						
ROW = 3							
-5.1305E 01	7.3866E 00	9.7048E 01	1.3423E 01	-2.9771E 01	-3.6194E 01	-1.5398E 01	1.4801E 01
6.1281E 01	9.4583E 00	-3.3349E 01	-2.9080E 01	-1.3559E 00	1.3281E 01	-4.1237E 01	3.5201E 01
-9.5698E 01	2.9778E 01	1.8819E 01	-2.2753E 00	9.3788E 00	3.7335E 01	2.0648E 01	-9.3772E 01
1.7708E 01	-1.7545E 01						
ROW = 4							
2.3167E 00	-7.9546E 00	-5.1672E 01	3.9852E 01	9.9043E 01	-4.7161E 01	-4.9324E 01	1.5160E 01
-1.4526E 01	3.1150E 01	3.7929E 01	-3.9014E 01	-2.1786E 01	1.3654E 01	-1.0940E 01	-1.4258E 01
1.7383E 01	-8.0637E 01	-1.6042E 01	2.9411E 01	-2.3009E 01	1.1462E 01	6.3921E 01	-1.1426E 01
1.3704E 01	7.1322E 00						
ROW = 5							
2.5541E 01	-3.5473E 00	-2.0432E 01	-4.3619E 00	-4.1491E 00	5.2457E 00	-1.5078E 00	3.0943E-01
-1.3631E 01	-8.2974E 00	-1.1392E 01	6.1652E 00	-1.4298E 00	2.9934E-01	5.9986E 01	-3.5218E 01
3.8356E 01	-2.1428E 01	-4.3194E 00	2.7675E 00	-1.1732E 01	1.3794E 01	1.5444E 01	-1.2446E 01
7.3494E-01	-8.6966E-01						
ROW = 6							
-2.0428E 01	2.2939E 01	4.8381E 01	-6.1071E 01	-8.8246E 01	4.7092E 01	2.0061E 01	-1.0573E 01
1.2980E 02	-5.4508E 01	-1.2168E 02	4.1483E 01	2.7379E 01	-9.3869E 00	1.8680E 01	2.9396E 01
-3.9298E 01	2.9735E 01	1.0211E 01	-6.2302E 00	3.1503E 00	-3.5601E 01	-5.5608E 01	5.6485E 01

-3.8222E 00 3.2049E 00

ROW = 7

-3.8812E 01 8.9212E 00 9.6134E 01 9.0531E 00 -4.3278E 01 -3.4636E 01 -3.5288E 00 1.6037E 01 -4.1830E 01 6.4161E 00
-3.8204E 01 1.3275E 01 -3.5500E 01 -1.1095E 01 1.5988E 01 -6.1644E 01 3.0756E 01 3.0756E 01 1.6846E 02 -7.1993E 01
-1.1160E 02 3.2843E 01 2.5274E 01 -2.5339E 00 1.5155E 00 4.0645E 01 4.8302E 01 -1.0286E 02 -7.5764E 01 8.0790E 01
2.5829E 01 -1.9464E 01

ROW = 8

-2.2110E 00 -8.7486E 00 -2.3877E 01 4.3515E 01 5.7703E 01 -5.3342E 01 -3.1276E 01 1.8439E 01 8.4735E 01 -6.6719E 00
-4.0281E 01 3.6079E 01 9.1105E 01 -4.4108E 01 -4.1402E 01 1.4968E 01 -6.4673E 00 -1.5341E 01 -7.0516E 00 7.2096E 01
4.4719E 01 -8.9305E 01 -2.8824E 01 3.2349E 01 -2.7338E 01 1.3075E 01 7.4375E 01 -1.5257E 01 -6.0331E 01 -6.3306E 00
1.3526E 01 7.4334E 00

ROW = 9

1.3856E 01 1.9056E 00 -9.8472E 00 -1.5674E 01 -1.0364E 01 1.5409E 01 1.4803E 00 -7.542E 00 1.2768E 01 2.7544E 00
4.1323E 00 -1.6213E 01 -2.0475E 01 1.4358E 01 3.1805E 00 -2.5191E 00 4.9659E 01 -1.5930E 01 -5.0990E 01 1.5056E 01
4.6699E 01 -1.3527E 00 2.2801E 01 -3.2728E 01 1.9836E 01 -3.8888E 00 -3.5838E 01 7.6729E 00 1.8667E 01 -4.7225E 00
-2.6737E 00 7.1304E 01

ROW = 10

-1.5778E 01 2.2887E 01 6.1884E 01 -5.5574E 01 -5.7811E 01 3.9851E 01 1.2421E 01 -8.1426E 00 -2.7109E 01 1.8909E 01
8.5062E 01 4.6544E 01 -7.9239E 01 3.3574E 01 1.7475E 01 -6.9458E 00 -5.5748E 01 2.4746E 01 1.7104E 02 -6.1606E 01
-1.4567E 02 4.3965E 01 1.0143E 01 -8.6003E 00 6.2655E 01 -3.1237E 01 -8.6281E 01 4.0612E 01 2.2504E 01 -1.0575E 01
4.5544E 01 -2.2762E 01

ROW = 11

-1.4516E 01 -1.9932E 00 2.8844E 01 2.6004E 01 -8.3497E 00 -4.0074E 01 -5.6511E 00 1.5691E 01 -1.0663E 01 -1.8481E 00
1.2721E 01 2.4424E 01 1.2298E 01 -3.6822E 01 -1.4027E 01 1.3942E 01 -5.8038E 01 1.5023E 01 1.2785E 02 -1.1442E 01
-7.2251E 01 -1.1024E 01 2.8939E 00 7.0450E 00 -4.5751E 01 3.5403E 01 1.2870E 02 -7.4329E 01 -1.1007E 02 4.8195E 01
2.7331E 01 -9.5679E 00

ROW = 12

-2.8039E 00 -5.9858E 00 -4.7594E 00 2.9352E 01 2.4543E 01 -3.6638E 01 -1.4746E 01 1.3058E 01 -1.9464E 00 -4.4864E 00
-1.2669E 01 2.4211E 01 3.3706E 01 -3.0281E 01 -1.8874E 01 1.0444E 01 6.2737E 00 -9.6044E 00 -6.1351E 01 4.7741E 01
1.0790E 02 -5.9562E 01 -9.2814E 01 2.0266E 01 -2.1016E 01 1.0345E 01 4.6808E 01 -1.1052E 01 -2.5529E 01 -4.3008E 00
-2.0738E 01 4.8474E 00

ROW = 13

-4.7319E 00 5.2570E 00 -1.6753E 01 -9.7899E 00 -1.3857E 01 3.6793E 00 1.8432E 00 5.4745E 01 -4.8585E 00 4.2234E 00
1.5743E 01 -7.5909E 00 -1.3473E 01 2.7943E 00 1.5661E 00 5.6100E 01 -1.7988E 01 9.2698E 00 5.1421E 01 -1.9970E 01
-3.9727E 01 1.4918E 01 6.2846E 00 -1.6790E 00 -2.8476E 01 7.7102E 01 8.9258E 01 -5.7658E 00 -7.9336E 01 6.0793E 00
1.8456E 01 -1.5832E 00

ROW = 14

-4.1329E 00 6.7988E 02 7.1851E 00 6.5565E 00 1.1468E 01 -1.1364E 01 -3.0645E 00 4.6402E 00 -2.7366E 00 1.4793E 02
2.4584E 00 6.2037E 00 5.3111E 00 -1.0181E 01 -4.9494E 00 -4.0692E 00 -1.7908E 01 4.7818E 00 3.6555E 01 -3.7524E 00
-2.1741E 01 -3.6051E 00 2.4342E 00 -3.8113E 01 6.6797E 00 7.6708E 01 -1.4618E 01 -3.9478E 01 6.6331E 00
-1.1280E 00 -8.1711E 01

ROW = 15

-2.5742E 01 -1.9888E 00 -9.1300E 00 1.1167E 01 1.4085E 01 -1.4335E 01 -7.6923E 00 5.1015E 00 -9.6039E 01 -1.5823E 00
-5.2555E 00 9.4447E 00 1.5941E 01 -1.2134E 01 -8.4229E 00 4.2248E 00 3.4441E 02 -2.0634E 00 -1.3249E 01 1.4461E 01
4.3113E 01 -1.9184E 01 -2.0747E 01 6.7208E 00 -1.1417E 01 3.2806E 00 -8.2608E 00 3.1077E 01 5.5439E 01 -5.9360E 00
-3.3645E 01 2.2849E 00

ROW = 16

3.5762E 01 -1.1221E 00 -7.7004E 01 5.7689E 00 1.3444E 02 -2.7473E 00 -1.2225E 00 2.2837E 00 3.1674E 02 -2.1102E 00
-7.3223E 00 4.8588E 01 1.9745E 01 -5.7688E 00 -6.9647E 00 1.7902E 00 1.3371E 00 -1.0620E 00 -1.0823E 01 8.6135E 00
3.4509E 01 -1.1041E 01 1.0542E 01 3.1481E 00 4.3847E 01 3.0411E 02 -4.1676E 01 1.6736E 00 7.5282E 01 -4.5065E 00
-2.5798E 00 7.7425E 00

Sample Problem 3.

Transonic AIC's are computed for a 45° delta wing at $M = 1.01$, $f = 5.5$ cps and a 1116.87 ft/sec (sea level). Figure 1.9 shows the wing geometry and AIC stations. The trailing surface is removed from the analysis by setting $X(5) = X(4) = X(3)$. There are 8 chordwise boxes on the wing and a total of 36 boxes in the overlay. Input parameters are summarized below and a listing of the data input cards and computer output follows.

$X(1) = 0.0'$ $X(2) = 2.0'$ $X(3) = 2.0'$ $X(4) = 2.0'$ $X(5) = 2.0'$
 $Y(1) = 0.0'$ $Y(2) = 0.0'$ $Y(3) = 2.0'$

SOUND = 1116.87	acoustic velocity (sea level)
NMACH = 1	number of Mach numbers
KF = 0	input frequency
NFREQ = 1	number of frequencies
NBW = 8	number of chordwise boxes on wing
LPUNCH = 1	punch AIC matrix for wing on cards
FMACH (1) = 1.01	Mach number
FREQ (1) = 5.5	frequency (cps)
NXWING = 4	number of chordwise AIC stations on wing
NYWING = 4	number of spanwise AIC stations on wing
NXCS = 0	number of chordwise AIC stations on control surface
NYCS = 0	number of spanwise AIC stations on control surface

$YAIC(1,W) = 0.2'$ $YAIC(2,W) = 0.6'$ $YAIC(3,W) = 1.0'$
 $YAIC(4,W) = 1.4'$

$XAIC(1,1,W) = 0.560'$ $XAIC(1,2,W) = 0.920'$ $XAIC(1,3,W) = 1.280'$
 $XAIC(1,4,W) = 1.640'$

$XAIC(2,1,W) = 0.880'$ $XAIC(2,2,W) = 1.160'$ $XAIC(2,3,W) = 1.440'$
 $XAIC(2,4,W) = 1.720'$

$XAIC(3,1,W) = 1.200'$ $XAIC(3,2,W) = 1.400'$ $XAIC(3,3,W) = 1.600'$
 $XAIC(3,4,W) = 1.800'$

$XAIC(4,1,W) = 1.520'$ $XAIC(4,2,W) = 1.640'$ $XAIC(4,3,W) = 1.760'$
 $XAIC(4,4,W) = 1.880'$

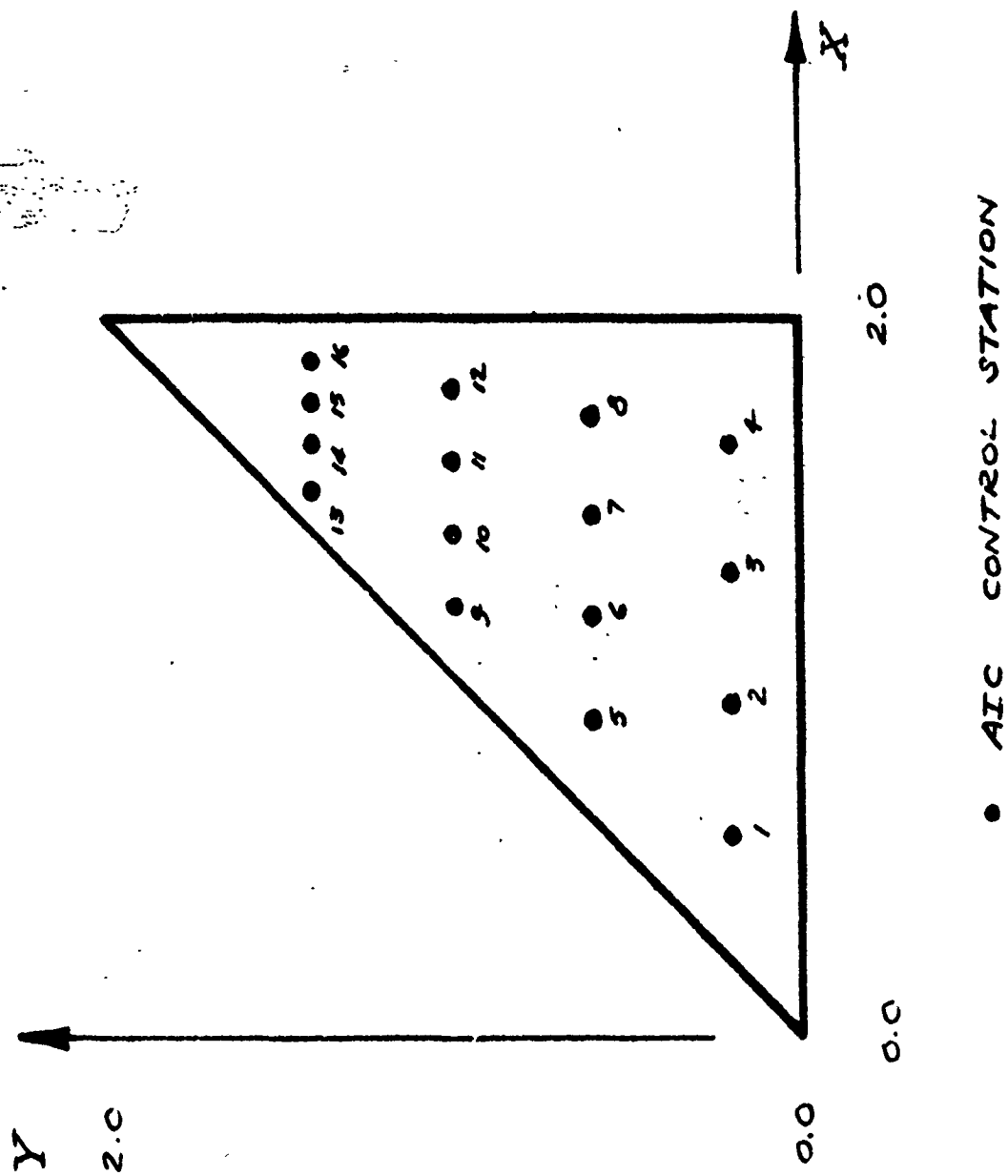


FIGURE 3. TRANSONIC SAMPLE PROBLEM 3.

HUGHES AIRCRAFT CO. TRANSONIC AIC PROGRAM

FLIGHT CONDITIONS AND GEOMETRY

MACH NUMBER = 1.01000 SPEED OF SOUND = 1116.870 L/T $\rho/\rho_0 = 1.700$

	WING	TAIL
L.E. STATION (L)	0.	2.000
ROOT CHORD (L)	2.000	0.
L.E. SPAN (L)	0.	2.000
T.E. SPAN (L)	2.000	2.000
TIP CHORD (L)	0.	0.
TOTAL AREA (L ²)	4.000	0.
CHORDWISE BOXES	8	0
SPANWISE BOXES	8	8

TOTAL CHORDWISE BOXES = 8 BOX CHORD = 2.66667E-01 L BOX SPAN = 2.66667E-01 L

HUGHES AIRCRAFT CO. TRANSONIC AIC PROGRAM (CONT-D)

MAP OF SONIC BOX OVERLAY
ON WING, TAIL AND WAKE
(S) - WING
(S) - TAIL
(.) - WAKE

S
SS
SSS
SSSS
SSSS
SSSSS
SSSSSS
SSSSSSS
SSSSSSSS

HUGHES AIRCRAFT CO. TRANSONIC AIC PROGRAM (CONT'D)

AIC COLLOCATION STATION COORDINATES ON THE WING				
VAIC	XAIC VALUES--			
0.20000E 00	0.56000E 00	0.92000E 00	0.12000E 01	0.16400E 01
0.60000E 00	0.88000E 00	0.11600E 01	0.14400E 01	0.17200E 01
0.10000E 01	0.12000E 01	0.14000E 01	0.16000E 01	0.18000E 01
0.14000E 01	0.15200E 01	0.16400E 01	0.17600E 01	0.18800E 01

HUGHES AIRCRAFT CO. TRANSONIC AIC PROGRAM (CONT-D)

OSCILLATORY FREQUENCY (CPS) 5.50000E 00

REFERENCE CHORD 1.00000E 00

REDUCED FREQUENCY (REF. CHORD) 3.06350E-02

REDUCED VELOCITY (REF. CHORD) 3.26424E 01

FREE STREAM MACH NUMBER 1.01000E 00

FREE STREAM VELOCITY 1.12804E 03

DENSITY 1.00

DYNAMIC PRESSURE (1/2*RH0*VEL**2) 6.36236E 05

AERODYNAMIC INFLUENCE COEFFICIENTS

	RL	IM	RL	IM	RL	IM	RL	IM
ROW = 1								
8.7025E 02	-1.1397E 01	-1.0753E 03	8.5271E 00	2.6966E 02	-8.5442E 00	-6.4619E 01	3.1197E 00	7.0578E 02
-1.4037E 03	5.7300E 01	7.5176E 02	-2.2638E 01	-5.3905E 01	-1.0970E 00	-2.6717E 02	2.3543E 01	5.0182E 02
-2.4554E 02	8.2174E 00	1.0950E 01	3.0992E 00	3.6300E 01	-3.1156E 00	-6.0810E 01	1.9210E 00	2.0033E 01
4.4868E 00	-3.2528E 00							4.4224E 00
ROW = 2								
-1.3155E 03	7.4571E 01	3.5403E 03	-1.7955E 02	-2.9693E 03	1.4356E 02	7.3662E 02	-4.0737E 01	1.2351E 03
-2.7188E 03	1.3060E 02	1.1702E 03	-3.1686E 01	-1.8675E 02	-1.0728E 01	2.0416E 01	3.2688E 02	-4.9194E 02
3.4177E 02	-1.3530E 02	-5.3316E 01	4.4423E 01	-1.5635E 02	3.1517E 01	3.0637E 02	-8.0707E 01	-2.2283E 02
7.2074E 01	-3.4178E 01							5.3792E 01
ROW = 3								
-6.0675E 02	5.6674E 00	1.5654E 03	-4.0444E 01	-1.0073E 03	7.4283E 01	1.0864E 02	-4.0987E 01	-1.7183E 03
3.9982E 03	-3.9216E 02	-2.7001E 03	-1.3300E 02	4.1528E 02	2.2715E 02	1.3947E 03	-2.5877E 02	3.5362E 02
-4.5700E 03	1.9738E 03	2.6169E 03	-1.0982E 03	4.3914E 01	-3.1424E 01	-2.3683E 03	9.8990E 02	4.2165E 03
-1.8915E 03	8.6044E 02							-1.8171E 03
ROW = 4								
3.1474E 02	-6.1947E 01	-3.7324E 03	9.7544E 02	7.3237E 03	-2.0556E 03	-3.9162E 03	1.1398E 03	-7.0161E 02
1.5792E 04	-6.8663E 03	-3.5483E 04	1.6230E 04	2.0394E 04	-2.4492E 03	-5.7352E 02	-2.6690E 01	-3.2179E 04
8.6477E 04	-3.8418E 04	-4.7729E 04	2.2315E 04	-1.7294E 03	9.1908E 02	4.5009E 04	-1.9498E 04	-9.1589E 04
1.6222E 04	-2.2452E 04							4.1035E 04
ROW = 5								
-4.6504E 02	4.4962E 01	1.4297E 03	-1.1337E 02	-1.0341E 03	8.6314E 01	2.1116E 02	-2.0333E 01	9.4565E 02
-0.6401E 01	5.5390E 01	1.5960E 02	-1.0990E 01	-2.1392E 01	-4.1808E 00	9.0070E 02	-2.6982E 01	-9.1396E 02
5.6734E 02	-6.3875E 01	-8.6159E 01	1.9604E 01	-1.1811E 02	1.4501E 02	2.2306E 02	-3.6124E 01	-1.5244E 02
4.6627E 01	-1.4957E 01							3.6924E 01
ROW = 6								
-3.7347E 02	3.3435E 01	9.8109E 02	-7.7250E 01	-7.2575E 02	5.1440E 01	1.1610E 02	-8.9662E 00	-1.0065E 03
2.9534E 03	-2.9664E 02	-2.7283E 03	3.1460E 02	7.8135E 02	-1.1272E 02	1.2671E 03	-1.4702E 02	-2.2096E 03
1.7047E 03	-4.1095E 02	-5.0237E 02	1.5433E 02	-0.0373E 02	4.9706E 01	5.4473E 02	-1.7668E 02	-6.0528E 02

2.6428E 02 -1.0841E 02

ROW = 7

1.4602E 02 -5.3032E 01 -4.7937E 02 1.1729E 02 6.3413E 02 -7.2575E 01 -2.9444E 02 7.1756E 00 -1.2834E 03 1.7754E 02
1.6670E 03 1.0368E 02 5.5383E 02 -7.4400E 02 -9.6771E 02 4.8222E 02 -3.2948E 02 2.0391E 01 5.4614E 03 -1.5128E 03
-9.4639E 03 2.9726E 03 4.5300E 03 -1.4841E 03 7.1349E 02 -1.6346E 02 -4.3446E 03 1.4555E 03 6.4538E 03 -2.4321E 03
-2.4194E 03 1.1428E 03

ROW = 8

6.9638E 01 -1.2039E 01 -1.9772E 03 5.8578E 02 4.3145E 03 -1.3219E 03 -2.4071E 03 7.4654E 02 2.9146E 02 -7.6132E 01
9.1765E 03 -4.2333E 03 -2.3224E 04 1.0400E 04 1.3757E 04 -6.0919E 03 -7.7872E 02 4.5696E 01 -2.4985E 04 1.0864E 04
6.1724E 04 -2.5866E 04 -3.6012E 04 1.4769E 04 -1.4361E 03 6.3602E 02 3.2808E 04 -1.2970E 04 -6.7533E 04 2.6895E 04
3.6344E 04 -1.4560E 04

ROW = 9

-7.6142E 01 1.8919E 00 2.2386E 02 5.6743E 00 -6.1709E 01 -2.4716E 01 -8.6206E 01 1.5347E 01 -6.8237E 02 8.9669E 01
1.4189E 03 -1.2105E 02 -6.4727E 02 -3.7622E 01 -8.9043E 01 6.7980E 01 3.9758E 01 -4.1138E 01 1.7987E 03 -2.1051E 02
-3.7892E 03 5.1218E 02 1.2545E 03 -2.6445E 02 3.2135E 02 -3.1037E 01 -1.3159E 03 2.6739E 02 1.7019E 03 -4.4737E 02
-7.0729E 02 2.1093E 02

ROW = 10

4.5586E 01 -1.3362E 01 -2.7404E 02 6.2048E 01 4.7212E 02 -8.6968E 01 -2.4370E 02 3.7651E 01 -1.9744E 02 1.0275E 01
4.8994E 02 5.1865E 02 -2.1315E 02 -3.3268E 01 6.4565E 01 1.7468E 01 -5.6787E 02 5.2291E 01 1.1199E 03 -1.1031E 02
-2.8609E 02 3.9135E 01 -2.6607E 02 1.7740E 01 2.3499E 02 -3.6424E 01 -3.9682E 01 2.8934E 01 -4.2610E 02 1.1546E 01
2.3069E 02 -2.4975E 01

ROW = 11

2.0174E 01 -7.0390E 00 -2.9245E 02 6.5264E 01 5.5966E 02 -1.1445E 02 -2.9342E 02 5.5670E 01 4.0889E 01 -2.6586E 01
7.5816E 01 -5.2061E 01 -2.5705E 02 2.1730E 02 1.4030E 02 -1.3913E 02 -5.2114E 02 8.6667E 01 -2.6234E 02 2.8505E 02
-2.2602E 03 -8.3958E 02 -1.4765E 03 4.6740E 02 1.2237E 02 -7.3359E 00 9.5517E 02 -4.0260E 02 -1.9765E 03 4.3035E 02
8.9876E 02 -4.7218E 02

ROW = 12

1.6626E 01 7.3377E 01 -3.2677E 02 4.1916E 01 5.9099E 02 -6.4773E 01 -2.7587E 02 2.2460E 01 5.3610E 02 -1.2707E 02
-2.2402E 03 5.3936E 02 5.0250E 03 -8.8048E 02 -2.7212E 03 4.6641E 02 -7.6936E 02 1.7188E 02 2.0634E 03 -5.0607E 02
-1.7094E 03 9.4752E 02 2.4740E 03 -6.1126E 02 4.0257E 02 -6.8342E 01 -3.4641E 03 5.4237E 01 8.0860E 03 -4.3480E 03
-5.7257E 03 8.6971E 02

ROW = 13

-2.7935E 00 -3.1123E 00 -3.1336E 02 8.1311E 04 7.7256E 02 -1.7323E 02 -4.5067E 02 9.4293E 01 2.3511E 02 -2.3230E 01
1.3809E 03 -3.4374E 02 -3.6127E 03 8.9274E 02 2.2677E 03 -5.2618E 02 -8.1305E 02 4.5824E 01 -3.1925E 03 9.7886E 02
1.070E 04 -2.4121E 03 -6.0644E 03 1.3865E 03 1.3865E 03 -4.3258E 02 4.3922E 01 6.5544E 03 -1.2033E 03 -1.2176E 04 2.4733E 03
4.538E 03 -1.5157E 03

ROW = 14

-4.7315E 00 4.2278E 02 9.4374E 01 -8.7091E 00 -2.2962E 02 2.7530E 01 1.4017E 02 -1.9536E 01 1.5820E 02 -2.7631E 01
-1.7522E 03 3.0617E 02 4.0006E 03 -6.4515E 02 -2.2836E 03 3.6551E 02 -3.0675E 02 4.3101E 01 3.3040E 03 -5.6857E 02
-3.674E 03 1.2682E 03 4.7704E 03 -7.4130E 02 2.0118E 02 -4.4301E 01 -4.2686E 03 6.6184E 02 9.4684E 03 -1.4225E 03
-5.4413E 03 8.3300E 02

ROW = 15

1.4797E 01 1.4797E 01 3.0011E 02 -2.7173E 01 -8.3469E 02 9.3555E 01 4.9640E 02 -0.8377E 01 5.5368E 02 -4.6709E 01
-2.723E 03 1.4723E 03 1.4022E 04 -2.2840E 03 -7.6277E 03 1.2703E 03 -1.0736E 03 1.5065E 02 1.3324E 04 -1.9900E 03
-9.46E 04 4.4387E 03 1.0096E 04 7.3412E 02 -1.5505E 02 -1.4040E 04 2.3145E 03 2.3145E 03 3.3139E 04 -4.0746E 03
-2.4115E 03

ROW = 16

1.7376E 00 1.7376E 00 3.7256E 02 -5.4776E 01 -9.2460E 02 1.4812E 02 5.0446E 02 -9.4621E 01 3.9145E 02 -7.2201E 01
-0.646E 03 1.7425E 03 1.3331E 04 -2.2603E 03 -7.6387E 03 1.2875E 03 -6.0449E 02 1.7535E 02 1.2286E 04 -2.0527E 03
-2.7599E 04 4.0631E 03 1.4224E 04 -2.7331E 03 2.2078E 02 -1.4514E 02 -1.5234E 04 2.4359E 03 3.2866E 04 -5.1872E 03
-1.4392E 04 2.8943E 03

PART V - SECTION B4.0

LISTING OF TRANSONIC AIC
COMPUTER PROGRAM


```

CHAIN      MAIN
COMPLEX Z,W,F,VPIC,DS,PHIW,CK,CZERO,PHI,PHITE,DPHI,
1          SPHI,ASQ,EXF,AIC
DIMENSION ASQ(40,40),F(45,45),S(45,45),R(45,45),C(45,45),B(45,45),
1          T(45,45),TEMP(45,45),TH(45,45),TI(45,45),Tr(45,45)
COMMON/C1/KBOX(1000),XF(5),YE(3),AR(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
COMMON/C2/AS,NMACH,FMACH(6),NFREQ,FREQ(10),NMODE,NSURF,LPUNCH
COMMON/C3/VPIC(80,15),DS(2025),PHIW(50),CK(40),DXE(6),TPI,KF
COMMON/C4/MOR(100),NBL(100),FQ,IFR,XL,NS,NTM,NBW,NBT
COMMON/C5/X,Y,DX,DY,EM,EK,EKB,EKR,NP,MP,NB,NROX,KODE,MODE
COMMON/C6/CZFRO,PHI,PHITE,DPHI,SPHI,RHO,NXCS,NYCS,NYBX(40)
COMMON/C8/XAIC(10,10,2),YAIC(10,2),NXBX(40),NXBXCS,NYWINO,NYWINO
COMMON/C9/W(45,45),AIC(45,45)
EQUIVALENCE (C,S,R),(ASQ,W,B),(DS,F,TH),(AIC,TEMP)
1 CALL DAIN
IF (NMODE .LE. 45) GO TO 5
WRITE (6,8)
8 FORMAT (1H1,5X,50H NUMBER OF AIC STATIONS EXCEEDS MAX ALLOWABLE (4
15)/5X,16H CASE TERMINATED)
GO TO 1
5 CONTINUE
DO 1000 MACH=1,NMACH
EM = FMACH(MACH)
IF (ABS(EM-1.0).GT.0.05) GO TO 1000
CALL CODE
CALL POUT(1)
CALL POUT(2)
NTRS=0
DO 7 J=1,NBS
7 NTRS=NTRS+NXBX(J)+NXBXCS
IF (NTRS .LE. 45) GO TO 17
WRITE (6,14)
14 FORMAT(1H1,5X,48H NUMBER OF MACH BOXES EXCEEDS MAX ALLOWABLE (45)
1/5X,16H CASE TERMINATED)
GO TO 1
17 CONTINUE
TPU=TP1/(AS*EM)
RFM = DX
CALL TRAMP (2,NTRS,NTCS,S,R,C,B,T,TR,TI,TH)
DO 550 I=1,NTRS
DO 550 J=1,NTCS
550 TEMP(I,J)=TR(I,J)
CALL TRAMP (1,NTRS,NTCS,S,R,C,B,T,TR,TI,TH)
DO 560 I=1,NTRS
DO 560 J=1,NTCS
560 TR(I,J)=TEMP(I,J)
DO 900 IFR=1,NFREQ
IF (KF .EQ. 1) FREQ(IFR)=FREQ(IFR)*FMACH(MACH)*AS/(TPI*X1*0.5)
FK=FREQ(IFR)*TPU
IF (KF .EQ. 0.0) GO TO 900
EKR = FK*RFM
EKR = EKR*X1/2.0
NMODE=NTRS
CALL POT2H
ARG=EK*DX
EXF=CMPLX(COS(ARG),-SIN(ARG))
DO 900 MODE=1,NMODE
X=0.5*DX
NH=1
DO 900 NP=1,NROX
MH=MOD(NP)

```

```

Y=0.0
KODE = KBOX(NB)
NS = 1
GO TO (12,11,12,11,11,120),KODE
11 NS = 2
12 DO 20 MP=1,MR
  SPH1 = CZERO
  IF(NP.GT.1) CALL PHIR
  IF (NS.EQ. 2) GO TO 13
  IR=0
  DO 21 IL=1,MP
21  IR=IR+NXBX(IL)
    IR=IR+NP-NXBX(1)
    GO TO 26
13  IR=0
    DO 22 IL=1,NRS
22  IR=IR+NXBX(IL)
    DO 23 IL=1,MP
23  IR=IR+NXBXCS
    IR=IR-NROX+NP
26  SR=IR(IR,MODE)
    SI=11(IR,MODE)*TPI*FREQ(IFR)/(FM*AS)
    CK(MP)=CMPLX(SR,SI)
    DS(NB)=CK(MP)
    DS(NB) = DS(NB) - SPH1
    Y = Y+DY
20  NB = NB+1
    NB = NB-MB
    DO 30 IQ=1,MR
    DO 30 JQ=1,MR
    IJQ = IABS(IQ-JQ)+1
25  ASQ(IQ,JQ) = VPIC(IJQ,1)
    IF(JQ.EQ.1) GO TO 30
    IJQ=IQ+JQ-1
    ASQ(IQ,JQ)=ASQ(IQ,JQ)+VPIC(IJQ,1)
30  CONTINUE
    LSQ=MSIMEQ(40,MB,1,ASQ,DS(NB))
    IF(LSQ.EQ.1) GO TO 39
    GO TO 900
39  CONTINUE
    Y = 0.0
    IF(NP.NE.1) GO TO 50
    DO 45 MP=1,MR
45  DS(MP) = DS(MP)*2.0/3.1415927
50  CONTINUE
    IF (KODE.NE.4) GO TO 80
    DO 60 MP=1,MR
    DS(NB) = PHIW(MP)+(DS(NB)-PHIW(MP))*2.0/3.1415927
60  NR=NR+1
    NR=NR-MR
80  CONTINUE
    DO 100 MP=1,MR
    IF(KODE.EQ.3) PHIW(MP)=DS(NB)*EXF
    IF(NP.EQ.NROX-1) PHIW(MP)=DS(NR)
    PHITE = DS(NR)
    IF(NP.EQ.NROX) PHITE = PHITE+(PHITE-PHIW(MP))*DXE(5)
    PHI = DS(NB)
    GO TO (120,121,120,121,121,127),KODE
120 IC=0
    DO 122 IL=1,MP
122 IC=IC+NXBX(IL)

```

```

      IC=IC+NP-NXBX(1)
      GO TO 126
121  IC=0
      DO 123 IL=1,NHS
123  IC=IC+NXBX(IL)
      DO 124 IL=1,MP
124  IC=IC+NXBXCS
      IC=IC-NBOX+NP
126  AIC(IC,MODE)=DS(NH)/FM
127  CONTINUE
      NB = NB + 1
100  Y=Y+DY
      GO TO 200
120  DO 130 MP=1,MH
      DS(NB)=PHIW(MP)
      PHIW(MP) = FFX*PHIW(MP)
      CK(MP)=CZERO
130  NB = NB+1
200  X = X+DX
500  CONTINUE
      CALL SD2 (S,R,C,R.T,TR,TH)
      DO /01 I=1,NTRS
      DO /01 J=1,NTRS
      SI=0.0
      IF (I.EQ. J) SI=TPI*FREQ(IFR)/(FM*AS)
      SR=TH(I,J)
701  W(I,J)=CMPLX(SR,SI)
      DO /02 I=1,NTRS
      DO /02 J=1,NTRS
      F(I,J)=(0.0,0.0)
      DO /02 K=1,NTRS
702  F(I,J)=F(I,J)+W(I,K)*AIC(K,J)
      CALL FORCE (R)
      DO /04 I=1,NTRS
      DO /04 J=1,NTRS
      AIC(I,J)=(0.0,0.0)
      DO /04 K=1,NTRS
      Z=CMPLX(C(I,K)*FQ/(0.5*(TPI*FREQ(IFR))*2*(YE(J)-YE(I))*(XE(3)-XE(
11))*2),0.0)
704  AIC(I,J)=AIC(I,J)-Z*F(K,J)
      CALL POUT(3)
      IF (IPUNCH .GT. 0) CALL POUT(4)
900  CONTINUE
1000 CONTINUE
      GO TO 1
      END

```

CFORCE

FORCE

```

SUBROUTINE FORCE (R)
  COMPLEX CZERO, PHI, PHIF, DPHI, SPHI
  COMPLEX VPIC, DS, PHIW, CK
  DIMENSION R(45,45)
  COMMON/C1/KBOX(1000), XE(5), YE(3), AR(3), X1, X2, X3, X4, Y1, Y2, BETA, NBS
  COMMON/C2/AS, NMACH, FMACH(6), NFREQ, FREQ(10), NMODE, NSURF, LPUNCH
  COMMON/C3/VPIC(80,15), DS(2025), PHIW(50), CK(40), DXE(6), TPI, KF
  COMMON/C4/MOR(100), NRL(100), FO, IFR, XL, NS, NTH, NRW, NRT
  COMMON/C5/X, Y, DX, DY, EM, EK, EKB, EKR, MP, MP, NB, NBOX, KODE, MODF
  COMMON/C6/CZERO, PHI, PHIF, DPHI, SPHI, RHO, NXCS, NYCS, NYRX(40)
  COMMON/C8/XAIC(10,10,2), YAIC(10,2), NXBX(40), NXBXCS, NYWING, NYWING
  NSURF=NRX(1)
  MR=MOR(NBOX)
  NMRXW=0
  DO 50 J=1, MR
50  NMRXW=NMRXW+NRX(1)
  KROW=NXWING+NYWING+NXCS+NYCS
  KCOL=0
  DO 100 J=1, MR
100 KCOL=KCOL+NRX(1)+NXRXCS
  DO 150 I=1, KROW
  DO 150 J=1, KCOL
150 R(I,J)=0.0
  DO 200 I=1, MR
  NCK=0
  FRF=1.0
  FRT=1.0
  FOF = 1.0
  YR=DY*FLOAT(1)-DY
  IJ=NYWING-1
  DO 610 III=1, IJ
  IF (0.5*(YAIC(III,1)+YAIC(III+1,1))-YE(1) .GT. YR-.5*DY) GO TO 650
610 CONTINUE
  IJ=NYWING
  GO TO 620
650 CONTINUE
  IF (YR-.5*DY .LT. 0.5*(YAIC(III,1)+YAIC(III+1,1))-YE(1) .AND.
1  YR+.5*DY .GT. 0.5*(YAIC(III,1)+YAIC(III+1,1))-YE(1)) NCK=1
  IF (NCK .EQ. 0) GO TO 620
  FRF=(0.5*(YAIC(III,1)+YAIC(III+1,1))-YE(1)-YR+.5*DY)/DY
  FRT=1.0-FRF
620 NROW=NXWING*(IJ-1)
  NCOL=0
  DO 650 III=1, IJ
650 NCOL=NCOL+NRX(III)
  NCOL=NCOL-NRX(1)
  KK=NRX(1)
  DO 750 K=1, KK
  DO 700 J=1, NYWING
  IF (XAIC(1, III, 1)-XE(1) .GE. (FLOAT(NXBX(1)-NXBX(1)+K)-.5)*DX)
100 GO TO 710
  IF (XAIC(NXWING, III, 1)-XE(1) .LE. (FLOAT(NXBX(1)-NXBX(1)+K)-.5)*
10X) GO TO 720
  IF (XAIC(J, III, 1)-XE(1) .GT. (FLOAT(NXRX(1)-NXBX(1)+K)-.5)*DX)
100 GO TO 750
700 CONTINUE
710 NRF=NROW+1
  NCF=NCOL+K
  R(NRF, NCF)=FRF
  IF (I .EQ. 1) R(NRF, NCF)=R(NRF, NCF)*0.5

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```

      IF (K .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*0.5
      IF (I .EQ. MR) FOF = (YE(3)-YE(1))-(FLOAT(MR)-1.5)*DY)/DY
      IF (I .EQ. MR) R(NRF,NCF)=R(NRF,NCF)*FOF
      GO TO 740
720  NRF=NROW+NXWING
      NCF=NCOL+K
      R(NRF,NCF)=FRB
      IF (I .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*0.5
      IF (K .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*0.5
      IF (I .EQ. MR) FOF = (YE(3)-YE(1))-(FLOAT(MR)-1.5)*DY)/DY
      IF (I .EQ. MR) R(NRF,NCF)=R(NRF,NCF)*FOF
      GO TO 740
730  R1=XAIC(J,III,1)-XE(1)-(FLOAT(NXB(1)-NXBX(1)+K)-0.5)*DX
      R3=XAIC(J,III,1)-XAIC(J-1,III,1)
      NRF=NROW+J
      NCF=NCOL+K
      R(NRF,NCF)=(1.0-R1/R3)*FRB
      R(NRF-1,NCF)=(R1/R3)*FRB
      IF (I .EQ. 1) R(NRF,NCF)=0.5*R(NRF,NCF)
      IF (I .EQ. 1) R(NRF-1,NCF)=0.5*R(NRF-1,NCF)
      IF (K .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*0.5
      IF (K .EQ. KK) R(NRF-1,NCF)=R(NRF-1,NCF)*0.5
      IF (I .EQ. MR) FOF = (YE(3)-YE(1))-(FLOAT(MR)-1.5)*DY)/DY
      IF (I .EQ. MR) R(NRF,NCF)=R(NRF,NCF)*FOF
      IF (I .EQ. MR) R(NRF-1,NCF)=R(NRF-1,NCF)*FOF
740  CONTINUE
      IF (NCK .EQ. 1 .AND. K .EQ. KK) GO TO 760
      GO TO 750
750  DO 850 KT=1,KK
      DO 800 JT=1,NXWING
      IF (XAIC(1,III+1,1)-XE(1) .GE. (FLOAT(NXB(1)-NXBX(1)+KT)-.5)*DX)
180  GO TO 810
      IF (XAIC(NXWING,III+1,1)-XF(1) .LE. (FLOAT(NXB(1)-NXBX(1)+KT)-.5)
190 *DX) GO TO 820
      IF (XAIC(JT,III+1,1)-XF(1) .GT. (FLOAT(NXB(1)-NXBX(1)+KT)-.5)*DX)
190  GO TO 830
800  CONTINUE
810  NRF=NROW+NXWING+1
      NCF=NCOL+KT
      R(NRF,NCF)=FRT*FOF
      IF (KT .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*0.5
      GO TO 840
820  NRF=NROW+2*NXWING
      NCF=NCOL+KT
      R(NRF,NCF)=FRT*FOF
      IF (KT .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*0.5
      GO TO 840
830  R1=XAIC(JT,III+1,1)-XE(1)-(FLOAT(NXB(1)-NXBX(1)+KT)-0.5)*DX
      R3=XAIC(JT,III+1,1)-XAIC(JT-1,III+1,1)
      NRF=NROW+NXWING+JT
      NCF=NCOL+KT
      R(NRF,NCF)=(1.0-R1/R3)*FRT*FOF
      R(NRF-1,NCF)=(R1/R3)*FRT*FOF
      IF (I .EQ. 1) R(NRF,NCF)=0.5*R(NRF,NCF)
      IF (I .EQ. 1) R(NRF-1,NCF)=0.5*R(NRF-1,NCF)
      IF (KT .EQ. KK) R(NRF,NCF)=0.5*R(NRF,NCF)
      IF (KT .EQ. KK) R(NRF-1,NCF)=0.5*R(NRF-1,NCF)
840  CONTINUE
850  CONTINUE
750  CONTINUE
800  CONTINUE

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```

DO 400 I=1,MR
KK=NXHXCS
NCK=0
FRR=1.0
FRT=1.0
FOF = 1.0
YR=0Y*FLOAT(1)-DY
II=NYCS-1
DO 410 III=1,II
IF (0.5*(YAIC(III,2)+YAIC(III+1,2))-YE(1)) .GT. YR-.5*DY) GO TO 430
410 CONTINUE
III=NYCS
GO TO 420
430 CONTINUE
IF (YR-.5*DY .LT. 0.5*(YAIC(III,2)+YAIC(III+1,2))-YE(1)) .AND.
1 YR+.5*DY .GT. 0.5*(YAIC(III,2)+YAIC(III+1,2))-YE(1)) NCK=1
IF (NCK .EQ. 0) GO TO 420
FRR=(0.5*(YAIC(III,2)+YAIC(III+1,2))-YE(1)-YR+.5*DY)/DY
FRT=1.0-FRR
420 NROW=NXWING+NYWING+NY 3*(III-1)
NCOL=NMHXM+(1-1)*NXBXL..
DO 450 K=1,NXHXCS
DO 400 J=1,NXCS
IF (XAIC(1,III,2)-XE(1)) .GE. (FLOAT(NBOX-NXHXCS+K)-.5)*DX)
1 GO TO 910
IF (XAIC(NXCS,III,2)-XE(1)) .LE. (FLOAT(NBOX-NXHXCS+K)-.5)*DX)
1 GO TO 920
IF (XAIC(J,III,2)-XE(1)) .GT. (FLOAT(NBOX-NXHXCS+K)-.5)*DX)
1 GO TO 930
900 CONTINUE
910 NRF=NROW+1
NCF=NCOL+K
R(NRF,NCF)=FRR
IF (I .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*0.5
IF (K .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*((FLOAT(NBOX-NXHXCS+1))*DX-
1 XE(4)+XE(1))/DX
IF (K .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*(XE(5)-XE(1)-(FLOAT(NBOX-1))*
1 DX)/DX
IF (I .EQ. MR) FOF=(YE(3)-YE(1)-(FLOAT(MR)-1.5)*DY)/DY
IF (I .EQ. MR) R(NRF,NCF)=R(NRF,NCF)*FOF
GO TO 940
920 NRF=NROW+NXCS
NCF=NCOL+K
R(NRF,NCF)=FRR
IF (I .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*0.5
IF (K .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*((FLOAT(NBOX-NXHXCS+1))*DX-
1 XE(4)+XE(1))/DX
IF (K .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*(XE(5)-XE(1)-(FLOAT(NBOX-1))*
1 DX)/DX
IF (I .EQ. MR) FOF = (YE(3)-YE(1)-(FLOAT(MR)-1.5)*DY)/DY
IF (I .EQ. MR) R(NRF,NCF)=R(NRF,NCF)*FOF
GO TO 940
930 R1=YAIC(J,III,2)-XE(1)-(FLOAT(NBOX-NXHXCS+K)-.5)*DX
R3=YAIC(J,III,2)-XAIC(J-1,III,2)
NRF=NROW+J
NCF=NCOL+K
R(NRF,NCF)=(1.0-R1/R3)*FRR
R(NRF-1,NCF)=(R1/R3)*FRR
IF (I .EQ. 1) R(NRF-1,NCF)=0.5*R(NRF-1,NCF)
IF (I .EQ. 1) R(NRF,NCF)=0.5*R(NRF,NCF)
IF (K .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*((FLOAT(NBOX-NXHXCS+K))*DX

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1-XF(4)+XE(1))/DX
IF (K .EQ. 1) R(NRF-1,NCF)=R(NRF-1,NCF)*( FLOAT(NBOX-NXBXC3+K)*DX
1-XF(4)+XF(1))/DX
IF (K .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*( XF(5)-XF(1)- FLOAT(NBOX-1)*
1DX)/DX
IF (K .EQ. KK) R(NRF-1,NCF)=R(NRF-1,NCF)*(XE(5)-XE(1)-
1FLOAT(NBOX-1)*DX)/DX
IF (I .EQ. MR) FOF = (YE(3)-YE(1)-(FLOAT(MR)-1.5)*DY)/DY
IF (I .EQ. MR) R(NRF,NCF)=R(NRF,NCF)*FOF
IF (I .EQ. MR) R(NRF-1,NCF)=R(NRF-1,NCF)*FOF
940 CONTINUE
IF (NCK .EQ. 1 .AND. K .EQ. KK) GO TO 960
GO TO 950
960 DO .50 KT=1, KK
DO .50 JT=1, NXCS
IF (XAIC(1,111+1,2)-XE(1) .GE. (FLOAT(NBOX-NXBXC3+KT)-.5)*DX)
1GO TO 310
IF (XAIC(NXCS,111+1,2)-XE(1) .LE. (FLOAT(NBOX-NXBXC3+KT)-.5)*DX)
1GO TO 320
IF (XAIC(JT,111+1,2)-XF(1) .GT. (FLOAT(NBOX-NXBXC3+KT)-.5)*DX)
1GO TO 330
300 CONTINUE
310 NRF=NROW+NXCS+1
NCF=NCOL+KT
R(NRF,NCF)=FRT*FOF
IF (KT .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*(XE(5)-XE(1)- FLOAT(NBOX-1)*
1DX)/DX
IF (KT .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*( FLOAT(NBOX-NXBXC3+1)*DX
1-XF(4)+XE(1))/DX
GO TO 340
320 NRF=NROW+2*NXCS
NCF=NCOL+KT
R(NRF,NCF)=FRT*FOF
IF (KT .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*(XE(5)-XE(1)- FLOAT(NBOX-1)*
1DX)/DX
IF (KT .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*( FLOAT(NBOX-NXBXC3+1)*DX
1-XF(4)+XE(1))/DX
GO TO 340
330 R1=XAIC(JT,111+1,2)-XE(1)-(FLOAT(NBOX-NXBXC3+KT)*DX-.5*DX)
R3=XAIC(JT,111+1,2)-XAIC(JT-1,111+1,2)
NRF=NROW+NXCS+JT
NCF=NCOL+KT
R(NRF,NCF)=(1.0-R1/R3)*FRT*FOF
R(NRF-1,NCF)=(R1/R3)*FRT*FOF
IF (I .EQ. 1) R(NRF,NCF)=0.5*R(NRF,NCF)
IF (I .EQ. 1) R(NRF-1,NCF)=0.5*R(NRF-1,NCF)
IF (KT .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*( FLOAT(NBOX-NXBXC3+1)*DX-
1XF(4)+XF(1))/DX
IF (KT .EQ. 1) R(NRF-1,NCF)=R(NRF-1,NCF)*(FLOAT(NBOX-NXBXC3+1)*DX-
1XF(4)+XF(1))/DX
IF (KT .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*(XE(5)-XE(1)-FLOAT(NBOX-1)*
1DX)/DX
IF (KT .EQ. KK) R(NRF-1,NCF)=R(NRF-1,NCF)*(XF(5)-XF(1)-FLOAT(NBOX-
11)*DX)/DX
340 CONTINUE
350 CONTINUE
950 CONTINUE
400 CONTINUE
RETURN
END

```

CCODE

CODE

SURROUTINE CODE

COMPLEX CZERO,PHI,PHITE,DPHI,SPHI

COMPLEX VPIC,DS,PHIW,CK

COMMON/C1/KBOX(1000),XF(5),YF(5),AR(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS

COMMON/C2/AS,NMACH,FMACH(6),NFREQ,FREQ(10),NMODE,NSURF,LPUNCH

COMMON/C3/VPIC(80,15),DS(2025),PHIW(50),CK(40),DXE(6),TPI,KF

COMMON/C4 NR(100),NBL(100),FO,IFR,XL,NS,NTM,NRW,NRT

COMMON/C5/X,Y,DX,DY,EM,EK,EKB,EKR,NP,MP,NB,NROX,KODE,MODE

COMMON/C6/CZERO,PHI,PHITE,DPHI,SPHI,RHO,NXCS,NYCS,NYBX(40)

COMMON/C8/XAIC(10,10,2),YAIC(10,2),NXBX(40),NXBXCS,NXWINQ,NYWINQ

BETA = EM

X1 = XF(3) - XF(1)

X2 = XF(3) - XF(2)

X3 = XF(4) - XF(1)

X4 = XF(5) - XF(4)

X5 = XF(5) - XF(1)

Y1 = YF(2) - YF(1)

Y2 = YF(3) - YF(1)

IF(X2.GT.X1.OR.X1.GT.X3.OR.X3.GT.X5.OR.X2.LT.0.0) GO TO 50

IF(Y1.GT.Y2.OR.Y1.LT.0.0) GO TO 50

TWI = 0.0

IF(Y2.NE.Y1) TWI = (X1 - X2) / (Y2 - Y1)

AR(1) = (Y2*(X2+X1) - Y1 * (X2-X1))

AR(2) = Y2*X4*2.0

AR(3) = AR(1) + AR(2)

10 DX = X1/(FLOAT(NRW) - 0.5)

IF (100.0* DX .GT. X5) GO TO 20

15 NRW = NRW-1

GO TO 10

20 DY = DX/BETA

YN1 = Y1/DY

YN2 = Y2/DY

XNL = Y1 - (X1-X2) / DX

XNT = YN2 + X5/DX

XNIF = X3/DX

XNTI = X5/DX

NBOX=XNIF+0.50000001

NBS = Y2/DY + 1.0

NRT = X4/DX + 0.5

DXF(1) = 1.0

DXF(2) = 1.0

DXF(3) = 0.5

DXF(4) = AINT(XNLE + 1.5) - XNLE

DXF(5) = XNIF - FLOAT(NBOX-1)

DXF(6) = 0.0

X = 0.5 * DX

NR = 0

KODE = 1

DO 40 I1=1,NR

40 NXRX(I1)=0

NXRXCS=0

DO 40 NP = 1,NROX

XN = FLOAT(NP) - 0.5

YW = YN2

IF (TWI .GT. 0.0) YW=AMINI(YW,YN1+XN/(TWI/BETA))

MH = IFIX(YW)+1

20 MOP(NP) = MH

IF (NR.GT.40) GO TO 15

IF (NP .EQ. NRW) KODE = 3

IF (NSURF .EQ. 1) GO TO 20


```

      IF (X.GT.X1) KODE = 6
      IF (NP.EQ.NHW) KODE = 3
      IF (X.GT.X3) KODE = 4
      IF (X.GT.X3+DX) KODE = 2
      IF (NP.EQ.NHDX) KODE = 5
20  IF (NR+MR.GT.2400) GO TO 15
      NH1(NP) = NH
      DO 10 MP = 1,MR
      IF (CODE.EQ.1 .OR. KODE.EQ.3) GO TO 70
      GO TO 71
70  NXRX(MP)=NXHX(M1)...
71  CONTINUE
      IF (MP.NE.1) GO TO 73
      IF (KODE.EQ.2 .OR. KODE.EQ.4 .OR. KODE.EQ.5) GO TO 72
      GO TO 74
72  NXRXCS=NXBXCS+1
73  CONTINUE
      NB = NB + 1
      Y=DY*FLOAT(MP)-0.5*DY
40  KBOX (NR) = KODE
      IF (KODE.EQ.1 .OR. KODE.EQ.3) NYBX(NP)=MP
40  X=X+DX
      QGRHO = 0.5*(AS*FM)**2
      FO = -R.0*DX*DY*QGRHO/FM*RHO
      RETURN
20  CALL EXIT
      RETURN
      END

```

CPOUT

POUT

```

SUBROUTINE POUT (IND)
  COMPLEX W,AIC
  COMPLEX VPIC,DS,PHIW,CK
  COMPLEX CZERO,PHI,PHITE,DPHI,SPHI
  DIMENSION SW(5,6),SURF(2,3),COD(7),C(50)
  COMMON/C1/KBOX(1000),XE(5),YE(3),AR(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
  COMMON/C2/AS,NMACH,FMACH(6),NFREQ,FREQ(10),NMODE,NSURF,LPUNCH
  COMMON/C3/VPIC(80,15),DS(2025),PHIW(50),CK(40),DXE(6),TPI,KF
  COMMON/C4/MOB(100),NBL(100),FO,IFR,XL,NS,NTM,NBW,NBT
  COMMON/C5/X,Y,DX,DY,EM,EK,EKR,EKR,NP,MP,N6,NBOX,KODE,MODE
  COMMON/C6/CZFP0,PHI,PHITE,DPHI,SPHI,RHO,NXCS,NYCS,NYRX(40)
  COMMON/C8/XA(1,10,10,2),YAIC(10,2),NXBX(40),NXBXCS,NYWIN0,NYWIN0
  COMMON/C9/W(45,45),AIC(45,45)
  DATA (SW(1,1),I=1,6)/26HMAP OF SONIC BOX OVERLAY ,
1      26HON WING, TAIL AND WAKE ,
2      26H      (S) - WING ,
3      26H      (S) - TAIL ,
4      26H      (.) = WAKE ,
5      26H      /
  DATA (SURF(1,1),I=1,3)/8HWING ,RHTAIL ,11HWING + TAIL /
  DATA COD/1HS,1HS,1HS,1HS,1HS,1H,,1H./
  GO TO (10,20,30,40), IND
10 WRITE(6,11) FM,AS,RHO,XE(1),XE(4),X1,X4,Y1,Y2,Y2,Y2,X2,X4,
  1AR(1),AR(2),NBW,NBT,NRS,NBS
11 FORMAT(1H1///// 32X,42HHUGHES AIRCRAFT CO. TRANSONIC AIC PROGRAM
  1 ///3/X,30HFLIGHT CONDITIONS AND GEOMETRY/1H0//15X, 13HMACH NUMBER
  2 =,F8.5,4X,16HSPEED OF SOUND =F10.3,4H L/T,4X,4HRHO=F5.2 //1H0/
  854X,4HWING,1RX.
  3 4HTAIL///22X,16HLE. STATION (L),2F22.3//22X,16HROOT CHORD (L),
  4 2F22.3// 22X,16HLE. SPAN (L),2F22.3//22X,16HT.E. SPAN (L),
  5 2F22.3// 22X,16HTIP CHORD (L),2F22.3//22X,16HTOTAL AREA (L*L),
  6 2F22.3// 22X,16HCHORDWISE BOXES ,119,122//
  7 22X,16HSPANWISE BOXES ,119,122)
  WRITE(6,12)NROX,DX,DY
12 FORMAT(1H0//,11X,25HTOTAL CHORDWISE BOXES =,13, 5X,11HBOX CHORD =,
  1 1P1E12.5,2H L, 5X,10HBOX SPAN =,1P1E12.5,2H L/ )
  WRITE (6,109)
109 FORMAT (1H1,//// 31X,50HHUGHES AIRCRAFT CO. TRANSONIC AIC PROGRAM
  1(CONT-D) ////)
  NB = 1
  DO 17 NP = 1,NROX
  MR = MOB(NP)
  DO 13 MP = 1,MR
  K = KROX(NB)
  C(MP) = COD(K)
13 NB = MR + 1
  IF(NP.GT.6) GO TO 15
  WRITE(6,14)(SW(1,NP),I=1,5),(C(MP),MP=1,MB)
14 FORMAT(10X,5A6,50A1)
  GO TO 17
15 WRITE(6,16) (C(MP),MP=1,MB)
16 FORMAT(40X,50A1)
17 CONTINUE
  GO TO 1000
20 NYS=NYWING
  NXS=NXWING
  DO 200 NS=1,2
  WRITE (6,201) (SURF(I,NS),I=1,3)
201 FORMAT(1H1,30X,50HHUGHES AIRCRAFT CO. TRANSONIC AIC PROGRAM (CONT-
  1D) ///// 28X,43HAIC COLLOCATION STATION COORDINATES ON THE 2A6/1HU

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2,10X, 4HYAIC, 15X,13HXAIC VALUFS--)
DO 202 IY=1,NYS
YC=YAIC(IY,NS)
202 WRITE (6,203) YC,(XAIC(IX,IY,NS),IX=1,NXS)
NYS=NYCS
NXS=NXCS
IF (NYS.EQ. 0 .OR. NXS.EQ. 0) GO TO 205
200 CONTINUE
205 RETURN
203 FORMAT (1H0,12X,5E17.6/(1H ,29X,4E17.6))
30 VEL=EM*AS
Q=0.5*RHO*VEL**2
RV=1.0/EKR
RR=X1/2.0
WRITE (6,220) FREQ(IFR),BR,EKR,RV,EM,VEL,RHO,Q
220 FORMAT(1H1,30X ,50HHUGHES AIRCRAFT CO. TRANSONIC AIC PROGRAM (CONT
1-D)////9X,20H OSCILLATORY FREQUENCY (CPS),4X,1PE12.5,/1H0,9X,15HRE
2FERENCE CHORD,4X,1PE12.5,/1H0,9X,30HREDUCED FREQUENCY (REF. CHORD)
3,4X,1PE12.5,/1H0,9X,29HREDUCED VELOCITY (REF. CHORD),4X,1PE12.5,
4/1H0,9X,23HFREE STREAM MACH NUMBER,4X,1PE12.5,/1H0,9X,20HFREE STRE
5AM VELOCITY,4X,1PE12.5,/1H0,9X,7HDENSITY,4X,0PF5.2,/1H0,9X,33HDYNA
6MIC PRESSURE (1/2*RHO*VEL**2),4X,1PE12.5,////)
WRITE (6,221)
221 FORMAT(///35X,34HAERODYNAMIC INFLUENCE COEFFICIENTS,///1X,2HRL,1*Y,
12HIM,10X,2HRL,10X,2HIM,10X,2HRL,10X,2HIM,10X,2HRL,10Y,2HIM,10X,2HR
2L,10X,2HIM,/)
NROWS=NYWING*NXWING+NYCS*NXCS
DO 222 NROW=1,NROWS
WRITE (6,223)NPOW
WRITE (6,224) (AIC(NROW,NCOL),NCOL=1,NROWS)
223 FORMAT (/ 5HROW = I2)
224 FORMAT (1P10F12.4)
222 CONTINUE
RETURN
40 NW=NXWING*NYWING
NC=NXCS*NYCS
NT=NW+NC
NW1=NW+1
GO TO (81,82,83,84),LPUNCH
81 CONTINUE
DO 301 I=1,NW
PUNCH 85, (AIC(I,J),J=1,NW)
301 CONTINUE
85 FORMAT (1P6E12.5)
RETURN
82 CONTINUE
DO 302 I=NW1,NT
PUNCH 85, (AIC(I,J),J=NW1,NT)
302 CONTINUE
RETURN
83 CONTINUE
DO 303 I=1,NW
PUNCH 85, (AIC(I,J),J=1,NW)
303 CONTINUE
DO 304 I=NW1,NT
PUNCH 85, (AIC(I,J),J=NW1,NT)
304 CONTINUE
RETURN
84 CONTINUE
DO 305 I=1,NT

```

T
PUNCH 85, (AIC(1,J),J=1,NT)
305 CONTINUE
T 1000 RETURN
END

```

CDAIN      DAIN
SUBROUTINE DAIN
COMPLEX VPIC,DS,PHIW,CK
COMPLEX CZERO,PHI,PHITE,DPHI,SPHI
COMMON/C1/KBOX(1000),XF(5),YF(5),AR(3),X1,X2,X3,X4,Y1,Y2,BFTA,NBS
COMMON/C2/AS,NMACH,FMACH(6),NFREQ,FREQ(10),NMODE,NSURF,LPUNCH
COMMON/C3/VPIC(80,15),DS(2025),PHIW(50),CK(40),DXE(6),TPI,KF
COMMON/C4/MOR(100),NBL(100),FQ,IFR,XL,NS,NTM,NBW,NBT
COMMON/C5/X,Y,DX,DY,EM,EK,EKR,EKR,NP,MP,MB,NROX,KODE,MODF
COMMON/C6/CZFR0,PHI,PHITE,DPHI,SPHI,RHO,NXCS,NYCS,NYWX(40)
COMMON/C8/XAIC(10,10,2),YAIC(10,2),NXBX(40),NXBXCS,NYWIN0,NYWIN0
READ(5,11) (XF(I),I=1,5)
READ (5,11) (YF(I),I=1,3),AS
READ (5,12) NMACH,KF,NFREQ,NBW,LPUNCH
READ(5,11) (FMACH(I),I=1,NMACH)
READ(5,11) (FREQ(I),I=1,NFREQ)
NSURF=2
IF(XF(4).LT.XF(5)) GO TO 10
NSURF=1
XE(4)=XF(3)
XE(5)=XF(3)
10 READ (5,12) NXWIN0,NYWIN0,NXCS,NYCS
READ (5,11) (YAIC(I,1),I=1,NYWIN0)
IF (NXCS .NE. 0) READ (5,11)(YAIC(I,2),I=1,NYCS)
READ (5,11) ((XAIC(I,J,1),I=1,NXWIN0),J=1,NYWIN0)
IF (NXCS .NE. 0) READ(5,11)((XAIC(I,J,2),I=1,NXCS),J=1,NYCS)
NMODE=NXWIN0+NYWIN0+NXCS+NYCS
RHO=1.0
11 FORMAT(6E12.8)
12 FORMAT(6I12)
RETURN
END

```

CCSTS

CSTS

BLOCK DATA

COMPLEX CZERO, PHI, PHITE, DPHI, SPHI

COMPLEX VPIC, DS, PHIW, CK

COMMON/C3/VPIC(80,15), DS(2025), PHIW(50), CK(40), DXE(6), TPI, KF

COMMON/C6/CZERO, PHI, PHITE, DPHI, SPHI, RHO, NXCS, NYCS, NTRX(40)

DATA CZERO/(0.0,0.0)/, TPI/6.2831853/

END

CPOT2H

POT2H

SUBROUTINE POT2H

COMPLEX CZERO,PHI,PHITE,DPHI,SPHI

COMPLEX VPIC,DS,PHIW,CK

COMPLEX CEX

COMMON/C1/KBOX(100),XF(5),YF(5),AR(3),X1,X2,X3,X4,Y1,Y2,HETA,NBS

COMMON/C2/AS,NMACH,FMACH(6),NFREQ,FREQ(10),NMODE,NSURF,LPUNCH

COMMON/C3/VPIC(80,15),DS(2025),PHIW(50),CK(40),DXE(6),TPI,KF

COMMON/C4/MOR(100),NBL(100),FQ,IFR,XL,NS,NTH,NBW,NRT

COMMON/C5/X,Y,DX,DY,FM,EK,EKR,EKR,NP,MP,NB,NROX,KODE,MODE

COMMON/C6/CZERO,PHI,PHITE,DPHI,SPHI,RHO,NXCS,NYCS,NYRX(40)

COMMON/C8/XAIC(10,10,2),YAIC(10,2),NXBX(40),NXRXCS,NXWING,NYWING

M=2*MOR(NBOX)

N=MIN0(NBOX,15)

DK=FKB

DK2=DK**2

M1=M-1

DKR=DK2/R.0

DK4=2.0*DKR

DK12=DK2/12.0

CM=0.5

DH=DK*0.5

DM=1.5*DH

DD=7.0*DK

DDH=DD

D1=0.25*DK2

R5=DK2/24.0

DO J=1,M

R1=0.0

R4=7.0/DM

R2=R5/R4-DH

R3=-0.5*R5

D3=DH*R4+R5

D4=DKR*R4

DD4=2.0*D4

CN=1.0

C3=0.0

C4=0.0

C7=0.0

C8=0.0

DO J=1,N

A1=DH/CN

C1=CM*COS(A1)

C2=-CM*SIN(A1)

CALL CSIN(A1,C5,C6)

C5=1-M*C5

C6=-CM*C6

C9=C1-C3

C10=C2-C4

C11=C5-C7

C12=C6-C8

VRF=R3*C9-R4*C10-R5*C3-R1*C11-R2*C12

VIN=R4*C9-R5*C10-R5*C4-R2*C11-R1*C12

VPIC(I,J)=CMPLX(VRF,VIN)

21 C3=C1

C4=C2

C7=C5

C8=C6

R1=R1-D1

R3=R3-D3

R4=R4-D4

```

      D4=D4+DD4
      CN=CN+2.0
2  CONTINUE
      CM=CM+1.0
      DM=DM+DDM
3  DDM=DDM+DD
      DO 5 J=1,N
      DO 4 I=1,M1
      K=M-I
4  VPIC(K+1,J)=VPIC(K+1,J)-VPIC(K,J)
5  VPIC(1,J)=2.0*VPIC(1,J)
      CM=0.0
      DM=0.0
      DDM=DK
      DO 12 I=1,M
      C/=0.0
      C8=0.0
      C9=0.0
      C10=0.0
      P1=0.0
      P2=0.0
      CN=1.0
      R6=0.5*DK12
      DO 10 J=1,N
      A1=CM/CN
      A2=DM/CN
      IF (A1-0.2) 7,7,8
7  R1=2.0-A1**2/1.0
      R2=-DK/(6.0*CN)
      GO 10 9
8  R3= SIN(A1)/A1
      R1=2.0*R3
      R2=(R3- COS(A1))/A2-DH/CN*B3
9  R3= COS(A2)/CN
      R4= SIN(A2)/CN
      C3=P1*R3+H2*R4
      C4=R2*R3-H1*R4
      R5=DH*CN
      C1=R5*C4-2.0*C3
      C2=-2.0*C4-R5*C3
      C5=C1-C/
      C6=C2-CN
      P3=P2-R6*CN
      P4=P3+2.0*DK12*(CN-1.0)
      VRF=C5-P1*C6+P3*C3-P4*C9
      VIM=C6+P1*C5+P3*C1-P4*C10
      VPIC(1,J)=VPIC(1,J)+CMPLX(VRF,VIM)
      P1=P1+DH
      P2=P2+CN*DK4
      CN=CN+2.0
      C/=C1
      C8=C2
      C9=C3
      C10=C4
      R6=R6+DK12
10 CONTINUE
      CM=CM+DK
      DM=DM+DDM
12 DDM=DDM+DD
      D3=1/K/(2.0*3.14159265)
      A1=0.0

```



```
DO 14 J=1,N  
CEX=D.5*CMPLX(SIN(A1), COS(A1))  
DO 13 I=1,M  
13 VPIC(I,J)=CEX*VPIC(I,J)  
14 A1=A1+DH  
RETURN  
END
```

CPHIR

PHIB

```
SUBROUTINE PHIB
COMPLEX CZERO, PHI, PHITE, DPHI, SPH
COMPLEX VPIC, DS, PHIW, CK
COMMON/C1/KNOX(1000), XF(5), YE(3), AR(3), X1, X2, X3, X4, Y1, Y2, BETA, NBS
COMMON/C2/AS, NMACH, FMACH(6), NFREQ, FREQ(10), NMODE, NSURF, LPUNCH
COMMON/C3/VPIC(80,15), DS(2025), PHIW(50), CK(40), DXE(6), TPI, KF
COMMON/C4/MOB(100), NBL(100), EQ, IFR, XL, NS, NTH, NBW, NRT
COMMON/C5/X, Y, DX, DY, EH, EK, EKR, FKR, NP, MP, NB, NROX, KODE, MODF
COMMON/C6/CZERO, PHI, PHITE, DPHI, SPH, RHO, NXCS, NYCS, NYRX(40)
COMMON/C8/XAIC(10,10,2), YAIC(10,2), NXBX(40), NXBXCS, NYWINO, NYWING
NQ=MIND(NP,15)
DO 10 I=2, NQ
  NU=NP-I+1
  JR=MOB(NU)
  NJ=NBL(NU)+1
  DO 20 J=1, JR
    K=1+IARS(MP-J)
    DPHI=VPIC(K,I)
    IF (J.EQ.1) GO TO 10
    K=MP+J-1
    DPHI=DPHI+VPIC(K,I)
10  SPH=SPH+DPHI*DS(NJ)
20  NJ=NJ+1
  RETURN
END
```

```

CSD/      SD2
SURROUTINE SD/ (S,R,C,R,T,TR,TH)
COMPLEX CZERO,PHI,PHITE,DPHI,SPHI
COMPLEX VPIC,DS,PHIW,CK
DIMENSION S(45,45),R(45,45),C(45,45),B(45,45),T(45,45),
1          TR(45,45),TH(45,45)
COMMON/C1/KROX(1000),XF(5),YE(3),AR(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
COMMON/C2/AS,NMACH,FMACH(6),NFREQ,FREQ(10),NMODE,NSURF,LPUNCH
COMMON/C3/VPIC(80,15),DS(2025),PHIW(50),CK(40),DXE(6),TPI,KF
COMMON/C4/MOR(100),NBL(100),EQ,IFR,XL,NS,NTM,NRW,NRT
COMMON/C5/X,Y,DX,DY,EM,EK,EKR,EKR,NP,MP,NB,NROX,KODE,MODE
COMMON/C6/CZERO,PHI,PHITE,DPHI,SPHI,RHO,NXCS,NYCS,NYRX(4)
COMMON/C7/XAIC(10,10,2),YAIC(10,2),NXHX(40),NXRXCS,NYWINO,NYWINO
C *** THIS SURROUTINE GENERATES THE REAL PART OF THE SUBSTANTIAL
C *** DERIVATIVE MATRIX FOR THE VELOCITY POTENTIAL
MH=MOR(NROX)
NH=0
DO 10 I=1,MH
10  NH=NH+NXRX(I)+NXRXCS
DO 20 I=1,NH
DO 20 J=1,NH
20  TH(I,J)=0.0
DO 100 I=1,MH
IF (NXRX(I).EQ.0) GO TO 100
NXS=NXRX(I)
CALL BMAT (NXS,NRSB,NCSB,R)
CALL TMAT (NXS,1,1,1,MSIZE,2,T,R)
DO 101 MR=1,MSIZE
DO 101 MC=1,NCSB
TR(MR,MC)=0.0
DO 101 MRC=1,MSIZE
101 TR(MR,MC)=TR(MR,MC)+T(MR,MRC)*R(MRC,MC)
CALL CMAT (NXS,1,2,1,NRSC,NCSC,2,C)
DO 102 MR=1,NRSC
DO 102 MC=1,NCSC
T(MR,MC)=0.0
DO 102 MRC=1,NCSC
102 T(MR,MC)=T(MR,MC)+C(MR,MRC)*TR(MRC,MC)
KROW=0
DO 140 II=1,1
140 KROW=KROW+NXHX(II)
KROW=KROW-NXHX(1)
DO 180 LR=1,NXS
IROW=KROW+LR
DO 180 LC=1,NXS
ICOL=KROW+LC
180 TH(IROW,ICOL)=T(LR,LC)
100 CONTINUE
IF (NXRXCS(1,2)) GO TO 300
DO 200 I=1,MH
CALL BMAT (NXRXCS,NRSH,NCSH,R)
CALL TMAT (NXRXCS,1,2,1,MSIZE,3,T,R)
DO 201 MR=1,MSIZE
DO 201 MC=1,NCSH
TR(MR,MC)=0.0
DO 201 MRC=1,MSIZE
201 TR(MR,MC)=TR(MR,MC)+T(MR,MRC)*R(MRC,MC)
CALL CMAT (NXRXCS,1,2,2,NRSC,NCSC,3,C)
DO 202 MR=1,NRSC
DO 202 MC=1,NCSC
T(MR,MC)=0.0

```

```

DO 202 MRC=1,NCSC
202 T(MR,MC)=T(MR,MC)+C(MR,MRC)*TR(MRC,MC)
KROW=0
DO 203 IJ=1,MH
203 KROW=KROW+NXRX(IJ)
KROW=KROW+(I-1)*NXRXCS
DO 204 LR=1,NXRXCS
NROW=KROW+LR
KCOL=KROW
DO 205 LC=1,NXRXCS
NCOL=KCOL+LC
205 TM(NROW,NCOL)=T(LR,LC)
200 CONTINUE
300 CONTINUE
RETURN
END

```

CTRAMP

```

SUBROUTINE TRAMP (NIF,MROWS,KCOLS,S,R,C,R,T,TR,TI,TH)
COMPLEX CZERO,PHI,PHITE,DPHI,SPHI
COMPLEX VPIC,DS,PHIW,CK
DIMENSION S(45,45),R(45,45),C(45,45),B(45,45),T(45,45),TR(45,45),
1      TI(45,45),TH(45,45)
COMMON/C1/KBOX(1000),XF(5),YE(3),AR(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
COMMON/C2/AS,NMACH,FMACH(6),NFREQ,FREQ(10),NMODE,NSURF,LPUNCH
COMMON/C3/VPIC(80,15),DS(2025),PHIW(50),CK(40),DXE(6),TPI,KF
COMMON/C4/MOR(100),NRL(100),FO,IFR,XL,NS,NTM,NRW,NRT
COMMON/C5/X,Y,DX,DY,EM,EK,EKR,FKR,NP,MP,NH,NHUX,KODE,MODF
COMMON/C6/CZERO,PHI,PHITE,DPHI,SPHI,RHO,NXCS,NYCS,NYWX(40)
COMMON/C8/XAIC(10,10,2),YAIC(10,2),NXBX(40),NXBXCS,NYWINO,NYWINO
MH=MOH(NBOX)
KCOLS=NXWING+NYWING+NXCS+NYCS
KROWS=MH*(NXWING+NXCS)
C *** ZERO TH MATRIX FOR SPANWISE INTERPOLATION
DO 20 I=1,KROWS
DO 20 J=1,KCOLS
20 TH(I,J)=0.0
C *** SPANWISE INTERPOLATION (WING)
IF (NYWING.EQ. 0) GO TO 1999
DO 1000 I=1,NXWING
CALL HMAT (NYWING,NRSH,NCSR,R)
CALL THAT (NYWING,2,1,I,MSIZE,1,T,R)
DO 1001 MR=1,MSIZE
DO 1001 MC=1,NCSR
TR(MR,MC)=0.0
DO 1001 MRC=1,MSIZE
1001 TR(MR,MC)=TR(MR,MC)+T(MR,MRC)*R(MRC,MC)
CALL SHAT (MR,NYWING,1,NRSC,NCSC,S)
DO 1002 MR=1,NRSC
DO 1002 MC=1,NCSC
T(MR,MC)=0.0
DO 1002 MRC=1,NCSC
1002 T(MR,MC)=T(MR,MC)+S(MR,MRC)*TR(MRC,MC)
KROW=(I-1)*MR
DO 1000 LR=1,MR
LROW=KROW+LR
KCOL=(I-1)*NYWING
DO 1000 LC=1,NYWING
LCOL=KCOL+LC
1000 TH(LROW,LCOL)=T(LR,LC)
1000 CONTINUE
1000 CONTINUE
C *** SPANWISE TRANSFORMATION (CONTROL SURFACE)
IF (NYCS.EQ. 0) GO TO 2999
DO 2000 I=1,NXCS
CALL HMAT (NYCS,NRSH,NCSR,R)
CALL THAT (NYCS,2,2,I,MSIZE,1,T,R)
DO 2001 MR=1,MSIZE
DO 2001 MC=1,NCSR
TR(MR,MC)=0.0
DO 2001 MRC=1,MSIZE
2001 TR(MR,MC)=TR(MR,MC)+T(MR,MRC)*R(MRC,MC)
CALL SHAT (MR,NYCS,2,NRSC,NCSC,S)
DO 2002 MR=1,NRSC
DO 2002 MC=1,NCSC
T(MR,MC)=0.0
DO 2002 MRC=1,NCSC
2002 T(MR,MC)=T(MR,MC)+S(MR,MRC)*TR(MRC,MC)

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```

      KROW=MR*NXWING+(I-1)*MR
      DO 2080 LR=1,MR
      LROW=KROW+LR
      KCOL=NXWING*NYWING+(I-1)*NYCS
      DO 2080 LC=1,NYCS
      LCOL=KCOL+LC
2080  TM(LROW,LCOL)=T(LR,LC)
2090  CONTINUE
2999  CONTINUE
C *** REARRANGE ROWS AND COLUMNS FOR CHORDWISE TRANSFORMATION
      CALL RMAT (MR,NXWING,MR,NXCS,MSIZE,R)
      DO 2050 MR=1,MSIZE
      DO 2050 MC=1,KCOLS
      TI(MR,MC)=0.0
      DO 2050 MRC=1,KROWS
2050  TI(MR,MC)=TI(MR,MC)+R(MR,MRC)*TM(MRC,MC)
C *** ZERO TM MATRIX FOR CHORDWISE INTERPOLATION
      MCOLS=MR*(NXWING+NXCS)
      MROWS=0
      DO 10 I=1,MR
      10  MROWS=MROWS+NXXRX(I)+NXXRXCS
      DO 60 I=1,MROWS
      DO 60 J=1,MCOLS
      60  TM(I,J)=0.0
C *** CHORDWISE INTERPOLATION (WING)
      IF (NXWING.EQ. 0) GO TO 3999
      DO 3000 I=1,MR
      CALL HMAT (NXWING,NRSH,NCSR,R)
      CALL THAT (NXWING,1,1,1,MSIZE,1,T,R)
      DO 3001 MR=1,MSIZE
      DO 3001 MC=1,NCSR
      TR(MR,MC)=0.0
      DO 3001 MRC=1,MSIZE
3001  TR(MR,MC)=TR(MR,MC)+T(MR,MRC)*R(MRC,MC)
      CALL CHAT (NXWING,I,NIF,1,NRSC,N CSC,1,C)
      DO 3002 MR=1,NRSC
      DO 3002 MC=1,NCSR
      T(MR,MC)=0.0
      DO 3002 MRC=1,N CSC
3002  T(MR,MC)=T(MR,MC)+C(MR,MRC)*TR(MRC,MC)
      KROW=0
      DO 40 I=1,I
      40  KROW=KROW+NXXRX(I)
      KROW=KROW-NXXRX(I)
      JJ=NXXRX(I)
      DO 3080 IR=1,JJ
      LROW=KROW+LR
      KCOL=(I-1)*NXWING
      DO 3080 LC=1,NXWING
      LCOL=KCOL+LC
      3080  TM(LROW,LCOL)=T(IR,LC)
      3090  CONTINUE
      3999  CONTINUE
C *** CHORDWISE INTERPOLATION (CONTROL SURFACE)
      IF (NXCS.EQ. 0) GO TO 4999
      DO 4000 I=1,MR
      CALL HMAT (NXCS,NRSH,NCSR,R)
      CALL THAT (NXCS,1,2,1,MSIZE,1,T,R)
      DO 4001 MR=1,MSIZE
      DO 4001 MC=1,NCSR
      TR(MR,MC)=0.0

```

```

DO 4001 MRC=1,MSIZE
4001 TR(MR,MC)=TR(MR,MC)+T(MR,MRC)*R(MRC,MC)
CALL CHAT (NXCS,1,NIF,2,NRSC,NCSC,1,C)
DO 4002 MR=1,NRSC
DO 4002 MC=1,NCSC
T(MR,MC)=0.0
DO 4002 MRC=1,NCSC
4002 T(MR,MC)=T(MR,MC)+C(MR,MRC)*TR(MRC,MC)
KROW=LROW+(I-1)*NXBXCS
DO 4000 LR=1,NXBXCS
NROW=KROW+LR
KCOL=MR*NXWING+(I-1)*NXCS
DO 4000 LC=1,NXCS
NCOL=KCOL+LC
4000 TM(NROW,NCOL)=T(LR,LC)
4000 CONTINUE
4000 CONTINUE
DO 5001 MR=1,MROWS
DO 5001 MC=1,KCOLS
TR(MR,MC)=0.0
DO 5001 MRC=1,MCOLS
5001 TR(MR,MC)=TR(MR,MC)+TM(MR,MRC)*TI(MRC,MC)
CALL RHAT (NXWING,NYWING,NXCS,NYCS,MSIZE,R)
DO 5050 I=1,MROWS
DO 5050 J=1,MSIZE
TI(I,J)=0.0
DO 5050 K=1,MSIZE
5050 TI(I,J)=TI(I,J)+TR(I,K)*R(K,J)
DO 5052 I=1,MROWS
DO 5052 J=1,MSIZE
5052 TR(I,J)=TI(I,J)
RETURN
END

```

CCHAT

```

SURROUTINE CCHAT (NAICPX, IY, NIF, NS, NRS, NCS, NE, C)
COMPLEX CZERO, PHI, PHITE, DPHI, SPHI
COMPLEX VPIC, DS, PHIW, CK
DIMENSION C(45, 45)
COMMON/C1/KBOX(10, 10), XE(5), YF(5), AR(3), X1, X2, X3, X4, Y1, Y2, W, TA, NBS
COMMON/C2/AS, NMACH, FMACH(6), NFREQ, FREQ(10), NMODE, NSURF, LPUNCH
COMMON/C3/VPIC(80, 15), DS(2025), PHIW(50), CK(40), DXE(6), TPI, KF
COMMON/C5/X, Y, DX, DY, EM, EK, EKR, FKR, NP, MP, NB, NBOX, KODE, MODF
COMMON/C6/CZERO, PHI, PHITE, DPHI, SPHI, RHO, NXCS, NYCS, NYDX(40)
COMMON/C8/XAIC(10, 10, 2), YAIC(10, 2), NXBX(40), NXBXCS, NYWING, NYWING

C *** FOR CHORDWISE INTERPOLATION
C *** NPTS = NUMBER OF CHORDWISE MACH BOXES
C *** NAICPX = NUMBER OF CHORDWISE AIC CONTROL POINTS
C *** IY = SPAN NUMBER
C *** NIF = CONTROL FOR DIFFERENTIATION (1=NO DERIVATIVE AND 2=D()/DX)
C *** NS = SURFACE (1=WING AND 2=TAIL)
  IF (NAICPX .GT. 3) GO TO 1
  NRS=NXBX(IY)
  IF (NS .EQ. 2) NRS=NXBXCS
  NCS=NAICPX
  DO 1 I=1, NRS
  DO 1 J=1, NCS
  1 C(I, J)=0.0
  GO TO 100
  3 NRS=NXBX(IY)
  IF (NS .EQ. 2) NRS=NXBXCS
  NCS=3*(NAICPX-2)
  DO 4 I=1, NRS
  DO 4 J=1, NCS
  4 C(I, J)=0.0
100 IF (NCS .GT. 6) GO TO 500
  IF (NCS .EQ. 6) GO TO 400
  GO TO (200, 200, 300), NCS
C *** TWO CHORDWISE AIC CONTROL POINTS
200 DO 210 I=1, NRS
  C(I, 1)=1.0
  C(I, 2)=XBOX(I, IY, NS, NE)
  IF (NIF .EQ. 2) C(I, 1)=0.0
  IF (NIF .EQ. 2) C(I, 2)=1.0
210 CONTINUE
  RETURN
C *** THREE CHORDWISE AIC CONTROL POINTS
300 DO 310 I=1, NRS
  C(I, 1)=1.0
  C(I, 2)=XBOX(I, IY, NS, NE)
  C(I, 3)=XBOX(I, IY, NS, NE)**2
  IF (NIF .EQ. 2) C(I, 1)=0.0
  IF (NIF .EQ. 2) C(I, 2)=1.0
  IF (NIF .EQ. 2) C(I, 3)=2.0*XBOX(I, IY, NS, NE)
310 CONTINUE
  RETURN
C *** FOUR CHORDWISE AIC CONTROL POINTS
400 DO 410 I=1, NRS
  NX=NAICPX-1
  DO 405 J=1, NX
  IF (0.5*(XINT(J, IY, NS, NE)+XINT(J+1, IY, NS, NE)) .GT. XBOX(I, IY, NS, NE)
  ) GO TO 401
405 CONTINUE
  NX=NAICPX
  GO TO 408

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407 NX=J
408 KC=1
    IF (NX .GT. 2) KC=4
    C(1,KC)=1.0
    C(1,KC+1)=XBOX(1,IY,NS,NE)
    C(1,KC+2)=C(1,KC+1)**2
    IF (NIF .EQ. 2) C(1,KC)=0.0
    IF (NIF .EQ. 2) C(1,KC+1)=1.0
    IF (NIF .EQ. 2) C(1,KC+2)=2.0*XBOX(1,IY,NS,NE)
410 CONTINUE
    RETURN
C *** .GT. FOUR AIC CONTROL POINTS
500 DO 510 J=1,NRS
    NX=NAICPX-1
    DO 505 J=1,NX
        IF (0.5*(XINT(J,IY,NS,NE)+XINT(J+1,IY,NS,NE)) .GT. XBOX(1,IY,NS,NE)
            1) GO TO 507
505 CONTINUE
    NX=NAICPX
    GO TO 508
507 NX=J
508 IF (NX .LT. 3) GO TO 550
    IF (NX .GT. NAICPX-2) GO TO 580
    KC=(NX-2)*3+1
    C(1,KC)=1.0
    C(1,KC+1)=XBOX(1,IY,NS,NE)
    C(1,KC+2)=C(1,KC+1)**2
    IF (NIF .EQ. 2) C(1,KC+1)=1.0
    IF (NIF .EQ. 2) C(1,KC+2)=XBOX(1,IY,NS,NE)
    IF (NIF .EQ. 2) C(1,KC)=0.0
    GO TO 510
550 C(1,1)=1.0
    C(1,2)=XBOX(1,IY,NS,NE)
    C(1,3)=C(1,2)**2
    IF (NIF .EQ. 2) C(1,1)=0.0
    IF (NIF .EQ. 2) C(1,2)=1.0
    IF (NIF .EQ. 2) C(1,3)=XBOX(1,IY,NS,NE)
    GO TO 510
580 C(1,NCS-2)=1.0
    C(1,NCS-1)=XBOX(1,IY,NS,NE)
    C(1,NCS)=C(1,NCS-1)**2
    IF (NIF .EQ. 2) C(1,NCS-2)=0.0
    IF (NIF .EQ. 2) C(1,NCS-1)=1.0
    IF (NIF .EQ. 2) C(1,NCS)=XBOX(1,IY,NS,NE)
510 CONTINUE
    RETURN
END

```

```

CTMAT  THAT
SURROUTINE THAT (NPTS,ND,NS,IY,MSIZE,NE,T,R)
DIMENSION T(45,45),R(45,45)
COMMON/CR/XAIC(10,10,2),YAIC(10,2),NXBX(40),NXBXC5,NXWING,NYWING
C *** GENERATES T**(-1) MATRIX
C *** NPTS = NUMBER OF AIC POINTS ALONG STRIP IN ND DIRECTION
C *** MSIZE = ORDER OF T MATRIX
C *** NS = SURFACE (1=WING AND 2=CONTROL SURFACE)
C *** ND = INTERPOLATION DIRECTION (1=CHORDWISE AND 2=SPANWISE)
IF (NPTS.LT. 4) MSIZE=NPTS
IF (NPTS.GT. 3) MSIZE=3*NPTS-6
DO 1 J=1,MSIZE
DO 1 K=1,MSIZE
1 T(J,K)=0.0
IF (NPTS.GT. 4) GO TO 5000
GO TO (2000,2000,3000,4000), NPTS
C *** NPTS=2 (TWO POINTS ALONG STRIP)
2000 T(1,1)=1.0
T(2,1)=1.0
IF (ND.EQ. 1) T(1,2)=XINT(1,IY,NS,NE)
IF (ND.EQ. 1) T(2,2)=XINT(2,IY,NS,NE)
IF (ND.EQ. 2) T(1,2)=YAIC(1,NS)
IF (ND.EQ. 2) T(2,2)=YAIC(2,NS)
GO TO 6000
C *** NPTS=3 (THREE POINTS ALONG STRIP)
3000 T(1,1)=1.0
T(2,1)=1.0
T(3,1)=1.0
IF (ND.EQ. 2) GO TO 5010
C *** NPTS=3 CHORDWISE DIRECTION
T(1,2)=XINT(1,IY,NS,NE)
T(1,3)=T(1,2)**2
T(2,2)=XINT(2,IY,NS,NE)
T(2,3)=T(2,2)**2
T(3,2)=XINT(3,IY,NS,NE)
T(3,3)=T(3,2)**2
GO TO 6000
C *** NPTS=3 SPANWISE DIRECTION
3010 T(1,2)=YAIC(1,NS)
T(1,3)=T(1,2)**2
T(2,2)=YAIC(2,NS)
T(2,3)=T(2,2)**2
T(3,2)=YAIC(3,NS)
T(3,3)=T(3,2)**2
GO TO 6000
C *** NPTS=4 (FOUR POINTS ALONG STRIP)
4000 T(1,1)=1.0
T(2,1)=1.0
T(3,1)=1.0
T(4,1)=1.0
T(5,1)=1.0
T(6,1)=1.0
T(3,4)=-1.0
T(4,5)=-1.0
IF (ND.EQ. 2) GO TO 4010
C *** NPTS=4 CHORDWISE DIRECTION
T(1,2)=XINT(1,IY,NS,NE)
T(1,3)=T(1,2)**2
T(2,2)=XINT(2,IY,NS,NE)
T(2,3)=T(2,2)**2
T(3,2)=0.5*(XINT(2,IY,NS,NE)+XINT(3,IY,NS,NE))

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      T(3,3)=T(3,2)**2
      T(3,5)=-T(3,2)
      T(3,6)=-T(3,3)
      T(4,3)=2.0*T(3,2)
      T(4,6)=-T(4,3)
      T(5,5)=XINT(3,1Y,NS,NE)
      T(5,6)=T(5,5)**2
      T(6,5)=XINT(4,1Y,NS,NE)
      T(6,6)=T(6,5)**2
      GO TO 6000
C *** NPTS=4 SPANWISE DIRECTION
4910 T(1,2)=YAIC(1,NS)
      T(1,3)=T(1,2)**2
      T(2,2)=YAIC(2,NS)
      T(2,3)=T(2,2)**2
      T(3,2)=0.5*(YAIC(1,NS)+YAIC(2,NS))
      T(3,3)=T(3,2)**2
      T(3,5)=-T(3,2)
      T(3,6)=-T(3,3)
      T(4,3)=2.0*T(3,2)
      T(4,6)=-T(4,3)
      T(5,5)=YAIC(3,NS)
      T(5,6)=T(5,5)**2
      T(6,5)=YAIC(4,NS)
      T(6,6)=T(6,5)**2
      GO TO 6000
C *** NPTS .GT. 4
5000 IF (NO .EQ. 2) GO TO 5500
C *** NPTS .GT. 4 (CHORDWISE DIRECTION)
      T(1,1)=1.0
      T(1,2)=XINT(1,1Y,NS,NE)
      T(1,3)=T(1,2)**2
      T(2,1)=1.0
      T(2,2)=XINT(2,1Y,NS,NE)
      T(2,3)=T(2,2)**2
      T(MSIZE,MSIZE-2)=1.0
      T(MSIZE,MSIZE-1)=XINT(NPTS,1Y,NS,NE)
      T(MSIZE,MSIZE)=T(MSIZE,MSIZE-1)**2
      T(MSIZE-1,MSIZE-2)=1.0
      T(MSIZE-1,MSIZE-1)=XINT(NPTS-1,1Y,NS,NE)
      T(MSIZE-1,MSIZE)=T(MSIZE-1,MSIZE-1)**2
      NT=NPTS-4
      DO 5010 N=1,NT
        NR=2+5*N
        NC=5*N+1
        NP=N+2
        T(NR,NC)=1.0
        T(NR,NC+1)=XINT(NP,1Y,NS,NE)
5010 T(NR,NC+2)=T(NR,NC+1)**2
        NI=NPTS-3
        DO 5020 N=1,NI
          NR=1+N
          NC=5*N-2
          T(NR,NC)=1.0
          T(NR+1,NC+1)=1.0
          T(NR,NC+3)=-1.0
          T(NR+1,NC+4)=-1.0
          T(NR,NC+1)=0.5*(XINT(N+1,1Y,NS,NE)+XINT(N+2,1Y,NS,NE))
          T(NR,NC+2)=T(NR,NC+1)**2
          T(NR,NC+4)=-T(NR,NC+1)
          T(NR,NC+5)=-T(NR,NC+2)

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```

      T(NP+1,NC+2)=2.0*T(NR,NC+1)
5020 T(NP+1,NC+5)=-T(NR+1,NC+2)
      GO TO 6000
C *** NPTS .GT. 4 (SPANWISE DIRECTION)
5500 T(1,1)=1.0
      T(1,2)=YAIC(1,NS)
      T(1,3)=T(1,2)**2
      T(2,1)=1.0
      T(2,2)=YAIC(2,NS)
      T(2,3)=T(2,2)**2
      T(MSIZE,MSIZE-2)=1.0
      T(MSIZE,MSIZE-1)=YAIC(NPTS,NS)
      T(MSIZE,MSIZE)=T(MSIZE,MSIZE-1)**2
      T(MSIZE-1,MSIZE-2)=1.0
      T(MSIZE-1,MSIZE-1)=YAIC(NPTS-1,NS)
      T(MSIZE-1,MSIZE)=T(MSIZE-1,MSIZE-1)**2
      NT=NPTS-4
      DO 5510 N=1,NT
        NR=2+.5*N
        NC=.5*N+1
        NP=N+2
        T(NR,NC)=1.0
        T(NR,NC+1)=YAIC(NP,NS)
5510 T(NR,NC+2)=T(NR,NC+1)**2
        NT=NPTS-3
        DO 5520 N=1,NT
          NR=.5*N
          NC=.5*N-2
          T(NR,NC)=1.0
          T(NP+1,NC+1)=1.0
          T(NP,NC+3)=-1.0
          T(NR+1,NC+4)=-1.0
          T(NR,NC+1)=0.5*(YAIC(N+1,NS)+YAIC(N+2,NS))
          T(NR,NC+2)=T(NR,NC+1)**2
          T(NR,NC+4)=-T(NR,NC+1)
          T(NP,NC+5)=-T(NR,NC+2)
          T(NR+1,NC+2)=2.0*T(NR,NC+1)
5520 T(NP+1,NC+5)=-T(NR+1,NC+2)
C *** INVERT T MATRIX
6000 CONTINUE
      CALL MINV (MSIZE,T,R)
      RETURN
      END

```

```

CCSIN      CSIN
SUBROUTINE CSIN(X1,U,S)
SINE AND COSINE INTEGRAL SUBROUTINE
C AND S ARE THE INTEGRALS OVER T FROM 1 TO INFINITY OF
COS(XT)/T AND SIN(XT)/T
C
SG=1.0
X=X1
IF (X) 1,2,2
1 SG=-SG
X=-X
2 X2=X*X
IF (X-1.0) 3,3,4
C
FOR ABS(X) LESS THAN 1 A SERIES EXPANSION IS USED
C
3 V=((X2/98.0-0.6)*.05*X2+1.0)*X2/18.0-1.0)*X+1.57079433
U=((X2/45.0-1.0)*X2/24.0+1.0)*X2/4.0-.5/7215665-ALOG(X)
GO TO 5
C
FOR ABS(X) GREATER THAN 1 APPROXIMATIONS OF HASTINGS ARE USED
C
4 P=((X2+19.394119)*X2+47.411538)*X2+8.493336)/((((X2+21.361055)
1 *X2+70.376196)*X2+30.038227)*X)
Q=((X2+21.383724)*X2+49.719775)*X2+5.049504)/((((X2+27.179581
1 *X2+119.918932)*X2+76.707876)*X2)
CO=COS (X)
SI=SIN (X)
U=Q*CO-P*SI
V=P*CO+Q*SI
5 S=V*SG
RETURN
END

```

```

CHMSINEC      MSINEC
      FUNCTION MSINEC(M,N,L,A,B)
      COMPLEX A,B,G
      DIMENSION A(M,1),B(M,1)
      DO 10 I = 1,N
      C = 0.0
      DO 10 J = 1,N
10  C=AMAX1(C,ABS(REAL(A(I,J))),ABS(AIMAG(A(I,J))))
      IF(C.EQ.0.0) GO TO 1000
      DO 20 J = 1,N
20  A(I,J) = A(I,J)/C
      DO 30 J = 1,1
30  R(I,J) = R(I,J)/C
      IF(N.EQ.1) GO TO 205
      NM = N - 1
      DO 40 J = 1,NM
      C = 0.0
      K = 0
      DO 40 I = J,N
      D=ABS(REAL(A(I,J)))+ABS(AIMAG(A(I,J)))
      IF(D.GE.D) GO TO 40
      K = I
      C = D
40  CONTINUE
      IF(K.EQ.0.OR.C.LT.1.E-7) GO TO 1000
      IF(K.EQ.J) GO TO 70
      DO 50 JJ = J,N
      G=A(J,JJ)
      A(J,JJ) = A(K,JJ)
50  A(K,JJ)=G
      DO 60 JJ = 1,L
      G=R(J,JJ)
      R(J,JJ) = R(K,JJ)
60  R(K,JJ)=G
70  G=1.0/A(J,J)
      JP = J + 1
      DO 80 JJ = JP,N
80  A(J,JJ)=A(J,JJ)*G
90  DO 100 JJ = 1,L
100 R(J,JJ)=R(J,JJ)*G
      DO 200 I = 1,N
      IF(I.EQ.J) GO TO 200
      G=A(I,J)
      DO 110 JJ = 1P,N
110 A(I,JJ)=A(I,JJ)-G*A(J,JJ)
      DO 120 JJ = 1,1
120 R(I,JJ)=R(I,JJ)-G*R(J,JJ)
200 CONTINUE
205 G=A(N,N)
      IF (ABS(REAL(G))+ABS(AIMAG(G)).LT.1.E-7) GO TO 1000
      DO 210 J = 1,L
210 R(N,J)=R(N,J)/G
      IF(N.EQ.1) GO TO 230
      DO 220 I = 1,NM
      DO 220 JJ = 1,1
220 R(I,JJ)=R(I,JJ)-A(I,N)*R(N,JJ)
230 MSINEC=1
      RETURN
1000 MSINEC=2
      RETURN
      END

```

CRMAT

```
SUBROUTINE RMAT (NXWING,NYWING,NXCS,NYCS,MSIZE,R)
  DIMENSION R(45,45)
  MSIZE=NXWING*NYWING+NXCS*NYCS
  DO 100 I=1,MSIZE
  DO 100 J=1,MSIZE
100  R(I,J)=0.0
    IF (NXWING .EQ. 0) GO TO 250
    K=1
    KK=1
    II=NYWING*NXWING
    DO 200 I=1,II
    R(I,K)=1.0
    K=K+NXWING
    IF (K .GT. II) KK=KK+1
    IF (K .GT. II) K=KK
200  CONTINUE
250  CONTINUE
    IF (NXCS .EQ. 0) GO TO 350
    II=NXCS*NYWING
    K=NXWING*NYWING+1
    KK=NXWING*NYWING+1
    DO 300 I=1,II
    IK=1+NXWING*NYWING
    R(I,K)=1.0
    K=K+NXCS
    IF (K .GT. MSIZE) KK=KK+1
    IF (K .GT. MSIZE) K=KK
300  CONTINUE
350  CONTINUE
    RETURN
  END
```

CXINT

```

FUNCTION XINT(NX,NY,NS,NE)
COMMON/C1/KROX(1000),XF(5),YF(3),AR(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
COMMON/C5/X,Y,DX,DY,EM,EK,EKR,EKR,MP,MP,NB,NBUX,KODE,MODE
COMMON/C8/XAIC(10,10,2),YAIC(10,2),NXBX(40),NXBXS,NYWINO,NYWINO
IF (NE .GT. 1) GO TO 400
IF (NS .EQ. 1) GO TO 200
XINT=XAIC(NX,1,NS)
RETURN
200 IF (FLOAT(NY)*DY-DY .GE. YF(2)) GO TO 300
XINT=XAIC(NX,1,NS)
RETURN
300 IF (YAIC(1,1) .LE. YF(2))
1SLOPE=(YAIC(NYWINO,1)-YF(2))/(XAIC(NX,NYWINO,1)-XAIC(NX,1,1))
IF (YAIC(1,1) .GT. YF(2))
1SLOPE=(YAIC(NYWINO,1)-YAIC(1,1))/(XAIC(NX,NYWINO,1)-XAIC(NX,1,1))
IF (YAIC(1,1) .LE. YF(2))
1XINT=(DY-FLOAT(NY)-DY-YF(2)+YF(1))/SLOPE + XAIC(NX,1,1)
IF (YAIC(1,1) .GT. YF(2))
1XINT=(DY-FLOAT(NY)-DY-YAIC(1,1)+YF(1))/SLOPE + XAIC(NX,1,1)
RETURN
400 XINT=DX*(FLOAT(NX)-0.5)
RETURN
END

```


CXROX

```
FUNCTION XROX(NX,NY,NS,NE)
COMMON/C1/KHGX(10,0),XF(5),YF(5),AR(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
COMMON/C5/X,Y,DX,DY,EM,EK,EKR,EKR,MP,MP,NB,NROX,KODE,MODF
COMMON/C8/XAIC(10,10,2),YAIC(10,2),NXBX(40),NXBXC5,NYWINO,NYWINO
IF (NE .GT. 1) GO TO 100
IF (NS .EQ. 2) GO TO 200
XBOX=DX*(FLOAT(NXHX(1))-FLOAT(NXBX(NY)))+DX*FLOAT(NX)-0.5*DX
RETURN
200 XBOX=XE(4)+DX*(FLOAT(NX)-0.5)
RETURN
300 XROX=DX*(FLOAT(NX)-0.5)
RETURN
END
```

GYBOX

FUNCTION YBOX(NY)
COMMON/C5/X,Y,DX,DY,EM,EK,EKR,EKR,NP,MP,NB,NBOX,KODE,MODE
YBOX=DY*(FLOAT(NY)-1.0)
RETURN
END

C RMAT

SUBROUTINE RMAT (NPTS, IROWS, ICOLS, R)

DIMENSION R(4,4)

C *** R = R(IROWS, ICOLS) MATRIX

C *** NPTS = NUMBER OF AIC STATIONS ALONG STRIP (CHORDWISE OR SPANWISE)

ICOLS=NPTS

IF (NPTS .GT. 3) GO TO 200

IROWS=NPTS

DO 50 I=1, IROWS

DO 50 J=1, ICOLS

R(I,J)=0.0

IF (I .EQ. J) R(I,J)=1.0

50 CONTINUE

RETURN

200 IROWS=6+(NPTS-4)*1

DO 300 I=1, IROWS

DO 300 J=1, ICOLS

300 R(I,J)=0.0

R(1,1)=1.0

R(2,2)=1.0

R(IROWS, ICOLS)=1.0

R(IROWS-1, ICOLS-1)=1.0

IF (NPTS .EQ. 4) GO TO 400

K=NPTS-4

DO 350 I=1, K

NR=I+1

NC=I+1

350 R(NR, NC)=1.0

400 RETURN

END

CSMAT

```

SURROUTINE SMAT (NIY,NAICPY,NS,NRS,NCS,S)
DIMENSION S(4,45)
COMMON/C1/KROX(1000),XE(5),YE(3),AR(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
COMMON/C8/XAIC(10,10,2),YAIC(10,2),NXBX(40),NXBXCS,NYWING,NYWING
C *** NIY = NUMBER OF SPANWISE MACH BOXES
C *** NAICPY = NUMBER OF SPANWISE AIC CONTROL POINTS
C *** NS = SURFACE (1=WING AND 2=TAIL)
C *** NRS = NUMBER OF ROWS IN S-MATRIX
C *** NCS = NUMBER OF COLUMNS IN S-MATRIX
C
COMMON
IF (NAICPY .GT. 3) GO TO 8
NRS=NIY
NCS=NAICPY
DO 6 I=1,NRS
DO 6 J=1,NCS
6 S(I,J)=0.0
GO TO 100
8 NRS=NIY
NCS=2+(NAICPY-2)
DO 9 I=1,NRS
DO 9 J=1,NCS
9 S(I,J)=0.0
100 IF (NCS .GT. 5) GO TO 500
IF (NCS .EQ. 5) GO TO 400
GO TO (200,200,300),NCS
C *** TWO AIC POINTS
200 DO 260 I=1,NIY
S(I,1)=1.0
S(I,2)=YBOX(I)
260 CONTINUE
RETURN
C *** THREE AIC POINTS
300 DO 360 I=1,NIY
S(I,1)=1.0
S(I,2)=YBOX(I)
S(I,3)=S(I,2)**2
360 CONTINUE
RETURN
C *** FOUR AIC POINTS
400 DO 490 I=1,NIY
IC=1
IF (YBOX(I) .LT. 0.5*(YAIC(2,NS)+YAIC(3,NS))) IC=1
S(I,IC)=1.0
S(I,IC+1)=YBOX(I)
S(I,IC+2)=S(I,IC+1)**2
490 CONTINUE
RETURN
C *** .GT. FOUR AIC POINTS
500 DO 520 J=1,NIY
NI=NAICPY-2
DO 525 J=1,NI
IF (0.5*(YAIC(J,NS)+YAIC(J+1,NS)) .GT. YBOX(I)) GO TO 525
525 CONTINUE
IC=1+NAICPY-4
GO TO 524
523 IC=(J-2)*3+4
IF (J .LT. 3) IC=1
524 S(I,IC)=1.0
S(I,IC+1)=YBOX(I)

```

$S(I, IC+2) = S(I, IC+1) * 2$
520 CONTINUE
RETURN
END

```

CMINV      MINV
SUBROUTINE MINV (NM,A,U)
DIMENSION A(1,45),U(45,45)
DO 9001 I=1,NM
DO 9001 J=1,NM
U(I,J)=0.0
IF (I.EQ.J) U(I,J)=1.0
9001 CONTINUE
FPS=0.000000001
DO 9015 I=1,NM
K=1
IF (I-NM) 9021,9017,9021
9021 IF (A(I,I)-FPS) 9006,9006,9007
9006 IF (-A(I,I)-FPS) 9006,9006,9007
9006 K=K+1
DO 9023 J=1,NM
U(I,J)=U(I,J)+U(K,J)
9023 A(I,J)=A(I,J)+A(K,J)
GO TO 9021
9007 DIV=A(I,I)
DO 9009 J=1,NM
U(I,J)=U(I,J)/DIV
9009 A(I,J)=A(I,J)/DIV
DO 9015 MM=1,NM
DELT=A(MM,I)
IF (ABS(DELT)-FPS) 9015,9015,9016
9016 IF (MM-I) 9010,9015,9010
9010 DO 9011 J=1,NM
U(MM,J)=U(MM,J)-U(I,J)*DELT
9011 A(MM,J)=A(MM,J)-A(I,J)*DELT
9015 CONTINUE
DO 9013 I=1,NM
DO 9013 J=1,NM
9013 A(I,J)=U(I,J)
RETURN
END

```

PART V - SECTION B5.0

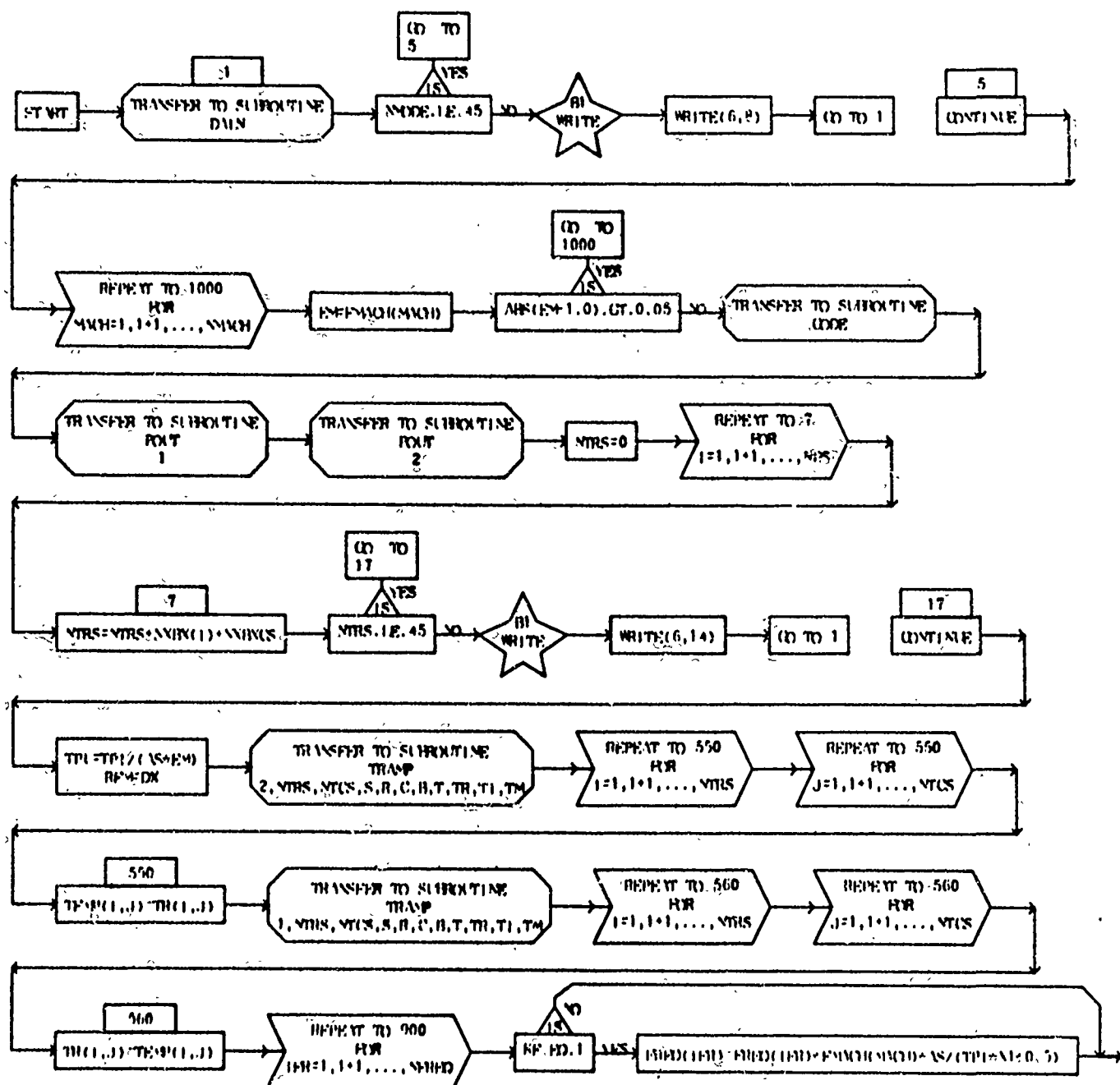
FLOW CHARTS FOR TRANSONIC

AIC COMPUTER PROGRAM

DIMENSIONED VARIABLES

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R	45,45	T	45,45	TRIP	45,45	TM	45,45	TI	45,45
TR									

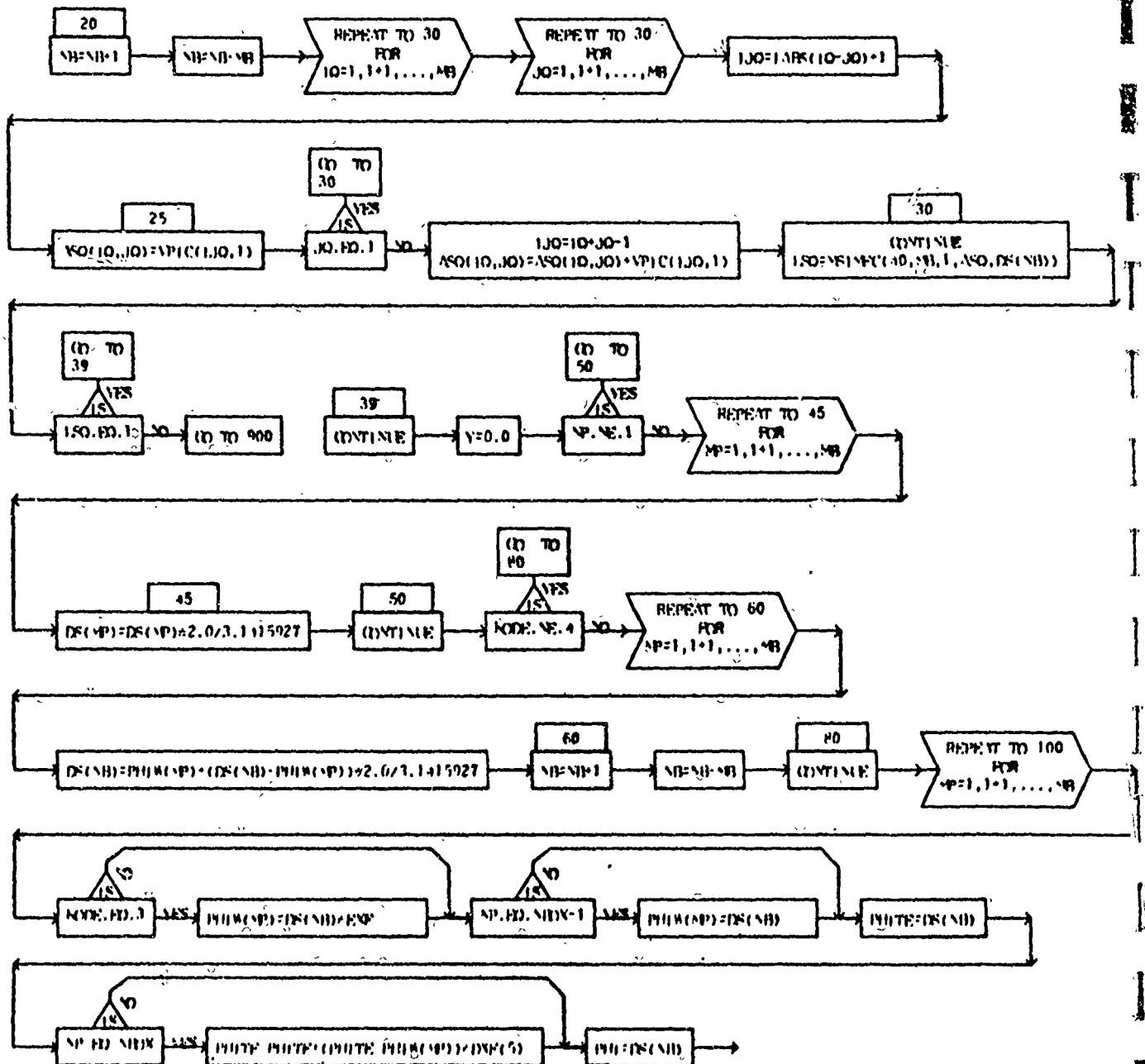
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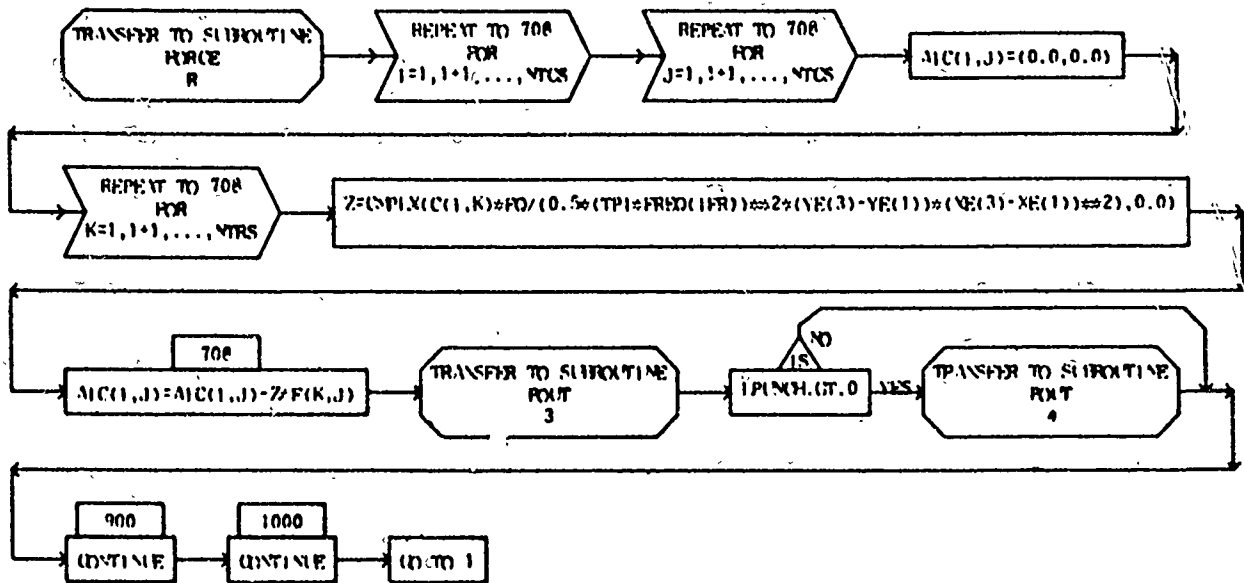
(COMPLEX Z, W, F, VPIC, DS, PHIW, CX, C7990, PHI, PHITE, DPHI,

PAGE 3



COMPLEX Z,W,F,VPIC,DS,PHIW,CK,CZERO,PHI,PHITE,DPHI,

PAGE 5



NOT NOT

D I M E N S I O N E D V A R I A B L E S

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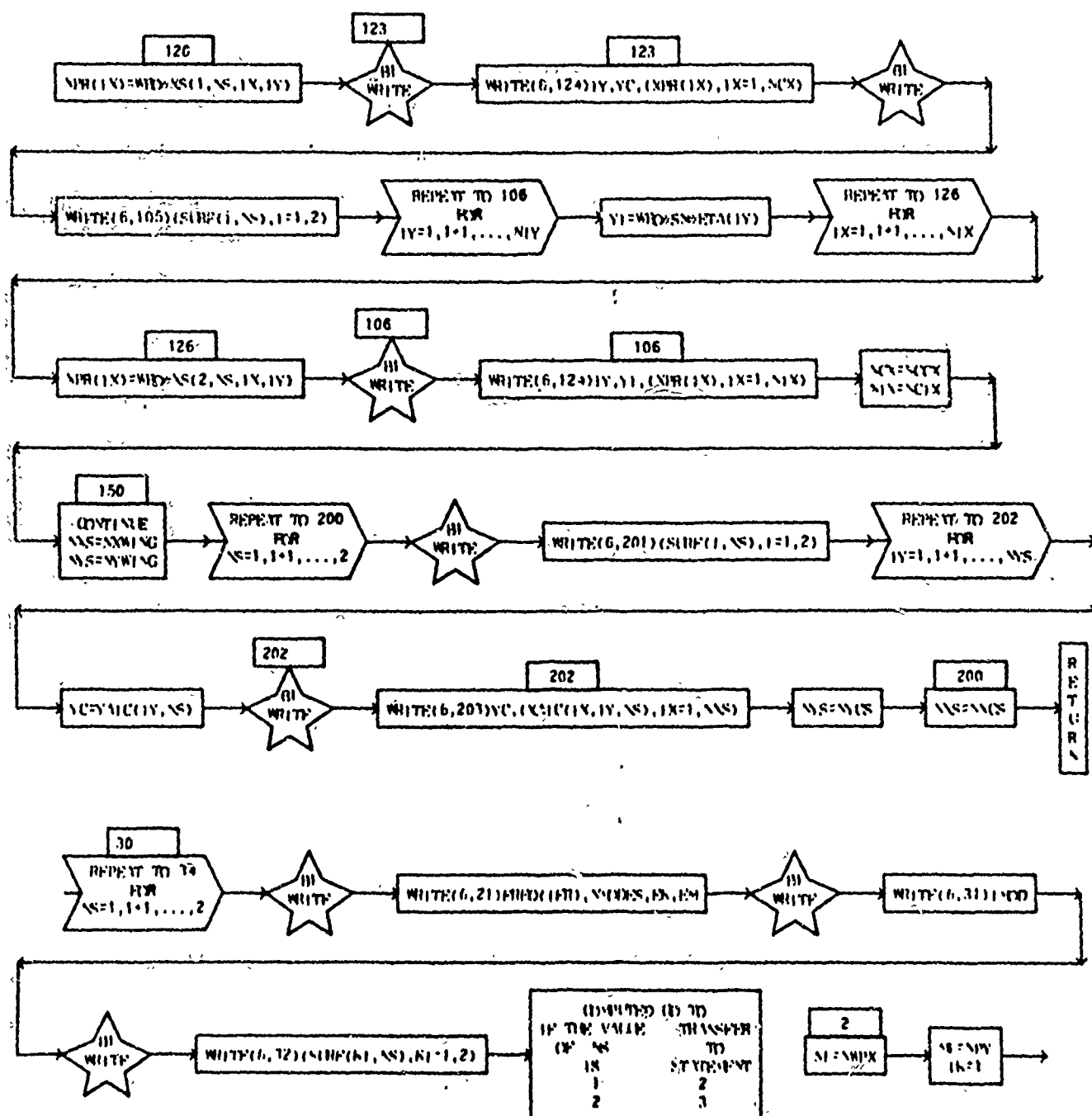
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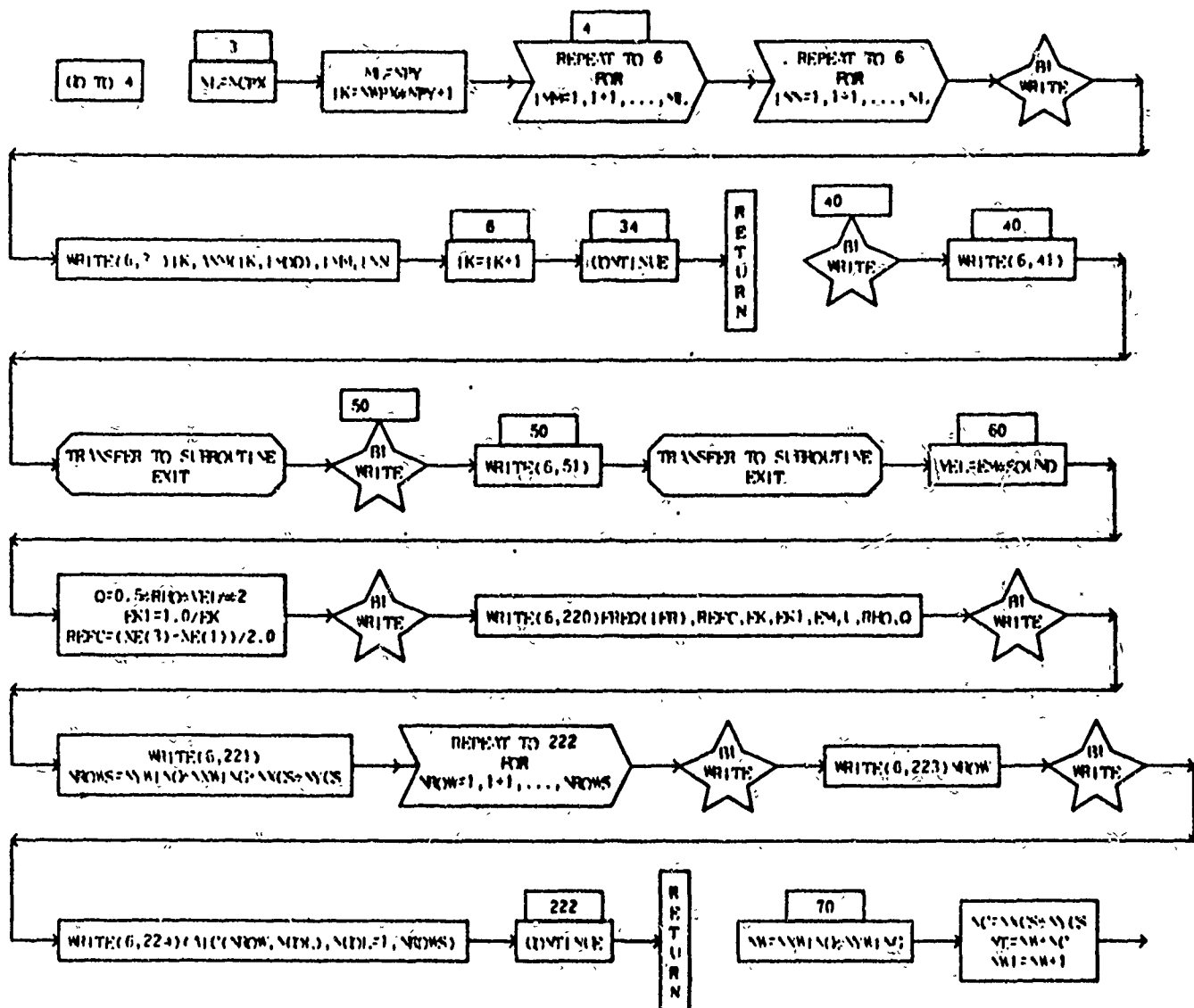
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SUBROUTINE ROUT(IND)

PAGE 3

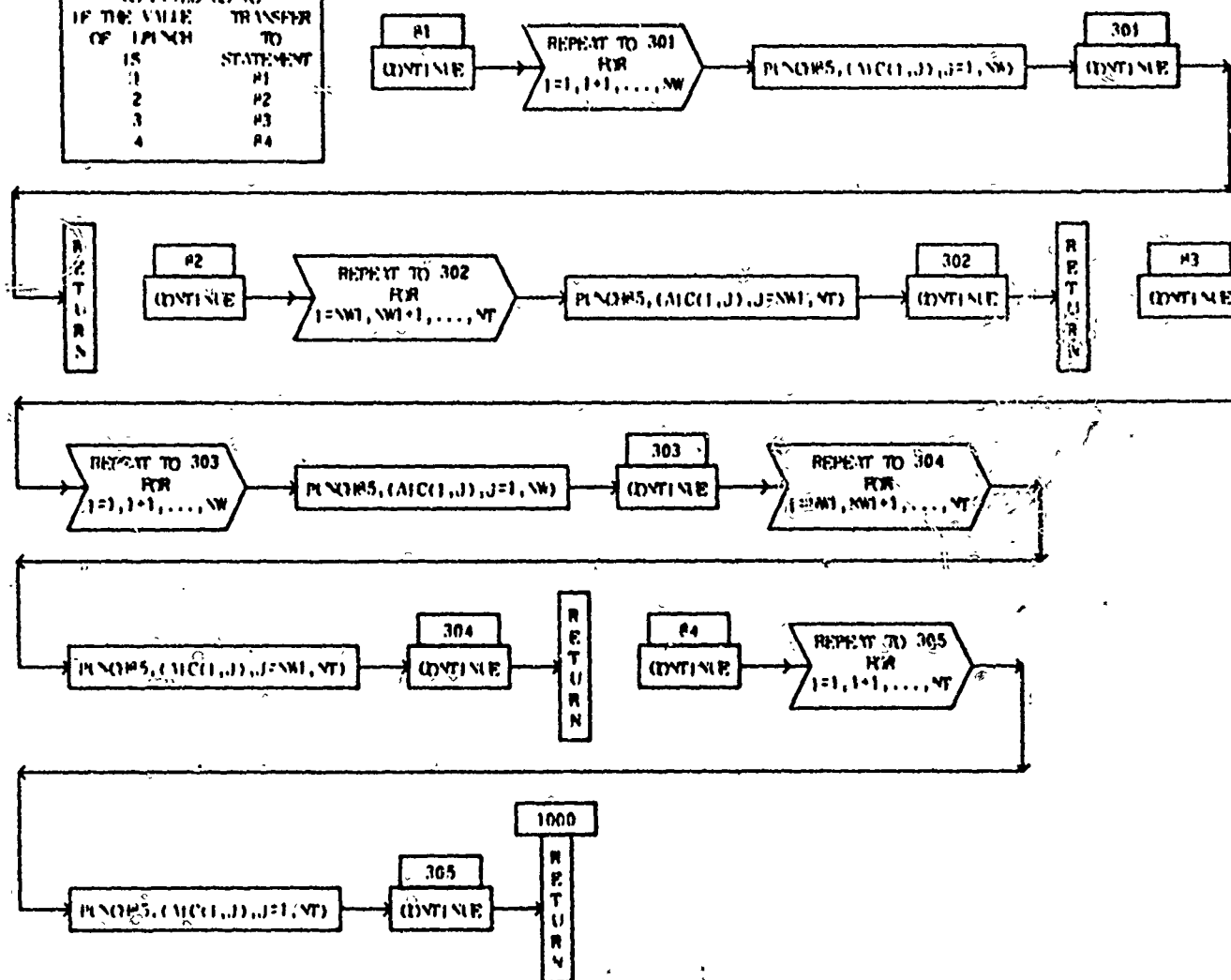


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SUBROUTINE KOUT(IND)

PAGE 4

COMPUTED ID TO IF THE VALUE TRANSFER OF PUNCH TO	STATEMENT
1	P1
2	P2
3	P3
4	P4



NRCE NRCE

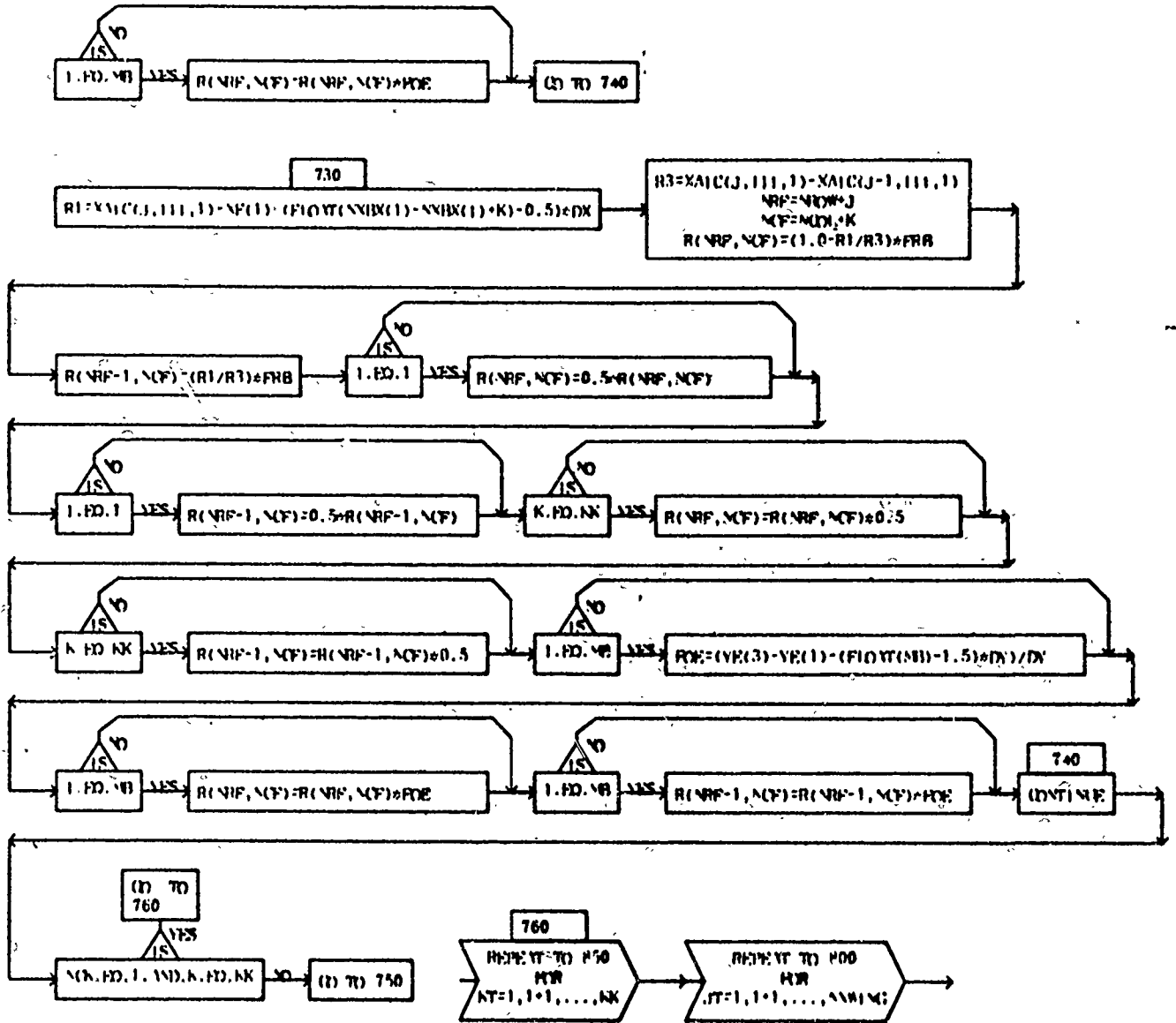
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R	45, 45								



SUBROUTINE FORCE (R)

PAGE 3

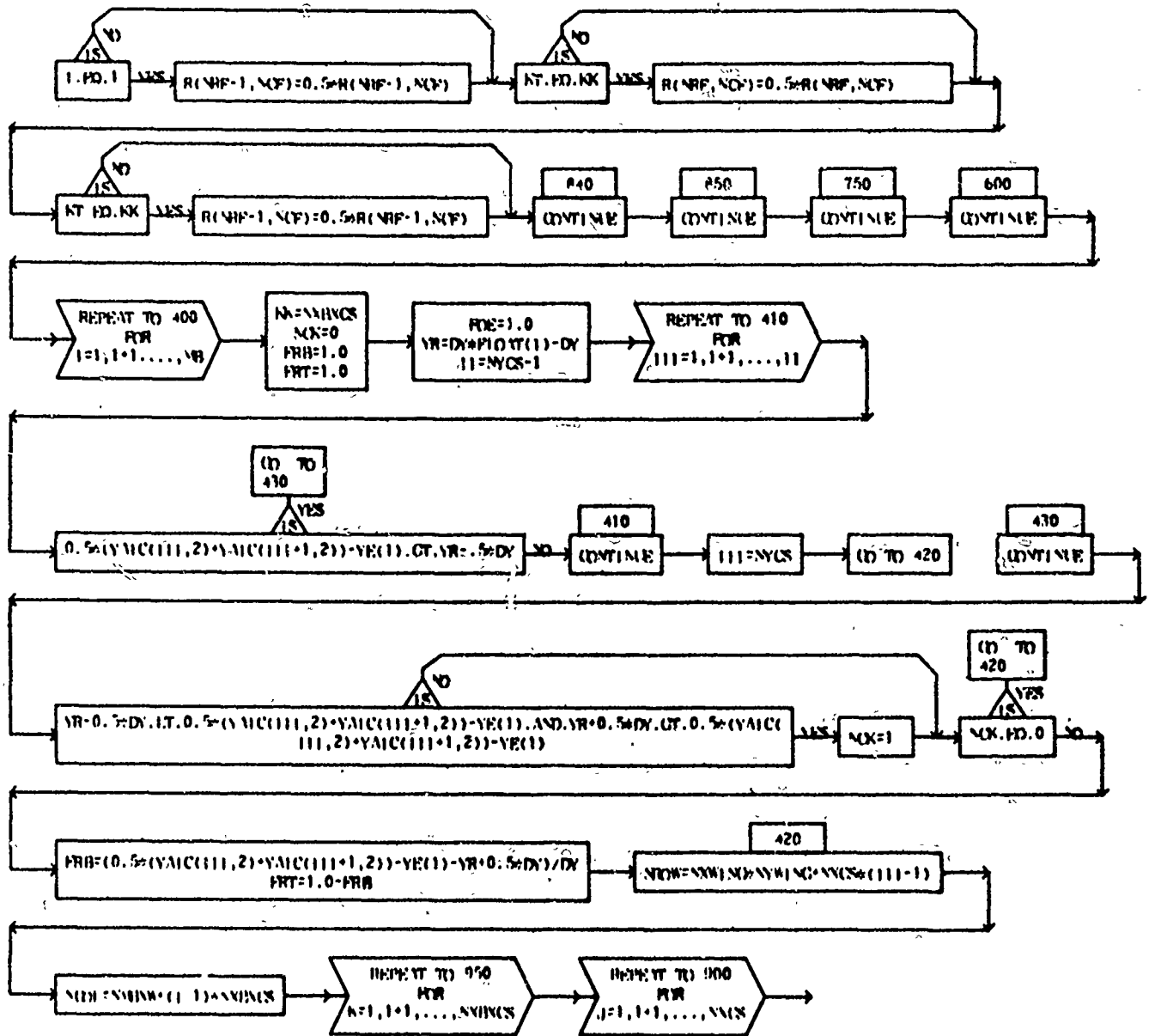


1142



SLEW RATE FORCE (R)

PAGE 5

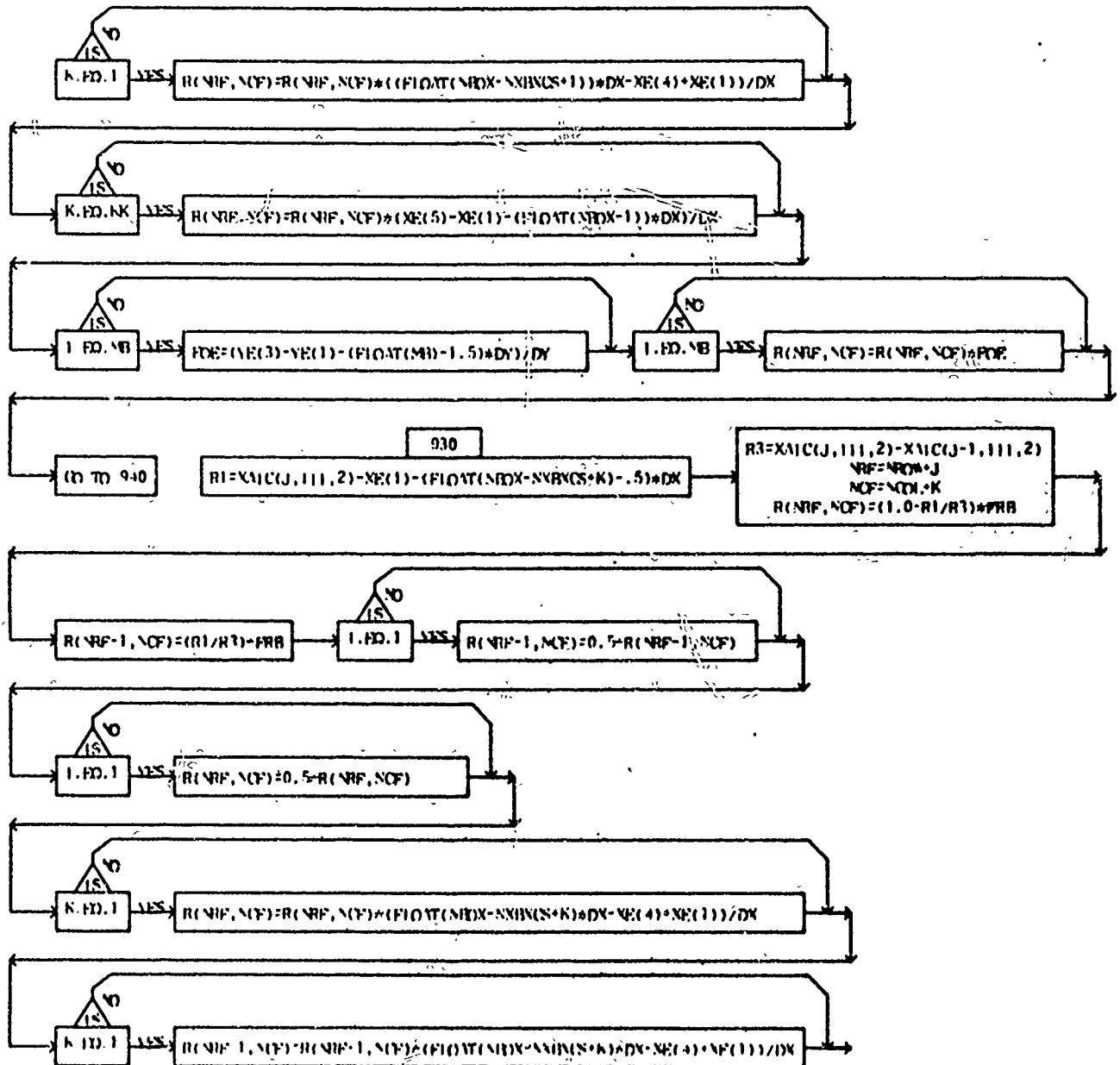


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SUBROUTINE FORCE (R)

PAGE 7

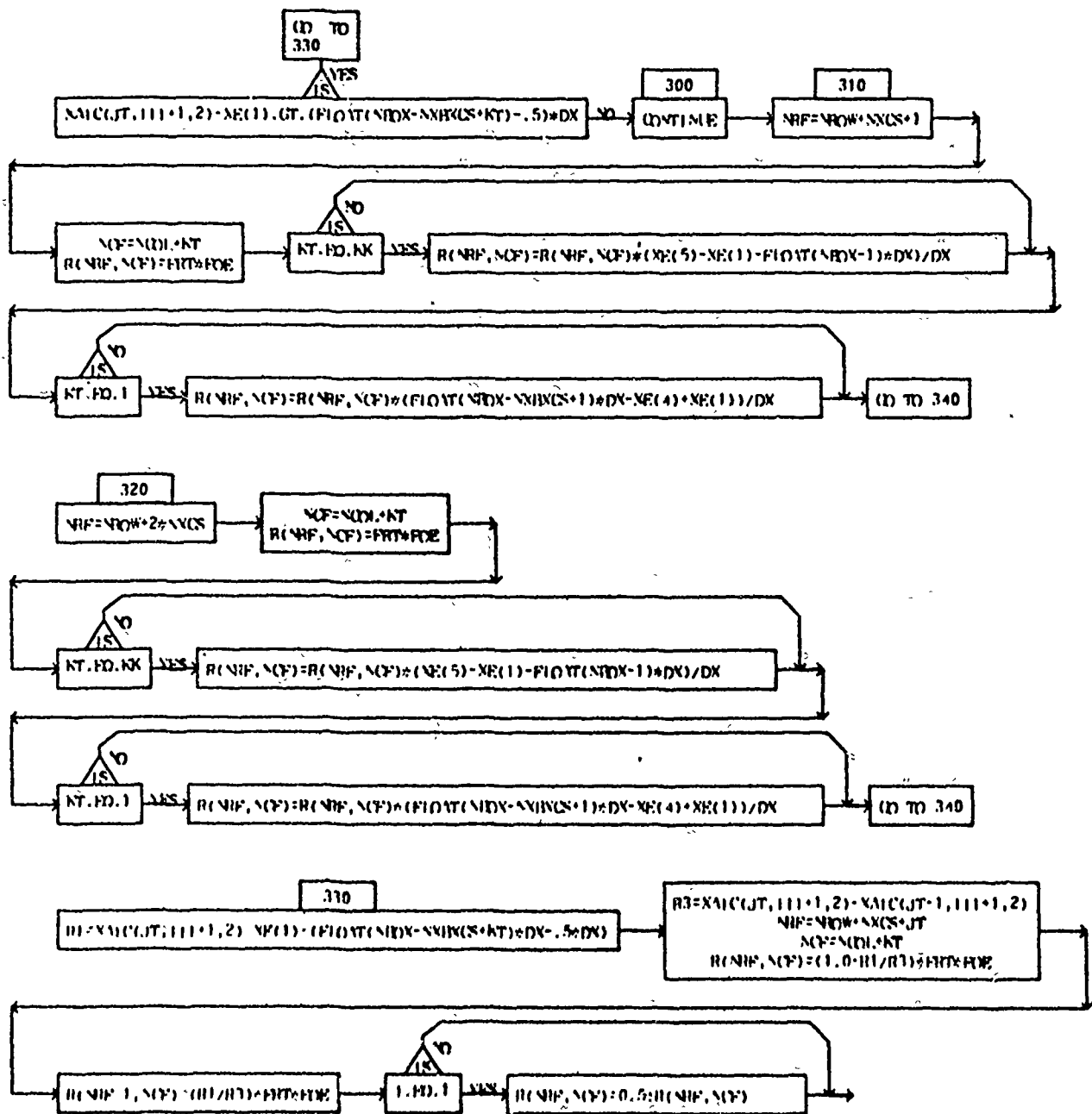


PAGE 2



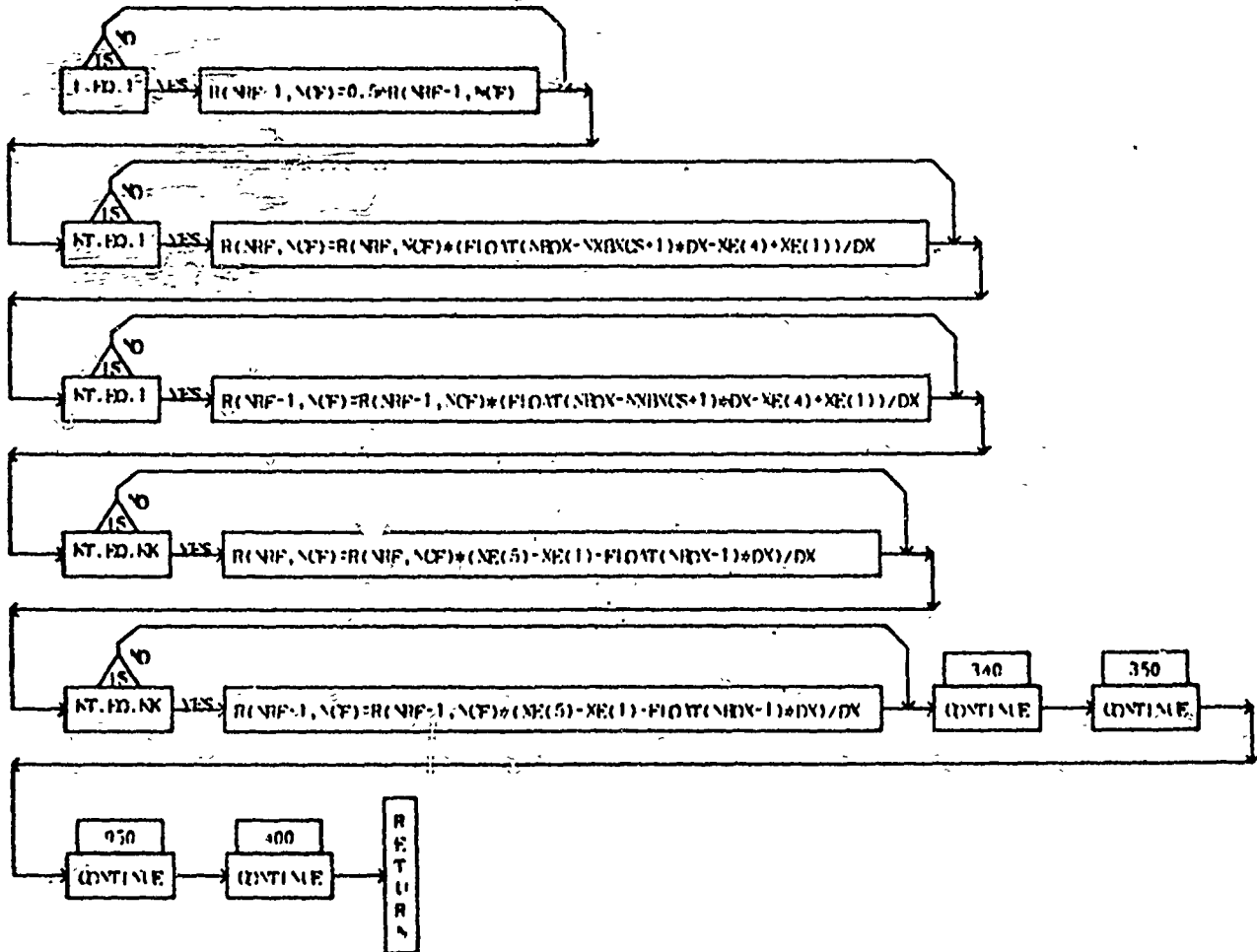
SUBROUTINE FORCE (R)

PAGE 9



SUBROUTINE FORCE (R)

PAGE 10



245



PAGE 2



MIN MIN

0578

0578

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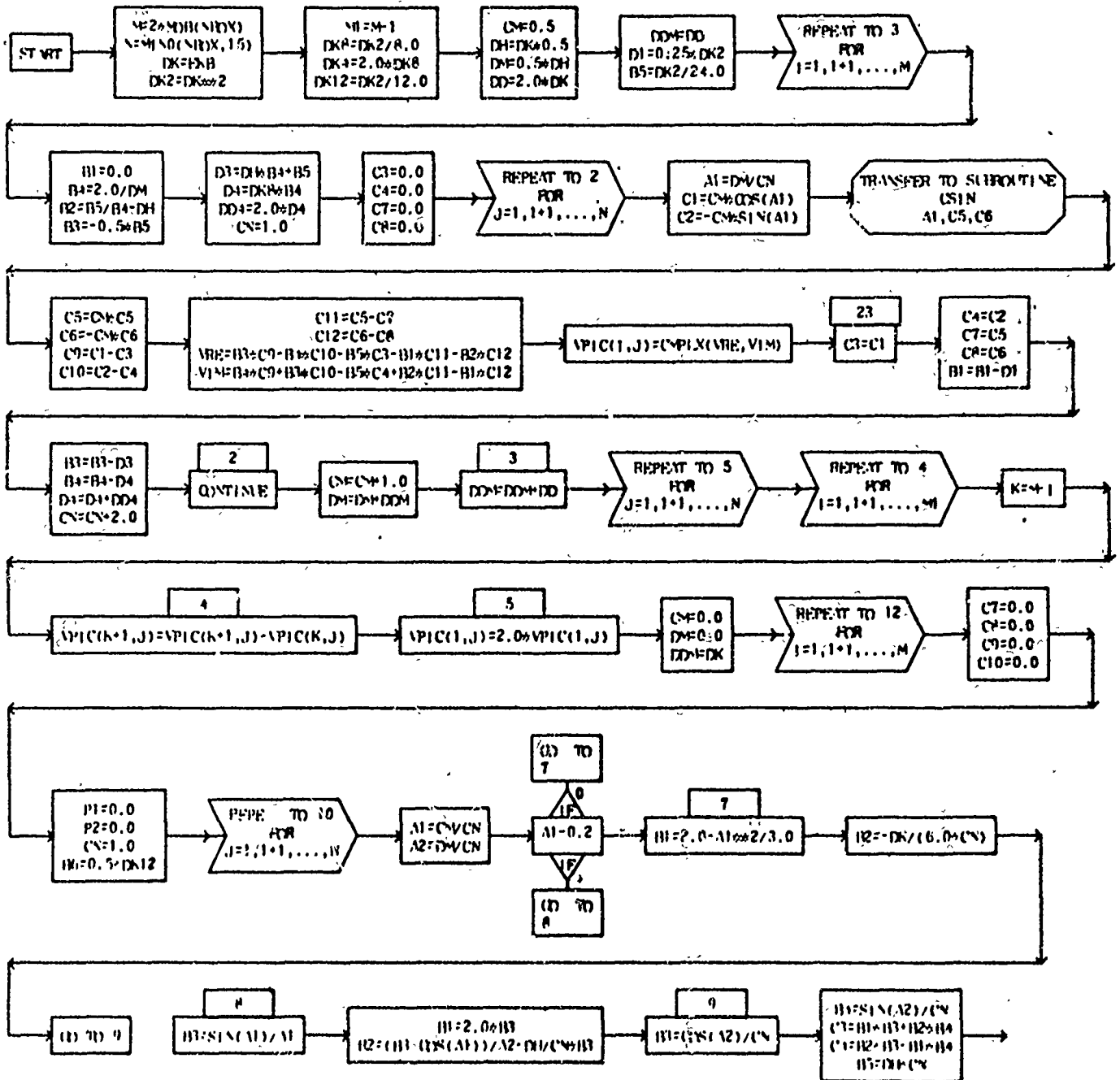
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1972H

1972H

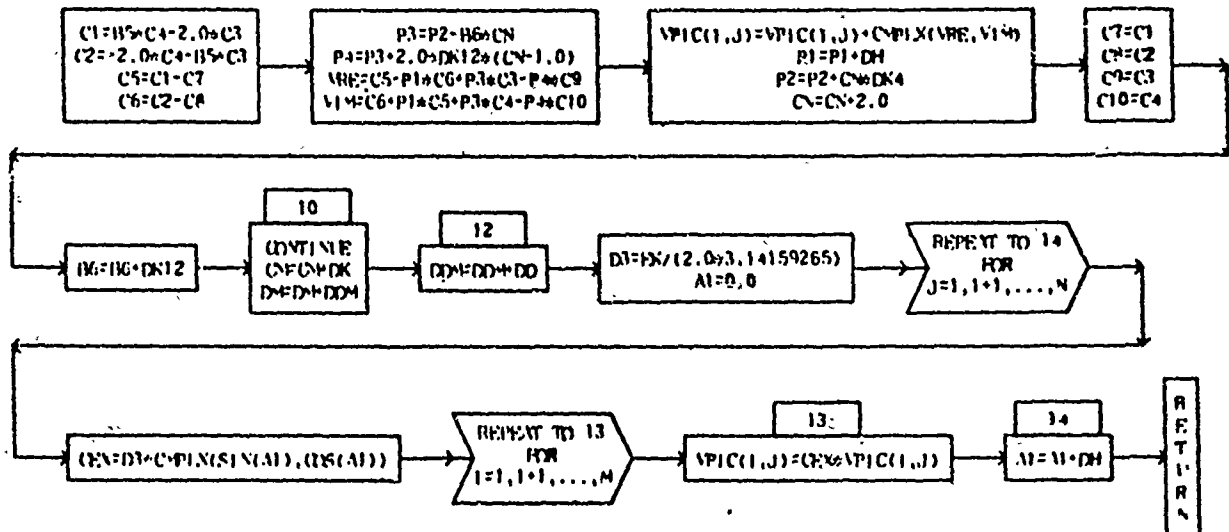
SUBROUTINE ROT2H

PAGE 1



SUBROUTINE RUT2H

PAGE 2



RUB RUB



502

502

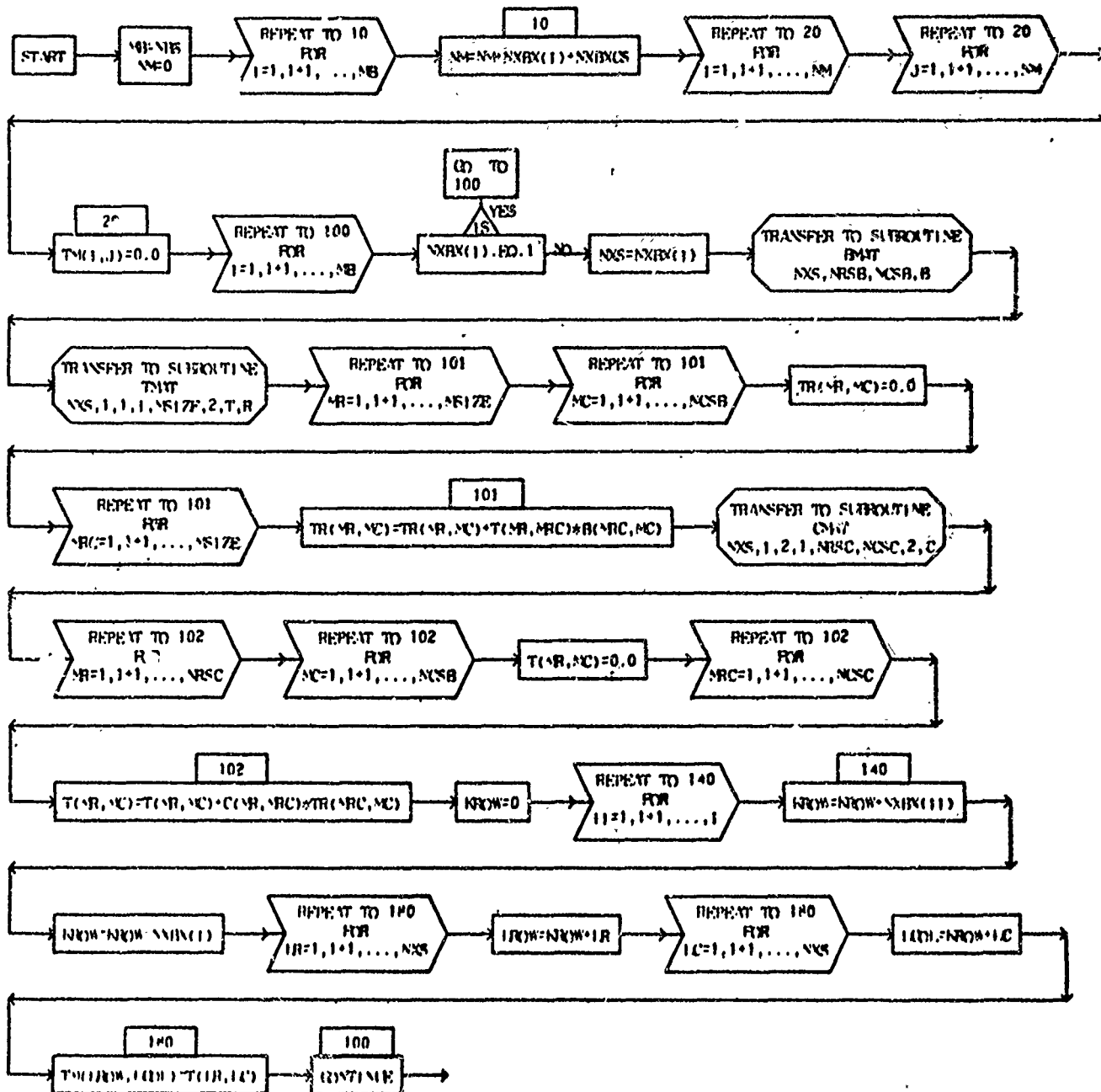
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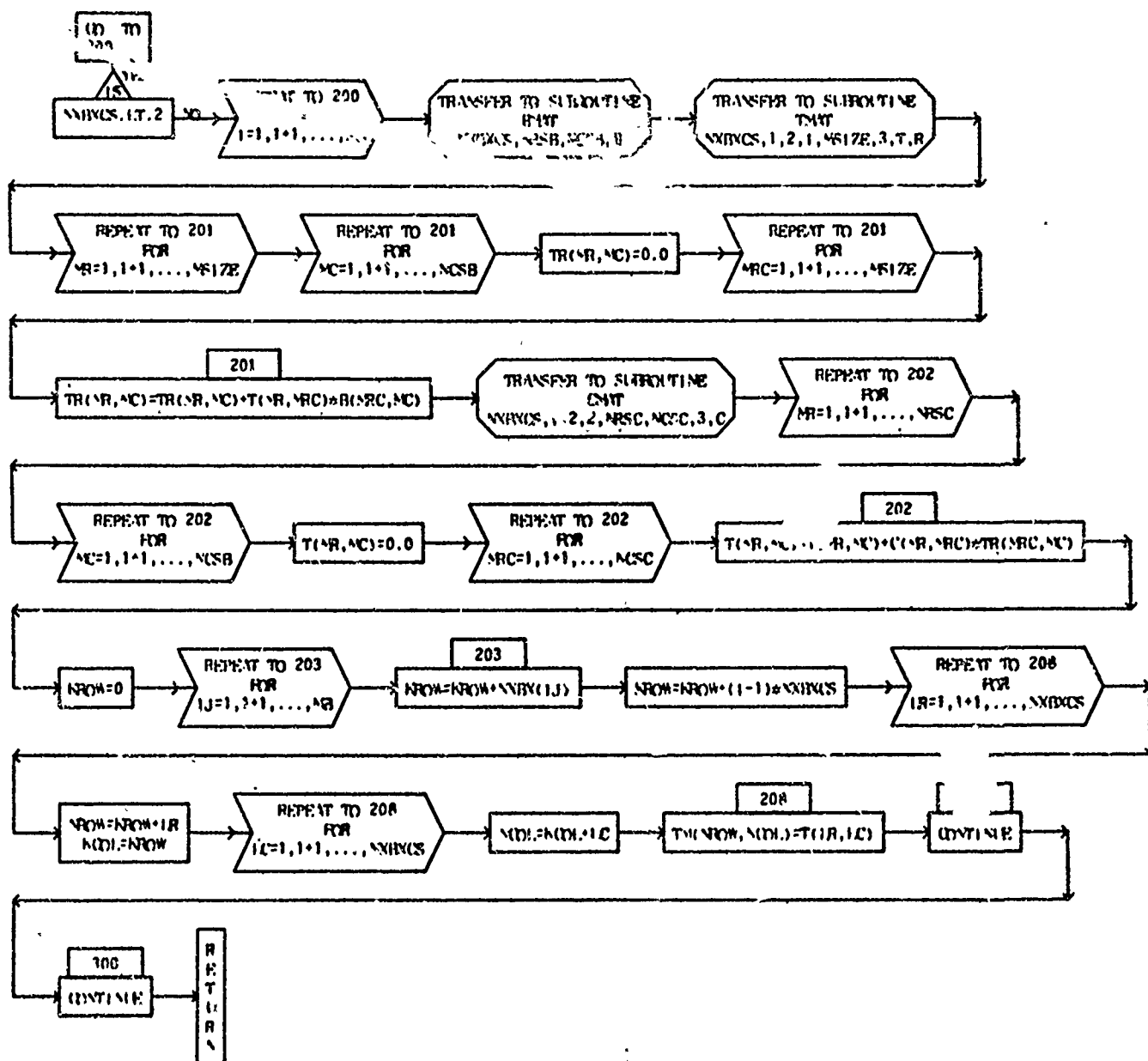
D I M E N S I O N E D V A R I A B L E S

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TH	45, 45	TM	45, 45						

SUBROUTINE SD2 (S,R,C,B,T,TR,TM)

PAGE 1





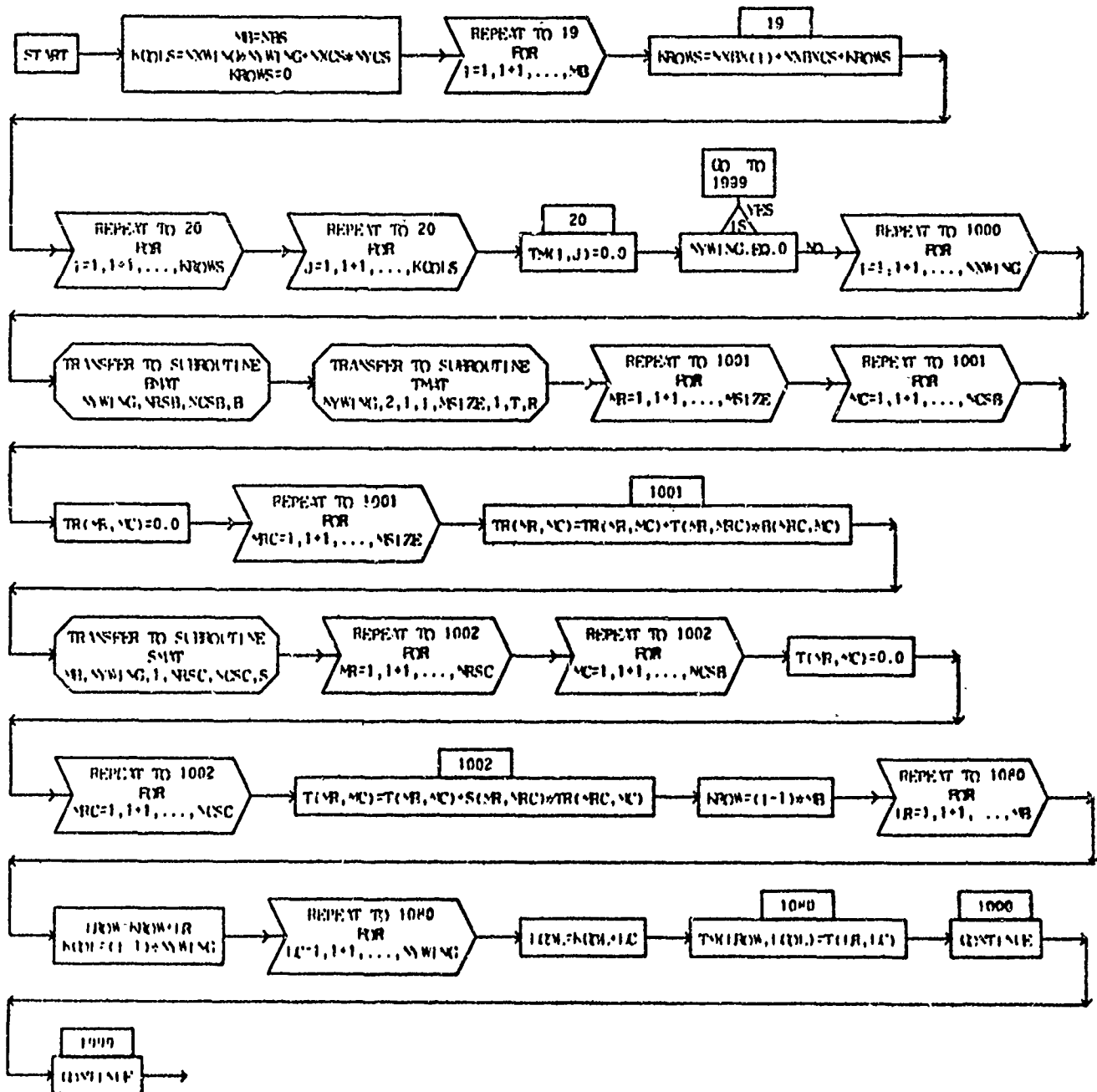
TRIP

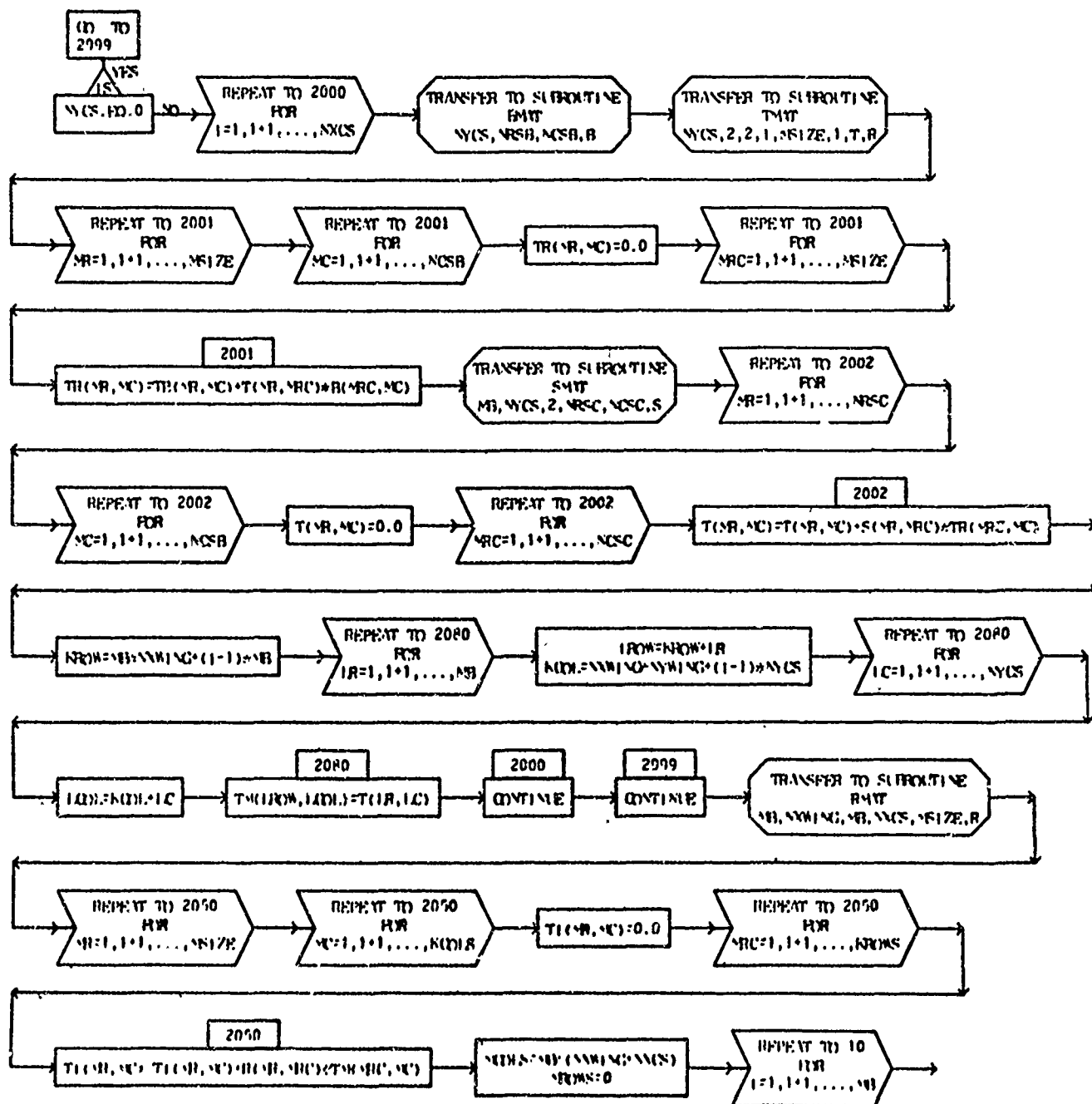
D I M E N S I O N E D V A R I A B L E S

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3	45,45	R	45,45	C	45,45	B	45,45	T	45,45
TR	45,45	TI	45,45	TM	45,45				

SUBROUTINE TRAP (NIF, NROWS, KCOLS, S, R, C, B, T, TR, TI, TM)

PAGE 1





PAGE 3

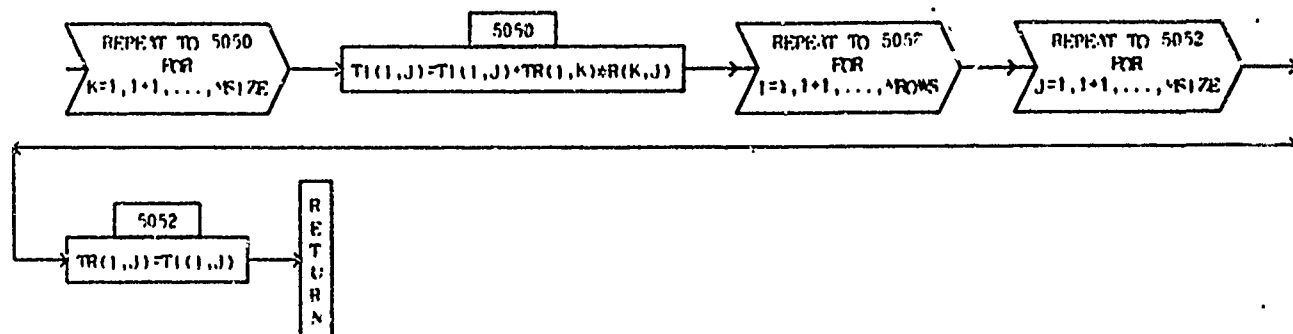


PAGE 4



SUBROUTINE TRAMP (NIF, *ROWS, KCOLS, S, R, C, B, T, TR, TI, TM)

PAGE 3

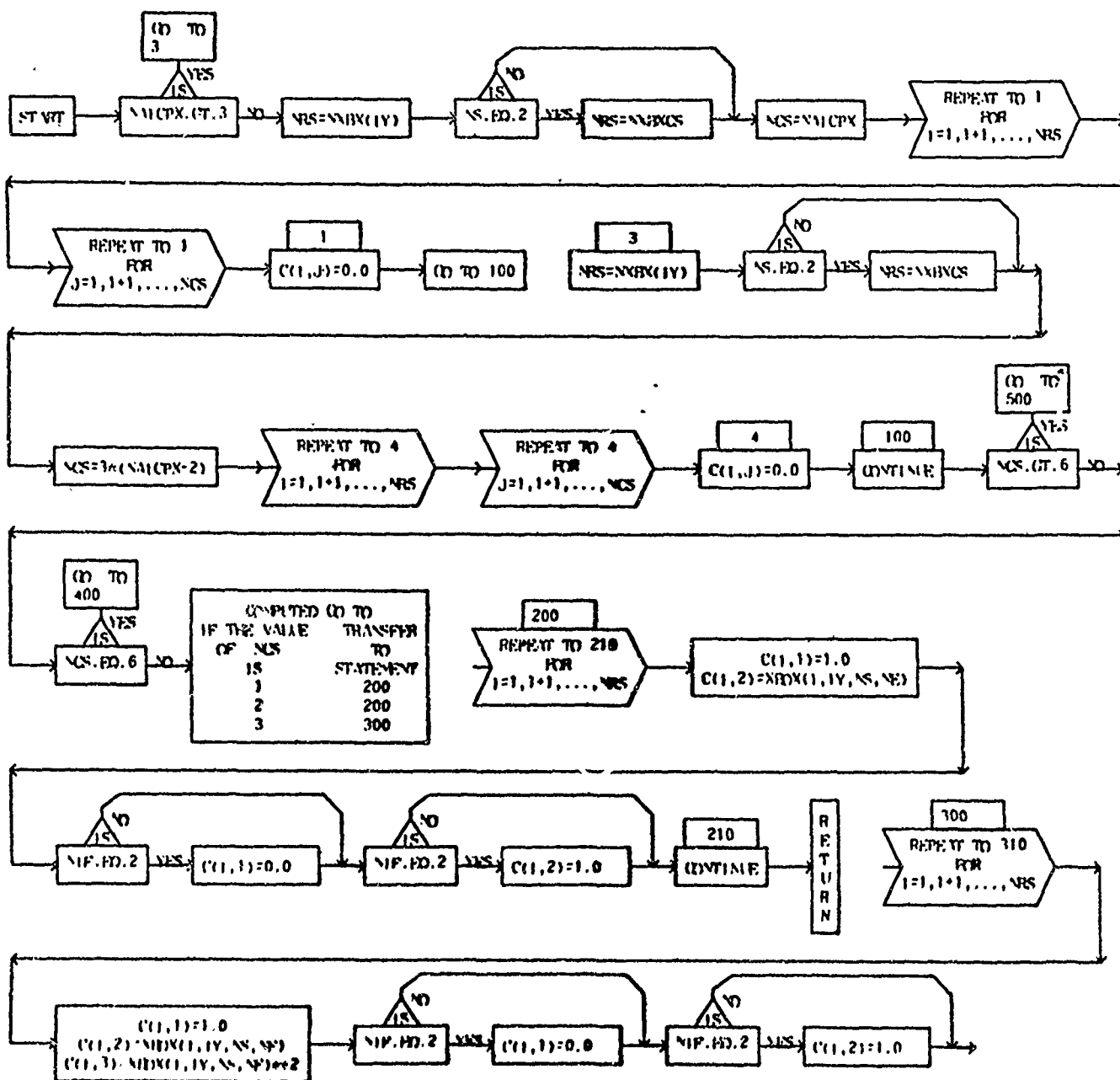


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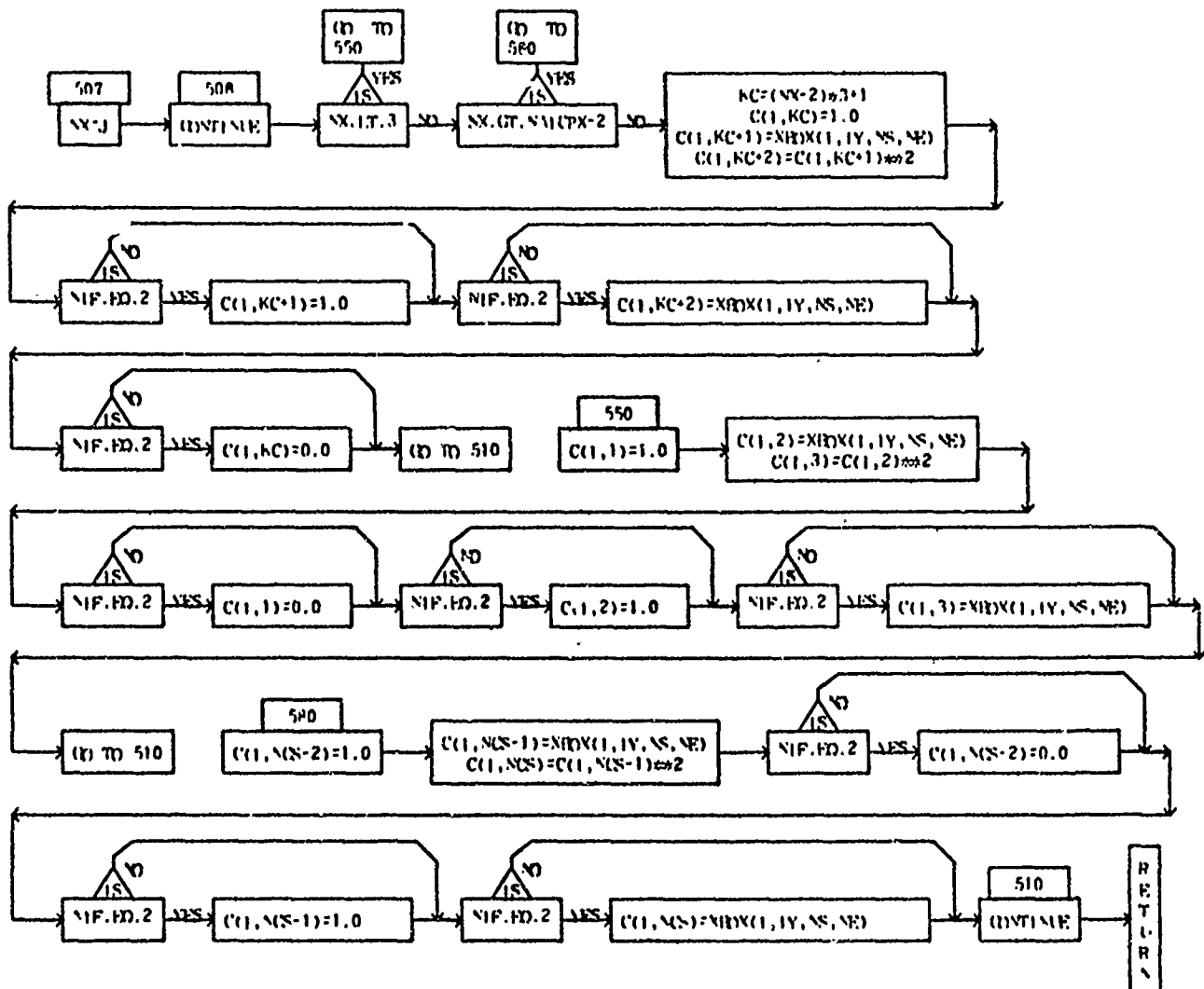
D I M E N S I O N E D V A R I A B L E S

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C	45,45								

Р 447.1



PMZ 3



TMT TMT

D I M E N S I O N E D V A R I A B L E S

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T	45,45	R	45,45						

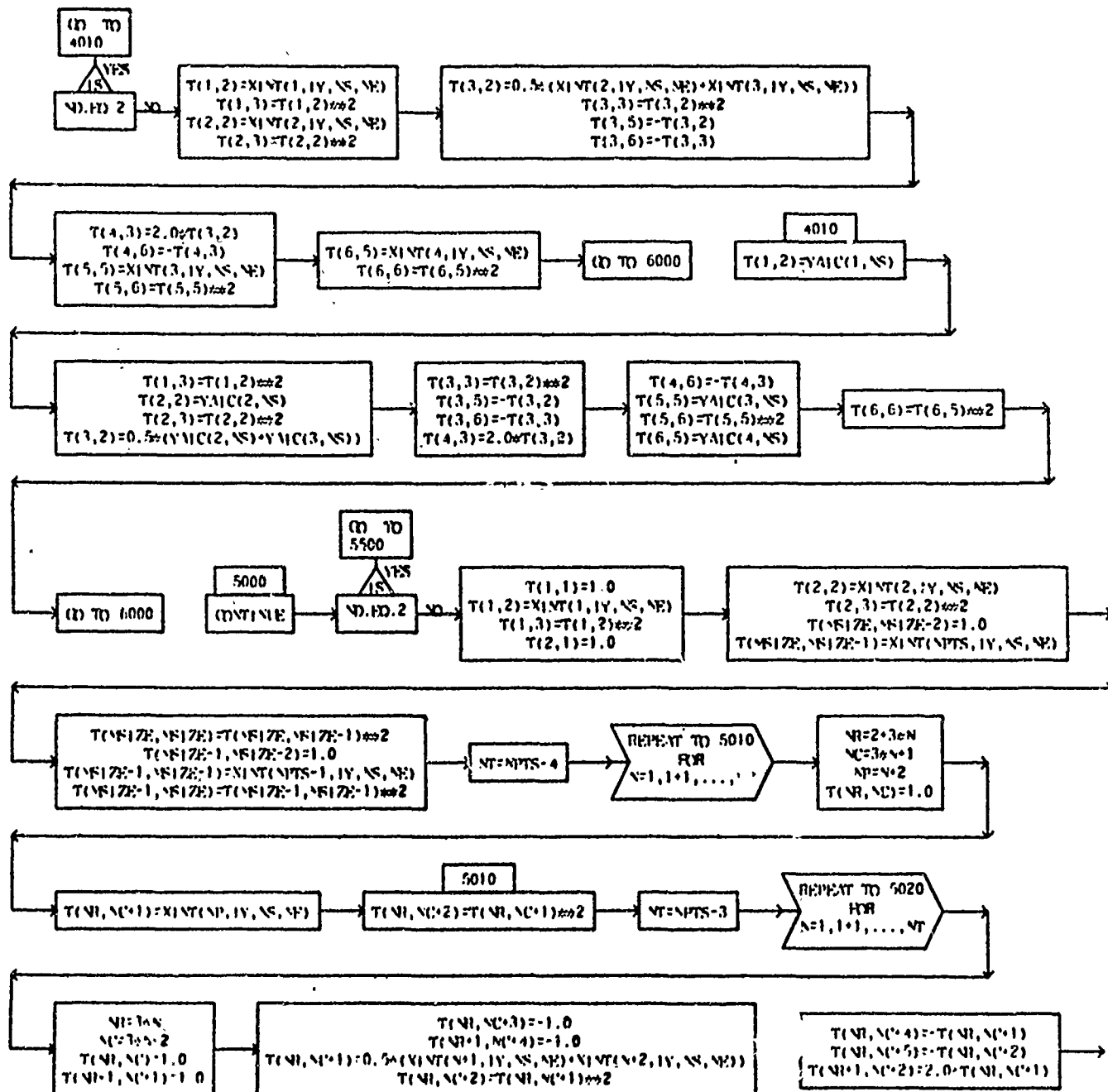
SUBROUTINE TMT (MPTS,ND,NS,IY,MSIZE,NE,T,R)

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SUBROUTINE TMT (NPTS, ND, NS, IV, NSIZE, NE, T, R)

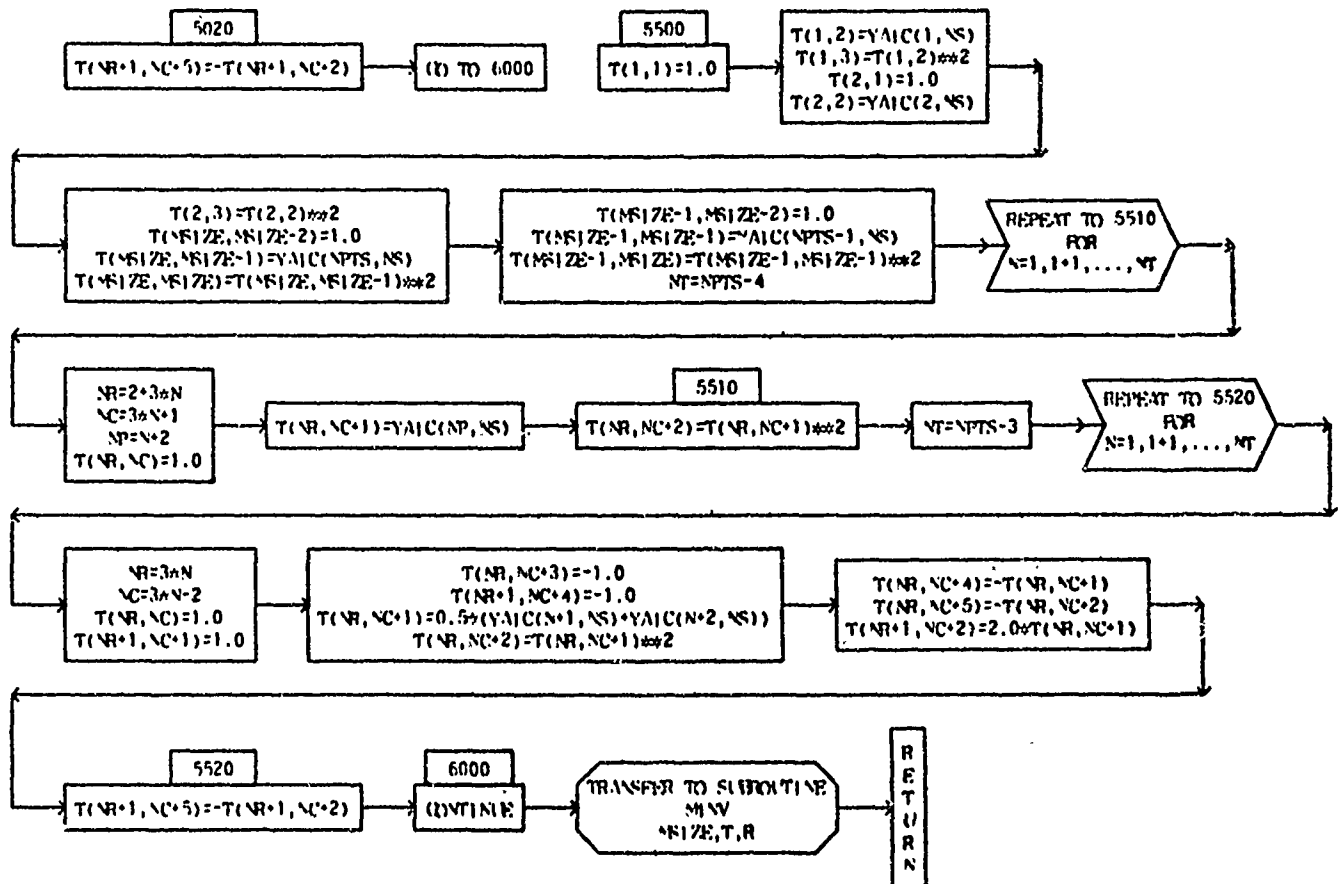
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SUBROUTINE TMAT (NPTS,ND,NS,IV,MSIZE,NE,T,R)

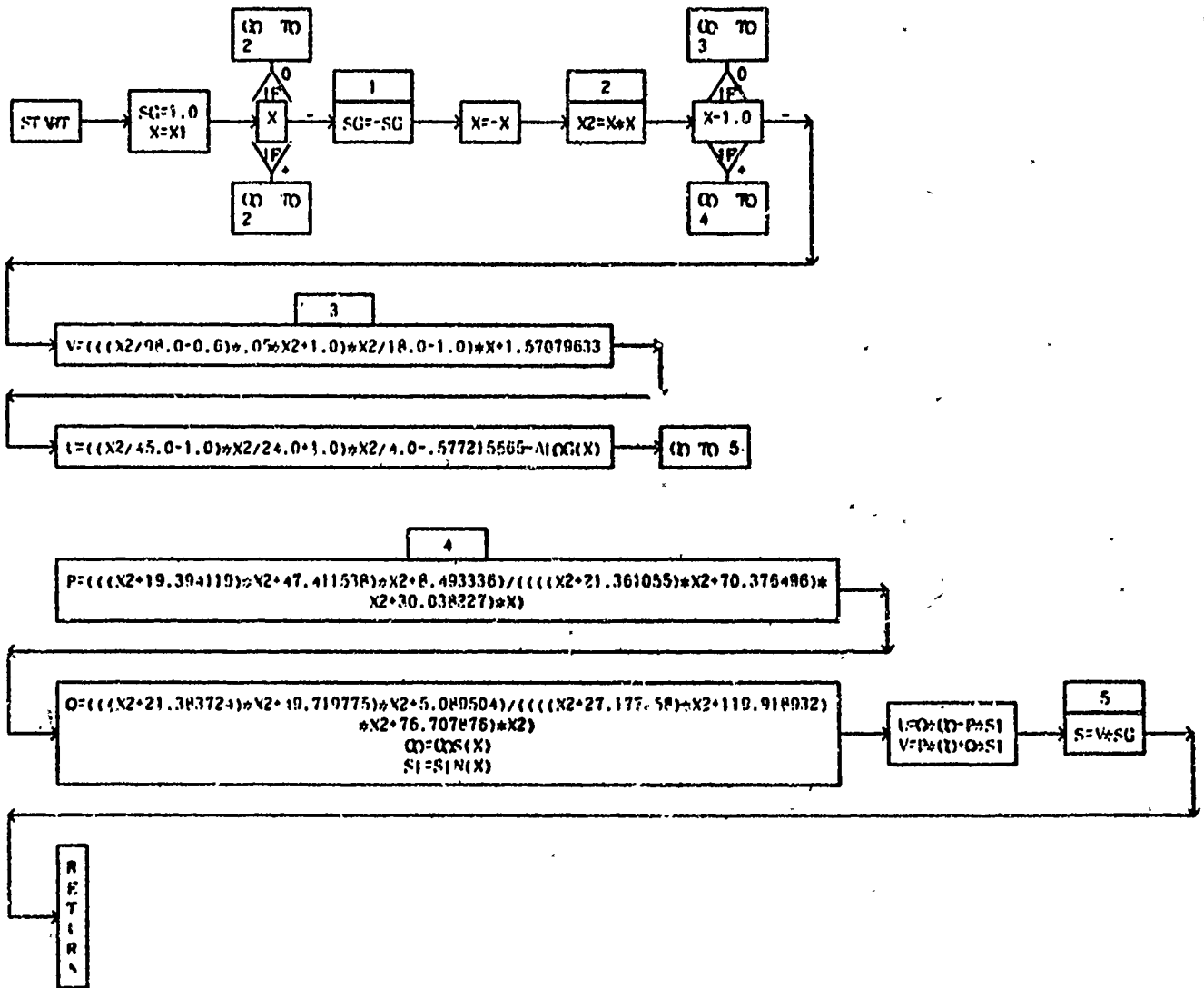
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CSIN CSIN

SUBROUTINE CSIN(X),U,S)

PAGE 1

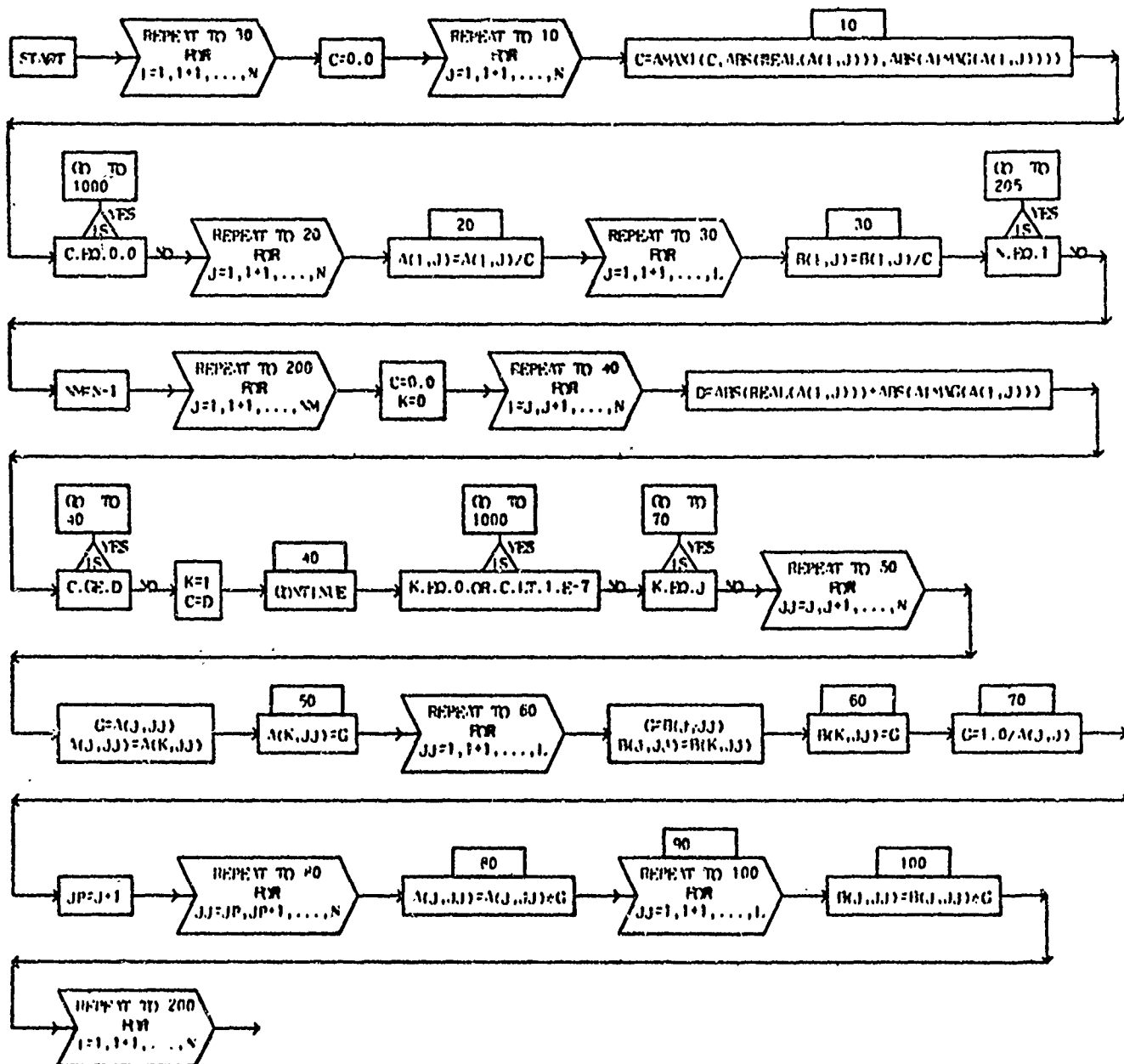


PRIME PRIME

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FUNCTION ABS(CM,N,I,A,B)

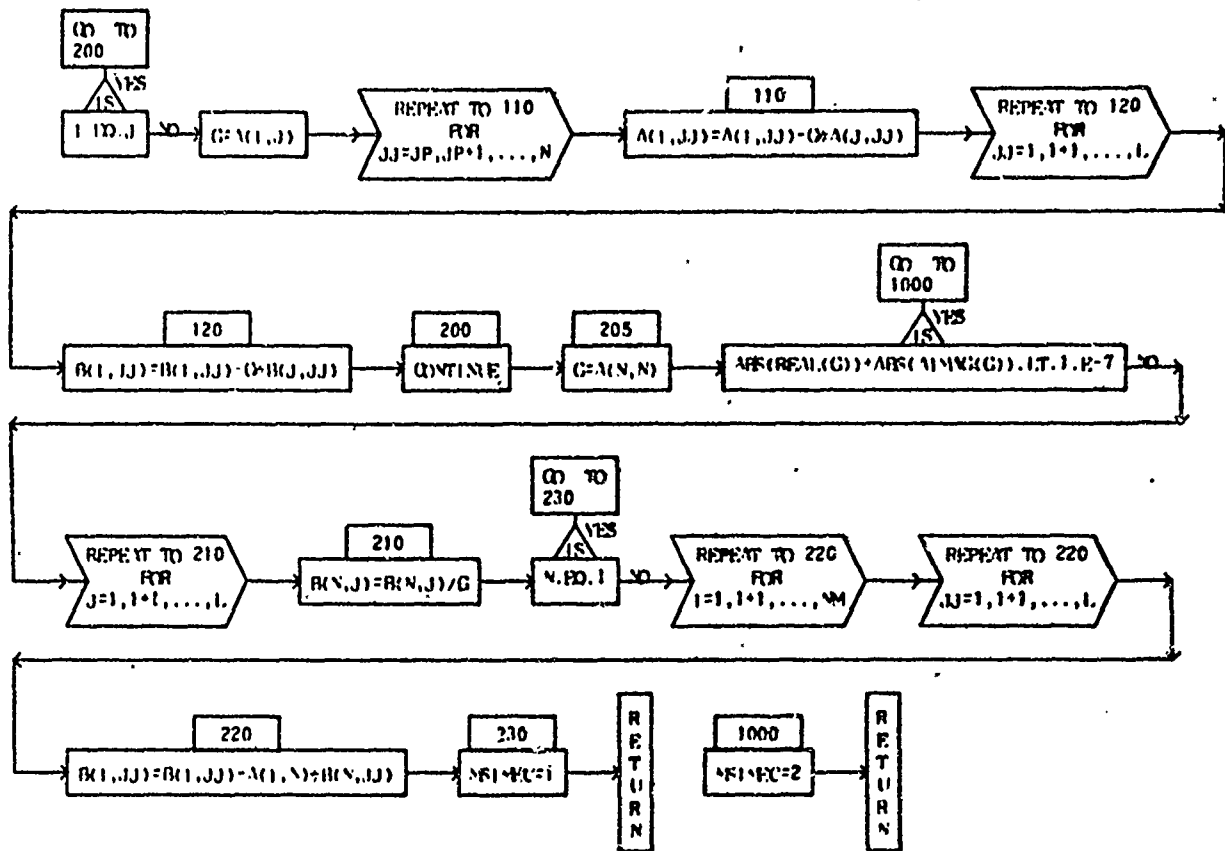
PAGE 1



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FUNCTION NSIPEC(M,N,L,A,B)

PAGE 2



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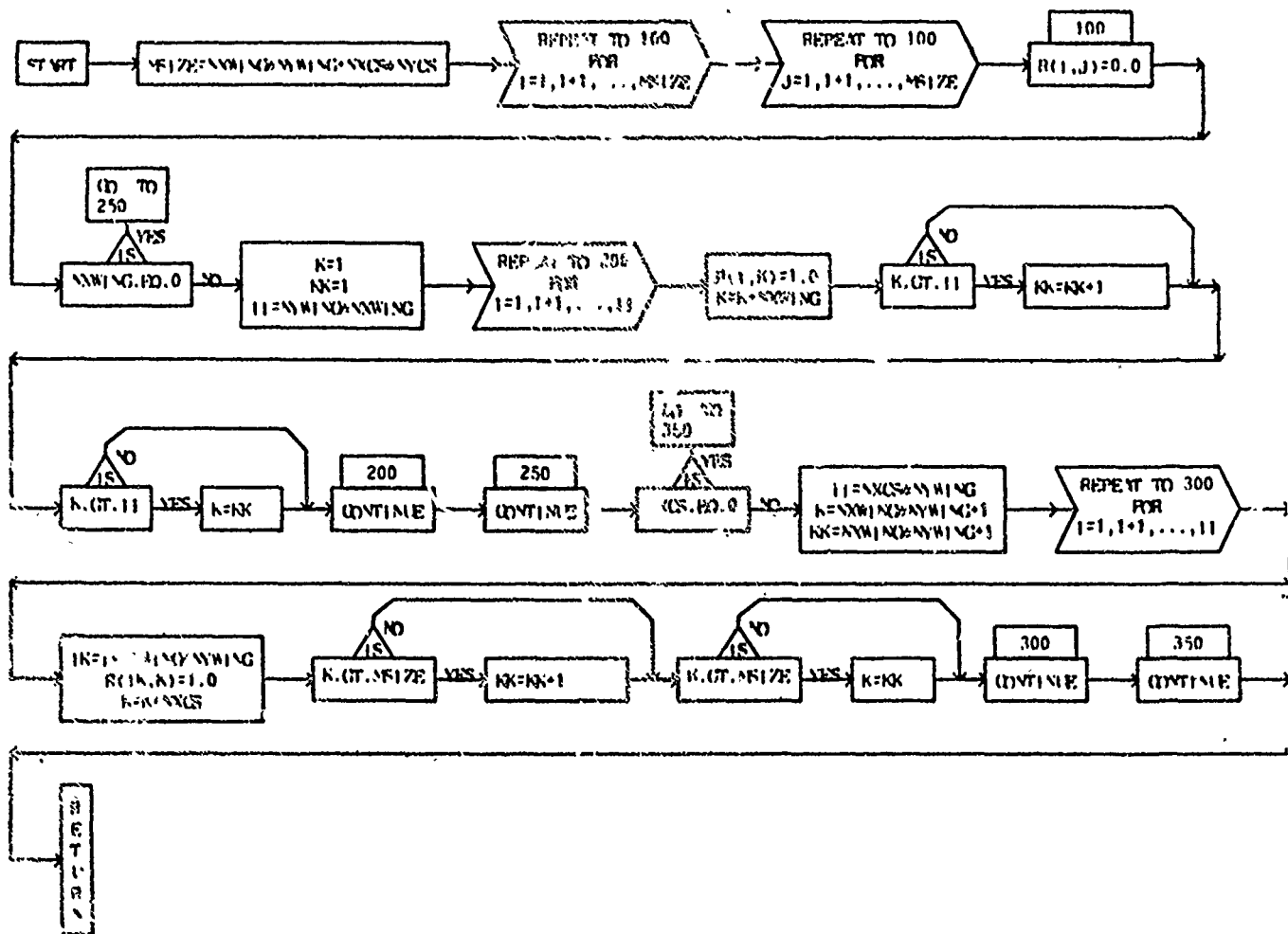
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D I M E N S I O N E D V A R I A B L E S

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R	45, 45								

SUBROUTINE RMT (XWING, YWING, XCS, YCS, MSIZE, R)

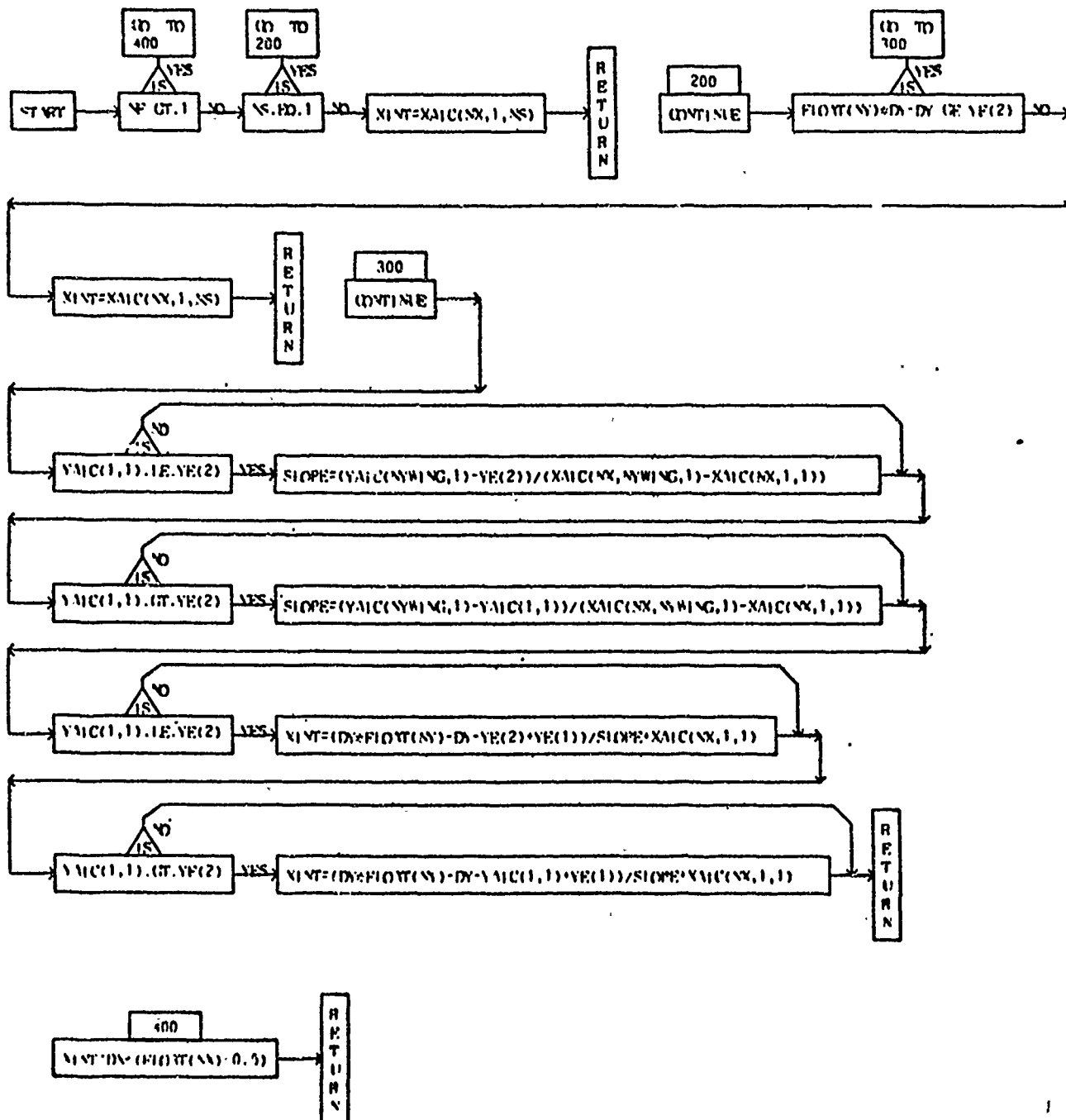
PAGE 1



XI 47

FUNCTION XINT(SX,SY,SS,SE)

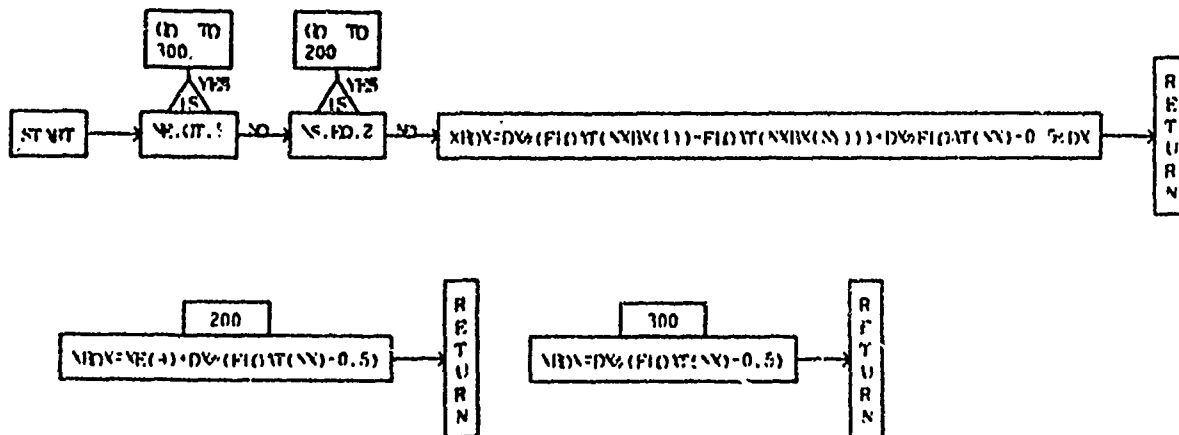
PAGE 1



1874

FUNCTION MIX(X, W, NS, NE)

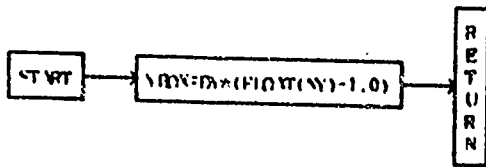
PAGE 1



1000

FUNCTION VBOX(W)

PAGE 1



0417

D I M E N S I O N E D V A R I A B L E S

S Y M B O L	S T O R A G E S	S Y M B O L	S T O R A G E S	S Y M B O L	S T O R A G E S	S Y M B O L	S T O R A G E S	S Y M B O L	S T O R A G E S
B	45, 45								



SMY

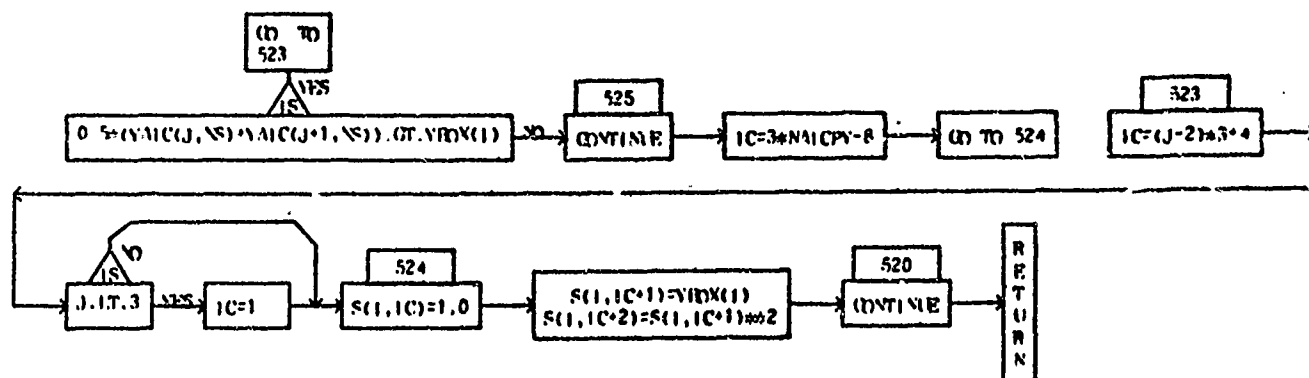
DIMENSIONED VARIABLES

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PXZ: 1



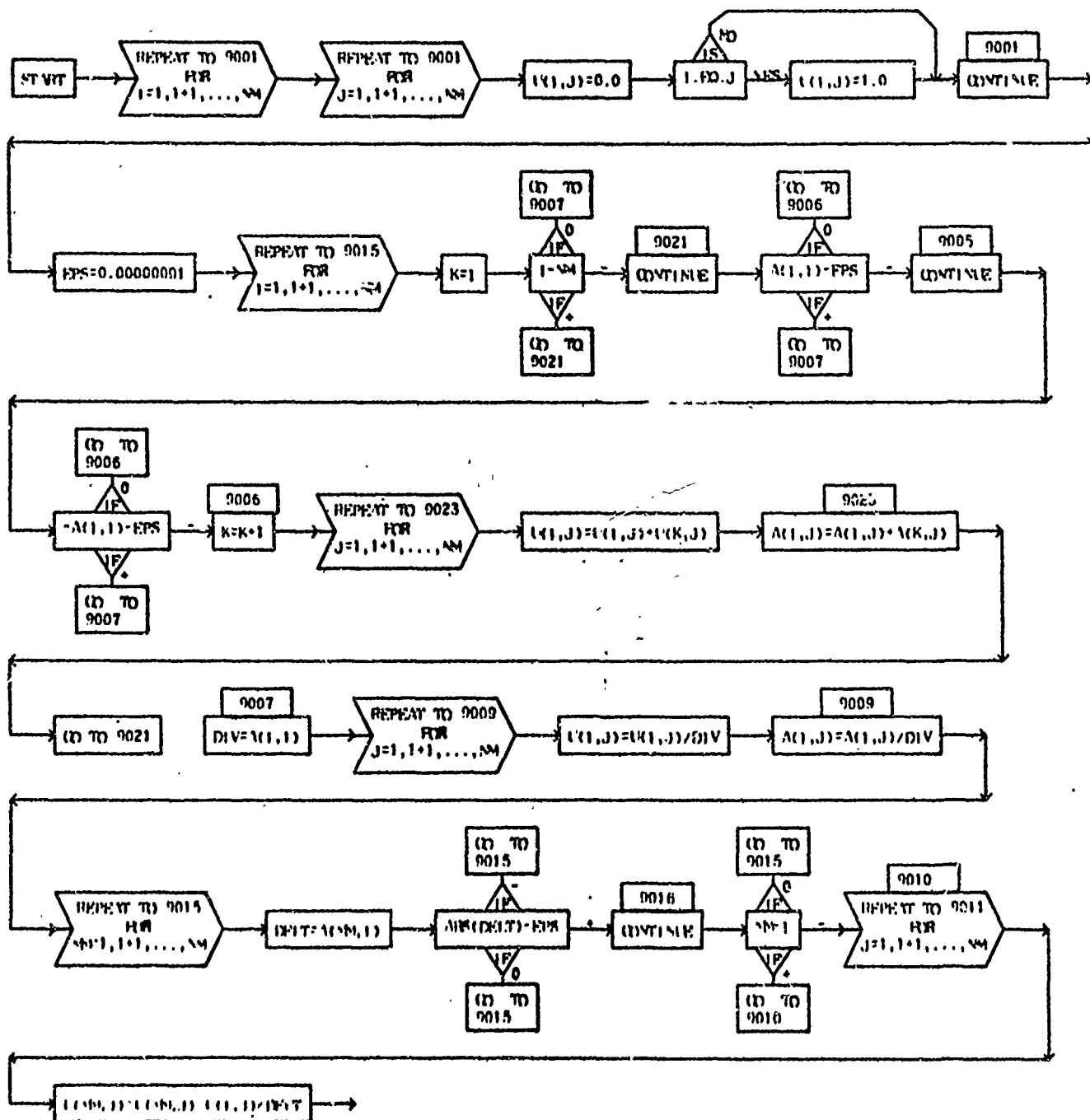
P. 44. 2



www

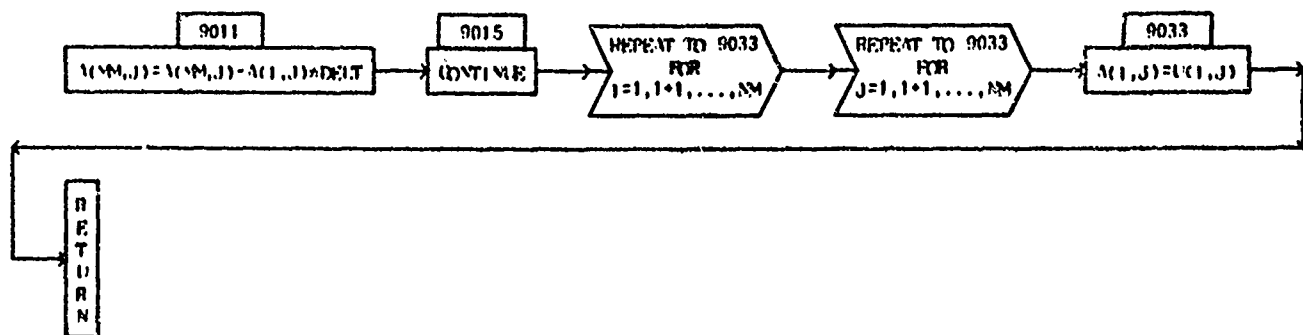
D I M E N S I O N E D V A R I A B L E S

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1	45,45	0	45,45						



SUBROUTINE MINV (NM,A,U)

PAGE 2



PART VI - SECTION A

TECHNICAL DISCUSSION OF THE
SUPERSONIC BOX METHOD

The linearized flow equation is in the form of a hyperbolic differential equation when the flight speed exceeds the speed of sound. The supersonic version

$$\beta^2 \phi_{xx} - \phi_{yy} - \phi_{zz} = -M^2 [2ik \phi_x - k^2 \phi] \quad (6.1)$$

where $\beta^2 = M^2 - 1$, has solutions only within characteristic regions, called Mach cones. Linearized supersonic flow theory has led to closed-form solutions for many types of lifting surfaces in steady flow (Reference 11), such as the rectangular wing, delta wing, and trapezoidal wing. These solutions are derived easily because the influence of a small perturbation is confined to its downstream or aft Mach cone. Conversely, the only disturbances that can influence a particular point are confined to its upstream or fore Mach cone.

The most elementary disturbance that can be placed in the flow and that is a solution to Equation (6.1) is the pulsating source. The source, placed at (ξ, η, ζ) emanates spherical disturbances and has a velocity potential induced at x, y, z , given by

$$\phi_s = \Lambda(\xi, \eta, \zeta) G(x - \xi, y - \eta, z - \zeta)$$

$$G(x - \xi, y - \eta, z - \zeta) = -\frac{1}{\pi R} \exp \left[-i \bar{k} (x - \xi) \right] \cos \left[\frac{\bar{k}}{M} R \right] \quad (6.2)$$

where

$$R = \sqrt{(x - \xi)^2 + \beta^2 [(y - \eta)^2 + (z - \zeta)^2]}, \quad \bar{k} = k M^2 / \beta^2, \text{ and } \Lambda(\xi, \eta, \zeta)$$

represents the strength of the source. This type of disturbance has no influence outside the downstream Mach cone and is discontinuous at the point (ξ, η, ζ) . To provide the necessary antisymmetry of disturbances with the symmetric source solution, we could place a pair of sources on either side of the $z = 0$ plane and require the lower source strength to be equal in magnitude and opposite in sense if we could isolate the lower from the upper half space. Since disturbances are confined to Mach cones, this isolation is possible if the entire region of disturbances in the $z = 0$ plane is covered with two source sheets placed on both sides with the distance between them infinitesimally small.

Applying this source-superposition technique to the wing and downstream control surface problem requires constructing for the configuration a Mach envelope that contains all possible disturbances. The entire $z = 0$ plane within that boundary is covered with source sheets immediately above and below the plane. A typical configuration with foremost and aftmost Mach cone intercepts with the $z = 0$ plane is shown in Figure 6.1.

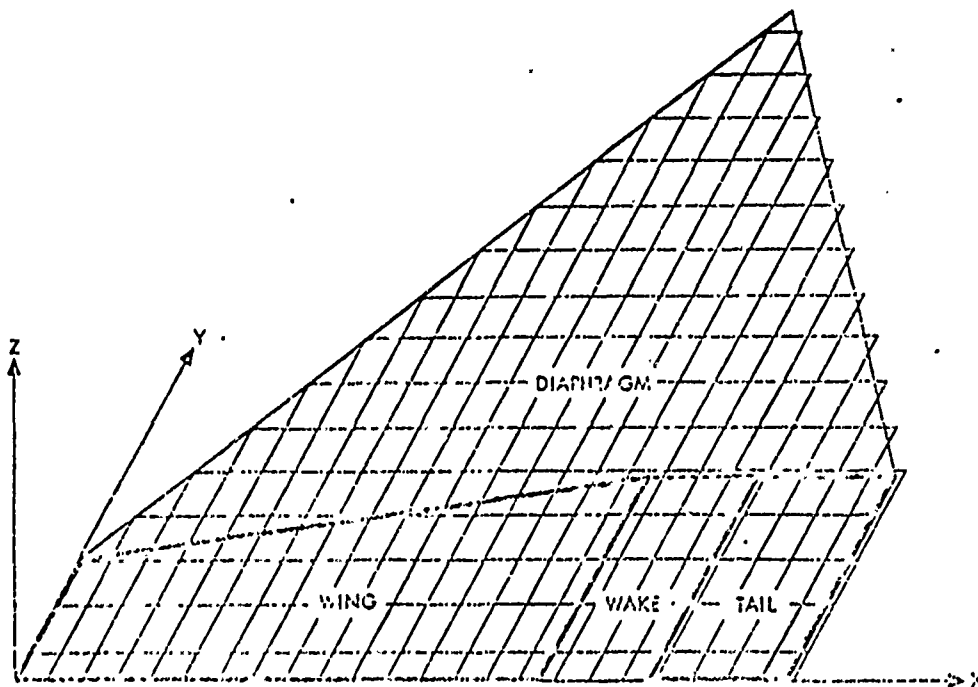


FIGURE 6.1 - SUPERSONIC BOX OVERLAY FOR A TYPICAL CONFIGURATION AT LOW SUPERSONIC MACH NUMBER

The strength distribution over the bottom sheets is to be equal at adjacent points but opposite in sense,

$$A(\xi, \eta, o^+) = -A(\xi, \eta, o^-) \quad (6.3)$$

and determined by boundary conditions so that loading acts only on regions superposed over lifting surfaces. This strength distribution has been shown (Reference 12) to be equal everywhere to the local downwash. When this condition is used, $A(\xi, \eta, o^+) = w(\xi, \eta, o^+)$, the velocity potential at (x, y, o^+) can be written as

$$\phi = \iint w(\xi, \eta) G(x - \xi, y - \eta) d\xi d\eta \quad (6.4)$$

where the range of integration extends over the region of the source sheet contained in the upstream Mach cone from the point. Substitution of the tangential flow condition for the downwash would yield a solvable integral equation if the source sheet covered only a lifting surface. Such is not the case when the Mach number normal to any swept edge is subsonic.

The downwash distribution between any subsonic edge and the Mach envelope (diaphragm) can be determined (Reference 13) by simply satisfying the condition that the pressure is continuous between any two adjacent field points that are not on opposite sides of a lifting surface. If no disturbances lie upstream along the line, $y = \text{constant}$, $z = \text{constant}$, then the velocity potential will also be continuous and the linearized pressure-velocity potential relation yields the condition that

$$\phi(x, y, o^+) - \phi(x, y, o^-) = 0$$

which leads to

$$\phi(x, y, o^+) = \phi(x, y, o^-) = 0 \quad (6.5)$$

when the antisymmetric condition that the upper potential equals minus the lower potential is applied. The downwash in the diaphragm region can then be evaluated by the integral equation

$$\phi = \iint w(\xi, \eta) G(x - \xi, y - \eta) d\xi d\eta \quad (6.6)$$

which has been solved for special cases (Reference 13).

The downwash distribution in the wake region can also be determined by satisfaction of the continuous pressure condition. In this case the potential has a non-zero constant value at (x, y) . Substitution of the wake condition, $\phi_{\text{wake}} = \phi_{\text{TE}} \exp -ik(x - x_{\text{TE}})$ (6.7)

into Equation (6.4) provides the relationship

$$\phi_{\text{WTE}} \left[\exp -ik \left(x - x_{\text{WTE}} \right) \right] = \iint w(\xi, \eta) G(x - \xi, y - \eta) d\xi d\eta \quad (6.8)$$

which requires knowledge of the upstream downwash distribution within the fore Mach cone to solve for the local wake downwash.

Computation of the downwash (source strength) distribution over the entire disturbance region and subsequent velocity potential distribution over the lifting surfaces for any supersonic Mach number and any non-negative reduced frequency for configurations of interest can be accomplished if the method developed in Reference 14 and extended in Reference 3 is followed. We cover the region of disturbances with a grid of rectangular boxes of length Δ and width Δ/β adjusted so that box edges lie along the y-axis and box centers lie along the x-axis and wing trailing edge. The box width is determined so that the box diagonals are parallel with Mach lines, hence the name Mach box. The configuration used in this development is shown in Figure 3 with Mach boxes covering the wing, wake, tail, and diaphragm regions. Boxes are in each of these regions according to the location of their respective centers.

Consider the downwash or source strength distribution to be approximated by a set of point values determined by satisfying the appropriate boundary conditions at box centers. When each central value is considered constant over its associated box, the velocity potential at any box center can be computed from

$$\phi_{n,m} = \sum_{\nu} \sum_{\mu} w_{\nu,\mu} \phi(n - \nu, |m - \mu|) \quad (6.9)$$

where $n = x/\Delta$, $m = \beta y/\Delta$, $\nu = \xi/\Delta$, $\mu = \beta \eta/\Delta$ are box center coordinates.

The influence coefficients (IC) are given by

$$\phi(n - \nu, |m - \mu|) = \iint_{\substack{\text{BOX} \\ \text{AREA}}} G(n - \nu, m - \mu) d\xi d\eta \quad (6.10)$$

where the unit source potential, G , is integrated over that portion of the box area at (ν, μ) that is within the fore Mach cone from the box center at (n, m) . Methods of evaluation of the IC for each pair of relative box locations at a particular Mach number and reduced frequency are presented in Reference 3.

Equation (6.9) is applied to the boxes one at a time beginning at the center box in the first row, then proceeding outward. After completing the first row, the same procedure is followed in the second row, etc. In following this procedure, it is found that there exists only one unknown in each box, since all of the upstream quantities except those in the box being computed will be available. This advantage is obtained because of the use of Mach boxes wherein the forward integration cone from the box center will not include any areas from the same row. Then in evaluating Equation (6.9) it follows that only $\phi_{n,m}$ and $w_{n,m}$ are unknown, and one may then write

$$\phi_{n,m} - w_{n,m} \phi(0, 0) = \sum_{\nu > n} \sum_{\mu > m} w_{\nu,\mu} \phi(n - \nu, |m - \mu|) \quad (6.11)$$

where $\Phi(o, o)$ as is indicated in Equation(6.10) represents the integral of G over the forward quarter of the Mach box. This relationship has all the upstream influence represented on the right side and the total minus the local velocity potential on the left side.

Any box on either surface has its downwash given by the tangential flow condition and its velocity potential given by Equation (6.11).

$\phi_{n,m}$ can then be determined from this equation.

Boxes entirely in the diaphragm region have zero velocity potential and the source strength is then determined by

$$w_{n,m} = - \frac{1}{\Phi(o, o)} \sum_{\nu > n} \sum_{\mu > m} w_{\nu, \mu} \Phi(n - \nu, |m - \mu|) \quad (6.12)$$

which is Equation(6.11) with $\phi_{n,m} = 0$. Any box that is intersected by a subsonic edge has its source strength modified by a linear interpolation between the downwash at the box center computed as if it were first a surface box and then a diaphragm box (Reference 15). This interpolation is based on the proportion of the box area lying in the two regions. The downwash at the center of a wake box is computed by substituting Equation (6.7) into Equation(6.11) to obtain

$$w_{n,m} = - \frac{1}{\Phi(o, o)} \left\{ \phi_{W_{TE}} \exp \left[-ik(n - n_{W_{TE}}) \right] \sum_{\nu > n} \sum_{\mu > m} w_{\nu, \mu} \Phi(n - \nu, |m - \mu|) \right\} \quad (6.13)$$

where the velocity potential at the wing trailing edge ties in the same box column ($m = \text{constant}$) with the wake box of interest.

Utilizing the above equations for either downwash or velocity potential, we can build up the point value distribution of velocity potential for both surfaces deforming harmonically at the same frequency. The values at the wing trailing edge are at box centers, and the values at the tail leading and trailing edge may be computed by the method described in the previous section.

PART VI - SECTION B

SUPERSONIC AIC COMPUTER PROGRAM DESCRIPTION

A FORTRAN IV computer program is presented which computes supersonic unsteady aerodynamic influence coefficients for a variety of single or tandem lifting surfaces. The solution is based on the source superposition method and a Mach box approximation is employed to reduce the integral equations to sums of constant values of source strengths at box centers times integrals which are functions of relative position, Mach number and reduced frequency.

The various tandem configurations which can be analyzed are shown in Figure 6.2. Also it is possible to analyze a single surface (the wing). The aerodynamic surfaces are assumed to have a plane of symmetry parallel to the free stream flow. The upstream surface must have an unswept trailing edge and the rectangular trailing surface must have the same spanwise dimension as the trailing edge of the wing.

The program allows up to 40 AIC control points. The AIC stations must satisfy the following requirements:

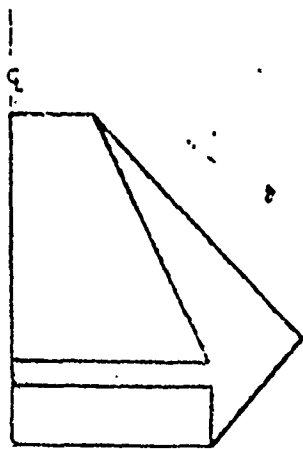
- (1) The chordwise rows must be parallel to the flow stream
- (2) The chordwise rows on a surface must have the same number of control points
- (3) The control points in each spanwise row must have the same fractional chordwise location
- (4) The origin for the AIC station coordinates and the wing and control surface coordinates must be at the leading edge root of the wing.

Examples of acceptable AIC control point patterns for the supersonic program are illustrated in Figure 6.3.

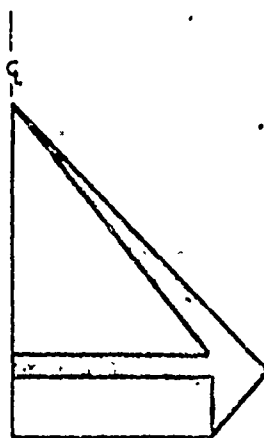
The supersonic AIC program is presently limited to 45 boxes on the aerodynamic surfaces. This limitation does not include the diaphragm boxes in the gap and outboard region. The restriction results from performing all operations on the computer in core without utilizing peripheral tape and disc units.

The user specifies the number of boxes along the wing root and the computer program determines the size of the boxes and overlay pattern which will cover the planform. The box centers of the first chordwise row will lie along the root of the surfaces. The last spanwise row of boxes on the wing will have their centers on the trailing edge. If NBW is selected by the user as the number of chordwise boxes on the wing root and if the wing root dimension is $2b_r$, then

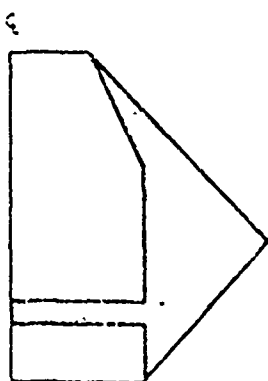
the box size will be $\Delta_c \times \Delta_s$ where $\Delta_c = 2b_r / (NBW - .5)$ and $\Delta_s = \Delta_c / \sqrt{M^2 - 1}$. Δ_c is the chordwise width and Δ_s is the spanwise box width. Knowing the size of the boxes and the planform geometry, the user can estimate if the 45 box restriction is satisfied. An example of a typical overlay is shown in Figure 6.4.



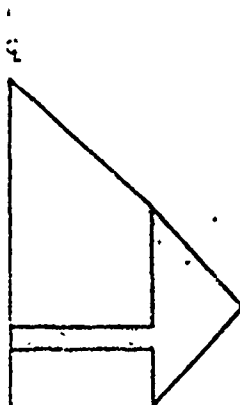
TRAPEZOIDAL



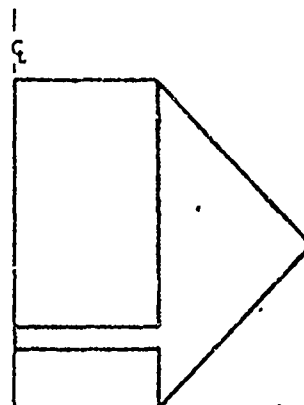
DELTA



TRAPEZOIDAL (CROPPED)



DELTA (CROPPED)



RECTANGULAR

 TRIANGLE REGION

Figure 6.2

Tandem Coplanar Configurations at Supersonic Mach Number

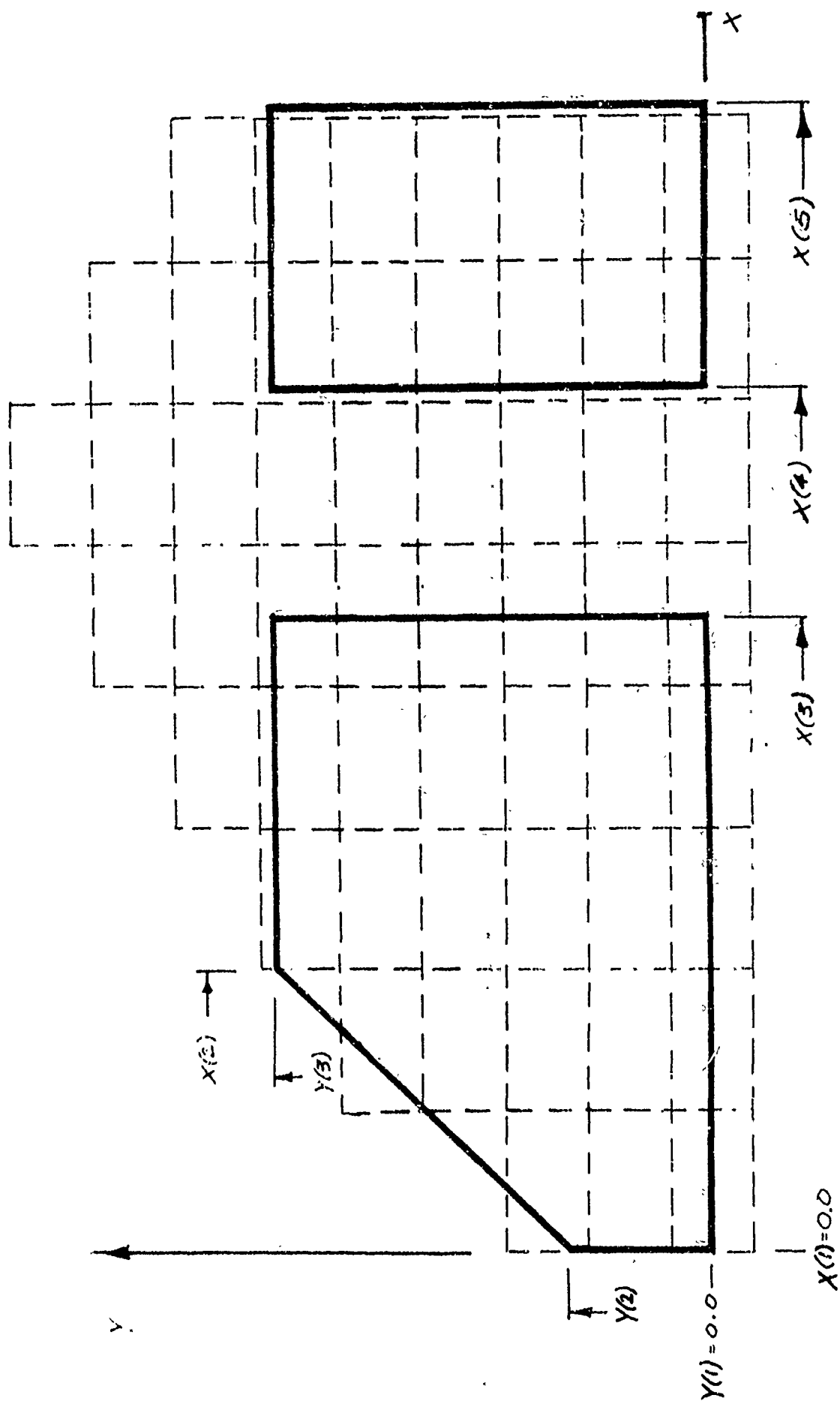


FIGURE 6.4 - GEOMETRIC DESCRIPTION AND SUPERSONIC BOX OVERLAY

The supersonic AIC computer program consists of a main program (DRIVE) and 20 subroutines and function subprogram. Execution begins with DRIVE calling DAIN which reads the input data. Control then passes to a Mach number loop where a check is made to insure $M \geq 1.1$. Subroutine CODE is called to approximate the surface and diaphragm regions with a Mach box overlay. The subroutine POUT is called and the input flight conditions, geometry and map of the Mach box overlay are printed. The AIC station locations are also printed if the option is exercised. Following POUT, a check is made to determine if the number of boxes on the wing and control surface does not exceed 45.

The subroutine TRAMP is called by DRIVE to generate the substantial derivative matrix $[W]$. The $[W]$ matrix relates the Mach boxes on the surface to the AIC control points and serves as a substantial derivative operator. Subroutines called by TRAMP are CMAT, SMAT, TMAT, BMAT, RMAT and MINV.

A frequency loop is entered and velocity potential influence coefficients are calculated by subroutine CAFI. The coefficients are dependent on relative position of the Mach boxes, Mach number and reduced frequency.

The velocity potential is computed next. The source strength of the surface boxes is determined by satisfying the tangential flow boundary condition and source strength of the diaphragm boxes is computed through satisfaction of the boundary condition requiring the velocity potential at the box centers be zero. Diaphragm boxes in the wake of the leading surface have their source strength computed through satisfaction of the condition that the velocity potential be equal to the value computed by the wake condition. Boxes intersected by a leading or side edge have their source strengths adjusted by a linear interpolation formula based on the portion of the box area actually on the surface. This adjustment is performed by function subprogram ARLE. The velocity potential at the box centers on the surfaces is computed by subroutine PHIB by summing the box contributions.

The velocity potentials are converted to pressure through a substantial derivative operator generated by SD2. Multiplying pressure by the box area yields the force at each box center on the surfaces. These forces are transferred to the AIC stations through static considerations, thereby forming the AIC matrix. This operation is performed by subroutine FORCE. The output subroutine POUT is called to print the AIC matrix.

1.0 PROCESSING REQUIREMENTS

The input and output files used by the program are 05 and 06, respectively. All read and write statements are contained in the main program (DRIVE) and subroutines DAIN and POUT. Peripheral tape and disc units are not used by the program. Approximately 40,000 cells of core storage is required.

A standard input form of six 12-column fields per card is used by the program. Floating point numbers (6E12.5 format) may be anywhere within the appropriate field, but fixed point numbers (6I12 format) must be right adjusted. Detailed instructions for data input are given and listings of data cards for sample problems are provided.

2.0 INPUT INSTRUCTIONS

Instructions for preparing input data for the supersonic AIC computer program are presented here. The field location and format for each quantity is specified. Any set of units may be used for geometric dimensions and acoustic velocity as long as they are consistent, e.g., if inches is used for length, then the acoustic velocity must have dimensions of inches per second. The required data and the sequence in which the information is entered is as follows:

1. Streamwise Coordinates (6E12.5 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	X(1)	X(2)	X(3)	X(4)	X(5)	
Item	(1)	(2)	(3)	(4)	(5)	

- (1) X(1) Wing root leading edge coordinate
- (2) X(2) Wing tip leading edge coordinate
- (3) X(3) Wing trailing edge coordinate
- (4) X(4) Control surface leading edge coordinate
- (5) X(5) Control surface trailing edge coordinate

A single surface, the wing, may be analyzed by setting X(4) and X(5) equal to X(3). The various configurations are generated as shown in Table 6.1. The origin for the planform and AIC station coordinates must be at the leading edge root of the wing, therefore X(1) and Y(1) described below, must always be zero.

2. Spanwise Coordinates and Acoustic Velocity (6E12.5 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	Y(1)	Y(2)	Y(3)	SOUND		
Item	(1)	(2)	(3)	(4)		

- (1) Y(1) Wing root spanwise coordinate
- (2) Y(2) Wing leading edge spanwise coordinate
- (3) Y(3) Wing (and control surface) tip spanwise coordinate
- (4) SOUND Speed of sound at altitude for which analysis is performed

TABLE 6.1 - OPTIONAL CONFIGURATIONS

CONFIGURATION	CHORDWISE COORDINATE	SPANWISE COORDINATE
RECTANGULAR	$X(1) = 0.0$ $X(2) = 0.0$ $X(3) > 0.0$ $X(4) \geq X(3)$ $X(5) \geq X(4)$	$Y(1) = 0.0$ $Y(2) = 0.0$ $Y(3) > 0.0$
DELTA	$X(1) = 0.0$ $X(2) > 0.0$ $X(3) = X(2)$ $X(4) \geq X(3)$ $X(5) \geq X(4)$	$Y(1) = 0.0$ $Y(2) = 0.0$ $Y(3) > 0.0$
TRAPEZOIDAL	$X(1) = 0.0$ $X(2) > 0.0$ $X(3) = X(2)$ $X(4) \geq X(3)$ $X(5) \geq X(4)$	$Y(1) = 0.0$ $Y(2) > 0.0$ $Y(3) > Y(2)$
TRAPEZOIDAL (CROPPED)	$X(1) = 0.0$ $X(2) > X(1)$ $X(3) > X(2)$ $X(4) \geq X(3)$ $X(5) \geq X(4)$	$Y(1) = 0.0$ $Y(2) > 0.0$ $Y(3) > Y(2)$
DELTA (CROPPED)	$X(1) = 0.0$ $X(2) > 0.0$ $X(3) > X(2)$ $X(4) \geq X(3)$ $X(5) \geq X(4)$	$Y(1) = 0.0$ $Y(2) = 0.0$ $Y(3) > Y(2)$

3. General Information (6112 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	NMACH	KF	NFREQ	NBW	LPUNCH	
Item	(1)	(2)	(3)	(4)	(5)	

(1) NMACH Number of Mach numbers (maximum 5)

(2) KF Option to input frequencies or reduced frequencies:

KF = 0 frequencies

KF = 1 reduced frequency

(3) NFREQ Number of frequencies or reduced frequencies at
each Mach number (maximum 10)

(4) NBW Number of chordwise boxes on wing

(5) LPUNCH Option to punch AICs on cards:

LPUNCH = 0 no punch output

LPUNCH = 1 punch AICs for wing only

LPUNCH = 2 punch AICs for control surface only

LPUNCH = 3 punch individual AIC matrix for
wing and control surface

LPUNCH = 4 punch total AIC matrix for wing-
control surface combination

The AIC matrices are punched by rows with a IP6El2.5 format. Each row of an AIC matrix begins on a new card.

4. Mach Numbers (6El2.5 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	FMACH(1)	FMACH(2)	FMACH(3)	FMACH(4)	FMACH(5)	FMACH(6)
Item	(1)	(2)	(3)	(4)	(5)	(6)

(1) FMACH (1) Mach number

(2) FMACH (2) Mach number

. .
.
.
.
(NMACH) FMACH (NMACH) Mach number

Enter NMACH value of Mach number (see Part 3, Item 1). Mach numbers must be greater than 1.1.

5. Frequencies (or Reduced Frequencies (6E12.5 format))

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	FREQ(1)	FREQ(2)	FREQ(3)	FREQ(4)	FREQ(5)	FREQ(6)
Item	(1)	(2)	(3)	(4)	(5)	(6)

Input NFREQ values of frequency or reduced frequency (see Part 3, Items 2 and 3). Reduced frequency is defined as $k_r = \frac{\omega b_r}{U}$ where b_r is the semi-chord of the wing root, U is the free stream velocity and ω is the oscillatory angular frequency in radians/sec.

(1) FREQ (1) frequency (cps) or k_r
 (2) FREQ (2) frequency (cps) or k_r
 . . .
 . . .
 (NFREQ) FREQ (NFREQ) frequency (cps) or k_r

If NFREQ > 6, continue input of FREQ (7) to FREQ (NFREQ) on new card.

6. Number of AIC Stations (6I12 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	NXWING	NYWING	NXCS	NYCS		
Item	(1)	(2)	(3)	(4)		

(1) NXWING Number of chordwise AIC collocation stations on wing
 (2) NYWING Number of spanwise AIC collocation stations on wing
 (3) NXCS Number of chordwise AIC collocation stations on control surface. Set equal to zero if analysis is for wing only
 (4) NYCS Number of spanwise AIC collocation stations on control surface. Set equal to zero if analysis is for wing only.

7. Spanwise Location of AIC Stations on Wing (6E12.5 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	YAIC(1,W)	YAIC(2,W)	YAIC(3,W)	YAIC(4,W)	YAIC(5,W)	YAIC(6,W)
Item	(1)	(2)	(3)	(4)	(5)	(6)

- (1) YAIC (1,W) Spanwise coordinate of first row of AIC
collocation stations on wing
- (2) YAIC (2,W) Spanwise coordinate of second row of AIC
collocation stations on wing
- . .
- . .
- . .
- (NYWING) YAIC (NYWING, W) Spanwise coordinate of last row of AIC
collocation stations on wing

AIC station rows are numbered from root to tip of surface. If
NYWING > 6, continue input on new card(s).

8. Spanwise Location of AIC Stations on Control Surface (6E12.5 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	YAIC(1,CS)	YAIC(2,CS)	YAIC(3,CS)	YAIC(4,CS)	YAIC(5,CS)	YAIC(6,CS)
Item	(1)	(2)	(3)	(4)	(5)	(6)

- (1) YAIC (1,CS) Spanwise coordinate for first row of AIC
collocation stations on control surface
- (2) YAIC (2,CS) Spanwise coordinate of second row of AIC
collocation stations on control surface
- . .
- . .
- . .
- (NYCS) YAIC (NYCS, CS) Spanwise coordinate of last row of AIC
collocation stations on control surface

Omit this input if only the wing is analyzed. For NYCS > 6, continue
input on new card(s). AIC station rows are numbered from root to tip
of surface.

9. Chordwise Location of AIC Stations on Wing (6E12.5 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	XAIC(W,1,1)	XAIC(W,1,2)	XAIC(W,1,3)	...	...	...
Item	(1)	(2)	(3)	(4)	(5)	(6)

- (1) XAIC (W,1,1) Streamwise coordinate of first AIC collocation station in first row on wing
- (2) XAIC (W,1,2) Streamwise coordinate of second AIC collocation station in first row on wing
- : :
- : :
- : :
- (NXWING) XAIC(W, NYWING, NXWING) Streamwise coordinate of last AIC collocation station in last row on wing

Streamwise numbering sequence is from leading edge to trailing edge (see Figure 6.3). Continue input of values for each row immediately after the last value of the preceeding row; do not begin input of each row on new card.

10. Chordwise Location of AIC Stations on Control Surface (6E12.5 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	XAIC(CS,1,1)	XAIC(CS,1,2)	XAIC(CS,1,3)	...	...	...
Item	(1)	(2)	(3)	(4)	(5)	(6)

Procedure to input streamwise coordinate location of AIC stations on control surface is the same as wing above. Omit this input if only wing is analyzed.

3.0 SAMPLE PROBLEMS

Three sample problems are presented to demonstrate the use of the supersonic AIC computer program. Configurations analyzed include a trapezoidal wing-rectangular control surface combination, a cropped trapezoidal wing and a delta wing. Description of input parameters and complete listing of input data cards and computer output are given with each sample problem.

Sample Problem 1.

Supersonic AICs are computed for a trapezoidal wing and rectangular control surface. The planform geometry and AIC stations are shown in Figure 6.5. The dimensional unit used for length is feet, therefore the acoustic velocity is entered as ft/sec. The analysis is for $M = 1.5$, $k_r = 0.10$ and $a = 1116.87$ ft/sec (sea level). Four chordwise boxes are used for the wing. The resulting box overlay has 15 boxes on the wing and 8 on the control surface, thereby satisfying the 45 box limitation. Also, there are 13 diaphragm boxes in the gap and outboard region. Input parameters are summarized below and a listing of the input data cards and computer output follows.

$X(1) = 0.0'$	$X(2) = 1.0'$	$X(3) = 2.0'$	$X(4) = 3.0'$	$X(5) = 4.0'$
$Y(1) = 0.0'$	$Y(2) = 1.0'$	$Y(3) = 2.0'$		
SOUND = 1116.87 ft/sec		Acoustic velocity (sea level)		
MMACH = 1		Number of Mach numbers		
KF = 1		Input reduced frequency		
NFREQ = 1		Number of reduced frequencies		
NBW = 4		Number of chordwise boxes on wing		
LPUNCH = 4		Punch combined wing-control surface AIC matrix on cards		
FMACH (1) = 1.5		Mach number		
FREQ (1) = 0.10		Reduced frequency		
NXWING = 4		Number of chordwise AIC stations on wing		
NYWING = 4		Number of spanwise AIC stations on wing		
NXCS = 2		Number of chordwise AIC stations on control surface		
NYCS = 3		Number of spanwise AIC stations on control surface		

$$YAIC(1,W) = 0.2'$$

$$YAIC(4,W) = 1.8'$$

$$YAIC(2,W) = 0.7'$$

$$YAIC(3,W) = 1.3'$$

$$YAIC(1,CS) = .3'$$

$$YAIC(2,CS) = 1.0'$$

$$YAIC(3,CS) = 1.7'$$

$$XAIC(1,1,W) = 0.10'$$

$$XAIC(1,4,W) = 1.90'$$

$$XAIC(2,1,W) = 0.10'$$

$$XAIC(2,4,W) = 1.90'$$

$$XAIC(3,1,W) = 0.38'$$

$$XAIC(3,4,W) = 1.915'$$

$$XAIC(4,1,W) = 0.86'$$

$$XAIC(4,4,W) = 1.94'$$

$$XAIC(1,2,W) = 0.70'$$

$$XAIC(2,2,W) = 0.70'$$

$$XAIC(3,2,W) = 0.90'$$

$$XAIC(4,2,W) = 1.22'$$

$$XAIC(1,3,W) = 1.30'$$

$$XAIC(2,3,W) = 1.30'$$

$$XAIC(3,3,W) = 1.405'$$

$$XAIC(4,3,W) = 1.58'$$

$$XAIC(1,1,CS) = 3.25'$$

$$XAIC(2,1,CS) = 3.25'$$

$$XAIC(3,1,CS) = 3.25'$$

$$XAIC(1,2,CS) = 3.75'$$

$$XAIC(2,2,CS) = 3.75'$$

$$XAIC(3,2,CS) = 3.75'$$

$$YAIC(1,W) = 0.2'$$

$$YAIC(4,W) = 1.8'$$

$$YAIC(2,W) = 0.7'$$

$$YAIC(3,W) = 1.3'$$

$$YAIC(1,CS) = .3'$$

$$YAIC(2,CS) = 1.0'$$

$$YAIC(3,CS) = 1.7'$$

$$XAIC(1,1,W) = 0.10'$$

$$XAIC(1,4,W) = 1.90'$$

$$XAIC(2,1,W) = 0.10'$$

$$XAIC(2,4,W) = 1.90'$$

$$XAIC(3,1,W) = 0.38'$$

$$XAIC(3,4,W) = 1.915'$$

$$XAIC(4,1,W) = 0.86'$$

$$XAIC(4,4,W) = 1.94'$$

$$XAIC(1,2,W) = 0.70'$$

$$XAIC(2,2,W) = 0.70'$$

$$XAIC(3,2,W) = 0.90'$$

$$XAIC(4,2,W) = 1.22'$$

$$XAIC(1,3,W) = 1.20'$$

$$XAIC(2,3,W) = 1.30'$$

$$XAIC(3,3,W) = 1.405'$$

$$XAIC(4,3,W) = 1.58'$$

$$XAIC(1,1,CS) = 3.25'$$

$$XAIC(2,1,CS) = 3.25'$$

$$XAIC(3,1,CS) = 3.25'$$

$$XAIC(1,2,CS) = 3.75'$$

$$XAIC(2,2,CS) = 3.75'$$

$$XAIC(3,2,CS) = 3.75'$$

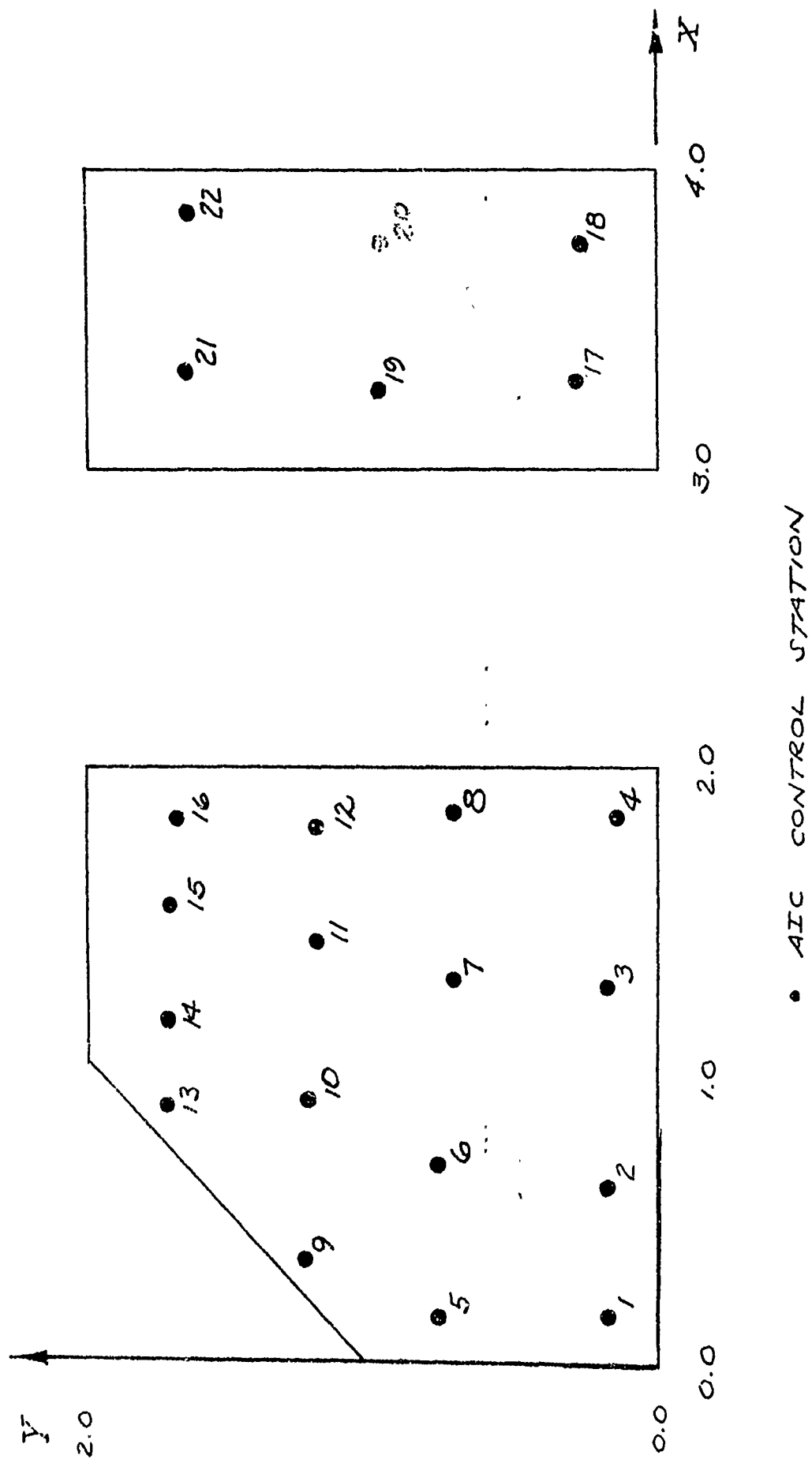


FIGURE 6.5 - SUPERSONIC SAMPLE PROBLEM 1.

```

*****
***** DATA CARD COLUMN NUMBER *****
*****
1111111111222222222233333333334444444444555555555566666666667777777778
123456789012345678901234567890123456789012345678901234567890
*****

```

```

0.0      1.0      2.0      3.0      4.0
0.0      1.0      2.0      1116.87      4
1.5      1      1
0.1      4      2      3
0.20     0.70     1.30     1.80
0.30     1.00     1.70
0.100    0.700    1.300
1.300    1.900    0.380    0.100
9.860    1.220    1.580    1.405
3.250    3.750    3.250    3.750
                                Y-WING
                                Y-TAIL
                                X-WING
                                X-WING
                                X-WING
                                X-TAIL

```

```

*****
***** DATA CARD COLUMN NUMBER *****
*****
1111111111222222222233333333334444444444555555555566666666667777777778
123456789012345678901234567890123456789012345678901234567890
*****

```

FIGURE 6.6 -- LISTING OF INPUT DATA CARDS FOR SUPERSONIC PROBLEM 1.

HUGHES AIRCRAFT CO. SUPERSONIC AIC PROGRAM

FLIGHT CONDITIONS AND GEOMETRY

MACH NUMBER = 1.50000 SPEED OF SOUND = 1116.870 L/T $\rho/\rho_0 = 1.00$

	WING	TAIL
L.E. STATION (L)	0.	3.000
ROOT CHORD (L)	2.000	1.000
L.E. SPAN (L)	1.000	2.000
T.E. SPAN (L)	2.000	2.000
TIP CHORD (L)	1.000	1.000
TOTAL AREA (L ²)	7.000	4.000
CHORDWISE BOXES	4	2
SPANWISE BOXES	4	4

TOTAL CHORDWISE BOXES = 7 BOX CHORD = 5.71428E-01 L BOX SPAN = 5.11101E-01 L

HUGHES AIRCRAFT CO. SUPERSONIC AIC PROGRAM (CONT'D)

HAP OF MACH BOX OVERLAY ON	SSS
WING, TAIL, AND DIAPHRAGM	SSSS
(S) - WING	SSSS.
(S) - TAIL	SSSS..
(.) - WAKE	
(.) - DIAPHRAGM	SSSS..
	SSSS.

AIC COLLOCATION STATION COORDINATES ON THE WING

YAIC	XAIC VALUES--		
0.200000E 00	0.100000E 00	0.700000E 00	0.130000E 01
0.700000E 00	0.100000E 00	0.700000E 00	0.130000E 01
0.130000E 01	0.380000E 00	0.900000E 00	0.140500E 01
0.180000E 01	0.850000E 00	0.122000E 01	0.158000E 01

HUGHES AIRCRAFT CO. SUPERSONIC AIC PROGRAM (CONT-D)

AIC COLLOCATION SECTION COORDINATES ON THE TAIL

YAIC	XAIC VALUES--	
0.390000E 01	0.325000E 01	0.375000F 01
0.100000E 01	0.325000E 01	0.375000E 01
0.170000E 01	0.325000E 01	0.375000F 01

HUGHES AIRCRAFT CO. SUPERSONIC AIC PROGRAM (CONT-D)

OSCILLATORY FREQUENCY (CPS) 2.66633E 01

REFERENCE CHORD 1.00000E 00

REDUCED FREQUENCY (REF. CHORD) 1.00000E-01

REDUCED VELOCITY (REF. CHORD) 1.00000E 01

FREE STREAM MACH NUMBER 1.50000E 00

FREE STREAM VELOCITY 1.67530E 03

DENSITY 1.00

DYNAMIC PRESSURE (1/2*RH0*VEL**2) 1.40332E 06

AERODYNAMIC INFLUENCE COEFFICIENTS

	R _L	IM	RL	IM	RL	IM	RL	IM
ROW = 1								
1.8526E 01	-2.1350E 00	-7.4711E 00	1.1749E 00	-1.7022E 01	-5.3347E-01	5.9082E 00	6.5727E-02	8.5079E 00
1.7824E 01	8.0830E-01	1.1737E 01	-4.5722E-01	-2.4169E 00	8.6140E-02	1.7266E 00	7.9486E-02	-6.8265E-01
-1.6490E 00	7.9419E-03	6.1367E-01	5.2591E-03	-1.3993E-01	-3.4482E-02	3.4869E-04	4.6109E-02	2.2277E-01
-8.5426E-02	-1.1001E-03	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.
ROW = 2								
4.2209E 00	-3.7703E-01	1.7189E 01	-7.4886E-01	-2.1317E 01	-4.7041E-01	-1.2466E-01	4.8262E-02	1.1807E 01
-1.5303E 01	9.1834E-01	3.0776E 00	1.8774E-01	3.4872E-01	-4.2794E-02	3.2466E 00	-5.2381E-01	-1.1039E 00
-2.1352E 00	-1.4747E-01	-2.9927E-02	1.2573E-02	-5.1404E-01	8.7424E-02	2.0671E-01	-5.5793E-02	3.0762E-01
3.4794E-03	-1.5341E-03	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.
ROW = 3								
-1.2637E 01	1.4622E 00	1.7835E 01	-9.8145E-01	1.6454E 01	-1.0673E 00	-2.1619E 01	-2.5826E-01	5.1414E 00
3.8143E 00	-4.8789E-01	-1.1642E 01	6.4721E-01	2.5698E 00	1.8758E-01	3.4387E 00	-9.5692E-01	-8.6434E-01
9.8238E-02	1.1292E-01	-2.7424E 00	-3.0093E-02	5.9097E-02	8.5600E-03	-3.6956E-01	3.1835E-02	-7.7395E-02
3.9197E-01	2.2609E-03	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.
ROW = 4								
-2.6279E 00	1.0374E 00	-2.4266E 01	7.1643E-03	6.2085E 01	-3.6780E-01	-3.5132E 01	-1.0056E 00	-5.1481E 00
1.6028E 01	-1.9470E 00	-1.0770E 01	3.7016E-01	-1.7884E-01	4.9600E-01	1.7865E 00	-5.0265E-01	-8.9012E-02
2.9135E 00	7.6823E-01	-4.6846E 00	-1.6069E-01	1.3096E 00	-2.3903E-01	-1.4007E 00	2.6910E-01	-5.8988E-01
6.7650E-01	1.7474E-02	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.
ROW = 5								
1.7100E 01	-1.4548E 00	-2.4655E 01	1.4477E 00	8.4535E 00	-7.5430E-01	-9.1659E-01	1.2872E-01	3.5176E 00
1.1602E 01	-4.9408E-01	-2.1321E 01	1.5970E-01	5.9850E 00	-4.1859E-02	7.7272E 00	-9.2137E-01	-0.0645E 00
8.8348E-01	-5.0032E-01	4.5573E-01	8.4067E-02	-2.4249E 00	2.6727E-01	-2.6694E 00	-1.0295E-01	-4.9678E-02
-1.3434E-01	-2.4436E-03	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	0.	0.	0.

ROW = 6	1.5732E-01	-1.9826E-00	1.2553E-01	8.0769E-01	-3.6703E-01	9.3080E-02	3.9372E-01	-3.6218E-02	-4.2715E-00	5.1245E-01
	2.0987E-01	-7.6767E-01	-1.6261E-01	-5.9617E-01	-4.3771E-01	8.1209E-02	-6.6609E-00	-6.4227E-01	-1.7456E-00	-3.3327E-02
	-5.1798E-00	4.2693E-02	2.3174E-01	-2.2418E-02	-9.6993E-02	3.9113E-03	-6.1797E-01	5.0061E-02	7.0449E-01	6.4920E-03
	1.2207E-02	-2.6306E-03	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ROW = 7	1.3620E-00	-6.1080E-01	1.1198E-01	-1.0407E-00	-8.4425E-00	4.2144E-01	-4.2394E-00	1.3789E-01	-6.3402E-00	1.5882E-01
	1.3823E-00	8.1771E-01	1.9651E-01	-1.1136E-00	-1.6786E-01	-3.3654E-01	2.5881E-00	-4.4518E-01	4.9280E-00	-3.5974E-01
	-1.3823E-00	-3.7827E-02	-5.6935E-00	7.4561E-02	-2.3126E-00	-2.7173E-01	-2.0918E-00	9.2178E-02	-7.6411E-01	8.9193E-02
	5.3114E-01	1.7651E-02	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ROW = 8	7.3730E-00	1.3901E-00	1.0845E-01	-2.3873E-00	8.6800E-00	2.4134E-01	-1.2200E-01	2.6576E-01	5.2127E-00	-1.1891E-00
	-2.7986E-01	1.7542E-00	4.6272E-01	2.1651E-01	-2.3530E-01	-1.1663E-00	1.2151E-00	-8.3385E-01	-2.4266E-00	5.7816E-01
	1.3330E-01	-4.5693E-01	-1.2192E-01	1.0603E-01	5.0321E-01	-2.3364E-01	2.4774E-00	-5.0119E-02	-3.8577E-00	1.2494E-01
	8.5890E-01	5.1899E-02	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ROW = 9	-2.8884E-00	1.1679E-00	1.6734E-00	-1.3424E-00	1.8203E-00	2.0160E-01	-5.5214E-01	-1.0224E-02	2.0606E-01	-3.0743E-00
	-2.0241E-01	2.6356E-00	-2.2724E-00	-7.9483E-01	1.8068E-00	8.4478E-02	7.1084E-00	1.0132E-00	2.2934E-01	-1.5651E-00
	-2.0626E-01	3.3247E-01	4.8277E-00	-4.5569E-02	-1.5794E-00	1.1640E-01	8.1475E-01	6.8349E-02	1.1543E-00	-1.1374E-01
	-3.8423E-01	2.9035E-02	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ROW = 10	-5.1967E-00	-4.3124E-01	-7.4376E-00	5.3458E-01	2.2566E-00	-3.2124E-01	-1.4332E-02	4.6689E-02	8.8063E-00	-2.2514E-00
	-3.3797E-00	1.3629E-00	-5.3979E-00	1.3482E-01	-1.4762E-01	-1.7592E-01	-4.3915E-00	-2.8525E-01	4.6287E-01	-1.2780E-00
	-5.1685E-01	3.4108E-01	9.7477E-00	-1.2215E-01	9.1662E-01	-4.7758E-01	8.6125E-00	3.9927E-01	-1.2822E-01	-3.0039E-01
	3.2801E-00	7.6775E-02	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ROW = 11	1.2129E-01	-3.2884E-00	-9.2228E-00	1.9974E-00	-3.6600E-00	4.0965E-01	5.5196E-01	2.3562E-03	-8.8456E-00	1.6449E-00
	1.5040E-01	-1.2656E-00	-3.1946E-01	-3.2553E-03	-5.8505E-00	9.0000E-02	-6.9172E-00	8.9534E-01	8.5671E-00	-4.9192E-01
	2.6525E-01	-1.4469E-00	-2.8168E-01	-4.9391E-02	-8.9305E-01	1.7874E-01	1.8338E-00	-1.5733E-01	5.2769E-00	-2.8839E-01
	-6.2179E-00	5.1444E-03	0.	0.	0.	0.	0.	0.	0.	0.
	0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
ROW = 12	3.8515E-00	-1.9871E-00	3.9377E-00	3.1948E-01	-8.5645E-00	1.0438E-00	5.9798E-01	-4.9431E-02	-2.7188E-00	1.0964E-00
	-3.6064E-00	-6.0563E-01	1.5506E-01	-6.2899E-01	-9.1398E-00	-1.2535E-01	-1.0320E-01	1.6344E-00	-9.	

[illegible]

Sample Problem 2.

A cropped trapezoidal wing is analyzed at $M = 2.0$, $k_r = 0.10$ and $a = 1116.87$ ft/sec (sea level). The trailing surface is removed from the analysis by setting $X(5) = X(4) = X(3)$. The wing geometry and AIC stations are shown in Figure 6.7. Five chordwise boxes were specified. The resulting overlay has 32 boxes on the wing and 2 diaphragm boxes. Input information is summarized below and a listing of the input data cards and computer output follows.

$X(1) = 0.0'$ $X(2) = 1.0'$ $X(3) = 2.0'$ $X(4) = 2.0'$ $X(5) = 2.0'$
 $Y(1) = 0.0'$ $Y(2) = 1.0'$ $Y(3) = 2.0'$

SOUND = 1116.87 ft/sec	Acoustic velocity (sea level)
NMACH = 1	Number of Mach numbers
KF = 1	Input reduced frequency
NFREQ = 1	Number of reduced frequencies
NBW = 5	Number of chordwise boxes on wing
LPUNCH = 0	Do not punch AIC matrix on cards
FMACH (1) = 2.0	Mach number
FREQ (1) = 0.10	Reduced frequency
NXWING = 3	Number of chordwise AIC stations on wing
NYWING = 5	Number of spanwise AIC stations on wing
NXCS = 0	Number of chordwise AIC stations on control surface
NYCS = 0	Number of spanwise AIC stations on control surface

$YAIC(1,W) = 0.20'$	$YAIC(2,W) = 0.60'$	$YAIC(3,W) = 1.00'$
$YAIC(4,W) = 1.40'$	$YAIC(5,W) = 1.80'$	
$XAIC(1,1,W) = 0.575'$	$XAIC(1,2,W) = 1.050'$	$XAIC(1,3,W) = 1.525'$
$XAIC(2,1,W) = 0.725'$	$XAIC(2,2,W) = 1.150'$	$XAIC(2,3,W) = 1.575'$
$XAIC(3,1,W) = 0.875'$	$XAIC(3,2,W) = 1.250'$	$XAIC(3,3,W) = 1.625'$
$XAIC(4,1,W) = 1.025'$	$XAIC(4,2,W) = 1.350'$	$XAIC(4,3,W) = 1.675'$
$XAIC(5,1,W) = 1.175'$	$XAIC(5,2,W) = 1.450'$	$XAIC(5,3,W) = 1.725'$

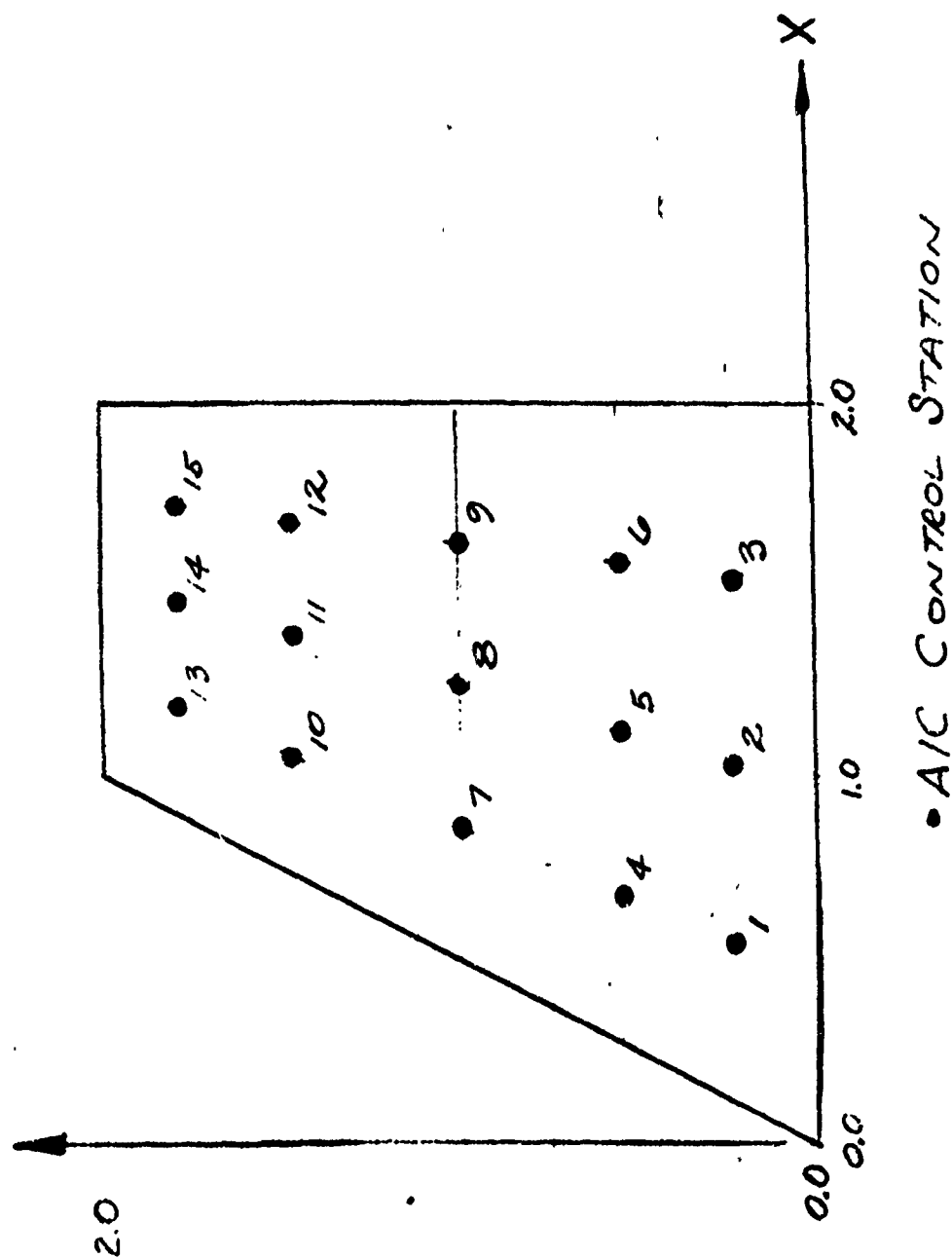


FIGURE 6.7 SUPERSONIC SAMPLE PROBLEM 2

[illegible][illegible][illegible]

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HUGHES AIRCRAFT CO. SUPERSONIC AIC PROGRAM

FLIGHT CONDITIONS AND GEOMETRY

MACH NUMBER = 2.00000 SPEED OF SOUND = 1116.870 L/T RHO = 1.00

	WING	TAIL
L.E. STATION (L)	0.	2.000
ROOT CHORD (L)	2.000	0.
L.E. SPAN (L)	0.	2.000
T.E. SPAN (L)	2.000	2.000
TIP CHORD (L)	1.000	0.
TOTAL AREA (L ² L)	6.000	0.
CHORDWISE BOXES	5	0
SPANWISE BOXES	8	8

TOTAL CHORDWISE BOXES = 5 BOX CHORD = 4.4444E-01 L BOX SPAN = 2.56600E-01 L

HUGHES AIRCRAFT CO, SUPERSONIC AIC PROGRAM (CONT-D)

MAP OF MACH BOX OVERLAY ON
WING, TAIL, AND DIAPHRAGM
(S) - WING
(S) - TAIL
(.) - WAKE
SS
SSSSSS
SSSSSSSS.
SSSSSSSS.
SSSSSSSS

HUGHES AIRCRAFT CO. SUPERSONIC AIC PROGRAM (CONT-D)

AIC COLLOCATION STATION COORDINATES ON THE WING

YAIC	YAIC VALUES--		
0.20000E 00	0.57500E 00	0.10500E 01	0.15250E 01
0.60000E 00	0.72500E 00	0.11500E 01	0.15750E 01
0.10000E 01	0.87500E 00	0.12500E 01	0.16250E 01
0.14000E 01	0.10250E 01	0.13500E 01	0.16750E 01
0.18000E 01	0.11750E 01	0.14500E 01	0.17250E 01

HUGHES AIRCRAFT CO. SUPERSONIC AIC PROGRAM (CONT'D)

OSCILLATORY FREQUENCY (CPS) 3.55511E 01
REFERENCE CHORD 1.00000E 00
REDUCED FREQUENCY (REF. CHORD) 1.00000E-01
REDUCED VELOCITY (REF. CHORD) 1.00000E 01
FREE STREAM MACH NUMBER 2.00000E 00
FREE STREAM VELOCITY 2.23374E 03
DENSITY 1.00
DYNAMIC PRESSURE (1/2* ρ *V²) 2.49480E 06

AERODYNAMIC INFLUENCE COEFFICIENTS

RL	IM	RL	IM	RL	IM	RL	IM
ROW = 1							
8.2860E 01	-4.5122E 00	-1.2642E 02	4.0978E 01	-1.5152E 00	-3.9196E 01	3.1016E 00	5.9121E 01
-1.9901E 01	1.1306E 00	1.5757E 01	-1.2014E 00	1.2691E 00	8.1718E 00	-4.4785E-01	-2.4720E 00
3.7527E 00	-1.8728E-01	-1.2797E 00	6.6115E-02	2.4598E-01	-1.4841E-02	-3.7253E-01	1.3461E-02
ROW = 2							
2.6648E 01	-1.0626E 00	-3.1793E 01	6.4230E-01	5.1599E 00	-6.2222E-01	1.0975E 00	4.7470E-01
4.9119E 00	1.0759E-01	-9.5343E-01	2.0185E-01	3.0098E 00	-3.6046E-01	-2.0535E 00	9.0601E-02
-2.6594E-01	1.5682E-02	2.5425E-01	-5.4586E-05	8.1137E-02	-1.7226E-02	-9.6611E-02	2.2557E-02
ROW = 3							
-1.0319E 01	8.2589E-01	4.2487E 01	-4.2077E-01	-3.2107E 01	-1.4610E 00	3.9416E 01	-3.2900E 00
2.9249E 01	-1.8321E 00	-1.6221E 01	4.2059E 00	2.6893E 01	-5.6525E 00	-1.0593E 01	1.6383E 00
-6.9687E 00	1.4718E 00	2.6342E 00	-4.5779E-01	-1.3972E 00	3.3746E-01	2.1875E 00	-4.7069E-01
ROW = 4							
7.6467E 00	-9.0918E-01	-1.9466E 01	1.6968E 00	7.6242E 00	-7.8776E-01	2.6544E 01	-1.1990E 00
4.1258E 00	1.0679E-01	1.3691E 01	-7.7754E-01	-2.2820E 01	1.0676E 00	9.1347E 00	-4.4928E-01
7.0563E 00	-5.1117E-01	-2.8145E 00	2.0255E-01	6.6430E-01	-5.2861E-02	-1.4423E 00	7.0459E-02
ROW = 5							
1.0078E 01	-1.6108E 00	-1.2765E 01	1.9001E 00	2.6903E 00	-5.5055E-01	-8.5560E 00	1.7209E 00
-1.5403E 01	4.8785E-01	1.3034E 01	-1.4058E 00	-1.6791E 01	1.5384E 00	3.7333E 00	-4.9435E-01
1.3913E 00	-6.4131E-03	4.0722E-02	-1.8297E-02	7.7461E-01	-7.5140E-02	-1.0188E 00	7.6932E-02
ROW = 6							
-9.0771E-01	-1.0041E-01	1.5116E 01	-1.2715E 00	-1.4266E 01	7.2570E-01	-3.7901E 01	9.1132E-01
-3.9178E 01	-2.2332E 00	-4.9504E 00	2.6633E-01	2.3455E 01	-1.3584E 00	-1.6834E 01	5.4470E-01
-1.4808E 01	1.6362E 00	6.7824E 00	-6.0903E-01	-7.8634E-01	1.2896E-01	2.0766E 00	-2.4028E-01
ROW = 7							
-7.3981E-01	-1.3193E-01	1.7204E 00	-1.9439E-02	-1.0003E 00	1.1761E-01	-3.5070E 00	1.0428E 00
1.2801E 00	3.6117E-02	4.9956E 01	-2.9696E 00	-5.9050E 01	1.5585E 00	1.4070E 01	-5.5225E-01
-4.0000E 00	-7.6821E-01	4.0516E 00	-2.9441E-01	-1.6992E 00	-3.7946E-02	-1.8284E-00	-3.1328E-02
ROW = 8							
-7.3981E-01	-1.3193E-01	1.7204E 00	-1.9439E-02	-1.0003E 00	1.1761E-01	-3.5070E 00	1.0428E 00
1.2801E 00	3.6117E-02	4.9956E 01	-2.9696E 00	-5.9050E 01	1.5585E 00	1.4070E 01	-5.5225E-01
-4.0000E 00	-7.6821E-01	4.0516E 00	-2.9441E-01	-1.6992E 00	-3.7946E-02	-1.8284E-00	-3.1328E-02

ROW = 8	1.3463E 00	-4.1179E-01	-2.9841E 00	7.7756E-01	1.6307E 00	-3.4905E-01	4.8076E 00	-5.4211E-01	-4.6561E 00	3.2834E-01
	-1.7116E-01	-9.5724E-03	-4.6664E 00	9.0596E-01	2.0278E 01	-1.4472E 00	-1.5597E 01	1.3910E-01	6.0076E 00	-4.9008E-01
	-9.6039E 00	4.8225E-01	3.5874E 00	-6.5007E-02	-5.4068E-01	6.6484E-02	1.6391E 00	-9.4963E-02	-1.0974E 00	7.9663E-03
ROW = 9	1.2453E 01	-3.0610E 00	-1.7128E 01	3.8544E 00	4.6039E 00	-1.1756E 00	-5.5658E 00	1.3376E 00	1.6720E 01	-2.5245E 00
	-1.1152E 01	9.6065E-01	-4.7184E 01	1.1026E 00	1.0116E 02	4.3355E-01	-5.6536E 01	-1.9092E 00	9.9536E 00	-5.0010E-01
	-1.0645E 01	-3.2871E-01	6.6407E-01	5.4669E-01	3.2013E-01	-3.5068E-01	1.7928E 00	5.4742E-01	-2.1151E 00	-2.7173E-01
ROW = 10	4.3502E 00	-5.7173E-01	-5.8496E 00	6.1172E-01	1.4878E 00	-1.6921E-01	-1.6510E 01	1.8200E 00	2.4259E 01	-2.2132E 00
	-7.7233E 00	7.4115E-01	3.2814E 01	-2.6862E 00	-5.0745E 01	3.3371E 00	1.7714E 01	-1.2254E 00	9.1334E 00	7.9664E-01
	-3.9528E 00	-1.8736E 00	-5.1726E 00	6.1488E-01	1.0502E 01	-7.7011E-01	-1.6618E 01	1.0229E 00	6.1116E 00	-3.8930E-01
ROW = 11	1.4089E 00	-2.7444E-01	-1.7376E 00	2.8224E-01	3.2027E-01	-6.2748E-02	-1.2443E 00	1.8094E-01	1.0949E 00	-1.2832E-01
	1.5627E-01	1.2526E-02	5.3944E 00	-5.6027E-01	-4.5372E 00	4.1980E-01	-8.7377E-01	-1.0317E-01	-4.1597E 00	4.2889E-01
	1.6918E 01	-6.4243E-01	-1.2751E 01	-5.2439E-02	6.8391E 00	-5.1972E-01	-8.4363E 00	5.3208E-01	1.5904E 00	-1.6374E-01
ROW = 12	-4.2925E-01	-7.4189E-02	-4.0911E-01	4.0326E-01	8.4808E-01	-2.6767E-01	9.5629E 00	-1.6658E 00	-1.4331E 01	1.9907E 00
	4.7321E 00	-5.3532E-01	-7.7062E 00	8.4641E-01	2.4004E 01	-1.8206E 00	-1.6507E 01	6.6266E-01	-3.5878E 01	6.2599E-01
	8.1322E 01	4.9875E-01	-4.5419E 01	-1.4175E 00	6.6535E 00	-1.1056E 00	-4.9092E-01	1.0513E 00	-6.1849E 00	-3.0807E-01
ROW = 13	-3.5710E 00	2.5335E-01	-7.7648E 00	1.4075E 00	1.1404E 01	-9.1186E-01	2.4742E 00	-4.8814E-01	5.4340E 00	-5.7632E-01
	-7.8653E 00	5.3625E-01	-1.9234E 01	2.5766E 00	1.6146E 01	-2.7483E 00	-1.6444E 00	6.8874E-01	3.2566E 01	-3.1566E 00
	-4.7524E 01	3.9586E 00	1.4923E 01	-1.3763E 00	4.3377E 01	-2.2437E 00	-5.4863E 01	1.9480E 00	1.1461E 01	-5.8667E-01
ROW = 14	1.9916E-01	-2.3901E-01	-3.4365E 00	6.7248E-01	3.2440E 00	-2.7910E-01	-2.4803E 00	6.6302E-01	6.1036E 00	-1.1614E 00
	-3.6209E 00	4.2679E-01	3.3118E 00	-6.8924E-01	-6.5568E 00	1.0454E 00	3.2883E 00	-3.4629E-01	1.8442E 00	-1.8229E-02
	3.6267E 00	-3.3586E-01	-5.4774E 00	1.2053E-01	-1.2027E 01	8.7354E-01	3.1631E 01	-1.0362E 00	-1.9551E 01	-4.8667E-02
ROW = 15	2.2454E 00	-5.7706E-01	-3.8351E 00	8.5636E-01	1.5819E 00	-3.0787E-01	-6.8436E 00	1.5889E 00	1.1038E 01	-2.2217E 00
	-4.1598E 00	7.3725E-01	1.4633E 01	-2.3999E 00	-2.2895E 01	3.1263E 00	8.2255E 00	-9.6423E-01	-1.2193E 01	8.7097E-01
	3.1987E 01	-1.5442E 00	-1.9755E 01	4.2893E-01	-4.8770E 01	1.6843E 00	9.8550E 01	-9.3946E-01	-4.9750E 01	-7.7787E-01

Sample Problem 3.

A 45° delta wing is analyzed at $M = 2.0$, $f = 5.5$ cps and $a = 1116.87$ ft/sec (sea level). The trailing surface is removed from the analysis by setting $X(5) = X(4) = X(3)$. The wing geometry and AIC station locations are shown in Figure 6.9. Six boxes were specified along wing root. The Mach box overlay has 34 boxes. Input parameters are summarized below and a listing of the input data cards and computer output follows.

$X(1) = 0.0'$	$X(2) = 2.0'$	$X(3) = 2.0'$	$X(4) = 2.0'$	$X(5) = 2.0'$
$Y(1) = 0.0'$	$Y(2) = 0.0'$	$Y(3) = 2.0'$		

SOUND = 1116.87 ft/sec	Acoustic velocity (sea level)
NMACH = 1	Number of Mach numbers
KF = 0	Input frequency
NFREQ = 1	Number of frequencies
NEW = 6	Number of chordwise boxes on wing
LPUNCH = 1	Punch AIC matrix for wing on cards
FMACH (1) = 2.0	Mach number
FREQ (1) = 5.5	Frequency (cps)
NXWING = 3	Number of chordwise AIC stations on wing
NYWING = 4	Number of spanwise AIC stations on wing
NXCS = 0	Number of chordwise AIC stations on control surface
NYCS = 0	Number of spanwise AIC stations on control surface

$YAIC(1,W) = 0.2'$	$YAIC(2,W) = 0.6'$	$YAIC(3,W) = 1.0'$
$YAIC(4,W) = 1.4'$		

$XAIC(1,1,W) = 0.560'$	$XAIC(1,2,W) = 1.100'$	$XAIC(1,3,W) = 1.640'$
$XAIC(2,1,W) = 0.880'$	$XAIC(2,2,W) = 1.300'$	$XAIC(2,3,W) = 1.720'$
$XAIC(3,1,W) = 1.200'$	$XAIC(3,2,W) = 1.500'$	$XAIC(3,3,W) = 1.800'$
$XAIC(4,1,W) = 1.520'$	$XAIC(4,2,W) = 1.700'$	$XAIC(4,3,W) = 1.880'$

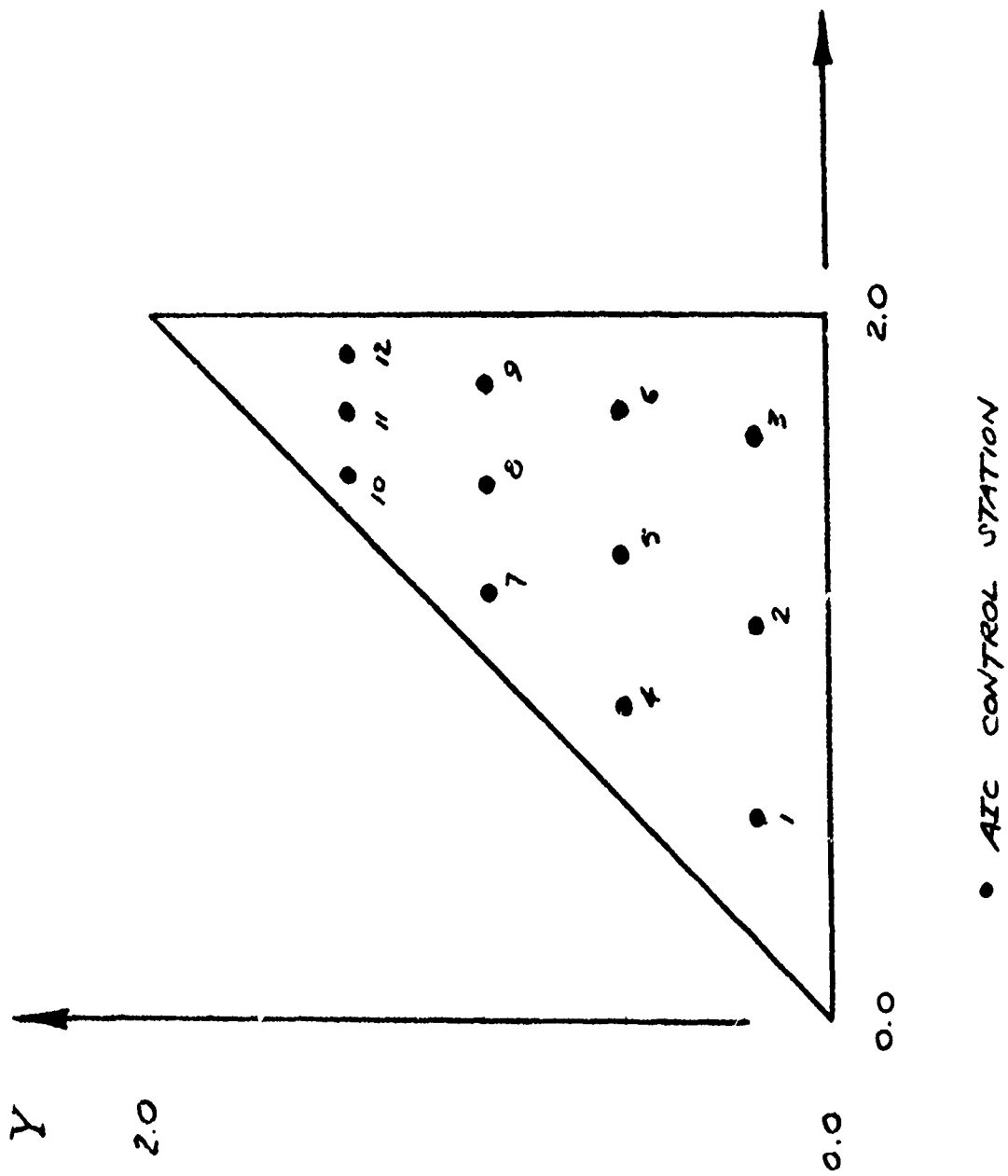


FIGURE 6.9 - SUPERSONIC SAMPLE PROBLEM 3.

HUGHES AIRCRAFT CO. SUPERSONIC AIC PROGRAM

FLIGHT CONDITIONS AND GEOMETRY

MACH NUMBER = 2.00000 SPEED OF SOUND = 1116.870 L/T RHO = 1.00

	WING	TAIL
L.E. STATION (L)	0.	2.000
ROOT CHORD (L)	2.000	0.
L.E. SPAN (L)	0.	2.000
T.E. SPAN (L)	2.000	2.000
TIP CHORD (L)	0.	0.
TOTAL AREA (L ²)	4.000	0
CHORDWISE BOXES	5	5
SPANWISE BOXES	11	11

TOTAL CHORDWISE BOXES = 4 BOX CHORD = 3.63636E-01 L BOX SPAN = 2.09946E-01 L

JOINTS AIRCRAFT CO. SUPERSONIC AIC PROGRAM (CONT'D)

MAP OF EACH BOX OVERLAY ON
 WING, TAIL, AND DIAPHRAGM
 (S) - WING
 (S) - TAIL
 (.) - WAKE
 (.) - DIAPHRAGM

S
 SSS
 SSSSS
 SSSSSS
 SSSSSSS
 SSSSSSSS
 SSSSSSSSS

HUGHES AIRCRAFT CO. SUPERSONIC AIC PROGRAM (CONT'D)

AIC COLLOCATION STATION COORDINATES ON THE WING			
YAIC	XAIC VAL JFS--		
0.20000E 00	0.50000E 00	0.11000E 01	0.16400E 01
0.60000E 00	0.80000E 00	0.13000E 01	0.17200E 01
0.10000E 01	0.12000E 01	0.15000E 01	0.18000E 01
0.14000E 01	0.15200E 01	0.17000E 01	0.18800E 01

HUGHES AIRCRAFT CO. SUPERSONIC A/C PROGRAM (CONT-D)

OSCILLATORY FREQUENCY (CPS) 5.50020E 00

REFERENCE CHORD 1.00000E 00

REDUCED FREQUENCY (REF. CHORD) 1.54707E-02

REDUCED VELOCITY (REF. CHORD) 6.46303E 01

FREE STREAM MACH NUMBER 2.00000E 00

FREE STREAM VELOCITY 2.23374E 03

DENSITY 1.00

DYNAMIC PRESSURE (1/2*RR0*VEL**2) 2.49480E 06

AERODYNAMIC INFLUENCE COEFFICIENTS

RL	IM	RL	IM	RL	IM	RL	IM
ROW = 1							
1.0441E 03	-3.2330E 00	-1.4420E 03	-2.0007E 00	3.9882E 02	-4.3389E-01	-9.3514E 01	-1.1029E 00
1.3215E 01	-6.5403E-01	3.2352E 01	-1.4617E-01	-1.1997E 02	-5.5718E-01	2.7620E 01	1.1833E-02
1.3273E 01	6.2754E-02	-3.0483E 00	-1.6137E-03				
ROW = 2							
7.0303E 02	-1.4910E 00	-6.9225E 02	-3.3729E 00	-1.0763E 01	-1.2428E 00	2.1712E 02	-5.3094E-01
2.2863E 02	-2.5374E-01	-6.8500E 01	1.2637E 00	1.5028E 02	-1.9723E 00	-8.1782E 01	4.5503E-01
-1.6419E 01	2.1460E-01	8.0671E 00	-4.9075E-02				
ROW = 3							
-3.7155E 01	-7.9149E-01	9.5114E 02	3.5863E 00	-8.1395E 02	-9.3385E 00	9.6132E 02	-9.6589E 00
6.9160E 02	-5.7192E 00	-2.3005E 02	6.9199E 00	3.6197E 02	-6.3093E 00	-1.5190E 02	1.7223E 00
-4.2149E 01	8.9703E-01	1.6931E 01	-1.8519E-01				
ROW = 4							
2.4510E 02	-4.1041E 00	-6.2173E 02	1.1052E 01	3.7666E 02	-5.4068E 00	9.2812E 02	-1.6264E 00
6.8901E 01	2.8683E 00	2.4654E 01	-1.7794E 00	-2.4813E 02	4.8540E 00	1.5348E 02	-2.2100E 00
2.9583E 01	-4.9086E-01	-1.7100E 01	2.2666E-01				
ROW = 5							
3.5916E 02	-5.9558E 00	-4.0957E 02	4.2036E 00	5.0377E 01	-1.0644E 00	-3.7919E 01	7.0750E 00
-4.3740E 02	1.3620E 00	1.9298E 02	-1.7167E 00	-1.0235E 02	7.0703E-01	-6.3365E-01	-2.1606E-01
7.6467E 00	-9.4710E-01	2.0254E 00	1.0522E-02				
ROW = 6							
1.0741E 02	-1.0037E 00	1.0530E 02	-2.1701E 00	-2.1275E 02	1.0037E 00	-7.9278E 02	6.1951E 00
-1.0054E 03	-6.2871E 00	2.7100E 02	-6.1429E 00	-1.3636E 02	4.7067E 00	-1.3674E 02	-2.7963E 00
-7.9710E 01	8.2112E-01	3.0641E 01	-8.8402E-02				
ROW = 7							
-2.1046E 02	2.4294E 00	4.9182E 00	2.5712E 00	2.0650E 02	-1.7346E 00	-6.0668E 02	-4.6740E 00
1.6691E 01	-7.5464E-02	7.4082E 02	-3.6465E 00	-6.9332E 02	2.4040E 00	1.5249E 02	-1.1923E 00

-2.6795E 02 1.9145E 00 1.1591E 02 -6.5176E-01

ROW = 8

6.5254E 01 -2.7411E 00 -1.9163E 02 5.3029E 00 1.2637E 02 -1.9813E 00 3.4384E 01 1.7329E-01 1.5790E 02 -3.9334E 00
-1.9220E 02 1.5751E 00 5.7831E 01 -3.9135E-01 3.9547E 02 -1.5152E-01 -4.5350E 02 -1.2117E 00 1.2504E 02 -9.5576E-01
-1.3190E 02 8.2621E-01 4.3124E 00 -2.7435E-01

ROW = 9

2.0509E 02 -6.4651E 00 -2.8614E 02 7.2924E 01 6.1018E 01 -2.1191E 00 -1.7688E 02 3.2944E 00 5.1066E 02 -6.7317E 00
-3.3370E 02 2.3611E 00 -9.5149E 02 1.8504E 00 2.3845E 03 1.1171E 00 -1.4310E 03 -5.0602E 00 6.5098E 01 -1.2034E 00
8.0034E 01 7.2383E-01 -1.6513E 02 -2.8514E-01

ROW = 10

6.4107E 01 -2.7347E 00 -2.9997E 02 5.9661E 00 2.2561E 02 -1.7726E 00 -2.9849E 02 4.4422E 00 5.2420E 02 -8.3946E 00
-2.2549E 02 2.0558E 00 1.0158E 03 -9.6264E 00 -1.4241E 03 9.7377E 00 4.0844E 02 -2.5068E 00 -3.7189E 02 2.7458E 00
1.0158E 03 -4.5381E 00 -4.9391E 02 5.9188E-01

ROW = 11

3.1375E 01 -1.6721E 00 -1.3581E 02 3.6458E 00 1.0445E 02 -1.4152E 00 -5.0742E 01 1.1190E 00 1.5641E 02 -2.0919E 00
-1.0545E 02 6.5623E-01 3.8305E 02 -4.5357E 00 -5.2318E 02 3.9404E 00 1.4012E 02 -4.7778E-01 -4.3844E 02 1.6346E 00
1.9168E 03 -3.2557E 00 -1.2742E 03 -1.0703E-01

ROW = 12

7.1610E-01 1.0344E 00 -2.2171E 01 -2.0325E 00 2.1469E 01 1.1374E 00 1.5615E 02 -1.9620E 01 -1.9336E 02 5.1634E 01
3.7255E 01 -3.2590E 01 -1.4524E 02 4.0777E 01 3.7085E 02 -1.1813E 02 -2.2564E 02 7.6702E 01 -4.8480E 02 -3.7054E 01
1.5932E 03 1.0792E 02 -1.1194E 03 -7.2489E 01

PART VI - SECTION B4.0

LISTING OF SUPERSONIC AIC
COMPUTER PROGRAM

```

CDRIVE      DRIVE
COMPLEX CZERO,VPIC,SS,PHIW,SPHI,PHI,PHITE,DPHI,EXF,W,F,AIC,Z
DIMENSION F(45,45),W(45,45),S(45,45),R(45,45),
1          TEMP(45,45),R(45,45),C(45,45),T(45,45),TH(45,45),
2          TI(45,45),TR(45,45)
COMMON/C1/KHOX(1000),XF(5),YE(5),X1,Y2,X3,X4,Y1,Y2,BETA,NBS
COMMON/C2/AS,NMACH,FMACH(6),NFREQ,FRFQ(10),NMODE,NSURF,LPUNCH,KF
COMMON/C3/VPIC(2025),SS(2025),PHIW(50),SPHI,CZERO,PHI,PHITE,DPHI
COMMON/C4/MOR(50),NRL(50),KC(50),KL(28),RSL(20),DXE(2),TPI,U
COMMON/C5/X,Y,DX,DY,EM,EK,EKR,FKR,NP,MP,NB,NROX,KODE,MODE,NBW,NBT
COMMON/C6/XL,NS,K,J,IFR,TWL,RHO
COMMON/C7/XAIC(10,10,2),YAIC(10,2),NXBX(40),NYBX(40),NXHXCS
COMMON/C8/NXWING,NYWING,NXCS,NYCS
COMMON/C9/AIC(45,45),AR(3)
EQUIVALENCE (C,S,R),(VPIC,W,R),(SS,F,TH),(AIC,TEMP)
1 CALL DAIN
  IF (NMODE .LE. 45) GO TO 5
  WRITE (6,8)
8 FORMAT (1H1,5X,50K NUMBER OF AIC STATIONS EXCEEDS MAX ALLOWABLE (4
15)/5X,16H CASE TERMINATED)
  GO TO 1
5 CONTINUE
  DO 1000 MACH=1,NMACH
    FM=FMACH(MACH)
    IF (EM .LT. 1.1) GO TO 1000
    CALL CODE
    TOR=TWL/BETA
    CALL POUT(1)
    CALL POUT(2)
    NTRS=0
    DO / I=1,NBS
7 NTRS=NTRS+NXRX(I)+NXHXCS
    IF (NTRS .LE. 45) GO TO 13
    WRITE (6,14)
14 FORMAT(1H1,5X,48H NUMBER OF MACH BOXES EXCEEDS MAX ALLOWABLE (45)
1/5X,16H CASE TERMINATED)
    GO TO 1
13 CONTINUE
  U=AS*EM
  TPI=TPI/U
  RFM=DX*(FM/BETA)**2
  CALL TRAMP (2,NTRS,NTCS,S,R,C,R,T,TR,TI,TH)
  DO 550 I=1,NTRS
  DO 550 J=1,NTCS
550 TEMP(I,J)=TR(I,J)
  CALL TRAMP (1,NTRS,NTCS,S,R,C,R,T,TR,TI,TH)
  DO 560 I=1,NTRS
  DO 560 J=1,NTCS
560 TR(I,J)=TEMP(I,J)
  NMODE=NTCS
  DO 1000 IFR=1,NFREQ
  IF (KF .EQ. 1) FREQ(IFR)=FREQ(IFR)*FMACH(MACH)*AS/(TPI*X1*0.5)
  FR=FREQ(IFR)*TPI
  FKR=FR*RFM
  FKR=FKR*X1/2.0
  CALL CAPI
  ARG=FKR*DX
  EXF=CMPLX(COS(ARG),-SIN(ARG))
  DO 500 MOUT=1,NMODE
  X=0.5*DX
  NH=1

```

```

DO 100 NP=1,NROX
KD=KBOX(NB)
NS=1
GO TO (70,60,70,60,60,70,70),KD
60 NS=2
70 MR=MOR(NP)
Y=0.0
DO 100 MP=1,MH
KODF=KBOX(NH)
SPHI=CZERO
IF (NP.GT. 1) CALL PHIB
SPHI=SPHI*DY
PHI=CZFRO
GO TO (40,40,40,40,40,20,30), KODE
20 SPHI=SPHI-PHIW(MP)
PHI=PHIW(MP)
PHIW(MP)=PHIW(MP)*EXF
GO TO 50
30 IF (KD.LT. 6) GO TO 40
50 SS(NB)=-SPHI/VPIC/DY
GO TO 90
40 IF (NS.EQ. 2) GO TO 45
IR=0
DO 21 IL=1,MP
21 IR=IR+NXRX(IL)
IR=IR-NP-NXRX(1)
GO TO 26
45 IR=0
DO 22 IL=1,NRS
22 IR=IR+NXRX(IL)
DO 23 IL=1,MP
23 IR=IR+NXRXCS
IR=IR-NROX+NP
26 SR=FM*AS*TR(IR,MODE)
SI=1PI*FREQ(IFR)*TI(IR,MODE)
SS(NB)=CMPLX(SR,SI)
IF (KD.LT. 6) SS(NB)=SS(NB)-ARLE(TOR)*(SS(NB)+SPHI/VPIC/DY)
IF (KODE.GE. 6) GO TO 90
PHI=SPHI+SS(NB)*VPIC*DY
IF (KODF.EQ. 3) PHIW(MP)=PHI*EXF
IF (NP.EQ. NROX-1) PHIW(MP)=PHI
IF (NP.EQ. NROX) PHIF=PHI+(PHI-PHIW(MP))*DXE(5)
GO TO (120,121,120,121,121,127,127),KODE
120 IC=0
DO 122 IL=1,MP
122 IC=IC+NXRX(IL)
IC=IC-NP-NXRX(1)
GO TO 126
121 IC=0
DO 123 IL=1,NRS
123 IC=IC+NXRX(IL)
DO 124 IL=1,MP
124 IC=IC+NXRXCS
IC=IC-NROX+NP
125 AIC(IC,MODE)=PHI
127 CONTINUE
90 CONTINUE
NH=NH+1
KD=KODF
100 Y=Y+DY
200 X=X+DX

```

```

500 CONTINUE
CALL SD2 (S,R,C,B,T,TR,TH)
DO /01 I=1,NTRS
DO /01 J=1,NTRS
SI=0.0
IF (I.EQ. J) SI=TP1*FREQ(IFR)/(FM*AS)
SR=TH(I,J)
701 W(I,J)=CMPLX(SR,SI)
DO /02 I=1,NTRS
DO /02 J=1,NTCS
F(I,J)=(0.0,0.0,0.0)
DO /02 K=1,NTRS
702 F(I,J)=F(I,J)-W(I,K)*AIC(K,J)
ZCON=(4.0*DX*DY*FM*AS)/((TP1*FREQ(IFR))**2*(YE(J)-YE(1))*
1(XF(3)-XF(1))**2)
CALL FORCE (R)
DO /08 I=1,NTCS
DO /08 J=1,NTCS
AIC(I,J)=(0.0,0.0,0.0)
DO /08 K=1,NTRS
Z=CMPLX(C(I,K)*ZCON,0.0)
708 AIC(I,J)=AIC(I,J)-Z*F(K,J)
CALL POUT(3)
IF (LPUNCH.GT. 0) CALL POUT(4)
900 CONTINUE
1000 CONTINUE
GO TO 1
END

```

CDAIN

DAIN

SUBROUTINE DAIN

COMPLEX CZERO,VPIC,SS,PHIW,SPHI,PHI,PHITE,DPHI

COMMON/C1/KROX(1000),XE(5),YE(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS

COMMON/C2/AS,NMACH,FMACH(6),NFREQ,FREQ(10),NMODE,NSURF,LPUNCH,KF

COMMON/C3/VPIC(2025),SS(2025),PHIW(50),SPHI,CZERO,PHI,PHITE,DPHI

COMMON/C4/MOR(50),NBL(50),KC(50),KL(28),BSL(20),DXE(7),TPI,U

COMMON/C5/X,Y,DX,DY,EM,EK,EKB,EKR,NP,MP,NB,NROX,KODE,MODE,NBW,NBT

COMMON/C6/XI,NS,K,J,IFR,TWL,RHO

COMMON/C7/XAIC(10,10,2),YAIC(10,2),NXBX(40),NYBX(40),NXBXC

COMMON/C8/NXWING,NYWING,NXCS,NYCS

READ(5,11) (XF(I),I=1,5)

READ(5,11) (YE(I),I=1,3),AS

READ(5,12) NMACH,KF,NFREQ,NBW,LPUNCH

READ(5,11) (FMACH(I),I=1,NMACH)

READ(5,11) (FREQ(I),I=1,NFREQ)

NSURF=2

IF(XF(4).LT.XE(5)) GO TO 10

NSURF=1

XE(4)=XE(5)

XE(5)=XF(5)

10 READ(5,12) NXWING,NYWING,NXCS,NYCS

READ(5,11) (YAIC(I,1),I=1,NYWING)

IF(NXCS.NE.0) READ(5,11) (YAIC(I,2),I=1,NYCS)

READ(5,11) ((XAIC(I,J,1),I=1,NXWING),J=1,NYWING)

IF(NXCS.NE.0) READ(5,11) ((XAIC(I,J,2),I=1,NXCS),J=1,NYCS)

RHO=1.0

NMODE=NXWING*NYWING*NXCS*NYCS

11 FORMAT(6F12.8)

12 FORMAT(6I12)

RETURN

END

CCODE

CODE

SUBROUTINE CODE

COMPLEX CZERO,VPIC,SS,PHIW,SPHI,PHI,PHITE,DPHI

COMPLEX AIC

COMMON/C1/KHOX(1000),XF(5),YE(5),X1,X2,X3,X4,Y1,Y2,BETA,NBS

COMMON/C2/AS,NMACH,FMACH(6),NFREQ,FREQ(10),NMODE,NSURF,LPUNCH,KF

COMMON/C3/VPIC(2025),SS(2025),PHIW(50),SPHI,CZERO,PHI,PHITE,DPHI

COMMON/C4/MOR(50),NHL(50),KC(50),KL(28),BSL(20),DXE(7),TPI,U

COMMON/C5/X,Y,DX,DY,EM,EK,EKR,EKR,NP,NP,NB,NDOX,KODE,MODE,NBW,NBT

COMMON/C6/XL,NS,K,J,IFR,TWL,RHO

COMMON/C7/XAIC(10,10,2),YAIC(10,2),NXBX(40),NYBX(40),NXBXC5

COMMON/C8/NXWING,NYWING,NXCS,NYCS

COMMON/C9/AIC(45,45),AR(3)

BETA = SQRT((FM * FM)-1.0)

X1 = XF(3) - XF(1)

X2 = XF(3) - XF(2)

X3 = XF(4) - XF(1)

X4 = XF(5) - XF(4)

X5 = XF(5) - XF(1)

Y1 = YE(2) - YE(1)

Y2 = YE(3) - YE(1)

IF(X2.GT.X1.OR.X1.GT.X3.OR.X1.GT.X5.OR.X2.LT.0.0) GO TO 50

IF(Y1.GT.Y2.OR.Y1.LT.0.0) GO TO 50

Y2L = 0.0

IF(Y2.NE.Y1) TWL = (X1 - X2) / (Y2 - Y1)

AR(1) = (Y2*(X2+X1) - Y1 * (X2-X1))

AR(2) = Y2*X4*2.0

AR(3) = AR(1) + AR(2)

10 DX = X1/(FLOAT(NBW) - 0.5)

IF (50.0 * DX .GT. X5) GO TO 20

15 NBW = NBW-1

GO TO 10

20 DY = DX/BETA

YN1 = Y1/DY

YN2 = Y2/DY

XN1 = YN2 - (X1-X2) / DX

XN2 = YN2 + X5/DX

XN1L = X3/DX

XN1F=X5/DX

NROX=XN1F+0.50000007

NBS = Y2/DY + 1.0

NBT = X4/DX + 0.5

DXE(1) = 1.0

DXE(2) = 1.0

DXE(3) = 0.5

DXE(4) = AIN*(XN1L + 1.5) - XN1L

DXE(5)=XN1F-FLOAT(NROX-1)

DXE(6) = 0.0

DXE(7) = 0.0

X = 0.5 * DX

FR = 0

NRC = MIN1(AMAX1(XN1L,FLOAT(NROX)-0.5,YN1,FLOAT(NROX)-0.5),XN1F-FLOAT
(NROX)+0.5)+1

DO 40 I=1,NRC

40 NXBX(I)=0

NXBXC5=0

DO 40 NP = 1,NROX

XN = FLOAT(NP) - 1.5

YN = YN2

IF (TWL .GT. 0.0) YN=AMIN1(YN,YN1+XN/(TWL/BETA))

IF(X.GT.XE(7)) GO TO 24

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      MB = MIN1(AMAX1(YW,XN+YN1),XNT-XN)+1
      GO TO 28
24  MB = MIN1(AMAX1(XNL+XN,XN+YN1),XNT-XN)+1
28  MOR(MP) = M3
      KODE = 1
      IF (MP.EQ.NRW) KODE = 3
      IF (NSURF.EQ.1) GO TO 29
      IF (X.GT.X1) KODE = 6
      IF (MP.EQ.NRW) KODE = 3
      IF (X.GT.X1) KODE = 4
      IF (X.GT.X1+DX) KODE = 2
      IF (MP.EQ.NROX) KODE = 5
29  IF (NR+MR.GT.2000) GO TO 15
      NBI(MP) = NH
      DO 30 MP = 1,MR
      YN = MP-1
      NR = NR + 1
      IF (YN.GT.YW) KODE = 7
      IF (KODE.EQ.1.OR.KODE.EQ.3) GO TO 70
      GO TO 71
70  NXRX(MP)=NXRX(MP)+1
71  CONTINUE
      IF (MP.NE.1) GO TO 73
      IF (KODE.EQ.2.OR.KODE.EQ.4.OR.KODE.EQ.5) GO TO 72
      GO TO 74
72  NXRXCS=NXRXCS+1
73  CONTINUE
      Y=DY*FLOAT(MP)-0.5*DY
      IF (KODE.EQ.1.OR.KODE.EQ.3) NYRX(MP)=MP
30  KBOX(NR) = KODE
40  X = X+DX
      RETURN
50  CALL EXIT
      RETURN
      END

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CPOUT

POUT

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SUBROUTINE POUT(IND)
COMPLEX CZERO,VPIC,SS,PHIW,SPHI,PHI,PHITE,DPHI
COMPLEX W,AIC
DIMENSION SW(5,6),SURF(2,3),COD(7),C(50)
COMMON/C1/KHOX(1000),XE(5),YE(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
COMMON/C2/AS,NMACH,FMACH(6),NFREQ,FREQ(10),NMODE,NSURF,LPUNCH,KF
COMMON/C3/VPIC(2025),SS(2025),PHIW(50),SPHI,CZERO,PHI,PHITE,DPHI
COMMON/C4/MOR(50),NRL(50),KC(50),KL(28),BSL(20),DXE(7),TPI,U
COMMON/C5/X,Y,DX,DY,EM,EK,EKR,EKR,NP,MP,NB,NBOX,KODE,MODE,NBW,NBT
COMMON/C6/XL,NS,K,J,IFR,TWL,RHO
COMMON/C7/XAIC(10,10,2),YAIC(10,2),NXBX(40),NYBX(40),NXBXCS
COMMON/C8/NXWING,NYWING,NXCS,NYCS
COMMON/C9/AIC(45,45),AR(3)
DATA (SW(1,1),I=1,6)/26HMAP OF MACH BOX OVERLAY ON,
1      26HWING, TAIL, AND DIAPHRAGM ,
2      26H      (S) - WING ,
3      26H      (S) - TAIL ,
4      26H      (.) - WAKE ,
5      26H      (.) - DIAPHRAGM /
DATA (SURF(1,1),I=1,3)/8HWING ,RHTAIL ,1HWING + TAIL /
DATA COD/1HS,1HS,1HS,1HS,1HS,1H,.1H./
GO TO (10,20,30,40), IND
10 WRITE(6,11)EM,AS,RHO,XE(1),XE(4),X1,X4,Y1,Y2,Y2,Y2,X2,X4,AR(1),
1 AR(2),NRW,NBT,NRS,NBS
11 FORMAT(1H1//// 32X,43HHUGHES AIRCRAFT CO. SUPERSONIC AIC PROGRAM
1 //37X,30HFLIGHT CONDITIONS AND GEOMETRY/1H0//15X, 13HMACH NUMBER
2 =,F8.5,4X,16HSPEED OF SOUND =F10.3,4H L/T,4X,4HRO=,F6.2 //1H0/
X54X,4HWING,10X,
3 4HTAIL//22X,16HLE. STATION (L),2F22.3//22X,16HROOT CHORD (L),
4 2F22.3// 22X,16HLE. SPAN (L),2F22.3//22X,16HT.E. SPAN (L),
5 2F22.3// 22X,16HTIP CHORD (L),2F22.3//22X,16HTOTAL AREA (L*L),
6 2F22.3// 22X,16HCHORDWISE BOXES ,119,122//22X,
716HSPANWISE BOXES ,119,122)
WRITE(6,12)NR0X,DX,DY
12 FORMAT(1H0//,11X,23HTOTAL CHORDWISE BOXES =,13, 5X,11HBOX CHORD =,
1 1P1E12.5,2H L, 5X,10HROX SPAN =,1P1E12.5,2H L/ )
WRITE(6,91)
41 FORMAT(1H1//// 24X,51HHUGHES AIRCRAFT CO. SUPERSONIC AIC PROGRAM
1(CONT-D) ////)
NR = 1
DO 17 NP = 1,NR0X
NR = MOR(NP)
IF(NR.GT.50) GO TO 800
DO 13 MP = 1,NR
K = KHOX(NR)
C(MP) = COD(K)
13 NR = NR + 1
IF(NP.GT.6) GO TO 15
WRITE(6,14)(SW(I,NP),I=1,5),(C(MP),MP=1,NR)
14 FORMAT(10X,5A6.50A1)
GO TO 17
15 WRITE(6,16) (C(MP),MP=1,NR)
16 FORMAT(40X,50A1)
17 CONTINUE
GO TO 1000
800 WRITE(6,801)
801 FORMAT(9X,52HWHEN MOR EXCEEDS 50 THE MAP PRINTING IS DISCONTINUED
1//1H0,4H
GO TO 1000
20 NYS=NYWING

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NXS=NXWING
DO 200 NS=1,2
WRITE (6,201) (SURF(I,NS),I=1,2)
201 FORMAT(1H1,2RX,51HHUGHES AIRCRAFT CO. SUPERSONIC AIC PROGRAM (CONT
1-D) //77/28X,43HAIC COLLOCATION STATION COORDINATES ON THE 2A6/1H0
2,19X, 4HYAIC, 13X,13HXAIC VALUES--)
DO 202 IY=1,NYS
YC=YAIC(IY,NS)
202 WRITE (6,203) YC,(XAIC(IX,IY,NS),IX=1,NXS)
NYS=NYCS
NXS=NXCS
IF (NYS .EQ. 0 .OR. NXS .EQ. 0) GO TO 205
200 CONTINUE
205 RETURN
203 FORMAT (1H0,12X,5E17.6/(1H ,29X,4E17.6))
30 VEL=EM*AS
Q=0.5*RHO*VEL**2
RV=1.0/EKR
RR=X1/2.0
WRITE (6,220) FREQ(IFR),BR,EKR,RV,EM,VEL,RHO,Q
220 FORMAT(1H1,31X,51HHUGHES AIRCRAFT CO. SUPERSONIC AIC PROGRAM (CONT
1-D)///9X,2HX OSCILLATORY FREQUENCY (CPS),4X,1PE12.5,/1H0,9X,15HRE
2FERENCE CHORD,4X,1PE12.5,/1H0,9X,30HREDUCED FREQUENCY (REF. CHORD)
3,4X,1PE12.5,/1H0,9X,29HREDUCED VELOCITY (REF. CHORD),4X,1PE12.5,
4/1H0,9X,23HREF STREAM MACH NUMBER,4X,1PE12.5,/1H0,9X,20HFREE STRE
5AM VELOCITY,4X,1PE12.5,/1H0,9X,7HDFNSITY,4X,0PF5.2,/1H0,9X,33HDYNA
6MIC PRESSURE (1/2*RHO*VEL**2),4X,1PE12.5,////)
WRITE (6,221)
221 FORMAT(///35X,34HAERODYNAMIC INFLUENCE COEFFICIENTS,///5X,2HRL,10X,
12HIM,10X,2HRI,10X,2HIM,10X,2HRL,10X,2HIM,10X,2HRL,10X,2HIM,10X,2HR
2L,10X,2HIM,/)
NROWS=NYWING*NXWING*NYCS*NXCS
DO 222 NROW=1,NROWS
WRITE (6,223)NROW
WRITE (6,224) (AIC(NROW,NCOL),NCOL=1,NROWS)
223 FORMAT (/ 5HROW = I2)
224 FORMAT (1P10F12.4)
222 CONTINUE
RETURN
40 NW=NXWING*NYWING
NC=NXCS*NYCS
NT=NW*NC
NW1=NW+1
GO TO (N1,N2,N3,N4),LPUNCH
N1 CONTINUE
DO 301 I=1,NW
PUNCH 85, (AIC(I,J),J=1,NW)
301 CONTINUE
85 FORMAT (1P6F12.5)
RETURN
82 CONTINUE
DO 302 I=NW1,NT
PUNCH 85, (AIC(I,J),J=NW1,NT)
302 CONTINUE
RETURN
83 CONTINUE
DO 303 I=1,NW
PUNCH 85, (AIC(I,J),J=1,NW)
303 CONTINUE
DO 304 I=NW1,NT

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      PUNCH A5, (A1C(I,J),J=NW1,NT)
304  CONTINUE
      RETURN
      N4  CONTINUE
      DO 305 I=1,NT
      PUNCH A5, (A1C(I,J),J=1,NT)
305  CONTINUE
1000  RETURN
      END
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CFORCE

FORCE

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SUBROUTINE FORCE (R)
  DIMENSION R(45,45)
  COMMON/C1/KHGX(1000),XE(5),YE(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
  COMMON/C5/X,Y,DX,DY,EM,EK,EKB,EKR,NP,PP,NB,NBUX,KODE,MODE,NBW,NBT
  COMMON/C7/XAIC(10,10,2),YAIC(10,2),NXBX(40),NYBX(40),NXBXC5
  COMMON/C8/NXWING,NYWING,NXCS,NYCS
  MR=NBS
  NMRXW=0
  DO 50 I=1,MR
50  NMRXW=NMRXW+NXRX(I)
  KROW=NXWING+NYWING+NXCS+NYCS
  KCOL=0
  DO 100 I=1,MR
100 KCOL=KCOL+NXRX(I)+NXBXC5
  DO 150 I=1,KROW
  DO 150 J=1,KCOL
150  Z(I,J)=0.0
  DO 600 I=1,MR
  NCK=0
  FRB=1.0
  FRT=1.0
  FOF = 1.0
  YR=DY*FLOAT(I)-DY
  II=NYWING-1
  DO 610 III=1,II
  IF (0.5*(YAIC(III,1)+YAIC(III+1,1))-YE(1) .GT. YR-.5*DY) GO TO 630
610 CONTINUE
  III=NYWING
  GO TO 620
630 CONTINUE
  IF (YR-0.5*DY .LT. 0.5*(YAIC(III,1)+YAIC(III+1,1))-YE(1) .AND.
1  YR+0.5*DY .GT. 0.5*(YAIC(III,1)+YAIC(III+1,1))-YE(1)) NCK=1
  IF (NCK .EQ. 0) GO TO 620
  FRB=(0.5*(YAIC(III,1)+YAIC(III+1,1))-YE(1)-YR+0.5*DY)/DY
  FRT=1.0-FRB
620 NROW=NXWING+(III-1)
  NCOL=0
  DO 650 IIII=1,II
650 NCOL=NCOL+NXRX(IIII)
  NCOL=NCOL-NXRX(I)
  KK=NXBX(I)
  DO 750 K=1,KK
  DO 700 J=1,NXWING
  IF (XAIC(1,III,1)-XE(1) .GE. (FLOAT(NXBX(1)-NXBX(I)+K)-.5)*DX)
100 GO TO 710
  IF (XAIC(NXWING,III,1)-XE(1) .LE. (FLOAT(NXBX(1)-NXBX(I)+K)-.5)*
10X) GO TO 720
  IF (XAIC(J,III,1)-XE(1) .GT. (FLOAT(NXBX(1)-NXBX(I)+K)-.5)*DX)
100 GO TO 730
700 CONTINUE
710 NRF=NROW+1
  NCF=NCOL+K
  R(NRF,NCF)=IRH
  IF (I .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*0.5
  IF (K .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*0.5
  IF (I .EQ. MR) FOF = (YE(3)-YE(1)-(FLOAT(MR)-1.5)*DY)/DY
  IF (I .EQ. MR) R(NRF,NCF)=R(NRF,NCF)*FOF
  GO TO 740
720 NRF=NROW+NXWING
  NCF=NCOL+K

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R(NRF,NCF)=FRH
IF (I .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*0.5
IF (K .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*0.5
IF (I .EQ. MR) FOF = (YE(3)-YE(1)-(FLOAT(MR)-1.5)*DY)/DY
IF (I .EQ. MR) R(NRF,NCF)=R(NRF,NCF)*FOF
GO TO 740
730 R1=XAIC(J,III,1)-XE(1)-(FLOAT(NXB(1)-NXB(I)+K)-0.5)*DX
R3=XAIC(J,III,1)-XAIC(J-1,III,1)
NRF=NROW+J
NCF=NCOL+K
R(NRF,NCF)=(1.0-R1/R3)*FRH
R(NRF-1,NCF)=(R1/R3)*FRH
IF (I .EQ. 1) R(NRF,NCF)=0.5*R(NRF,NCF)
IF (I .EQ. 1) R(NRF-1,NCF)=0.5*R(NRF-1,NCF)
IF (K .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*0.5
IF (K .EQ. KK) R(NRF-1,NCF)=R(NRF-1,NCF)*0.5
IF (I .EQ. MR) FOF=(YE(3)-YE(1)-(FLOAT(MR)-1.5)*DY)/DY
IF (I .EQ. MR) R(NRF,NCF)=R(NRF,NCF)*FOF
IF (I .EQ. MR) R(NRF-1,NCF)=R(NRF-1,NCF)*FOF
740 CONTINUE
IF (NCK .EQ. 1 .AND. K .EQ. KK) GO TO 760
GO TO 750
760 DO 850 KT=1,KK
DO 800 JT=1,NXWING
IF (XAIC(1,III+1,1)-XE(1) .GE. (FLOAT(NXB(1)-NXB(I)+KT)-.5)*DX)
1GO TO 810
IF (XAIC(NXWING,III+1,1)-XE(1) .LE. (FLOAT(NXB(1)-NXB(I)+KT)-.5)
1+DX) GO TO 820
IF (XAIC(JT,III+1,1)-XE(1) .GT. (FLOAT(NXB(1)-NXB(I)+KT)-.5)*DX)
1GO TO 830
800 CONTINUE
810 NRF=NROW+NXWING+1
NCF=NCOL+KT
R(NRF,NCF)=FRT*FOF
IF (KT .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*0.5
GO TO 840
820 NRF=NROW+2*NXWING
NCF=NCOL+KT
R(NRF,NCF)=FRT*FOF
IF (KT .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*0.5
GO TO 840
830 R1=XAIC(JT,III+1,1)-XE(1)-(FLOAT(NXB(1)-NXB(I)+KT)-0.5)*DX
R3=XAIC(JT,III+1,1)-XAIC(JT-1,III+1,1)
NRF=NROW+NXWING+JT
NCF=NCOL+KT
R(NRF,NCF)=(1.0-R1/R3)*FRT*FOF
R(NRF-1,NCF)=(R1/R3)*FRT*FOF
IF (I .EQ. 1) R(NRF,NCF)=0.5*R(NRF,NCF)
IF (I .EQ. 1) R(NRF-1,NCF)=0.5*R(NRF-1,NCF)
IF (KT .EQ. KK) R(NRF,NCF)=0.5*R(NRF,NCF)
IF (KT .EQ. KK) R(NRF-1,NCF)=0.5*R(NRF-1,NCF)
840 CONTINUE
850 CONTINUE
750 CONTINUE
600 CONTINUE
DO 400 I=1,MR
KK=NXBXS
NCK=0
FRH=1.0
FRT=1.0
FOF = 1.0

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YR=DY*FLOAT(I)-DY
II=NYCS-1
DO 410 III=1,II
IF (0.5*(YAIC(III,2)+YAIC(III+1,2))-YE(1) .GT. YR-.5*DY) GO TO 430
410 CONTINUE
III=NYCS
GO TO 420
430 CONTINUE
IF (YR-0.5*DY .LT. 0.5*(YAIC(III,2)+YAIC(III+1,2))-YE(1) .AND.
1 YR+0.5*DY .GT. 0.5*(YAIC(III,2)+YAIC(III+1,2))-YE(1)) NCK=1
IF (NCK .EQ. 0) GO TO 420
FRB=(0.5*(YAIC(III,2)+YAIC(III+1,2))-YE(1)-YR+0.5*DY)/DY
FRF=1.0-FRB
420 NROW=NXWING+NYWING+NXCS*(III-1)
NCOL=NMBXW+(I-1)*NXBXCS
DO 950 K=1,NXBXCS
DO 900 J=1,NXCS
IF (XAIC(1,III,2)-XE(1) .GE. (FLOAT(NBOX-NXBXCS+K)-.5)*DX)
1 GO TO 910
IF (XAIC(NXCS,III,2)-XE(1) .LE. (FLOAT(NBOX-NXBXCS+K)-.5)*DX)
1 GO TO 920
IF (XAIC(J,III,2)-XE(1) .GT. (FLOAT(NBOX-NXBXCS+K)-.5)*DX)
1 GO TO 930
900 CONTINUE
910 NRF=NROW+1
NCF=NCOL+K
R(NRF,NCF)=FRB
IF (I .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*0.5
IF (K .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*((FLOAT(NBOX-NXBXCS+1))*DX-
1-XF(4)+XF(1))/DX
IF (K .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*(XE(5)-XE(1)-(FLOAT(NBOX-1))*
1DX)/DX
IF (I .EQ. MR) FOF=(YE(3)-YE(1)-(FLOAT(MB)-1.5)*DY)/DY
IF (I .EQ. MR) R(NRF,NCF)=R(NRF,NCF)*FOF
GO TO 940
920 NRF=NROW+NXCS
NCF=NCOL+K
R(NRF,NCF)=FRB
IF (I .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*0.5
IF (K .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*((FLOAT(NBOX-NXBXCS+1))*DX-
1XF(4)+XF(1))/DX
IF (K .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*(XE(5)-XE(1)-(FLOAT(NBOX-1))*
1DX)/DX
IF (I .EQ. MR) FOF=(YE(3)-YE(1)-(FLOAT(MB)-1.5)*DY)/DY
IF (I .EQ. MR) R(NRF,NCF)=R(NRF,NCF)*FOF
GO TO 940
930 R1=XAIC(J,III,2)-XF(1)-(FLOAT(NBOX-NXBXCS+K)-.5)*DX
R3=XAIC(J,III,2)-XAIC(J-1,III,2)
NRF=NROW+J
NCF=NCOL+K
R(NRF,NCF)=(1.0-R1/R3)*FRB
R(NRF-1,NCF)=(R1/R3)*FRB
IF (I .EQ. 1) R(NRF-1,NCF)=0.5*R(NRF-1,NCF)
IF (I .EQ. 1) R(NRF,NCF)=0.5*R(NRF,NCF)
IF (K .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*(FLOAT(NBOX-NXBXCS+K)*DX-
1-XF(4)+XF(1))/DX
IF (K .EQ. 1) R(NRF-1,NCF)=R(NRF-1,NCF)*(FLOAT(NBOX-NXBXCS+K)*DX-
1-XF(4)+XF(1))/DX
IF (K .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*(XE(5)-XE(1)-FLOAT(NBOX-1)*
1DX)/DX

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      IF (K .EQ. KK) R(NRF-1,NCF)=R(NRF-1,NCF)*(XE(5)-XE(1)-
1FLOAT(NBOX-1)*DX)/DX
      IF (I .EQ. MR) FOE=(YE(J)-YE(1)-(FLOAT(MB)-1.5)*DY)/DY
      IF (I .EQ. MR) R(NRF,NCF)=R(NRF,NCF)+FOE
      IF (I .EQ. MR) R(NRF-1,NCF)=R(NRF-1,NCF)+FOE
940  CONTINUE
      IF (NCK .EQ. 1 .AND. K .EQ. KK) GO TO 960
      GO TO 950
960  GO 350 KT=1, KK
      GO 300 JT=1, NXCS
      IF (XAIC(1,111+1,2)-XE(1) .GE. (FLOAT(NBOX-NXBXC+KT)-.5)*DX)
100  GO 310
      IF (XAIC(NXCS,111+1,2)-XE(1) .LE. (FLOAT(NBOX-NXBXC+KT)-.5)*DX)
100  GO 320
      IF (XAIC(JT,111+1,2)-XF(1) .GT. (FLOAT(NBOX-NXBXC+KT)-.5)*DX)
100  GO 330
300  CONTINUE
310  NRF=NROW+NXCS+1
      NCF=NCOL+KT
      R(NRF,NCF)=FRT*FOE
      IF (KT .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*(XE(5)-XE(1)- FLOAT(NBOX-1)*
1DX)/DX
      IF (KT .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*( FLOAT(NBOX-NXBXC+1)*DX
1-XE(4)+XE(1))/DX
      GO TO 340
320  NRF=NROW+2*NXCS
      NCF=NCOL+KT
      R(NRF,NCF)=FRT*FOE
      IF (KT .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*(XE(5)-XE(1)- FLOAT(NBOX-1)*
1DX)/DX
      IF (KT .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*( FLOAT(NBOX-NXBXC+1)*DX
1-XF(4)+XE(1))/DX
      GO TO 340
330  R1=XAIC(JT,111+1,2)-XE(1)-(FLOAT(NBOX-NXBXC+KT)*DX-.5*DX)
      R3=XAIC(JT,111+1,2)-XAIC(JT-1,111+1,2)
      NRF=NROW+NXCS+JT
      NCF=NCOL+KT
      R(NRF,NCF)=(1.0-R1/R3)*FRT*FOE
      R(NRF-1,NCF)=(R1/R3)*FRT*FOE
      IF (I .EQ. 1) R(NRF,NCF)=0.5*R(NRF,NCF)
      IF (I .EQ. 1) R(NRF-1,NCF)=0.5*R(NRF-1,NCF)
      IF (KT .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*( FLOAT(NBOX-NXBXC+1)*DX-
1XF(4)+XE(1))/DX
      IF (KT .EQ. 1) R(NRF-1,NCF)=R(NRF-1,NCF)*(FLOAT(NBOX-NXBXC+1)*DX-
1XF(4)+XF(1))/DX
      IF (KT .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*(XE(5)-XE(1)-FLOAT(NBOX-1)*
1DX)/DX
      IF (KT .EQ. KK) R(NRF-1,NCF)=R(NRF-1,NCF)*(XE(5)-XE(1)-FLOAT(NBOX-
1)*DX)/DX
340  CONTINUE
350  CONTINUE
950  CONTINUE
400  CONTINUE
      RETURN
      END

```

CS02

SD2

SUBROUTINE SD2 (S,R,C,R,T,TR,TH)

DIMENSION S(45,45),R(45,45),C(45,45),b(45,45),T(45,45),

1 TR(45,45),TH(45,45)

COMMON/C1/KROX(1000),XE(5),YE(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS

COMMON/C4/MOR(50),NRL(50),KC(50),KL(28),BSL(20),DXE(7),TPI,U

COMMON/C5/X,Y,DX,DY,EM,EK,EKB,EKR,NP,PP,NB,NBOX,KODE,MODE,NBW,NBT

COMMON/C7/XAIC(10,10,2),YAIC(10,2),NXBX(40),NYBX(40),NXBXC

COMMON/C8/NXWING,NYWING,NXCS,NYCS

C *** THIS SUBROUTINE GENERATES THE REAL PART OF THE SUBSTANTIAL
C *** DERIVATIVE MATRIX FOR THE VELOCITY POTENTIAL

MSUB=NXBX(1)

MH=NBS

NM=0

DO 10 I=1,MH

10 NM=NM+NXBX(I)+NXBXC

DO 20 I=1,NM

DO 20 J=1,NM

20 TM(I,J)=0.0

DO 100 I=1,MR

IF (NXBX(I) .EQ. 1) GO TO 100

NXS=NXBX(I)

CALL BMAT (NXS,NRSH,NCSH,B)

CALL TMAT (NXS,1,1,1,MSIZE,2,T,R)

DO 101 MR=1,MSIZE

DO 101 MC=1,NCSH

TR(MR,MC)=0.0

DO 101 MRC=1,MSIZE

101 TR(MR,MC)=TR(MR,MC)+T(MR,MRC)*B(MRC,MC)

CALL CMAT (NXS,1,2,1,NRSC,NCSC,2,C)

DO 102 MR=1,NPSL

DO 102 MC=1,NCSH

T(MR,MC)=0.0

DO 102 MRC=1,NCSC

102 T(MR,MC)=T(MR,MC)+C(MR,MRC)*TR(MRC,MC)

KROW=0

DO 140 II=1,I

140 KROW=KROW+NXBX(I)

KROW=KROW-NXBX(I)

DO 180 LR=1,NXS

LROW=KROW+LR

DO 180 LC=1,NXS

LCOI=KROW+LC

180 TM(LROW,LCOI)=T(LR,LC)

100 CONTINUE

IF (NXBXC .EQ. 2) GO TO 300

DO 200 I=1,MR

CALL RMAT (NXBXC,NRSH,NCSH,B)

CALL IMAT (NXBXC,1,2,1,MSIZE,3,T,R)

DO 201 MR=1,MSIZE

DO 201 MC=1,NCSH

TR(MR,MC)=0.0

DO 201 MRC=1,MSIZE

201 TR(MR,MC)=TR(MR,MC)+T(MR,MRC)*B(MRC,MC)

CALL CMAT (NXBXC,1,2,2,NRSC,NCSC,3,C)

DO 202 MR=1,NRSC

DO 202 MC=1,NCSH

T(MR,MC)=0.0

DO 202 MRC=1,NCSC

202 T(MR,MC)=T(MR,MC)+C(MR,MRC)*TR(MRC,MC)

KROW=0


```

DO 203 IJ=1,MH
203 KROW=KROW+NXRX(IJ)
   KROW=KROW+(I-1)*NXBXC
DO 208 LR=1,NXRXCS
   NROW=KROW+LR
   KCOL=KROW
DO 208 LC=1,NXRXCS
   NCOL=KCOL+LC
208 TM(NROW,NCOL)=T(LR,LC)
200 CONTINUE
300 CONTINUE
   RETURN
   END

```

CIRAMP

```

SUBROUTINE IRAMP (NIF,MROWS,KCOLS,S,R,C,B,T,TR,TI,TH)
DIMENSION S(45,45),R(45,45),C(45,45),B(45,45),T(45,45),IR(45,45),
1      TI(45,45),TH(45,45)

```

```

COMMON/C1/KROX(1000),XF(5),YE(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
COMMON/C4/MOR(50),NHL(50),KC(50),KL(20),BSL(20),DXE(7),TPI,U
COMMON/C5/X,Y,DX,DY,EM,EK,EKB,EKR,NP,PP,NB,NBOX,KODE,MODE,NBW,NBT
COMMON/C7/XAIC(10,10,2),YAIC(10,2),NXHX(40),NYBX(40),NXBXC
COMMON/C8/NXWING,NYWING,NXCS,NYCS

```

```

MR=NBS

```

```

KCOLS=NXWING*NYWING+NXCS*NYCS

```

```

KROWS=0

```

```

DO 19 I=1,MR

```

```

19 KROWS=NXB(1)+NXBXC+KROWS

```

```

C *** ZERO TH MATRIX FOR SPANWISE INTERPOLATION

```

```

DO 20 I=1,KROWS

```

```

DO 20 J=1,KCOLS

```

```

20 TH(I,J)=0.0

```

```

C *** SPANWISE INTERPOLATION (WING)

```

```

IF (NYWING .EQ. 0) GO TO 1999

```

```

DO 1000 I=1,NXWING

```

```

CALL HMAT (NYWING,NRSH,NCSB,B)

```

```

CALL IMAT (NYWING,2,1,1,MSIZE,1,T,R)

```

```

DO 1001 MR=1,MSIZE

```

```

DO 1001 MC=1,NCSB

```

```

TR(MR,MC)=0.0

```

```

DO 1001 MRC=1,MSIZE

```

```

1001 TR(MR,MC)=TR(MR,MC)+T(MR,MRC)*B(MRC,MC)

```

```

CALL SMAT (MR,NYWING,1,NRSC,NCSC,S)

```

```

DO 1002 MR=1,NRSC

```

```

DO 1002 MC=1,NCSB

```

```

T(MR,MC)=0.0

```

```

DO 1002 MRC=1,NCSC

```

```

1002 T(MR,MC)=T(MR,MC)+S(MR,MRC)*TR(MRC,MC)

```

```

KROW=(I-1)*MR

```

```

DO 1080 LR=1,MR

```

```

LROW=KROW+LR

```

```

KCOL=(I-1)*NYWING

```

```

DO 1080 LC=1,NYWING

```

```

LCOL=KCOL+LC

```

```

1080 TH(LROW,LCOL)=T(LR,LC)

```

```

1000 CONTINUE

```

```

1999 CONTINUE

```

```

C *** SPANWISE TRANSFORMATION (CONTROL SURFACE)

```

```

IF (NYCS .EQ. 0) GO TO 2999

```

```

DO 2000 I=1,NXCS

```

```

CALL HMAT (NYCS,NRSH,NCSB,B)

```

```

CALL IMAT (NYCS,2,2,1,MSIZE,1,T,R)

```

```

DO 2001 MR=1,MSIZE

```

```

DO 2001 MC=1,NCSB

```

```

TR(MR,MC)=0.0

```

```

DO 2001 MRC=1,MSIZE

```

```

2001 TR(MR,MC)=TR(MR,MC)+T(MR,MRC)*B(MRC,MC)

```

```

CALL SMAT (MR,NYCS,2,NRSC,NCSC,S)

```

```

DO 2002 MR=1,NRSC

```

```

DO 2002 MC=1,NCSB

```

```

T(MR,MC)=0.0

```

```

DO 2002 MRC=1,NCSC

```

```

2002 T(MR,MC)=T(MR,MC)+S(MR,MRC)*TR(MRC,MC)

```

```

KROW=MR*NXWING+(I-1)*MR

```

```

DO 2080 LR=1,MR

```

```

      IROW=KROW+IR
      KCOL=NXWING*NYWING+(I-1)*NYCS
      DO 2080 LC=1,NYCS
      ICOL=KCOL+LC
2080  TM(IROW,LCOL)=T(LR,LC)
2000  CONTINUE
2999  CONTINUE
C *** REARRANGE ROWS AND COLUMNS FOR CHORDWISE TRANSFORMATION
      CALL RMAT (MR,NXWING,MR,NXCS,MSIZE,R)
      DO 2050 MR=1,MSIZE
      DO 2050 MC=1,KCOLS
      TI(MR,MC)=0.0
      DO 2050 MRC=1,KROWS
2050  TI(MR,MC)=TI(MR,MC)+R(MR,MRC)*TM(MRC,PC)
C *** ZERO TM MATRIX FOR CHORDWISE INTERPOLATION
      MCOLS=MB*(NXWING+NXCS)
      MROWS=0
      DO 10 I=1,MB
10    MROWS=MROWS+NXRX(I)+NXRXCS
      DO 60 I=1,MROWS
      DO 60 J=1,MCOLS
60    TM(I,J)=0.0
C *** CHORDWISE INTERPOLATION (WING)
      IF (NXWING.EQ. 0) GO TO 3999
      DO 3000 I=1,MB
      CALL RMAT (NXWING,NRSH,NCSB,B)
      CALL TMAT (NXWING,1,1,1,MSIZE,1,T,R)
      DO 3001 MR=1,MSIZE
      DO 3001 MC=1,NCSB
      TR(MR,MC)=0.0
      DO 3001 MRC=1,MSIZE
3001  TR(MR,MC)=TR(MR,MC)+T(MR,MRC)*B(MRC,MC)
      CALL CMAT (NXWING,1,NIF,1,NRSC,NCSC,1,C)
      DO 3002 MR=1,NRSC
      DO 3002 MC=1,NCSB
      T(MR,MC)=0.0
      DO 3002 MRC=1,NCSC
3002  T(MR,MC)=T(MR,MC)+C(MR,MRC)*TR(MRC,PC)
      KROW=0
      DO 40 II=1,I
40    KROW=KROW+NXRX(II)
      KROW=KROW-NXRX(I)
      IJ=NXHX(I)
      DO 3080 LR=1,IJ
      IROW=KROW+LR
      KCOL=(I-1)*NXWING
      DO 3080 LC=1,NXWING
      ICOL=KCOL+LC
3080  TM(IROW,ICOL)=T(LR,LC)
3000  CONTINUE
3999  CONTINUE
C *** CHORDWISE INTERPOLATION (CONTROL SURFACE)
      IF (NXCS.EQ. 0) GO TO 4999
      DO 4000 I=1,MB
      CALL RMAT (NXCS,NRSH,NCSB,B)
      CALL TMAT (NXCS,1,2,1,MSIZE,1,T,R)
      DO 4001 MR=1,MSIZE
      DO 4001 MC=1,NCSB
      TR(MR,MC)=0.0
      DO 4001 MRC=1,MSIZE
4001  TR(MR,MC)=TR(MR,MC)+T(MR,MRC)*B(MRC,MC)

```

```

CALL CMAT (NXCS,1,NIF,2,NRSC,NCSC,1,C)
DO 4002 MR=1,NRSC
DO 4002 MC=1,NCSC
T(MR,MC)=0.0
DO 4002 MRC=1,NCSC
4002 T(MR,MC)=T(MR,MC)+C(MR,MRC)*TR(MRC,MC)
KROW=LROW+(I-1)*NXBXCS
DO 4080 LR=1,NXBXCS
NROW=KROW+LR
KCOL=MB+NXWING+(I-1)*NXCS
DO 4080 LC=1,NXCS
NCOL=KCOL+LC
4080 TM(NROW,NCOL)=T(LR,LC)
4090 CONTINUE
4999 CONTINUE
DO 5001 MR=1,MROWS
DO 5001 MC=1,KCOLS
TR(MR,MC)=0.0
DO 5001 MRC=1,MCOLS
5001 TR(MR,MC)=TR(MR,MC)+TM(MR,MRC)*TI(MRC,MC)
CALL RMAT (NYWING,NYWING,NXCS,NYCS,MSIZE,R)
DO 5050 I=1,MROWS
DO 5050 J=1,MSIZE
TI(I,J)=0.0
DO 5050 K=1,MSIZE
5050 TI(I,J)=TI(I,J)+TR(I,K)*R(K,J)
DO 5052 I=1,MROWS
DO 5052 J=1,MSIZE
5052 TR(I,J)=TI(I,J)
RETURN
END

```

```

CRSL5      BSLS
SUBROUTINE HSL(S(ARG,N)
COMMON/C4/MUR(50),NBL(50),KC(50),KL(28),BSL(20),DXE(7),IPI,U
DO 1 I=1,20
1 BSL(I) = 0.0
ASQ = ARG**2
IF(ASQ.LT.0.01) GO TO 50
N = MIN1(17.0,(ARG + 10.0))
F = 2*N + 4
HSL(N+2) = (4.0*F*(F-1.0)/ASQ-(F-1.0)/F)*0.3F-30
PF = 0.0
J = 0
DO 10 I = J,N
M = N - I + 1
F = 2*M + 1
HSL(M) = (4.0*(F-1.0)/ASQ-1.0/F-1.0/(F-2.0))*HSL(M+1)-HSL(M+2)/F
10 PF = PF + 2.0*(F-2.0)*BSL(M+1)
PF = PF + HSL(1)
F = 0.0
IF(ABS(PF).GT.1.0) F = ABS(PF)*1.E-10
N = N + 2
DO 30 I = 1,N
IF(F.GE.ABS(HSL(I))) GO TO 20
HSL(I) = BSL(I)/PF
GO TO 30
20 BSL(I) = 0.0
30 CONTINUE
RETURN
50 HSL(2) = 0.125*ASQ
HSL(1) = 1.0 - 2.0*HSL(2)
N = 2
RETURN
END

```

CCONS

CONS

WLOCK DATA

COMPLEX CZERO,VPIC,SS,PHIW,SPHI,PHI,PHITE,DPHI

COMMON/C1/KROX(1000),XE(5),YE(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS

COMMON/C2/AS,NMACH,FMACH(6),NFREQ,FREQ(10),NMODE,NSURF,LPUNCH,KF

COMMON/C3/VPIC(2025),SS(2025),PHIW(50),SPHI,CZERO,PHI,PHITE,DPHI

COMMON/C4/MOR(50),NBL(50),KC(50),KL(26),BSL(20),DXE(7),TPI,U

COMMON/C5/X,Y,DX,DY,EM,EK,EKB,EKR,NP,MP,NH,NBOX,KUDE,MODE,NBW,NBT

COMMON/C6/XI,NS,K,J,IFR,TWL,RHO

COMMON/C7/XAIC(10,10,2),YAIC(10,2),NXBX(40),NYBX(40),NXBXCS

COMMON/C8/NXWING,NYWING,NXCS,NYCS

DATA KC/1,2,4,7,11,16,22,29,37,46,56,67,79,92,106,121,137,154,172,
1191,211,232,254,277,301,326,352,379,407,436,466,497,529,562,596,
2631,667,704,742,781,821,862,904,947,991,1036,1082,1129,1177,1226/
JTP/6.2831853/,CZERO/(0.0,0.0)/

DATA KL/1,1,1,2,3,1,4,5,6,1,7,8,9,10,1,11,12,13,14,15,1,16,17,18,
1 19,20,21,1/

END

CCAF1

CAFI

SUBROUTINE CAFI

COMPLEX CZERO,VPIC,SS,PHIW,SPHI,PHI,PHITE,DPHI

DIMENSION P(5),W(5)

COMMON/C1/KHDX(1000),XE(5),YE(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS

COMMON/C2/AS,NMACH,FMACH(6),NFREQ,FREQ(10),NMODE,NSURF,IPUNCH,KF

COMMON/C3/VPIC(2025),SS(2025),PHIW(50),SPHI,CZERO,PHI,PHITE,DPHI

COMMON/C4/MOH(50),NHL(50),KC(50),KL(20),BSL(20),DXE(7),IPI,U

COMMON/C5/X,Y,DX,DY,EH,EK,EKB,EKR,NP,NP,NH,NBOX,KODE,MODE,NBW,NBT

COMMON/C6/XI,NS,K,J,IFR,TWL,RHO

DATA P/0.95308992,0.76923465,0.5,0.23076535,0.84691008/

1 W/0.11846344,0.23931434,0.28444444,0.23931434,0.11846344/

PI = IPI/2.0

IF(EKB.GT.0.0) GO TO 10

VPIC = (-1.0,0.0)

GO TO 30

10 VPIC = CZERO

DO 20 I = 1,5

ARG = FKB*P(I)/2.0

F = -(0.5*ARG/FM)**2

ZJ = 1.0

FI = 1.0

AE = 1.0

DO 15 K = 1,20

AF = AE * F/FI**2

FI = FI + 1.0

IF(ABS(AE).LE.1.E-5) GO TO 20

15 ZJ = ZJ + AF

20 VPIC = VPIC - ZJ*W(I)*CMPLX(COS(ARG),-SIN(ARG))

30 DO 80 NP = 2,NBOX

KI = KC(NP)

KZ = KC(NP+1) - 1

DO 40 K = KI,K7

40 VPIC(K) = CZERO

NH = NP - 1

DO 80 I = 1,5

X = FLOAT(NH) - 0.5 + P(I)

ARG = EKB*X

PHI = W(I)*CMPLX(-COS(ARG),SIN(ARG))*2.0/PI

CALL HSL(S(ARG/FM,N))

K = KC(NP)

DO 70 MP = 1,NH

FOX = (FLOAT(MP) - 0.5)/X

C = SQR(1.0 - FOX**2)

AF = 2.0*ATAN(FOX/(1.0 + C))

S = 2.0*FOX*C

C = 2.0*C*C - 1.0

SO = 0.0

VIN = BSL*AF

F = 1.0

FI = 1.0

DO 50 I = 1,N

VIN = HSL(I+1)*S/FI - VIN

SN = 2.0*S*C - SO

SO = S

S = SN

F = -F

50 FI = FI + 1.0

DPHI = PHI*VIN*F

VPIC(K) = VPIC(K) + DPHI

VPIC(K+1) = VPIC(K+1) - DPHI

```
IF(MP.EQ.1) VPIC(K) = VPIC(K) + DPHI  
70 K = K + 1  
80 VPIC(K) = VPIC(K) + PI*BSL*PHI/2.0  
RETURN  
END
```



```

CPHIB      PHIB
SUBROUTINE PHIB
COMPLEX CZERO,VPIC,SS,PHIW,SPHI,PHI,PHITE,DPHI
COMMON/C3/VPIC(2025),SS(2025),PHIW(50),SPHI,CZERO,PHI,PHITE,DPHI
COMMON/C4/MUR(50),NHL(50),KC(50),NL(28),BSL(20),DXE(7),IP!,U
COMMON/C5/X,Y,DX,DY,EH,EK,EKB,EKR,NP,PP,NB,NROX,KODE,MODE,NBW,NBT
COMMON/C6/XI,NS,K,J,IFR,TWL,RHO
DO 20 I=2,NP
NU=NP-I+1
JL=MAX0(1,MP-I+1)
JR=MIN0(MOB(NU),MP-I-1)
NJ=NH1(NU)+JI
DO 20 J=JI,JR
K=KC(I)+IABS(MP-J)
DPHI=VPIC(K)
IF (J.GT.1-MP+1.OR.J.F0.1) GO TO 10
K=KC(I)+MP+J-2
DPHI=DPHI+VPIC(K)
10 SPHI=SPHI+DPHI*SS(NJ)
20 NJ=NJ+1
RETURN
END

```

CARLF

ARLE

FUNCTION ARIF(TOB)

COMMON/C1/KROX(1000),XF(5),YE(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS

COMMON/C5/X, DY,EM,EK,EKB,EKR,NP,PP,NH,NBOX,KODE,MODE,NBW,NBT

COMMON/C6/XI,US,K,J,IFR,TWL,RHO

IF(X-0.5*DX.GE.X1-X2) GO TO 10

IF (TOB .EQ. 0.0 .OR. TOB .GT. 1.0F+10) GO TO 20

YT = (Y-Y1)/DY+0.5-(X/DX-0.5)/TOB

XR = YT*TOB

YR = AMAX1(0.0,AMIN1(1.0,YT-1.0/TOB))

YT = AMIN1(1.0,AMAX1(0.0,YT))

XL = AMAX1(0.0,AMIN1(1.0,XR-TOB))

XP = AMIN1(1.0,AMAX1(0.0,XR))

ARLE = AMAX1(0.5*(YT*(XR+XL)+YB*(XR-XL)),0.0)

IF(MP.EQ.1) ARIF = 2.0*ARLE

RETURN

10 ARLE = AMIN1(1.0,AMAX1(0.0,(Y-Y2)/DY+0.5))

RETURN

20 ARIF = 0.0

RETURN

END

CCMAT

SUBROUTINE CMAT (NAICPX,IY,NIF,NS,NRS,NCS,NE,C)

DIMENSION C(45,45)

COMMON/C1/KROX(1000),XF(5),YE(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS

COMMON/C5/X,Y,DX,DY,EM,EK,EKB,EKR,NP,PP,NB,NBOX,KODE,MODE,NBW,NBT

COMMON/C7/XAIC(10,10,2),YAIC(10,2),NXBX(40),NYBX(40),NXBXCS

COMMON/C8/NXWING,NYWING,NXCS,NYCS

C *** FOR CHORDWISE INTERPOLATION

C *** NPTS = NUMBER OF CHORDWISE MACH BOXES

C *** NAICPX = NUMBER OF CHORDWISE AIC CONTROL POINTS

C *** IY = SPAN NUMBER

C *** NIF = CONTROL FOR DIFFERENTIATION (1=NO DERIVATIVE AND 2=D()/DX)

C *** NS = SURFACE (1=WING AND 2=TAIL)

IF (NAICPX .GT. 3) GO TO 3

NRS=NXBX(IY)

IF (NS .EQ. 2) NRS=NXBXCS

NCS=NAICPX

DO 1 I=1,NRS

DO 1 J=1,NCS

1 C(I,J)=0.0

GO TO 100

3 NRS=NXBX(IY)

IF (NS .EQ. 2) NRS=NXBXCS

NCS=3*(NAICPX-2)

DO 4 I=1,NRS

DO 4 J=1,NCS

4 C(I,J)=0.0

100 IF (NCS .GT. 6) GO TO 500

IF (NCS .EQ. 6) GO TO 400

GO TO (200,200,300),NCS

C *** TWO CHORDWISE AIC CONTROL POINTS

200 DO 210 I=1,NRS

C(I,1)=1.0

C(I,2)=XBOX(I,IY,NS,NE)

IF (NIF .EQ. 2) C(I,1)=0.0

IF (NIF .EQ. 2) C(I,2)=1.0

210 CONTINUE

RETURN

C *** THREE CHORDWISE AIC CONTROL POINTS

300 DO 310 I=1,NRS

C(I,1)=1.0

C(I,2)=XBOX(I,IY,NS,NE)

C(I,3)=XBOX(I,IY,NS,NE)**2

IF (NIF .EQ. 2) C(I,1)=0.0

IF (NIF .EQ. 2) C(I,2)=1.0

IF (NIF .EQ. 2) C(I,3)=2.0*XBOX(I,IY,NS,NE)

310 CONTINUE

RETURN

C *** FOUR CHORDWISE AIC CONTROL POINTS

400 DO 410 I=1,NRS

NX=NAICPX-1

DO 406 J=1,NX

IF (0.5*(XINT(J,IY,NS,NE)+XINT(J+1,IY,NS,NE)) .GT. XBOX(I,IY,NS,NE) 1) GO TO 407

406 CONTINUE

NX=NAICPX

DO 408

407 NX=J

408 KC=1

IF (NX .GT. 2) KC=4

C(I,KC)=1.0

```

      C(I,KC+1)=XROX(I,IY,NS,NE)
      C(I,KC+2)=C(I,KC+1)**2
      IF (NIF .EQ. 2) C(I,KC)=0.0
      IF (NIF .EQ. 2) C(I,KC+1)=1.0
      IF (NIF .EQ. 2) C(I,KC+2)=2.0*XBOX(I,IY,NS,NE)
410  CONTINUE
      RETURN
C *** .GT. FOUR AIC CONTROL POINTS
500  DO 510 I=1,NRS
      NX=NAICPX-1
      DO 506 J=1,NX
      IF (0.5*(XINT(J,IY,NS,NE)+XINT(J+1,IY,NS,NE)) .GT. XBOX(I,IY,NS,NE)
1) GO TO 507
506  CONTINUE
      NX=NAICPX
      GO TO 508
507  NX=J
508  IF (NX .LT. 3) GO TO 550
      IF (NX .GT. NAICPX-2) GO TO 580
      KC=(NX-2)*3+1
      C(I,KC)=1.0
      C(I,KC+1)=XROX(I,IY,NS,NE)
      C(I,KC+2)=C(I,KC+1)**2
      IF (NIF .EQ. 2) C(I,KC+1)=1.0
      IF (NIF .EQ. 2) C(I,KC+2)=XBOX(I,IY,NS,NE)
      IF (NIF .EQ. 2) C(I,KC)=0.0
      GO TO 510
550  C(I,1)=1.0
      C(I,2)=XROX(I,IY,NS,NE)
      C(I,3)=C(I,2)**2
      IF (NIF .EQ. 2) C(I,1)=0.0
      IF (NIF .EQ. 2) C(I,2)=1.0
      IF (NIF .EQ. 2) C(I,3)=XBOX(I,IY,NS,NE)
      GO TO 510
580  C(I,NCS-2)=1.0
      C(I,NCS-1)=XROX(I,IY,NS,NE)
      C(I,NCS)=C(I,NCS-1)**2
      IF (NIF .EQ. 2) C(I,NCS-2)=0.0
      IF (NIF .EQ. 2) C(I,NCS-1)=1.0
      IF (NIF .EQ. 2) C(I,NCS)=XBOX(I,IY,NS,NE)
510  CONTINUE
      RETURN
      END

```

CRMAT

```
SUBROUTINE RMAT (NXWING,NYWING,NXCS,NYCS,MSIZE,R)
  DIMENSION R(45,45)
  MSIZE=NXWING*NYWING+NXCS*NYCS
  DO 100 I=1,MSIZE
    DO 100 J=1,MSIZE
100  R(I,J)=0.0
    IF (NXWING .EQ. 0) GO TO 250
    K=1
    KK=1
    II=NYWING*NXWING
    DO 200 I=1,II
      R(I,K)=1.0
      K=K+NXWING
      IF (K .GT. II) KK=KK+1
      IF (K .GT. II) K=KK
200  CONTINUE
250  CONTINUE
    IF (NXCS .EQ. 0) GO TO 350
    II=NXCS*NYWING
    K=NXWING*NYWING+1
    KK=NXWING*NYWING+1
    DO 300 I=1,II
      IK=1+NXWING*NYWING
      R(IK,K)=1.0
      K=K+NXCS
      IF (K .GT. MSIZE) KK=KK+1
      IF (K .GT. MSIZE) K=KK
300  CONTINUE
350  CONTINUE
    RETURN
  END
```

CXINT

```
FUNCTION XINT(NX,NY,NS,NE)
COMMON/C1/KROX(1000),XF(5),YE(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
COMMON/C4/MOR(50),NHL(50),KC(50),KL(28),BSL(20),DXF(7),TPI,U
COMMON/C5/X,Y,DX,DY,FM,EK,EKR,EKR,NP,PP,NH,NBOX,KODE,MODE,NBW,NBT
COMMON/C7/XAIC(10,10,2),YAIC(10,2),NXBX(40),NYBX(40),NXBXC5
COMMON/C8/NXWING,NYWING,NXCS,NYCS
IF (NE .GT. 1) GO TO 400
IF (NS .EQ. 1) GO TO 200
XINT=XAIC(NX,1,NS)
RETURN
200 IF (FLOAT(NY)*DY-DY .GE. YE(2)) GO TO 300
XINT=XAIC(NX,1,NS)
RETURN
300 IF (YAIC(1,1) .LE. YE(2))
1SLOPE=(YAIC(NYWING,1)-YE(2))/(XAIC(NX,NYWING,1)-XAIC(NX,1,1))
IF (YAIC(1,1) .GT. YE(2))
1SLOPE=(YAIC(NYWING,1)-YAIC(1,1))/(XAIC(NX,NYWING,1)-XAIC(NX,1,1))
IF (YAIC(1,1) .LE. YE(2))
1XINT=(DY*FLOAT(NY)-DY-YE(2)+YE(1))/SLOPE + XAIC(NX,1,1)
IF (YAIC(1,1) .GT. YE(2))
1XINT=(DY*FLOAT(NY)-DY-YAIC(1,1)+YE(1))/SLOPE + XAIC(NX,1,1)
RETURN
400 XINT=DX*(FLOAT(NX)-0.5)
RETURN
END
```

CXBOX

```
FUNCTION XBOX(NX,NY,NS,NE)
COMMON/C1/KHGX(1000),XE(5),YE(3),X1,X2,X3,X4,Y1,Y2,BF1A,NBS
COMMON/C5/X,Y,DX,DY,EM,EK,EKB,EKR,NP,PP,NB,NBOX,KODE,MODE,NBW,NBT
COMMON/C7/XAIC(10,10,2),YAIC(10,2),NXBX(40),NYBX(40),NXBXC5
IF (NE .GT. 1) GO TO 300
IF (NS .EQ. 2) GO TO 200
XBOX=DX*(FLOAT(NXBX(1))-FLOAT(NXBX(NY)))+DX*FLOAT(NX)-0.5*DX
RETURN
200 XBOX=XE(4)+DX*(FLOAT(NX)-0.5)
RETURN
300 XBOX=DX*(FLOAT(NX)-0.5)
RETURN
END
```

CYBOX

```
FUNCTION YBOX(NY)
COMMON/C5/X,Y,DX,DY,FM,EK,EKB,EKR,NP,MP,NB,NBOX,KODE,MODE,NBW,NBT
YBOX=DY*(FLOAT(NY)-1.0)
RETURN
END
```



```

C BMAT
  SUBROUTINE BMAT (NPTS,IROWS,ICOLS,B)
    DIMENSION B(45,45)
C *** B = B(IROWS,ICOLS) MATRIX
C *** NPTS = NUMBER OF AIC STATIONS ALONG STRIP (CHORDWISE OR SPANWISE)
    ICOLS=NPTS
    IF (NPTS .GT. 3) GO TO 200
    IROWS=NPTS
    DO 50 I=1,IROWS
    DO 50 J=1,ICOLS
      B(I,J)=0.0
      IF (I .EQ. J) B(I,J)=1.0
    50 CONTINUE
    RETURN
  200 IROWS=6+(NPTS-4)*3
    DO 300 I=1,IROWS
    DO 300 J=1,ICOLS
  300 B(I,J)=0.0
      B(1,1)=1.0
      B(2,2)=1.0
      B(IROWS,ICOLS)=1.0
      B(IROWS-1,ICOLS-1)=1.0
      IF (NPTS .EQ. 4) GO TO 400
      K=NPTS-4
      DO 350 I=1,K
        NR=2+3*I
        NC=2+I
  350 B(NR,NC)=1.0
  400 RETURN
    END

```

CSMAT

```

SURROUTINE SMAT (NIY,NAICPY,NS,NRS,NCS,S)
DIMENSION S(45,45)
COMMON/C7/XAIC(10,10,2),YAIC(10,2),NXBX(40),NYBX(40),NXBXCS
COMMON/C8/NXWING,NYWING,NXCS,NYCS
C *** NAICPY = NUMBER OF SPANWISE AIC CONTROL POINTS
C *** NS = SURFACE (1=WING AND 2=TAIL)
C *** NRS = NUMBER OF ROWS IN S-MATRIX
C *** NCS = NUMBER OF COLUMNS IN S-MATRIX
C
COMMON
IF (NAICPY .GT. 3) GO TO 8
NPS=NIY
NCS=NAICPY
DO 6 I=1,NRS
DO 6 J=1,NCS
6 S(I,J)=0.0
GO TO 100
8 NRS=NIY
NCS=3*(NAICPY-2)
DO 9 I=1,NRS
DO 9 J=1,NCS
9 S(I,J)=0.0
100 IF (NCS .GT. 6) GO TO 500
IF (NCS .EQ. 6) GO TO 400
GO TO (200,200,300),NCS
C *** TWO AIC POINTS
200 DO 260 I=1,NIY
S(I,1)=1.0
S(I,2)=YBOX(I)
260 CONTINUE
RETURN
C *** THREE AIC POINTS
300 DO 360 I=1,NIY
S(I,1)=1.0
S(I,2)=YBOX(I)
S(I,3)=S(I,2)**2
360 CONTINUE
RETURN
C *** FOUR AIC POINTS
400 DO 490 I=1,NIY
IC=4
IF (YBOX(I) .LT. 0.5*(YAIC(2,NS)+YAIC(3,NS))) IC=1
S(I,IC)=1.0
S(I,IC+1)=YBOX(I)
S(I,IC+2)=S(I,IC+1)**2
490 CONTINUE
RETURN
C *** .GT. FOUR AIC POINTS
500 DO 520 I=1,NIY
NI=NAICPY-2
DO 525 J=1,NI
IF (0.5*(YAIC(J,NS)+YAIC(J+1,NS)) .GT. YBOX(I)) GO TO 523
525 CONTINUE
IC=3*NAICPY-8
GO TO 524
523 IC=(J-2)*3+4
IF (J .LT. 3) IC=1
524 S(I,IC)=1.0
S(I,IC+1)=YBOX(I)
S(I,IC+2)=S(I,IC+1)**2
520 CONTINUE

```

RETURN
END

```

CTMAT  TMAT
SUBROUTINE TMAT (NPPTS,ND,NS,IY,MSIZE,NE,T,R)
  DIMENSION T(45,45),R(45,45)
  COMMON/C7/XAIC(10,10,2),YAIC(10,2),NXBX(40),NYBX(40),NXBXC5
  COMMON/C8/NXWING,NYWING,NXCS,NYCS
  C *** GENERATES T**(-1) MATRIX
  C *** NPPTS = NUMBER OF AIC POINTS ALONG STRIP IN ND DIRECTION
  C *** MSIZE = ORDER OF T MATRIX
  C *** NS = SURFACE (1=WING AND 2=CONTROL SURFACE)
  C *** ND = INTERPOLATION DIRECTION (1=CHORDWISE AND 2=SPANWISE)
  IF (NPPTS .LT. 4) MSIZE=NPPTS
  IF (NPPTS .GE. 3) MSIZE=3*NPPTS-6
  DO 1 J=1,MSIZE
  DO 1 K=1,MSIZE
  1 T(J,K)=0.0
  IF (NPPTS .GE. 4) GO TO 5000
  GO TO (2000,2000,3000,4000), NPPTS
  C *** NPPTS=2 (TWO POINTS ALONG STRIP)
  2000 T(1,1)=1.0
  T(2,1)=1.0
  IF (ND .EQ. 1) T(1,2)=XINT(1,IY,NS,NE)
  IF (ND .EQ. 1) T(2,2)=XINT(2,IY,NS,NE)
  IF (ND .EQ. 2) T(1,2)=YAIC(1,NS)
  IF (ND .EQ. 2) T(2,2)=YAIC(2,NS)
  GO TO 6000
  C *** NPPTS=3 (THREE POINTS ALONG STRIP)
  3000 T(1,1)=1.0
  T(2,1)=1.0
  T(3,1)=1.0
  IF (ND .EQ. 2) GO TO 3010
  C *** NPPTS=3 CHORDWISE DIRECTION
  T(1,2)=XINT(1,IY,NS,NE)
  T(1,3)=T(1,2)**2
  T(2,2)=XINT(2,IY,NS,NE)
  T(2,3)=T(2,2)**2
  T(3,2)=XINT(3,IY,NS,NE)
  T(3,3)=T(3,2)**2
  GO TO 6000
  C *** NPPTS=3 SPANWISE DIRECTION
  3010 T(1,2)=YAIC(1,NS)
  T(1,3)=T(1,2)**2
  T(2,2)=YAIC(2,NS)
  T(2,3)=T(2,2)**2
  T(3,2)=YAIC(3,NS)
  T(3,3)=T(3,2)**2
  GO TO 6000
  C *** NPPTS=4 (FOUR POINTS ALONG STRIP)
  4000 T(1,1)=1.0
  T(2,1)=1.0
  T(3,1)=1.0
  T(4,1)=1.0
  T(5,1)=1.0
  T(6,1)=1.0
  T(3,4)=-1.0
  T(4,5)=-1.0
  IF (ND .EQ. 2) GO TO 4010
  C *** NPPTS=4 CHORDWISE DIRECTION
  T(1,2)=XINT(1,IY,NS,NE)
  T(1,3)=T(1,2)**2
  T(2,2)=XINT(2,IY,NS,NE)

```

```

T(2,3)=T(2,2)**2
T(3,2)=0.5*(XINT(2,IY,NS,NF)+XINT(3,IY,NS,NE))
T(3,3)=T(3,2)**2
T(3,5)=-T(3,2)
T(3,6)=-T(3,3)
T(4,3)=2.0*T(3,2)
T(4,6)=-T(4,3)
T(5,5)=XINT(3,IY,NS,NE)
T(5,6)=T(5,5)**2
T(6,5)=XINT(4,IY,NS,NE)
T(6,6)=T(6,5)**2
GO TO 6000

```

C *** NPTS=4 SPANWISE DIRECTION

```

4010 T(1,2)=YAIC(1,NS)
T(1,3)=T(1,2)**2
T(2,2)=YAIC(2,NS)
T(2,3)=T(2,2)**2
T(3,2)=0.5*(YAIC(2,NS)+YAIC(3,NS))
T(3,3)=T(3,2)**2
T(3,5)=-T(3,2)
T(3,6)=-T(3,3)
T(4,3)=2.0*T(3,2)
T(4,6)=-T(4,3)
T(5,5)=YAIC(3,NS)
T(5,6)=T(5,5)**2
T(6,5)=YAIC(4,NS)
T(6,6)=T(6,5)**2
GO TO 6000

```

C *** NPTS .GT. 4

5000 IF (ND.EQ. 2) GO TO 5500

C *** NPTS .GT. 4 (CHORDWISE DIRECTION)

```

T(1,1)=1.0
T(1,2)=XINT(1,IY,NS,NE)
T(1,3)=T(1,2)**2
T(2,1)=1.0
T(2,2)=XINT(2,IY,NS,NE)
T(2,3)=T(2,2)**2
T(MSIZE,MSIZE-2)=1.0
T(MSIZE,MSIZE-1)=XINT(NPTS,IY,NS,NE)
T(MSIZE,MSIZE)=T(MSIZE,MSIZE-1)**2
T(MSIZE-1,MSIZE-2)=1.0
T(MSIZE-1,MSIZE-1)=XINT(NPTS-1,IY,NS F)
T(MSIZE-1,MSIZE)=T(MSIZE-1,MSIZE-1)*
NI=NPTS-4

```

DO 5010 N=1,NI

NR=2+3*N

NC=3*N+1

NP=N+2

T(NR,NC)=1.0

T(NR,NC+1)=XINT(NP,IY,NS,NE)

5010 T(NR,NC+2)=T(NR,NC+1)**2

NI=NPTS-3

DO 5020 N=1,NI

NR=3*N

NC=3*N-2

T(NR,NC)=1.0

T(NR+1,NC+1)=1.0

T(NR,NC+3)=-1.0

T(NR+1,NC+4)=-1.0

T(NR,NC+1)=0.5*(XINT(N+1,IY,NS,NF)+XINT(N+2,IY,NS,NE))

T(NR,NC+2)=T(NR,NC+1)**2

```

T(NR,NC+4)=-T(NR,NC+1)
T(NR,NC+5)=-T(NR,NC+2)
T(NR+1,NC+2)=2.0*T(NR,NC+1)
5020 T(NR+1,NC+5)=-T(NR+1,NC+2)
GO TO 6000
*** NPTS .GT. 4 (SPANWISE DIRECTION)
5500 T(,1)=1.0
T(1,2)=YAIC(1,NS)
T(1,3)=T(1,2)**2
T(2,1)=1.0
T(2,2)=YAIC(2,NS)
T(2,3)=T(2,2)**2
T(MSIZE,MSIZE-2)=1.0
T(MSIZE,MSIZE-1)=YAIC(NPTS,NS)
T(MSIZE,MSIZE)=T(MSIZE,MSIZE-1)**2
T(MSIZE-1,MSIZE-2)=1.0
T(MSIZE-1,MSIZE-1)=YAIC(NPTS-1,NS)
T(MSIZE-1,MSIZE)=T(MSIZE-1,MSIZE-1)**2
NT=NPTS-4
DO 5510 N=1,NT
NR=2+J*N
NC=J*N+1
NP=N+2
T(NR,NC)=1.0
T(NR,NC+1)=YAIC(NP,NS)
5510 T(NR,NC+2)=T(NR,NC+1)**2
NI=NPTS-3
DO 5520 N=1,NI
NR=J*N
NC=J*N-2
T(NR,NC)=1.0
T(NR+1,NC+1)=1.0
T(NR,NC+3)=-1.0
T(NR+1,NC+4)=-1.0
T(NR,NC+1)=0.5*(YAIC(N+1,NS)+YAIC(N+2,NS))
T(NR,NC+2)=T(NR,NC+1)**2
T(NR,NC+4)=-T(NR,NC+1)
T(NR,NC+5)=-T(NR,NC+2)
T(NR+1,NC+2)=2.0*T(NR,NC+1)
5520 T(NR+1,NC+5)=-T(NR+1,NC+2)
*** INVERT T MATRIX
6000 CONTINUE
CALL MINV (MSIZE,I,K)
RETURN
END

```

```

C MINV      MINV
SUBROUTINE MINV (NM,A,U)
  DIMENSION A(45,45),U(45,45)
  DO 9001 I=1,NM
    DO 9001 J=1,NM
      U(I,J)=0.0
      IF (I.EQ.J) U(I,J)=1.0
9001 CONTINUE
  EPS=0.00000001
  DO 9015 I=1,NM
    K=1
    IF (I-NM) 9021,9007,9021
9021 IF (A(I,I)-EPS) 9005,9006,9007
9005 IF (-A(I,I)-EPS) 9006,9006,9007
9006 K=K+1
    DO 9023 J=1,NM
      U(I,J)=U(I,J)+U(K,J)
9023 A(I,J)=A(I,J)+A(K,J)
    GO TO 9021
9007 DIV=A(I,I)
    DO 9009 J=1,NM
      U(I,J)=U(I,J)/DIV
9009 A(I,J)=A(I,J)/DIV
    DO 9015 MM=1,NM
      DELT=A(MM,I)
      IF (ABS(DELT)-EPS) 9015,9015,9016
9016 IF (MM-I) 9010,9015,9010
9010 DO 9011 J=1,NM
      U(MM,J)=U(MM,J)-U(I,J)*DELT
9011 A(MM,J)=A(MM,J)-A(I,J)*DELT
9015 CONTINUE
    DO 9033 I=1,NM
      DO 9033 J=1,NM
9033 A(I,J)=U(I,J)
  RETURN
END

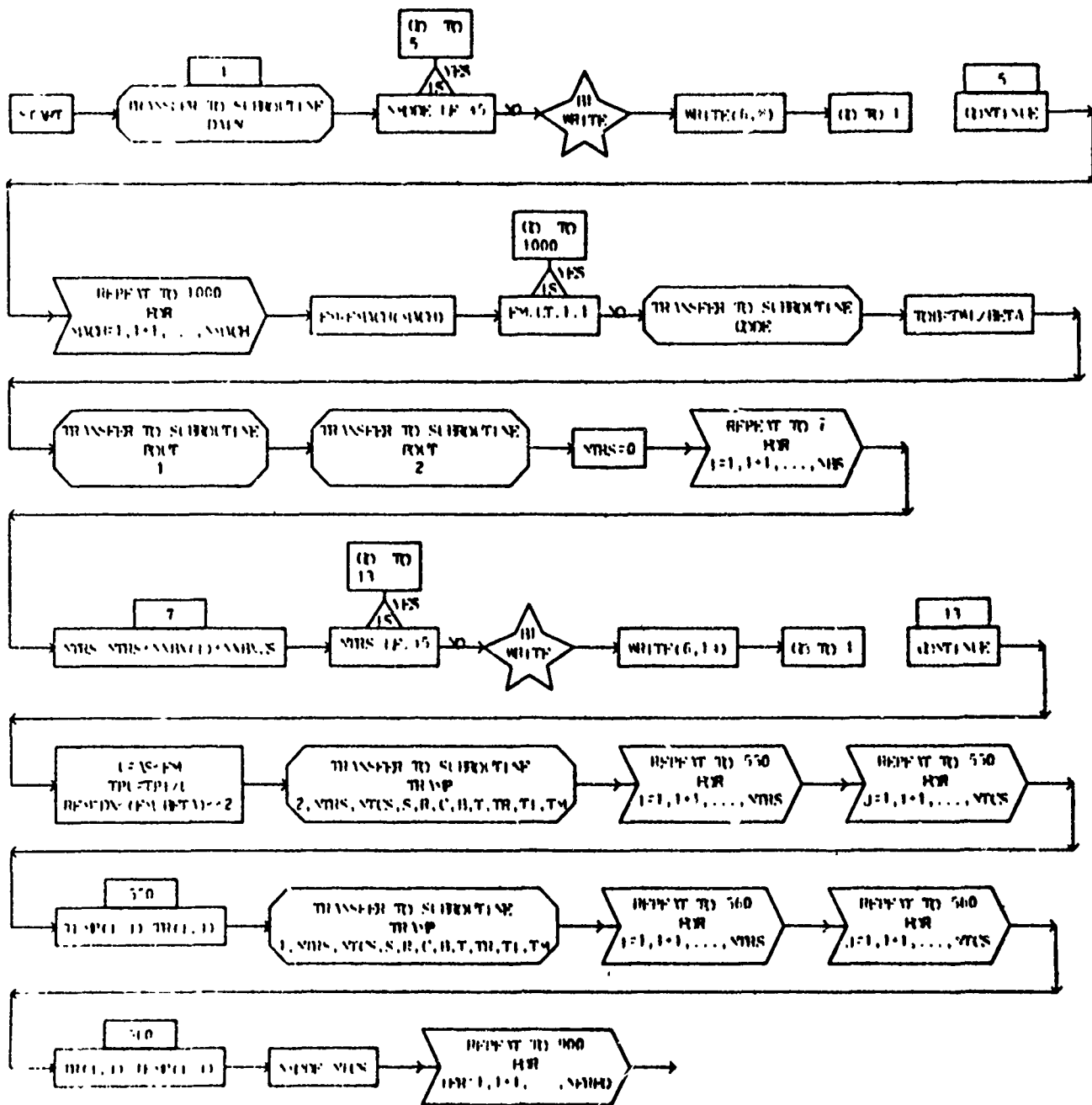
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PART VI - SECTION B5.0

FLOW CHARTS FOR SUPERSONIC AIC
COMPUTER PROGRAM

D I M E N S I O N E D V A R I A B L E S

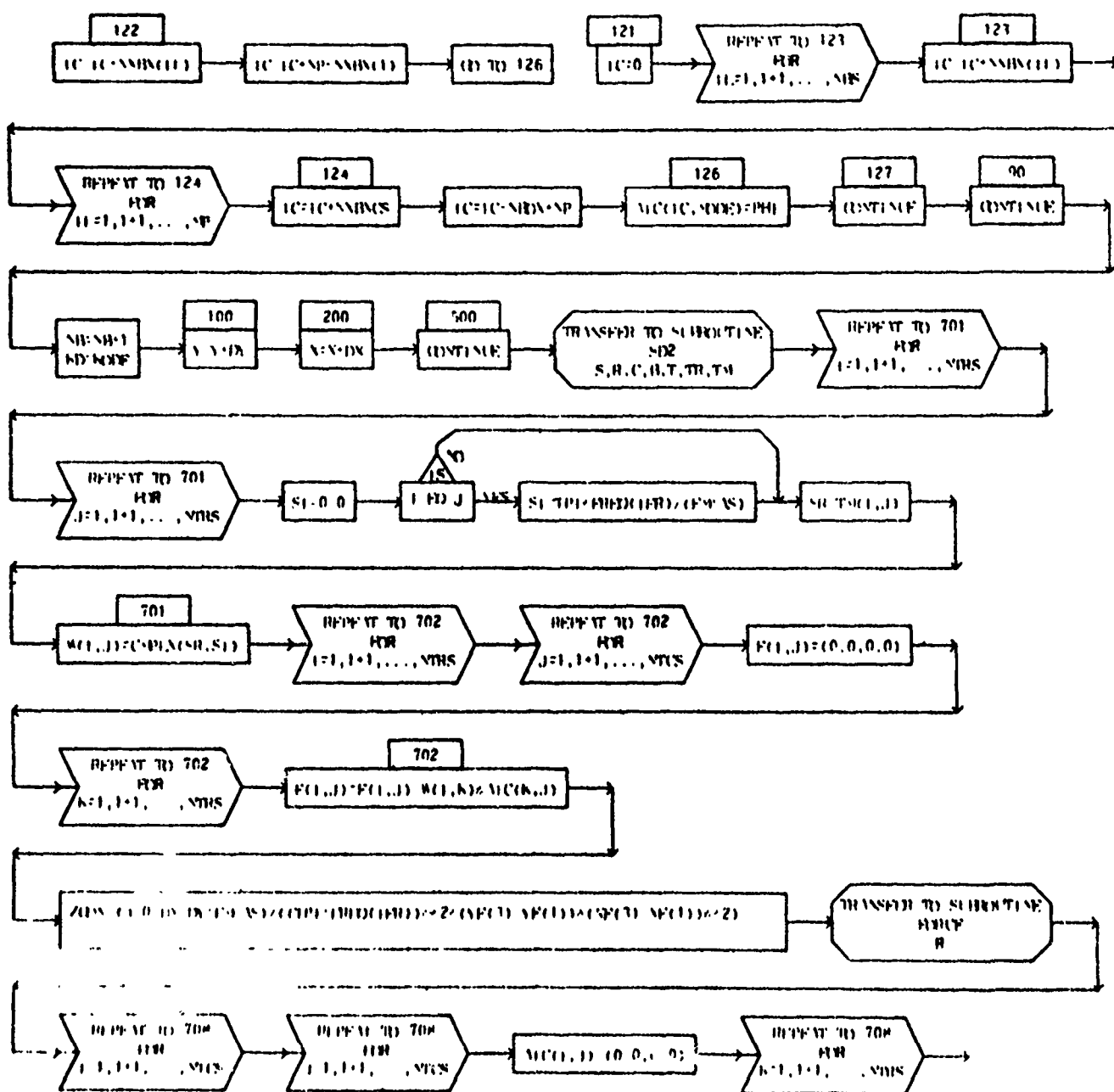
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B	45, 45	C	45, 45	T	45, 45	TM	45, 45	TI	45, 45
TR	45, 45								



242 3

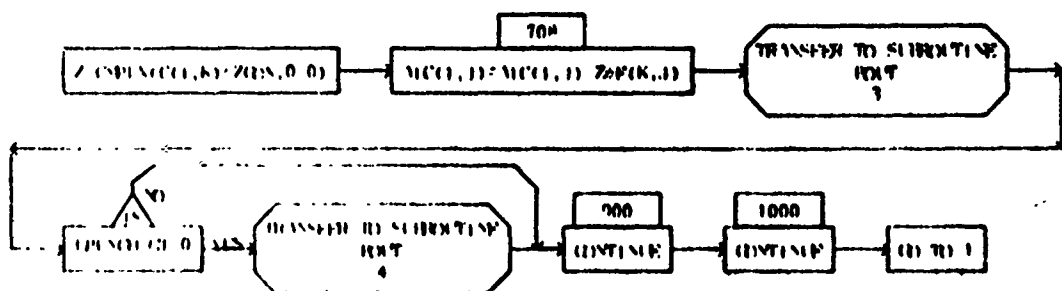


Р.У.Х.



(COMPX (790), PIC, SS, PHA, SPH, PHI, PHTE, IZHI, FNF, W, F, MC, Z

PAGE 3



142 1



PVV 1



742 ?



DIMENSIONED VARIABLES

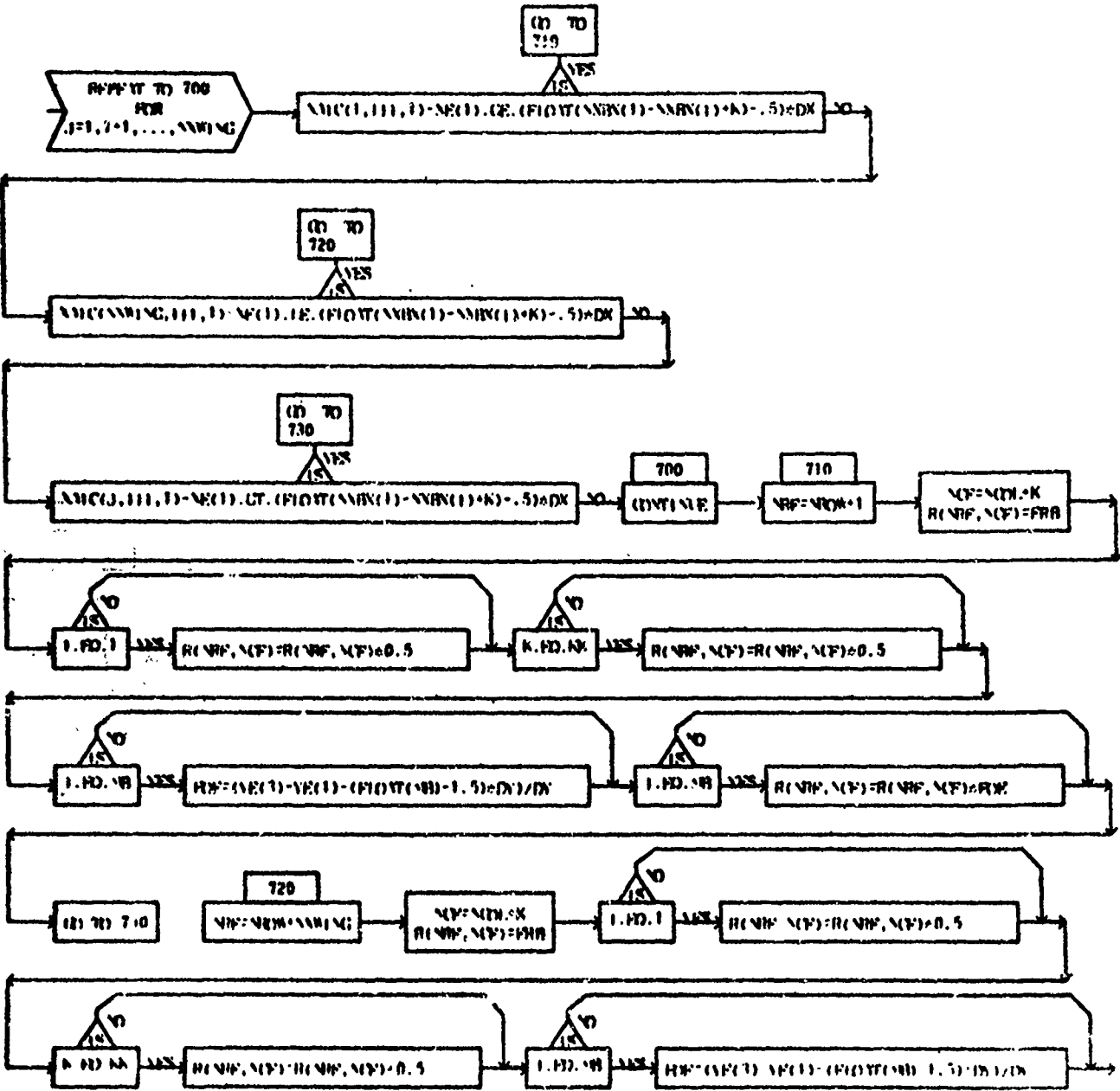
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SAFETY FORCE (R)

NOT REPRODUCIBLE

SUBROUTINE PRCE (M),

PAGE 2



PAGE 3

PAGE 3



PMZ 4



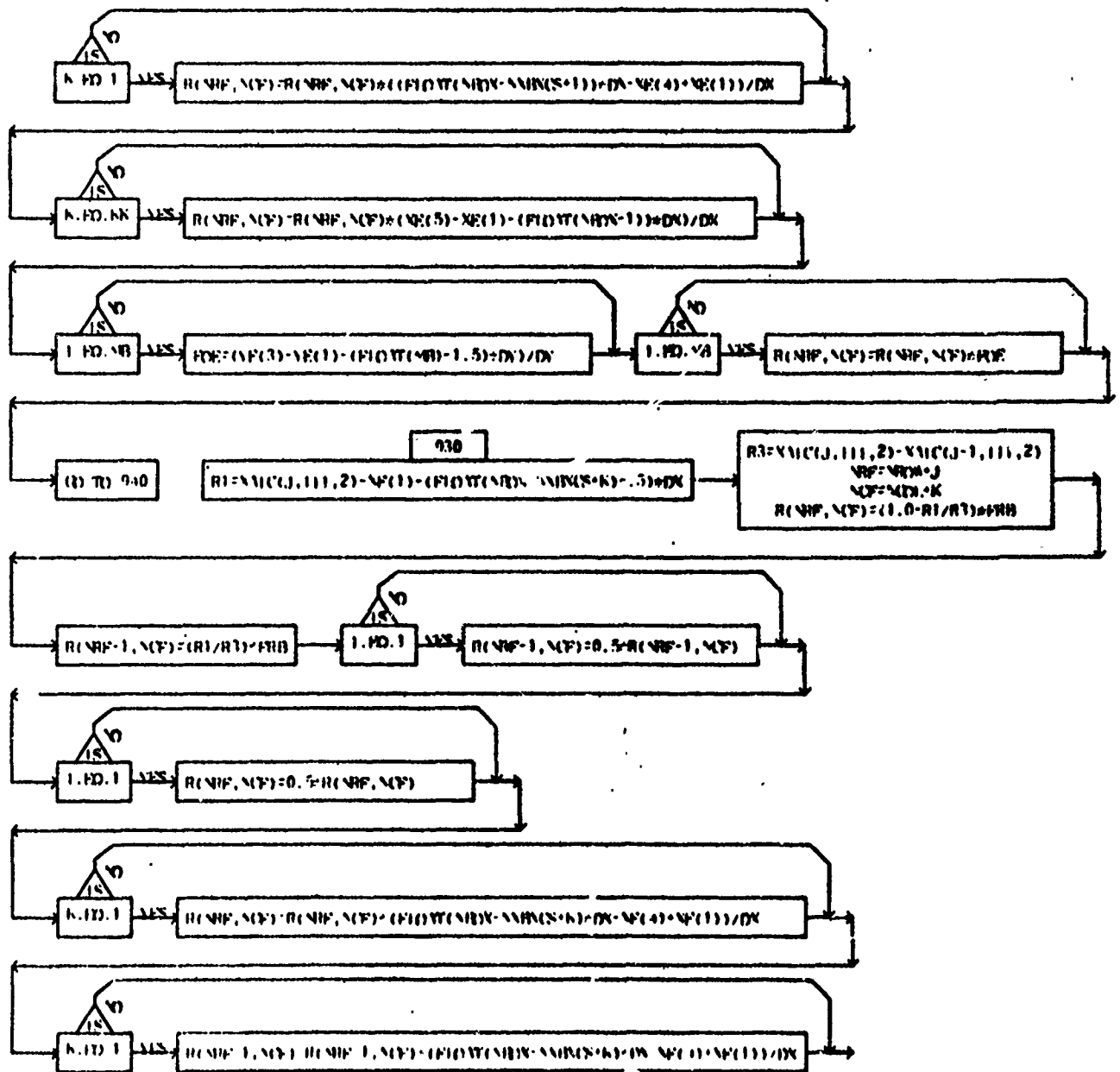
PM2.5





SLURRY MIXER (H)

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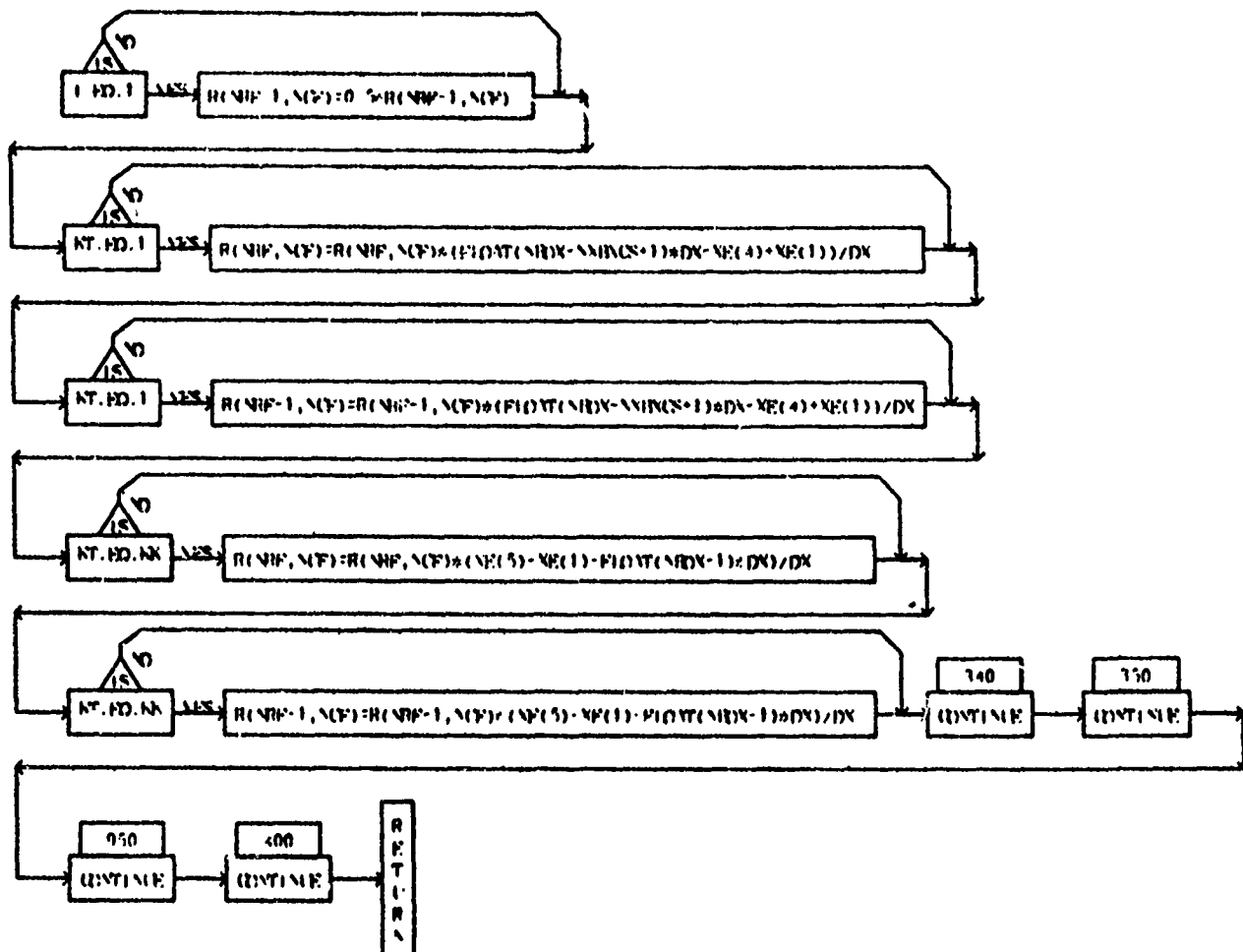
1142





SUBROUTINE FORCE (R)

PAGE 10



DIMENSIONED VARIABLES

SYNTH	STRINGS	SYNTH.	STRINGS	SYNTH.	STRINGS	SYNTH.	STRINGS	SYNTH	STRINGS
1	1.6	SYNTH	2.1	102	1	C	30		

ГЛАВА 1



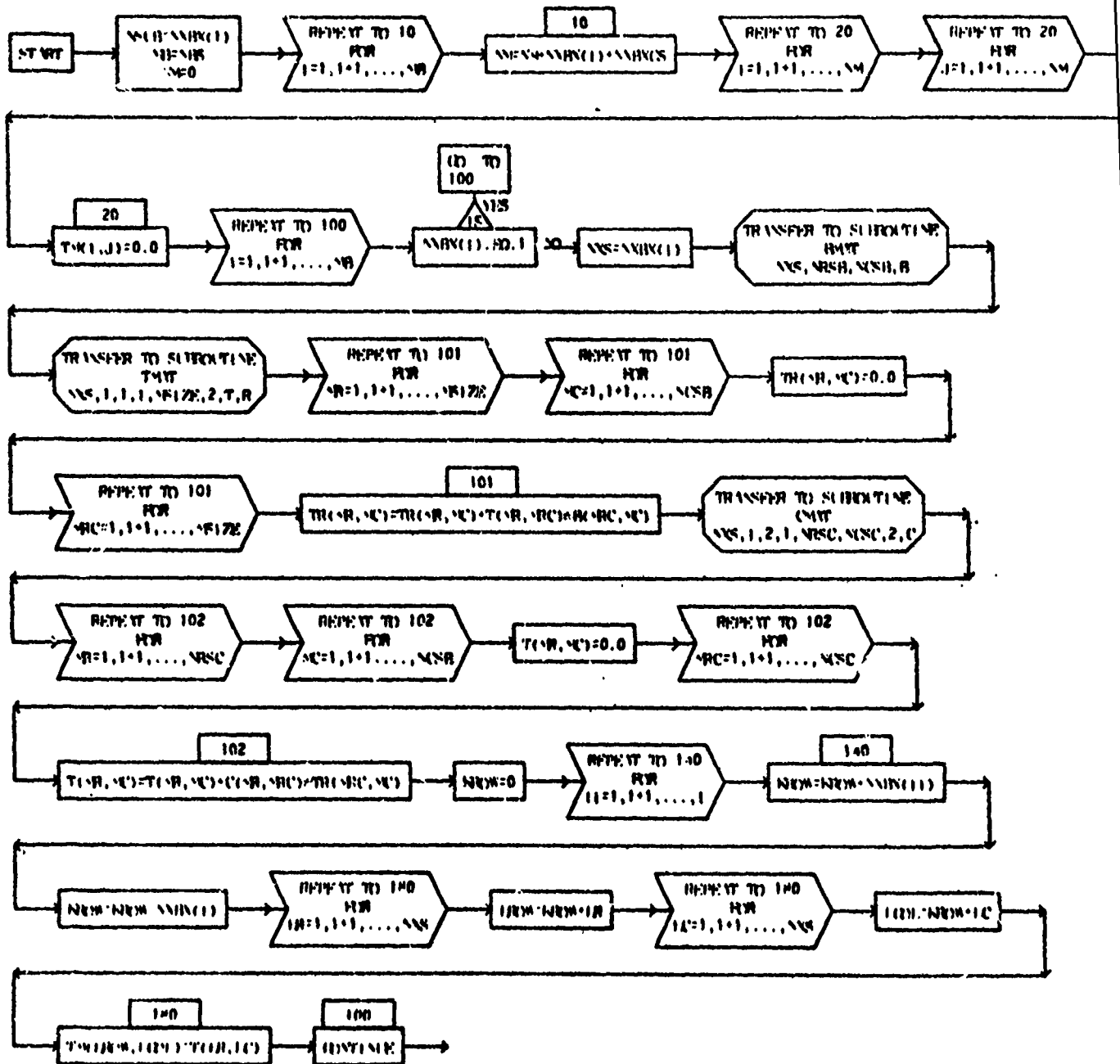
Page 2





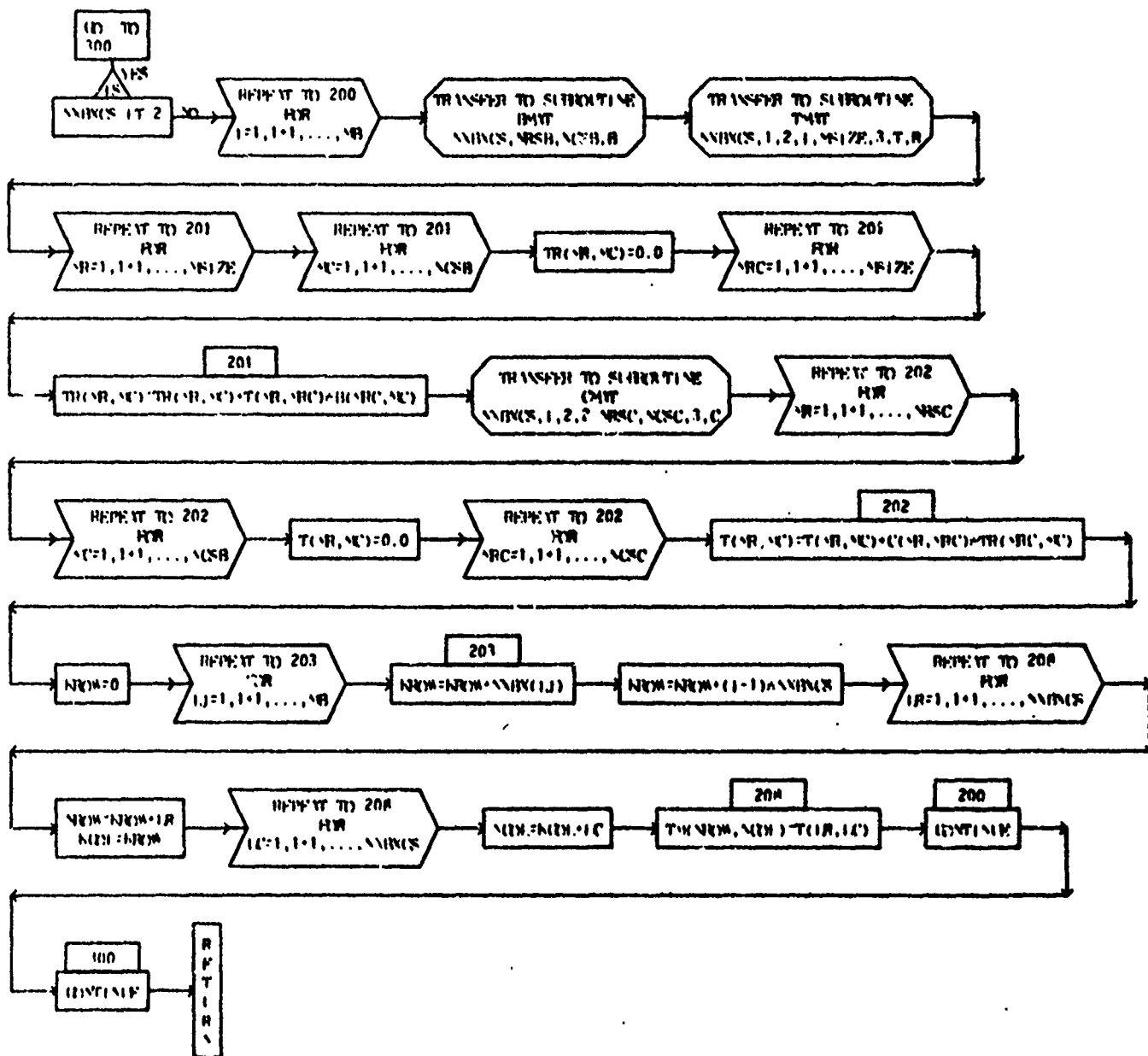
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TR	45,45	TM	45,45						



SUBROUTINE S02 (S,R;C,B,T,TR,TM)

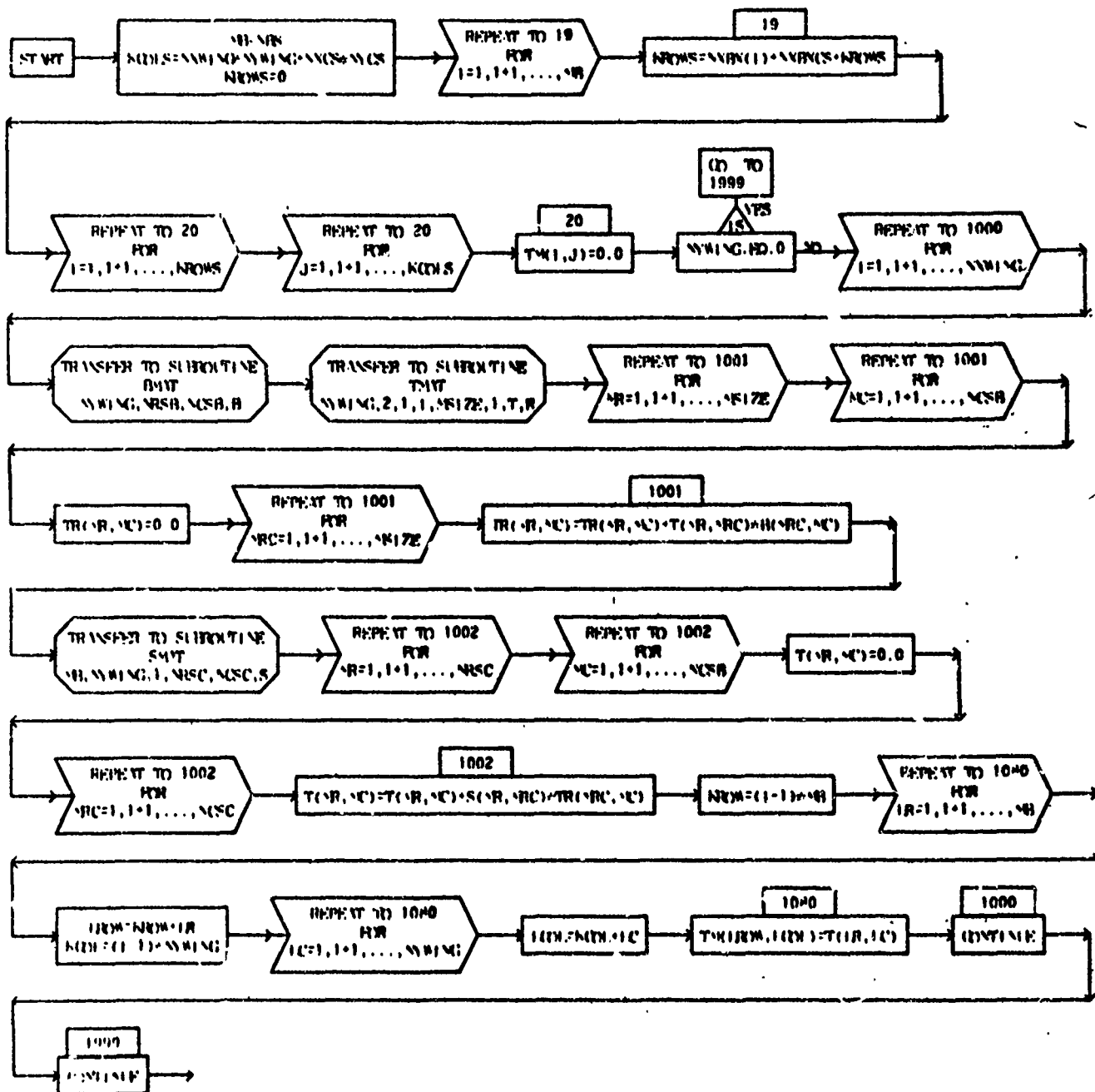
PAGE 2

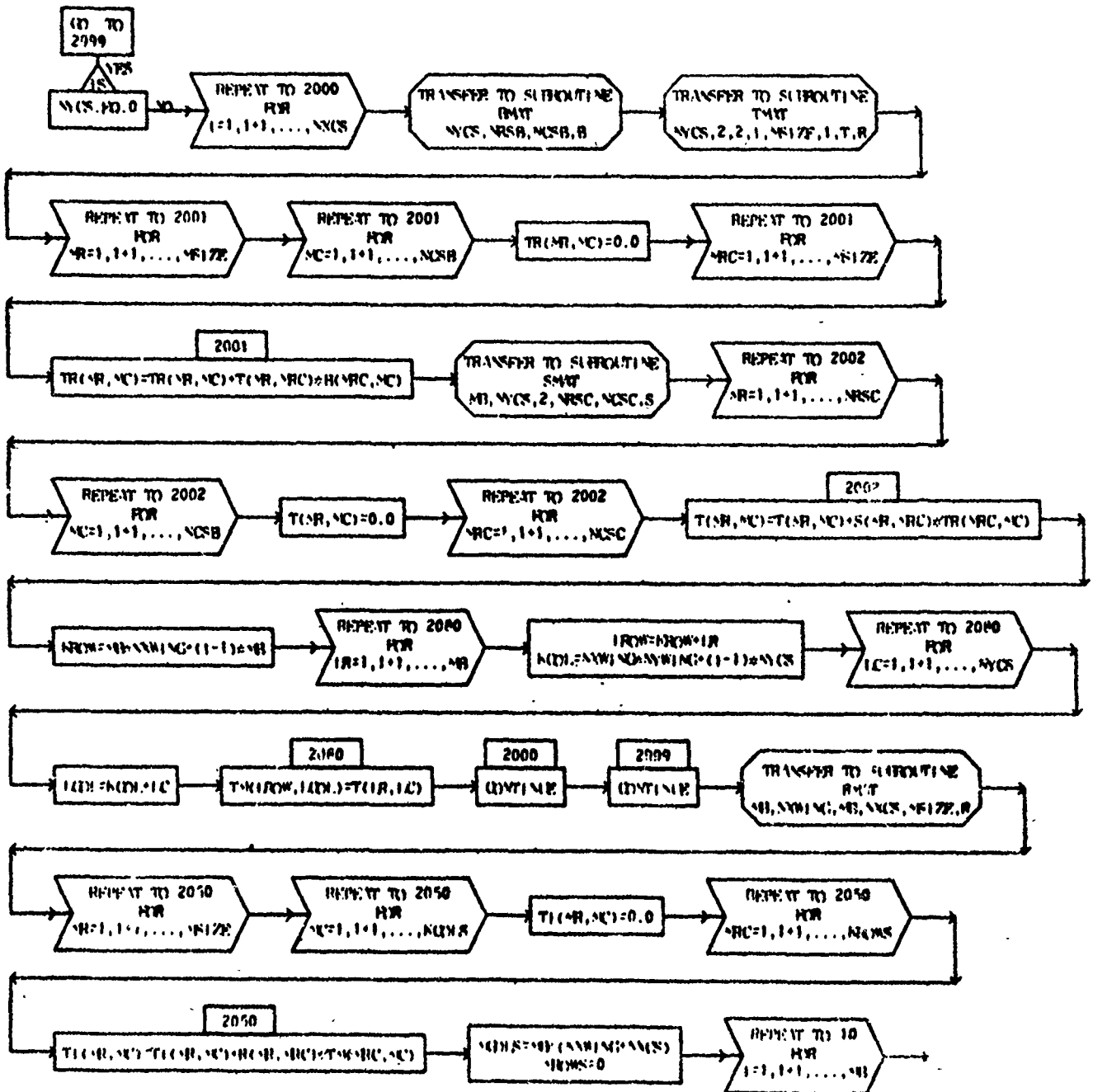


D I M E N S I O N E D V A R I A B L E S

SYMBOL	STORAGE	SYMBOL	STORAGE	SYMBOL	STORAGE	SYMBOL	STORAGE	SYMBOL	STORAGE
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TR	45,45	TI	45,45	TM	45,45				

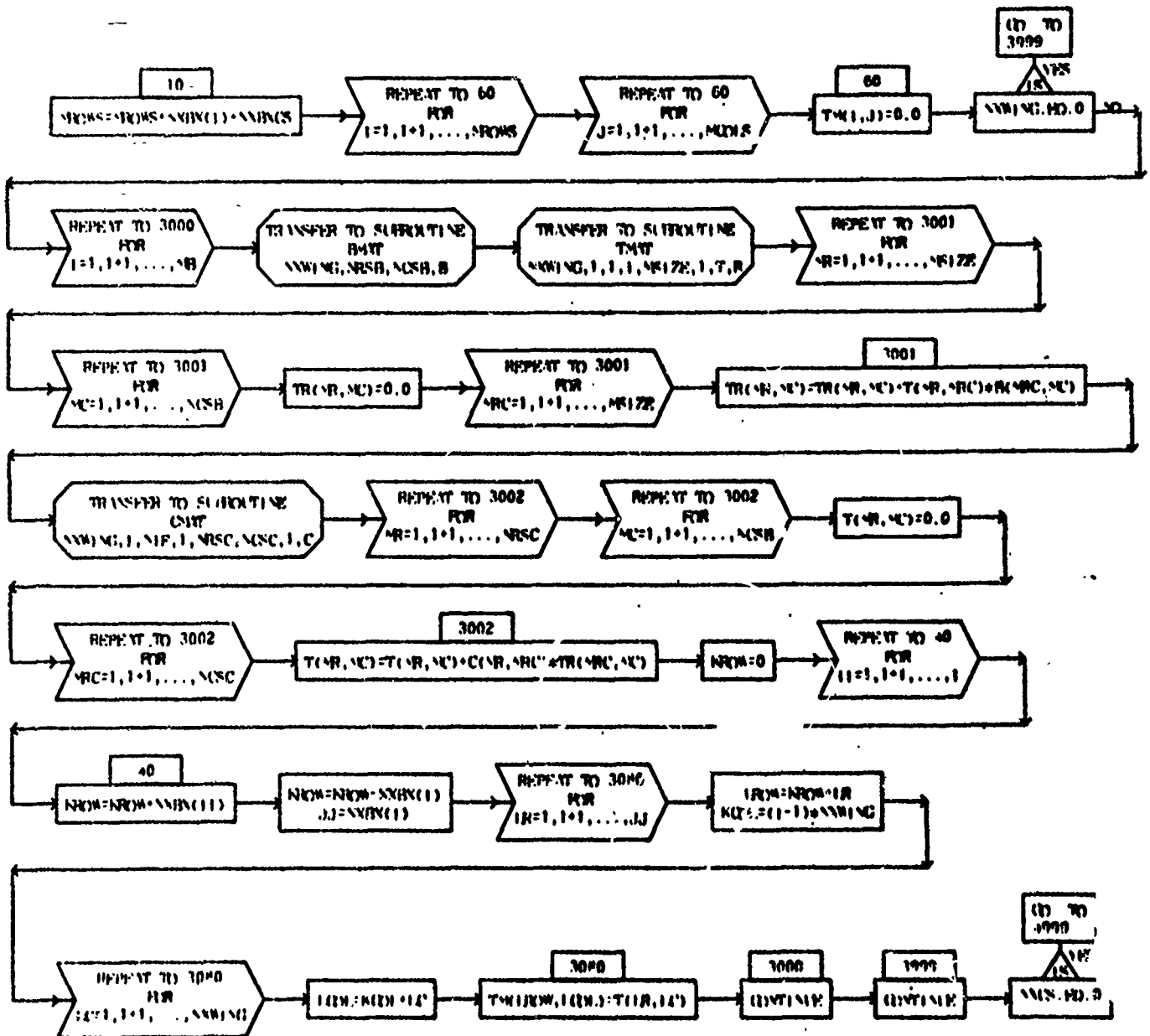
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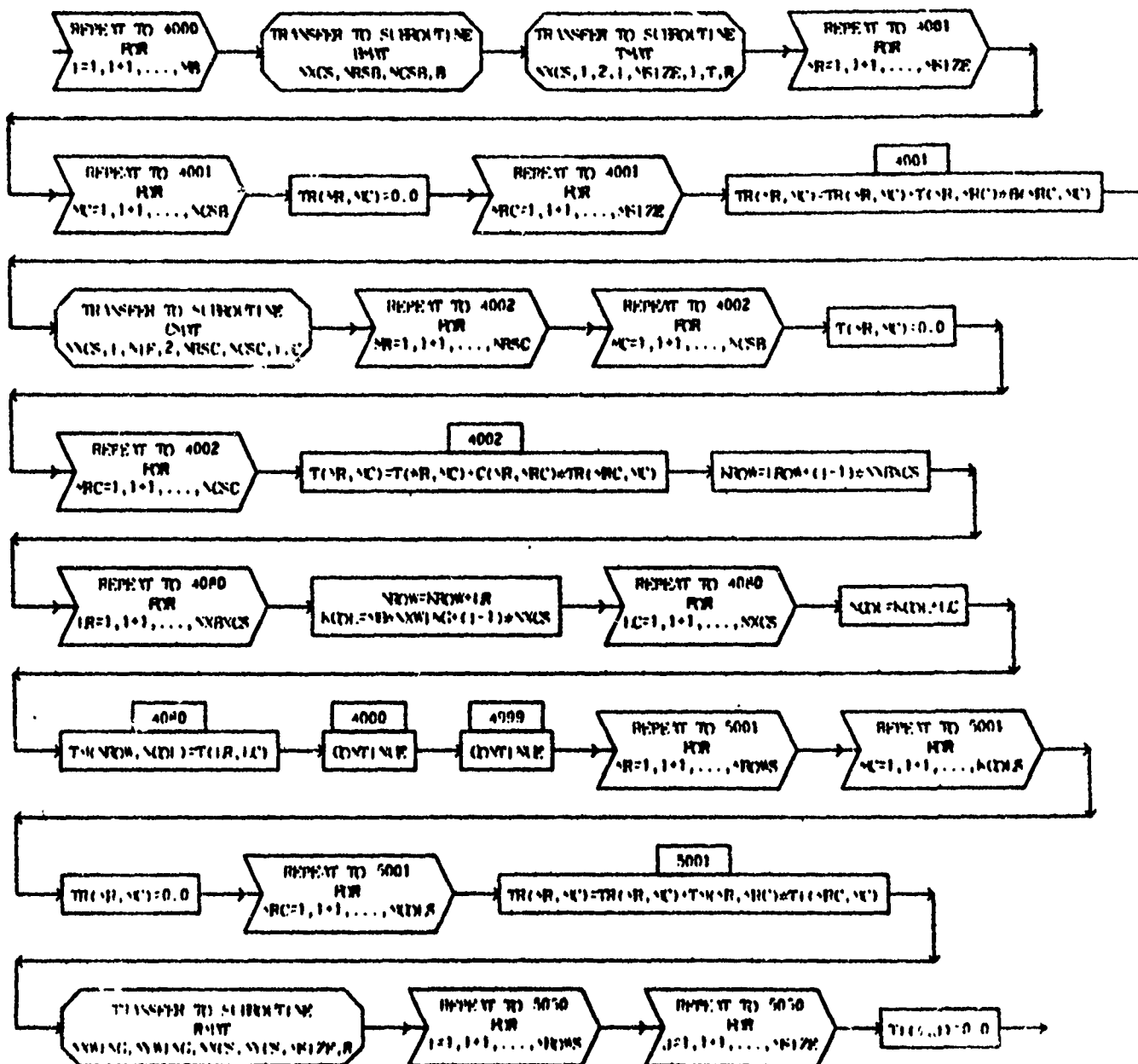




SUBROUTINE TRAP (NIF, NROWS, NCOLS, S, R, C, R, T, TR, TI, TQ)

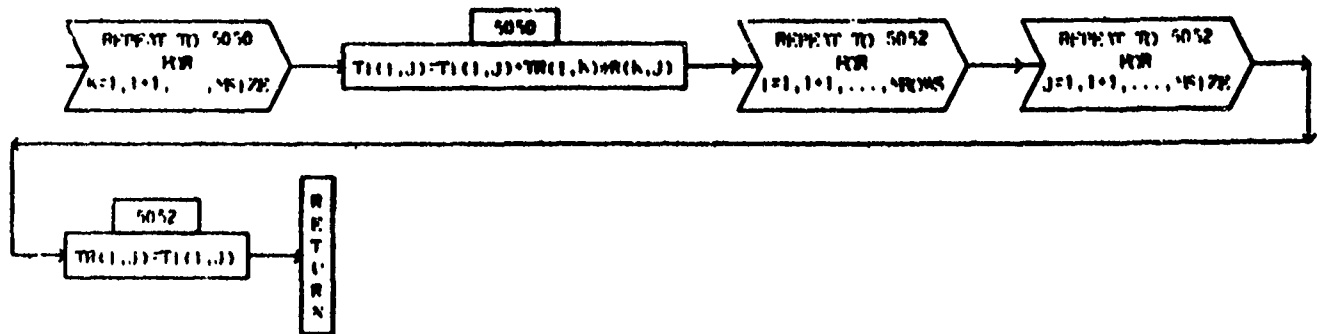
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ROUTINE TRAP (N12, N12S, K12S, S, R, C, R, T, TR, T1, T2)

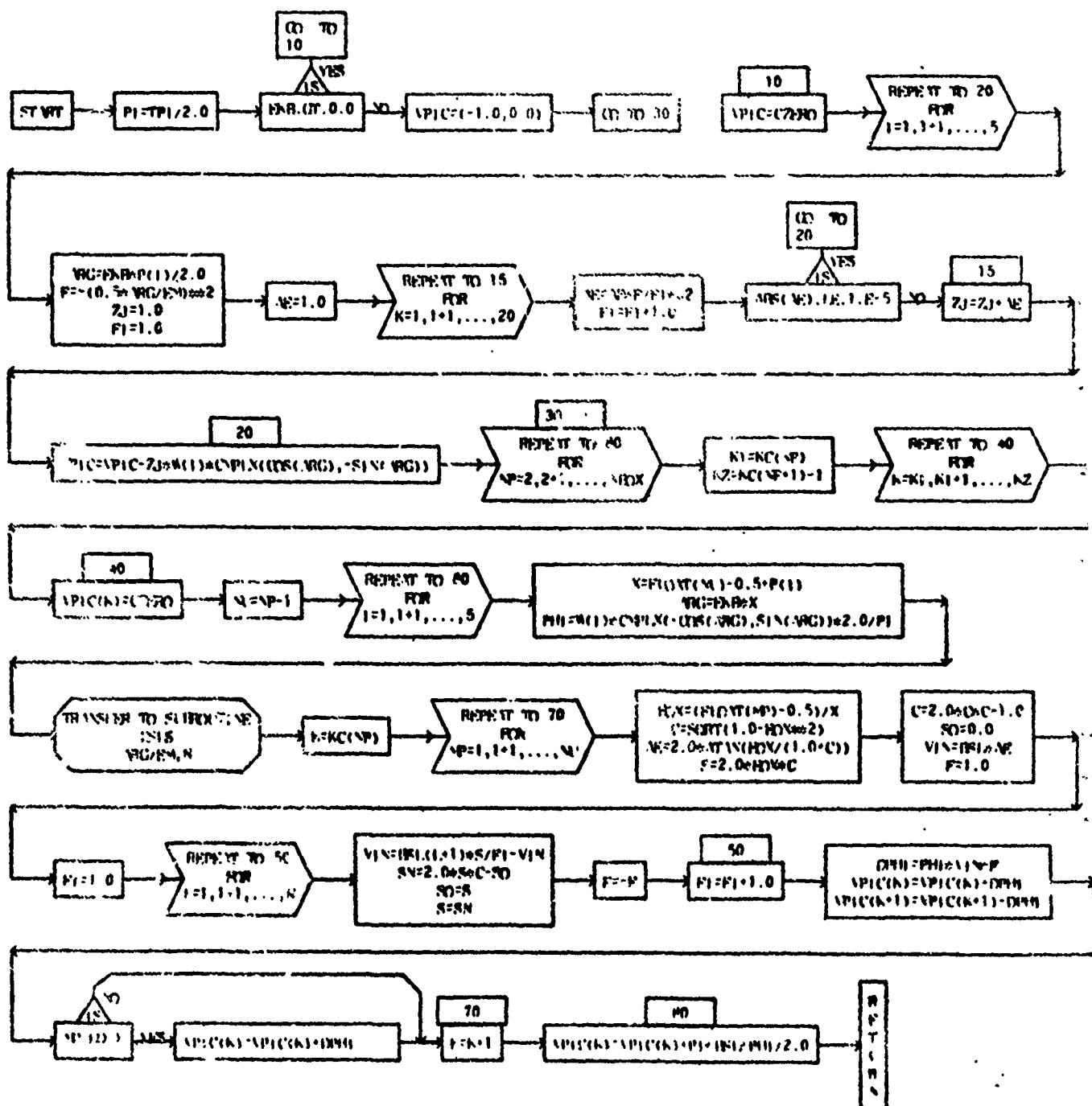
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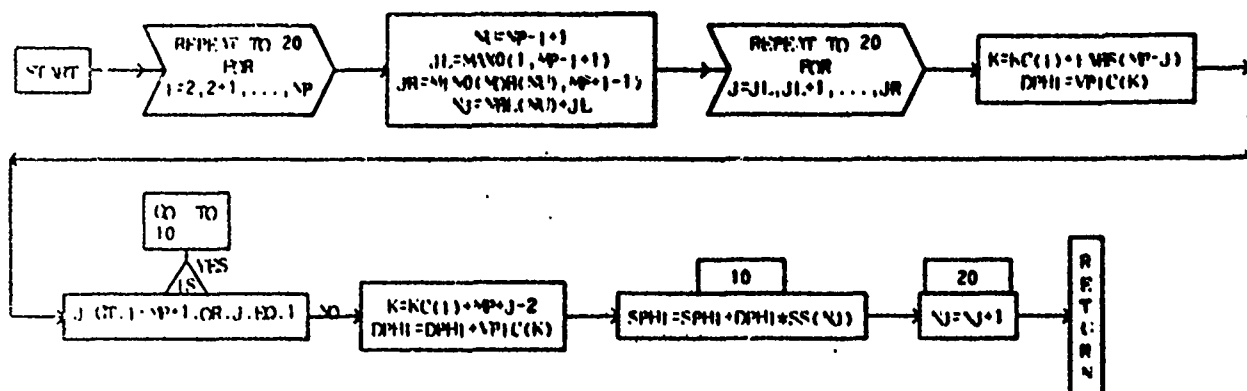
DIMENSIONED VARIABLES

SYNTH.	STORAGE	SYNTH.	STORAGE	SYNTH.	STORAGE	SYNTH.	STORAGE	SYNTH.	STORAGE
P	5	N	5						



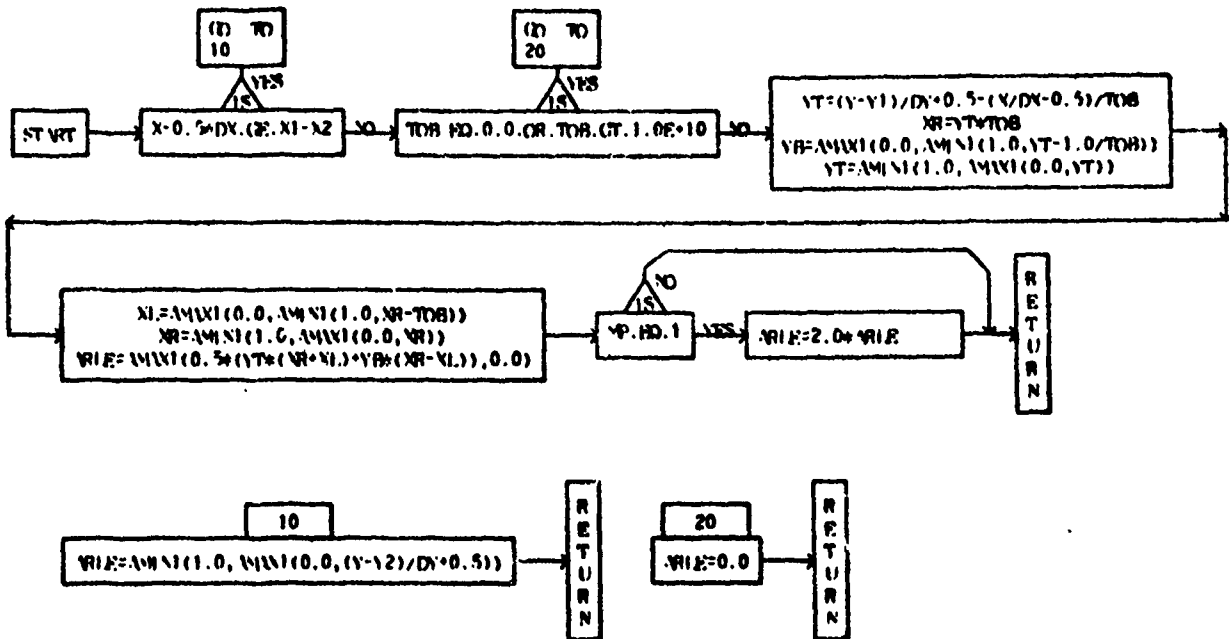
ALGORITHM PHB

PAGE 1



FUNCTION WIE(TOR)

PAGE 1



DIMENSIONED VARIABLES

SYMBOL	STORAGE	SYMBOL	STORAGE	SYMBOL	STORAGE	SYMBOL	STORAGE	SYMBOL	STORAGE
C	45, 45								



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DIMENSIONED VARIABLES

SYMBOL	STORAGE	SYMBOL	STORAGE	SYMBOL	STORAGE	SYMBOL	STORAGE	SYMBOL	STORAGE
R	45,45								

P 48)

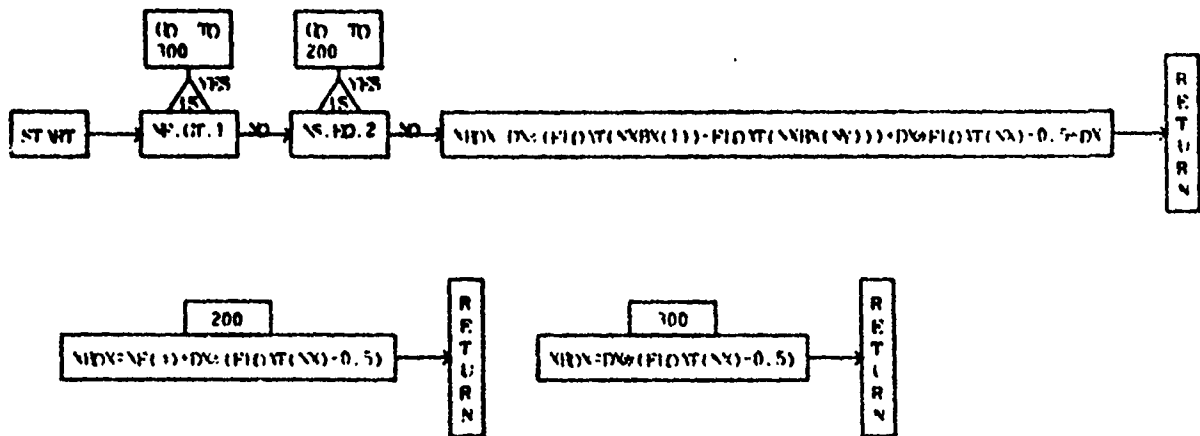


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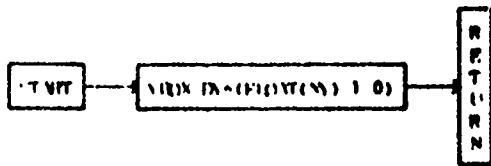
FUNCTION MIDX(NX, NY, NS, NE)

PAGE 1



FUNCTION VIEW(MV)

PAGE 1

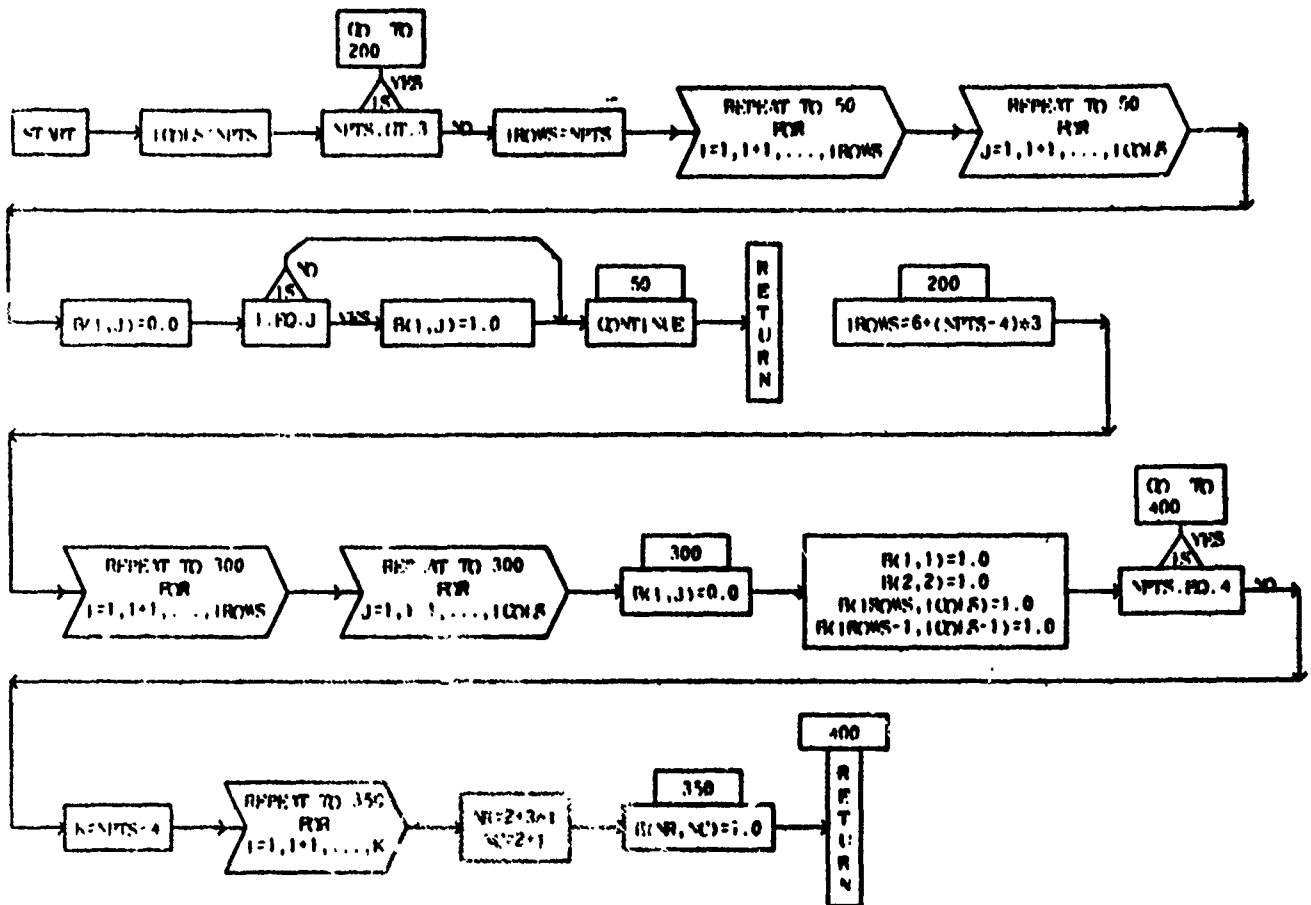


DIMENSIONED VARIABLES

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R	45, 45								

FUNCTION FMT (NPTS, IROWS, ICNLS, B)

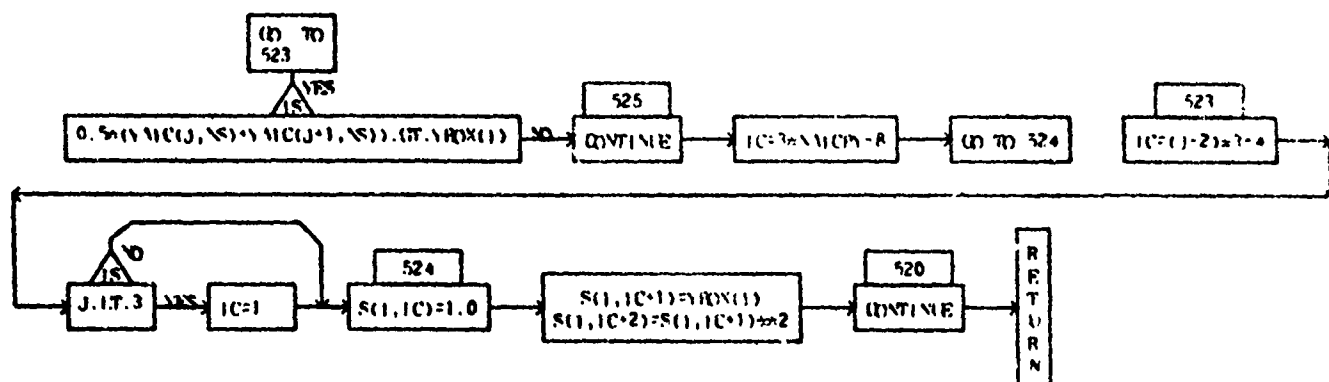
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DIMENSIONED VARIABLES

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S	45, 45								

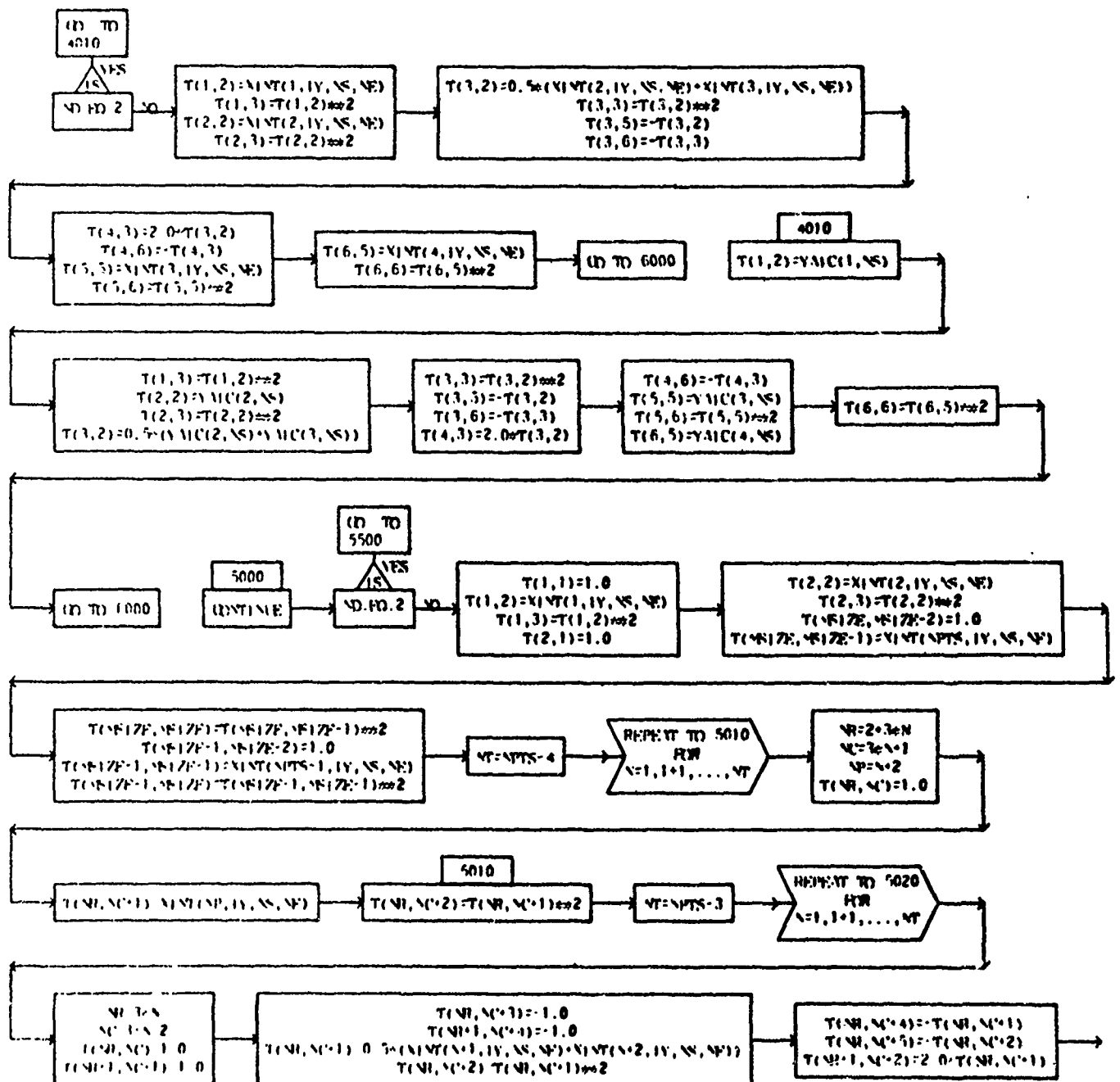
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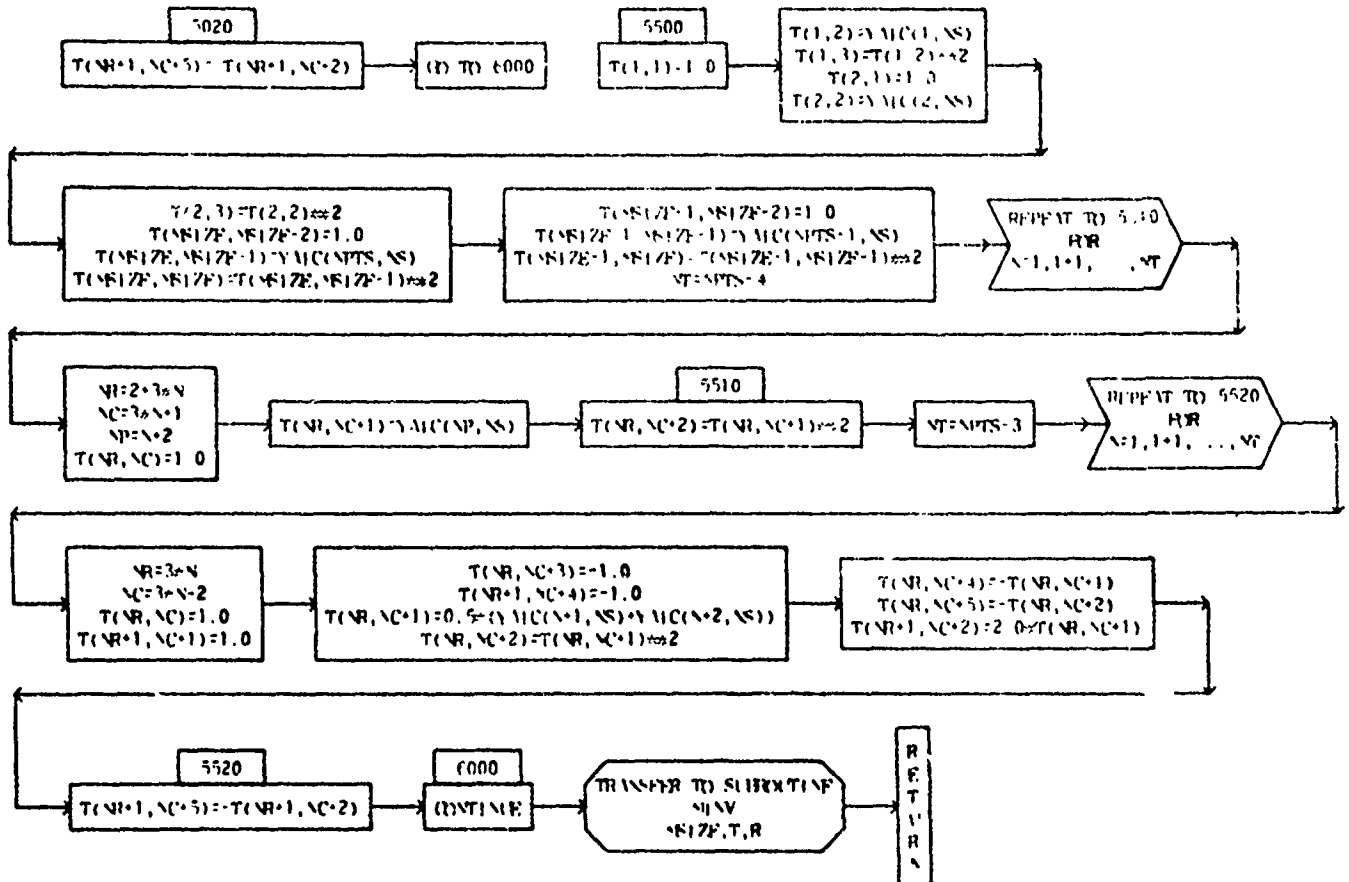


D I M E N S I O N E D V A R I A B L E S

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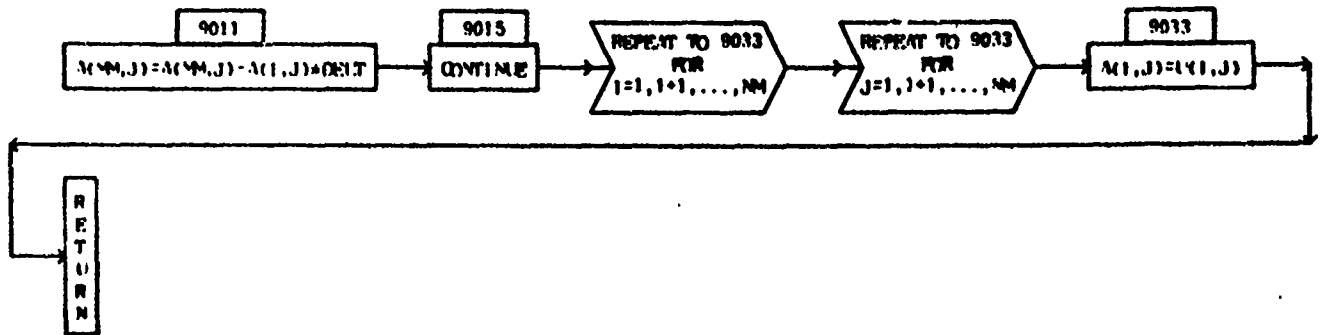




DIMENSIONED VARIABLES									
SYMBOL	STORAGE	SYMBOL	STORAGE	SYMBOL	STORAGE	SYMBOL	STORAGE	SYMBOL	STORAGE
A	45,45	I	45,45						

SUBROUTINE MINV (NM,A,U)

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PART VII

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13. ABSTRACT THIS STUDY COVERS THE DEVELOPMENT OF A SET OF COMPUTER PROGRAM TO PERFORM FLUTTER ANALYSIS BY THE COLLOCATION METHOD. WHILE THIS METHOD HAS BEEN KNOWN FOR SOME TIME, ONLY RECENTLY HAVE ADVANCES IN COMPUTER TECHNOLOGY MADE THE METHOD TECHNICALLY AND FINANCIALLY FEASIBLE. THE INGREDIENTS OF A COLLOCATION FLUTTER ANALYSIS ARE 1) A FLEXIBILITY MATRIX, 2) AERODYNAMIC INFLUENCE COEFFICIENT MATRIX, AND 3) AN EIGENVALUE SOLUTION. THIS STUDY IS PRESENTED IN FOUR VOLUMES. VOLUME I CONTAINS A GENERAL PROGRAM DISCUSSION. VOLUME II CONTAINS THE PROGRAM FLUENG WHICH CALCULATES THE FLEXIBILITY MATRIX. VOLUME III CONTAINS A SET OF THREE PROGRAMS TO CALCULATE AERODYNAMIC INFLUENCE COEFFICIENTS FOR SUBSONIC, TRANSONIC, AND SUPERSONIC FLIGHT REGIMES. VOLUME IV CONTAINS THE PROGRAM COFA WHICH SETS UP AND SOLVES THE FLUTTER EIGENVALUE MATRIX.			

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