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FORTRAN PROGRAMS FOR NUMERICAL AND GRAPHICAL ANALYSIS OF ELASTI--ETC(U)  
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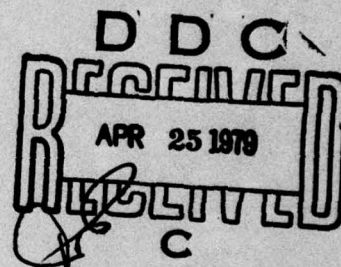
## **FORTTRAN Programs for Numerical and Graphical Analysis of Elastic Response, Radiated Sound Pressure, and Reflected Sound Pressure for Plane Plate Structures with Fluid on One Side**

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| FORTRAN PROGRAMS FOR NUMERICAL AND GRAPHICAL ANALYSIS OF ELASTIC RESPONSE, RADIATED SOUND PRESSURE, AND REFLECTED SOUND PRESSURE FOR PLANE PLATE STRUCTURES WITH FLUID ON ONE SIDE                                                                                                                                                                                                                                                                                                                                                                                                                                    |                       | Interim report on a continuing NRL problem                  |
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| Timoshenko-Mindlin Thick Plate Theory                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                 |                       | Plates with constrained layers                              |
| Composite Plane Plate Acoustic Computations                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                       | Plate coatings                                              |
| Elastic Response Function                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |                       | Radiated Sound                                              |
| Plates with welded coatings                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |                       | Reflected Sound                                             |
| Plates with slipping coatings                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |                       | Plate Acoustics (Continues)                                 |
| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number)                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |                       |                                                             |
| <p>A computer program is developed to compute radiated and reflected sound pressures as a function of angle at a given frequency or as a function of frequency at a given angle for infinite plate structures excited by a point force or by plane acoustic waves. The plate structures have a fluid on one side, and air on the other. To compute radiated and reflected pressures, it is necessary to compute the elastic response function and several characteristic parameters of the structure. The ability to change the way in which these calculations are computed is a major factor in program design.</p> |                       |                                                             |

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## CONTENTS

|                                     |    |
|-------------------------------------|----|
| OVERVIEW . . . . .                  | 1  |
| I. PLTWAV OUTPUT . . . . .          | 2  |
| A. GENERAL DESCRIPTION . . . . .    | 2  |
| B. NUMERICAL OUTPUT . . . . .       | 2  |
| <u>WAVDT.DAT</u> . . . . .          | 2  |
| <u>ARRAY WAVDT(10)</u> . . . . .    | 3  |
| C. PLOT OUTPUT . . . . .            | 3  |
| <u>FILES</u> . . . . .              | 3  |
| <u>PLOT FILE CONTENTS</u> . . . . . | 3  |
| II. PLTWAV INPUT . . . . .          | 4  |
| A. DESCRIPTION . . . . .            | 4  |
| B. INPUT DATA . . . . .             | 4  |
| C. INTERACTIVE INPUT . . . . .      | 6  |
| <u>INPUT DIALOGUE</u> . . . . .     | 6  |
| <u>EDIT</u> . . . . .               | 6  |
| <u>END</u> . . . . .                | 7  |
| D. AUTOMATIC INPUT . . . . .        | 7  |
| <u>PLTWAV.DAT</u> . . . . .         | 7  |
| III. TRACE . . . . .                | 10 |
| A. OVERALL . . . . .                | 10 |
| B. OUTPUT . . . . .                 | 10 |

|     |                                        |    |
|-----|----------------------------------------|----|
| C.  | INPUT . . . . .                        | 10 |
|     | <u>LINE TYPE DESIGNATION</u> . . . . . | 11 |
|     | <u>SCALING</u> . . . . .               | 11 |
|     | <u>PAPER ALIGNMENT</u> . . . . .       | 11 |
|     | <u>LEGEND.</u> . . . . .               | 11 |
| IV. | ALGORITHM DEVELOPMENT . . . . .        | 11 |
| A.  | EQUATIONS . . . . .                    | 11 |
| B.  | NAME LIST . . . . .                    | 13 |
| C.  | FORTRAN VERSIONS. . . . .              | 15 |
|     | APPENDICES . . . . .                   | 17 |
|     | A. PLTWAV                              |    |
|     | B. TRACE                               |    |

PLTWAV OUTPUT

GENERAL DESCRIPTION

FORTRAN Programs for Numerical and Graphical Analysis of Elastic  
Response, Radiated Sound Pressure, and Reflected Sound Pressure  
for Plane Plate Structures with Fluid on One Side

## OVERVIEW

A computer program package that evaluates the theoretical formulas derived from the Timoshenko-Mindlin thick plate theory, which describe the radiated and reflected acoustic fields<sup>1</sup>, is described. It was found that the expressions for the radiation and reflection were the same for each case analyzed, but that the elastic response function was not. The four cases implemented, whose results will be described elsewhere<sup>2</sup> are: a simple plane plate, a two-layer composite plate with a perfectly welded interface, a two-layer-slipping interface-composite plate, and a welded two-layer plate with a constraining layer.

Two programs are discussed in the following pages, the major portion taken up by PLTWAV, the program that does all the computation and file manipulation. Input, output, and algorithms are covered. The other program included here is TRACE, a plotting routine. This was developed so that the data from PLTWAV could be viewed on a CRT or plotter with appropriate scaling. In both cases, all the programs are in FORTRAN 4+, compatible with the Digital Electronics Corporation PDP 11/45 with the system RSX-11D or RSX-11M on the PDP 11/34.

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<sup>1</sup> Article to be published in J. Acoust. Soc. Am. by A.J. Rudgers

<sup>2</sup> NRL Formal Report to be published by A.J. Rudgers and M.D. Ring  
Note: Manuscript submitted January 18, 1979.



## I. PLTWAV OUTPUT

### A. GENERAL DESCRIPTION

The program PLTWAV is constructed so that numerical and/or plot output can be obtained. The file WAVDT.DAT;VERSION is created each run to provide a list of input and calculated parameters pertaining to the physical structure. This file is expanded when numerical output is desired. When plot output is desired, eight separate plot files are created in addition to WAVDT.DAT.

### B. NUMERICAL OUTPUT

#### WAVDT.DAT

The file WAVDT.DAT is a formatted file, a new octal version of which is created each run for the purpose of listing input and computed parameters in complex form. When numerical output is desired, this file is appended to include an entire listing of calculated data in a tabulated exponential form. Each column is written using an E12.5 format which yields five (5) significant digits. The columns, which are broken and labeled every ten entries, are as follows:

|        |                                                                     |
|--------|---------------------------------------------------------------------|
| THETA  | The emission angle $\theta$ in degrees                              |
| FREQ   | The frequency $f$ in Hz                                             |
| ROMEGA | The real part of the electric response function $\text{Re}[\Omega]$ |
| IOMEGA | The imaginary part $\text{Im}[\Omega]$                              |
| MOMEGA | The modulus of the elastic response function $\Omega$               |
| AOMEGA | The angle (phase) of $\Omega$ in radians                            |
| MREF   | The modulus of reflected pressure                                   |
| AREF   | The phase of reflected pressure in radians                          |
| MRAD   | The modulus of radiated pressure                                    |
| ARAD   | The phase of radiated pressure in radians                           |

#### ARRAY WAVDT(10)

The information written into WAVDT.DAT comes from two sources. The parameters come from the common section of the program, called PLTWAV.COM, while the calculated data come from the array WAVDT. The array is written to in the subroutine WAVDAT each time the computation loop of PLTWAV is completed. The file WAVDT.DAT has the array WAVDT written into it in the subroutine WRTFIL before the next pass through the computations.

#### C. PLOT OUTPUT FILES

When plot output is desired, new octal versions of the following eight unformatted files are created:

IOMEGA.PLT;VERSION  
ROMEGA.PLT;VERSION  
MOMEGA.PLT;VERSION  
AOMEGA.PLT;VERSION  
MREF.PLT;VERSION  
AREF.PLT;VERSION  
MRAD.PLT;VERSION  
ARAD.PLT;VERSION.

#### PLOT FILE CONTENTS

In each case, the plot file contains a heading followed by the data that is implied by the name of the file. The heading is written into the files by the subroutine HEADER, and includes:

IHEAD    Designates real or integer data  
XINIT    The first X value  
XDELTA   The X increment  
ITERM    = -1 to say that no further heading follows.

This heading is used by all the plot routines contained by the system used, with the exception of TRACE. Below the heading, the data is written using separate WRITE statements for X and Y. The X axis represents the parameter being searched through, either frequency F or emission angle THETA, while the Y axis takes data from the calculated value that the file name indicates.

## II. PLTWAV INPUT

### A. DESCRIPTION

Before the user tries to run PLTWAV, several choices need to be made, the first being whether to run interactively or automatically. In either case, the user must also decide what type of output is desired, and the range of the search to be implemented. These are the first data inputs the program needs. All the input that follows defines the physical structure to be analyzed and the information for subsequent runs. A complete run can be found in Appendix A-3.

### B. INPUT DATA

The chart that follows lists all the input parameters.

Decision Parameters (=> means "implies")

| <u>REFERENCE<br/>NUMBER</u> | <u>NAME</u> | <u>UNITS</u> | <u>FORMAT</u> | <u>COMMENTS</u>                                                            |
|-----------------------------|-------------|--------------|---------------|----------------------------------------------------------------------------|
| -                           | IAUTO       | -            | I1            | IAUTO designates the running mode<br>IAUTO=1=>automatic<br>=2=>interactive |
| 23                          | IDAT        | -            | I1            | designates output type<br>IDAT=1=>Numerical<br>=2=>Plot<br>=3=>Both        |



| <u>REFERENCE<br/>NUMBER</u> | <u>NAME</u> | <u>UNITS</u> | <u>FORMAT</u> | <u>COMMENTS</u>                                                                                                                                                    |
|-----------------------------|-------------|--------------|---------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 24                          | ITYPE       | -            | I1            | designates physical structure<br>ITYPE=1=>Simple plate<br>=2=>Composite-Welded interface<br>=3=>Composite-Slipping inter-<br>face<br>=4=>Constrained layer problem |
| 25                          | ISERCH      | -            | I1            | designates search parameter<br>ISERCH=1=>Emission angle THETA<br>=2=>Frequency F                                                                                   |

#### Emission Angle Search Parameters

|   |       |      |       |                          |
|---|-------|------|-------|--------------------------|
| 1 | THMIN | Deg. | F10.0 | Minimum angle for search |
| 2 | THMAX | Deg. | F10.0 | Maximum angle            |
| 3 | THINC | Deg. | F10.0 | Angle increment          |
| 4 | F     | Hz.  | F10.0 | Frequency                |

#### Frequency Search Parameters

|   |       |      |       |                              |
|---|-------|------|-------|------------------------------|
| 5 | FMIN  | Hz.  | F10.0 | Minimum frequency for search |
| 6 | FMAX  | Hz.  | F10.0 | Maximum frequency            |
| 7 | FINC  | Hz.  | F10.0 | Frequency increment          |
| 8 | THETA | Deg. | F10.0 | Emission angle $\theta$      |

#### Fluid Parameters

|    |    |                   |       |                   |
|----|----|-------------------|-------|-------------------|
| 9  | RO | kg/m <sup>3</sup> | F10.0 | fluid density     |
| 10 | C  | m/s               | F10.0 | fluid sound speed |

#### Plate Parameters

|    |        |                   |       |                 |
|----|--------|-------------------|-------|-----------------|
| 11 | HPLAT  | m                 | F10.0 | Plate thickness |
| 12 | ROPLAT | kg/m <sup>3</sup> | F10.2 | Plate density   |

| <u>REFERENCE<br/>NUMBER</u> | <u>NAME</u> | <u>UNITS</u>     | <u>FORMAT</u> | <u>COMMENTS</u>                  |
|-----------------------------|-------------|------------------|---------------|----------------------------------|
| 13                          | EPLAT       | N/m <sup>2</sup> | 2F10.0        | Complex Young's modulus of plate |
| 14                          | GPLAT       | N/m <sup>2</sup> | 2F10.0        | Complex Shear modulus of plate   |

#### Coating Parameters

|    |        |                     |
|----|--------|---------------------|
| 15 | HCOAT  | } same as for plate |
| 16 | ROCOAT |                     |
| 17 | ECOAT  |                     |
| 18 | GCOAT  |                     |

#### Constrained Layer Parameters

|    |        |                 |
|----|--------|-----------------|
| 19 | HCONL  | } same as above |
| 20 | ROCONL |                 |
| 21 | ECONL  |                 |
| 22 | GCONL  |                 |

### C. INTERACTIVE INPUT

#### INPUT DIALOGUE

When IAUTO=2, the input for PLTWAV becomes interactive via dialogue on the terminal. As can be seen from the parameter chart, no special formatting need be done by the user. Any value, be it integer, floating point, or exponential, will be accepted by the F10.0 format. The input sequence, which is in the same order as the data chart, can be seen in Appendix A-3.

#### EDIT

After the parameters have all been entered utilizing the appropriate subroutines, the routine EDIT is called. This portion of the program has a twofold function. During the first run, EDIT is

used to check the input parameters; during subsequent runs, EDIT is used to change values to those desired next. Both of these functions are implemented in the same way. If there is a value that is incorrect, or needs to be changed for the next run, the user types the reference number to the left of the parameter name. This causes the name and present value to be displayed. The user will then type in the new value and return. At this point, the entire parameter list will be displayed again and the user will be asked if they are all correct. This sequence can be repeated until all the values are as desired, at which time, a 0 (zero) is entered to return to the main (see Appendix A-3).

#### END

The last I/O for the run comes at the end of all the computation, when the user is asked if another run is desired. If a '1' is entered, the program will return to EDIT, while a '0' will end PLTWAV (see Appendix A-3).

#### D. AUTOMATIC INPUT

##### PLTWAV.DAT

To run in the automatic mode, the user must have previously created the input data file PLTWAV.DAT. This file is constructed so that exactly the same input sequence is used as when running interactively (refer to the data chart). Many runs can be accomplished by use of the reference numbers (ICHANG) and the repeat variable IRPT. The sequence is as follows:

IDAT

ITYPE

ISERCH

THMIN or FMIN

THMAX or FMAX



THINC or FINC

F or THETA

RO

C

HPLAT

ROPLAT

EPLAT

GPLAT

HCOAT

ROCOAT

ECOAT

GCOAT

HCONL

ROCONL

ECONL

GCONL

\*\*\*\*\*

IRPT

The repeat variable

IRPT=0=>no more runs

=1=>another run

ICHANGE

The parameter REFERENCE NUMBER

VALUE

New value of the parameter

ICHANGE

VALUE

⋮

ICHANGE=0=>return to main with all the data

IRPT

⋮

The program will end when IRPT=0; and since ICHANG=0 to return from the last data set, the last two entries in the list will be zero.

For example, let PLTWAV.DAT contain the following:

Example

```
3
1
1
0
90
.25
64E3
999.7
1447.24
.05
7782.4
21.6E10,0
8.29E10,0
1
4
32E3
0
0.
```

Then to begin with, both plot and numerical data are desired, so IDAT=3. It is a simple plate so ITYPE=1, and an angle search is to be implemented so ISERCH=1. The search will start at THMIN=0° and end at THMAX=90° with an increment of THINC=.25°, and the calculations will be made at the frequency F=64 kHz. The fluid density is RO=999.7 kg/m<sup>3</sup>, and the fluid sound speed is C=1447.24 m/sec. The plate thickness is HPLAT=.05m, and it has a density of ROPLAT=7782.4 kg/m<sup>3</sup>. Young's modulus is real and has a value

$E=21.6E10$ , while the shear modulus is  $G=8.29E10$ . A repeat run is desired, so  $IRPT=1$ . The reference number 4 is for frequency, so the new frequency is  $F=32$  kHz. There are no further changes, so  $ICHANG=0$ , and no more runs so  $IRPT=0$  (see Appendix A-3).

### III. TRACE

#### A. OVERALL

The program TRACE and its associated subroutines form a plotting package for use with the Textronix 4662 Interactive Plotter. Implemented to accept up to five different plot files and plot them with different line types, this package also allows for absolute scaling (linear only) and absolute size control (up to 10 x 15 inches). There is an option that will draw a legend on either side of the plot, but no labeling is performed.

#### B. OUTPUT

The plot output from TRACE includes five different line types. The curves are traced by means of alternating arcs of light and dark, the arc length being specified by the array DASH in the subroutine SETDSH. Specifications for setting DASH can be found in the subroutine TKDASH (see Appendix B-4).

A legend can also be plotted by TRACE by the use of the subroutine LABEL. The legend can appear on either side of the plot, and at any distance from the top.

#### C. INPUT

The input for TRACE is interactive via dialogue on the terminal. The user is asked how many curves are to be drawn, what the file specifications are, the scale limits, the label (legend) options, and to check the paper alignment.



#### LINE TYPE DESIGNATION

The plotter package can handle as many as five different files from any of the memory devices. The user types a number (1-5) when asked, and then types in the entire file specification for each curve. If a particular line type is not desired, a zero (0) is entered as the file specification. For example, if a solid line is not wanted, a zero is entered as the first file name.

#### SCALING

The user inputs minimum and maximum values for both axes. The scaling is computed on the basis of a 682 x 1023 grid. The entire grid can be as large at 10 x 15 inches and the axis limits can be of any value.

#### PAPER ALIGNMENT

When the user is asked to align the paper, he is told to enter an ordered pair. This ordered pair should be in terms of the scale, not the grid. Checking the corners seems to be sufficient.

#### LEGEND

The user is asked to specify the placement of the legend by right or left side, (0 means no legend), and placement below the normal position. The first is accomplished by typing R, L, or 0, while the latter is by typing an integer (0-585). The legend is normally 14 grid units down and 30 grid units inside the limits of the plot.

### IV. ALGORITHM DEVELOPMENT

#### A. EQUATIONS

Begin by noting that what is wanted are radiation and reflection,

which are governed by the following:

Pressure radiated:

$$P_{\text{rad}} = \cos\theta/[1 + j\Omega\cos\theta],$$

Pressure reflected:

$$P_{\text{ref}} = 1-2/[1 + j\Omega\cos\theta]$$

where there is a different structural response for each physical structure. For a simple plate, the elastic response function  $\Omega$  is:

$$\Omega = (k_0/\omega^2\rho) \left\{ h\rho_s\omega^2 - gh\tilde{k}^2 + \tilde{k}^2(gh)^2/[D\tilde{k}^2 + gh - \rho_s h^3\omega^2/12] \right\}.$$

For a composite plate with welded interface, the elastic response function is:

$$\begin{aligned} \Omega = (k_0/\omega^2\rho) \left\{ \omega^2(h\rho_s + h'\rho'_s) - \tilde{k}^2(g'h' + gh) \right. \\ \left. + \tilde{k}^2h^2[g^2 - (g')^2]/[\tilde{k}^2(D - \beta^2D')] \right. \\ \left. + h(g - \beta g') - (\beta\rho_s - \rho'_s)\omega^2h^2h'/12 \right\}. \end{aligned}$$

For a composite structure with slipping interface:

$$\begin{aligned} \Omega = (k_0/\omega^2\rho) \left\{ \omega^2(h\rho_s + h'\rho'_s) - \tilde{k}^2(gh + g'h') \right. \\ \left. + \tilde{k}^2(gh)^2/[\tilde{k}^2D + gh - \omega^2\rho_s h^3/12] \right. \\ \left. + \tilde{k}^2(g'h')^2/[\tilde{k}^2D' + g'h' - \omega^2\rho'_s h'^3/12] \right\}. \end{aligned}$$

For a constrained layer, the result is:

$$\Omega = (k_0/\omega^2 \rho) \left\{ \omega^2 (h \rho_s + h' \rho'_s + h'' \rho''_s) - \tilde{k}^2 (gh + g'h') \right. \\ \left. + \tilde{k}^2 h^2 [g^2 - (g')^2] / [\tilde{k}^2 \{D - \beta^2 D' + (h/h'') D''\}] \right. \\ \left. + h(g - \beta g') - (\beta \rho_s - \rho'_s) \omega^2 h^2 h' / 12 \right\}.$$

To do these computations, several secondary parameters are needed:

$$\kappa = (0.87 + 1.12\nu)/(1 + \nu)$$

$$g = \kappa^2 G$$

$$D = Eh^3/[12(1 - \nu^2)]$$

$$\omega^2 = (2\pi f)^2$$

$$\beta = h/h'$$

$$k_0 = 2\pi f/c$$

$$\tilde{k} = k_0 \sin \theta$$

#### B. NAME LIST

A name list is required to keep track of the parameters.

| <u>Program<br/>Name</u> | <u>Generic<br/>Name</u>     |
|-------------------------|-----------------------------|
| THETA                   | $\theta$                    |
| THMIN                   | $\theta_{\min}$             |
| THMAX                   | $\theta_{\max}$             |
| THINC                   | $\theta_{\text{increment}}$ |
| F                       | frequency                   |
| FMIN                    | $f_{\min}$                  |
| FMAX                    | $f_{\max}$                  |
| FINC                    | $f_{\text{increment}}$      |



| <u>Program Name</u> | <u>Generic Name</u>                           |
|---------------------|-----------------------------------------------|
| PI                  | $\pi$                                         |
| F2                  | $\omega^2$ (= angular frequency) <sup>2</sup> |
| CX1                 | 1                                             |
| CX2                 | 2                                             |
| CXJ                 | $j = \sqrt{-1}$                               |
| C                   | fluid sound speed c                           |
| RO                  | fluid density $\rho$                          |
| ROPLAT              | $\rho_s$ - density of plate                   |
| ROCOAT              | $\rho_s'$ - coat density                      |
| ROCONL              | $\rho_s''$ - constrained layer density        |
| H                   | h - thickness (general)                       |
| HPLAT               | h - thickness of plate                        |
| HCOAT               | h' - coat thickness                           |
| HCONL               | h'' - constrained layer thickness             |
| G                   | G - shear modulus (general)                   |
| GPLAT               | G - shear modulus of plate                    |
| GCOAT               | G' - shear modulus of coat                    |
| GCONL               | G'' - shear modulus of constrained layer      |
| SG                  | $\kappa^2 G$ modified shear (general)         |
| GP                  | g - modified shear of plate                   |
| GC                  | g' - modified shear of coat                   |
| GL                  | g'' - modified shear of constrained layer     |
| E                   | E - Young's Modulus (general)                 |
| EPLAT               | E - Young's Modulus of plate                  |
| ECOAT               | E' - Young's Modulus of coat                  |
| ECONL               | E'' - Young's Modulus of constrained layer    |
| BETA                | $\beta$                                       |
| KO                  | $k_0$                                         |
| K                   | k                                             |
| KAPA                | $\kappa$ - (general)                          |

| <u>Program Name</u> | <u>Generic Name</u>                  |
|---------------------|--------------------------------------|
| KAPAPL              | $\kappa$ - of plate                  |
| KAPACO              | $\kappa'$ - of coat                  |
| KAPACL              | $\kappa''$ - of constrained layer    |
| D                   | D (general) flexural rigidity        |
| DPLAT               | D - of plate                         |
| DCOAT               | D' - of coat                         |
| DCONL               | D'' - of constrained layer           |
| V                   | $\nu$ - (general) Poisson's ratio    |
| VPLAT               | $\nu$ - of plate                     |
| VCOAT               | $\nu'$ - of coat                     |
| VCONL               | $\nu''$ - of constrained layer       |
| RAD                 | $P_{rad}$                            |
| REF                 | $P_{ref}$                            |
| OMEGA               | $\Omega$ - elastic response function |

### C. FORTRAN VERSIONS

With these names, the FORTRAN versions become (in general):

```

RAD = COS(THETA)/[CX1 + CXJ * OMEGA * COS(THETA)]
REF = CX1 - CX2/[CX1 + CXJ * OMEGA * COS(THETA)]
V = [E/(CX2 * G)] - 1
KAPA = (.87 + 1.12V)/(1 + V)
SG = (KAPA) ** 2 * G
D = E * (H ** 3)/[12 * (1 - V ** 2)]
F2 = (2 * PI * F) ** 2
KO = 2 * PI * F/C
K = KO * SIN(THETA)

```

Wherever possible, constants that need to be complex are specified,

such as CMPLX(12.,0.). Each OMEGA is computed in a separate sub-routine. The simple plate  $\Omega$  is computed in OMEGA1, composite with welded interface in OMEGA2, and so on (see Appendix A-7).

## APPENDICES

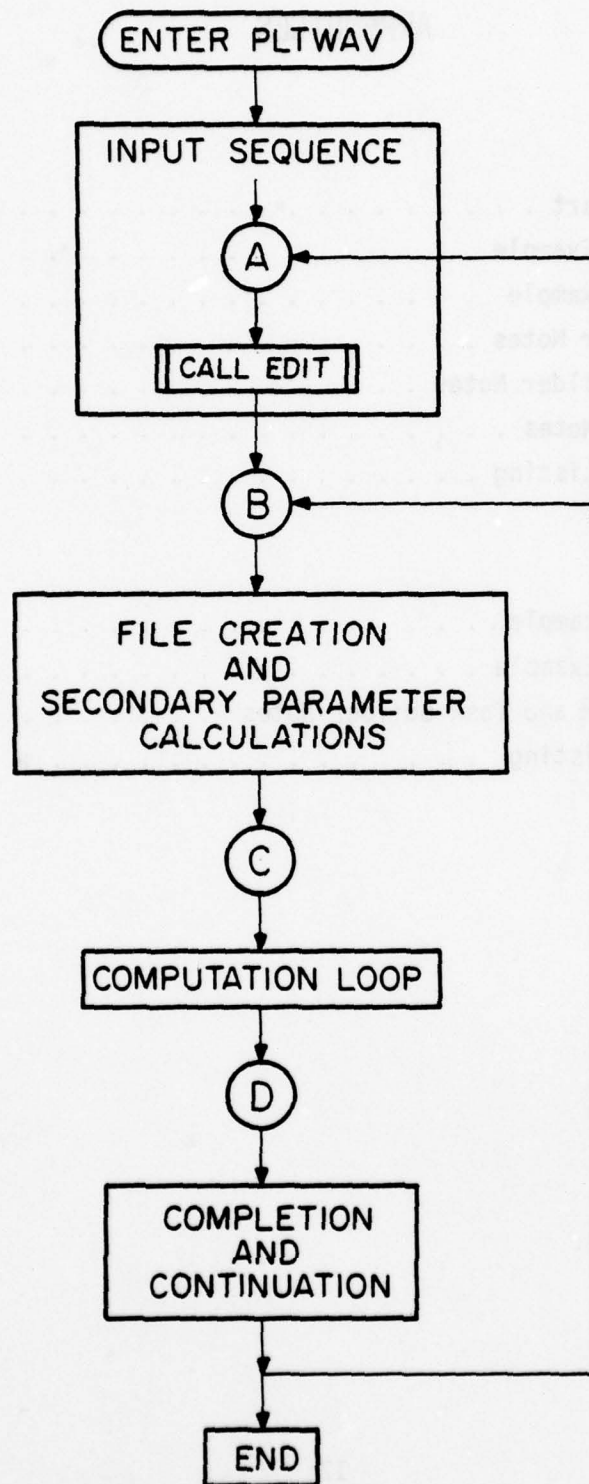
### A. PLTWAV

|                              |     |
|------------------------------|-----|
| Flow Chart . . . . .         | A-1 |
| Output Example . . . . .     | A-2 |
| Input Example . . . . .      | A-3 |
| Compiler Notes . . . . .     | A-4 |
| Task Builder Notes . . . . . | A-5 |
| COMMON Notes . . . . .       | A-6 |
| PLTWAV Listing . . . . .     | A-7 |

### B. TRACE

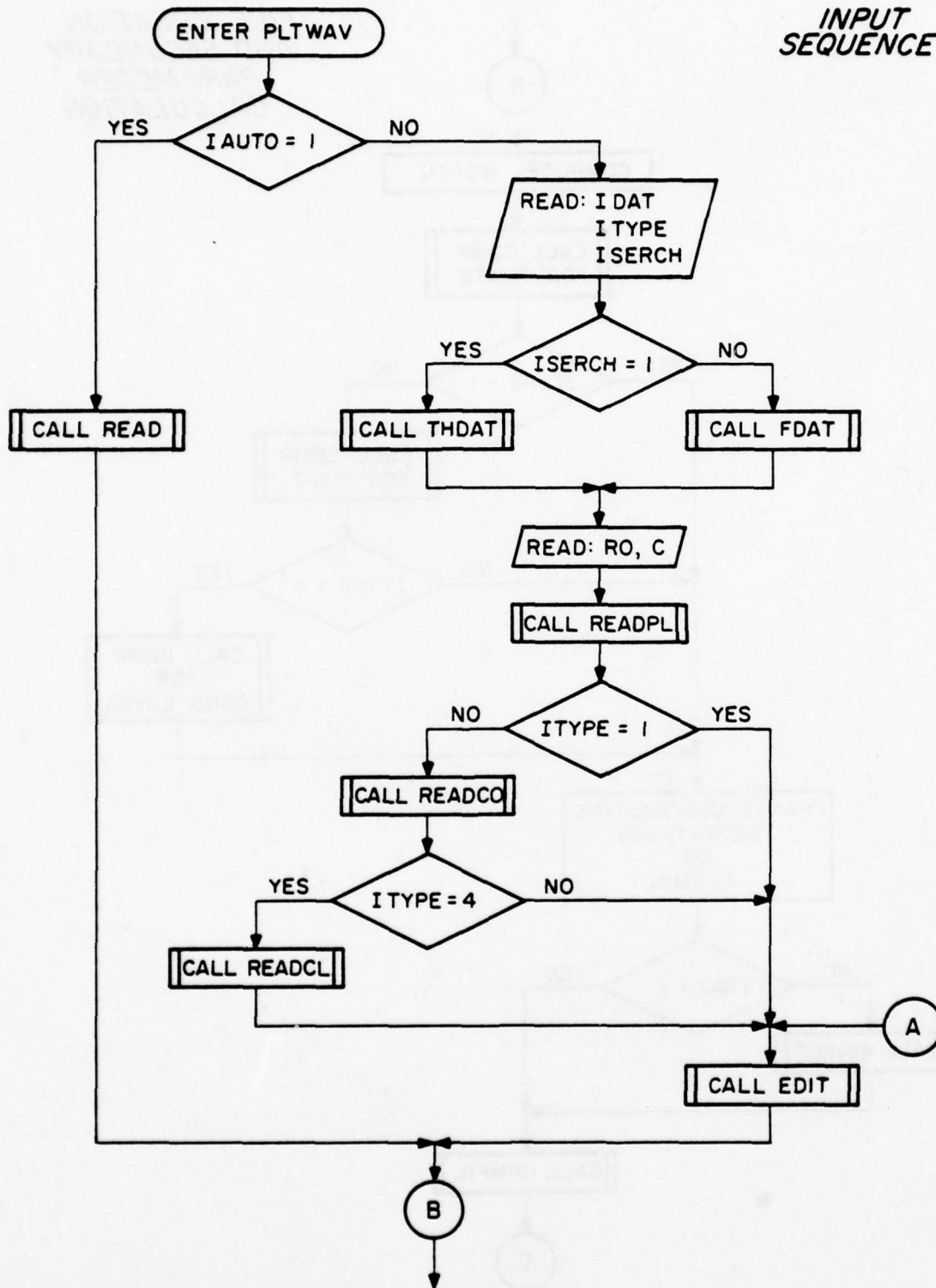
|                                           |     |
|-------------------------------------------|-----|
| Input Example. . . . .                    | B-1 |
| Output Example . . . . .                  | B-2 |
| Compiler and Task Builder Notes . . . . . | B-3 |
| TRACE Listing . . . . .                   | B-4 |



GENERAL  
FLOW  
DIAGRAM

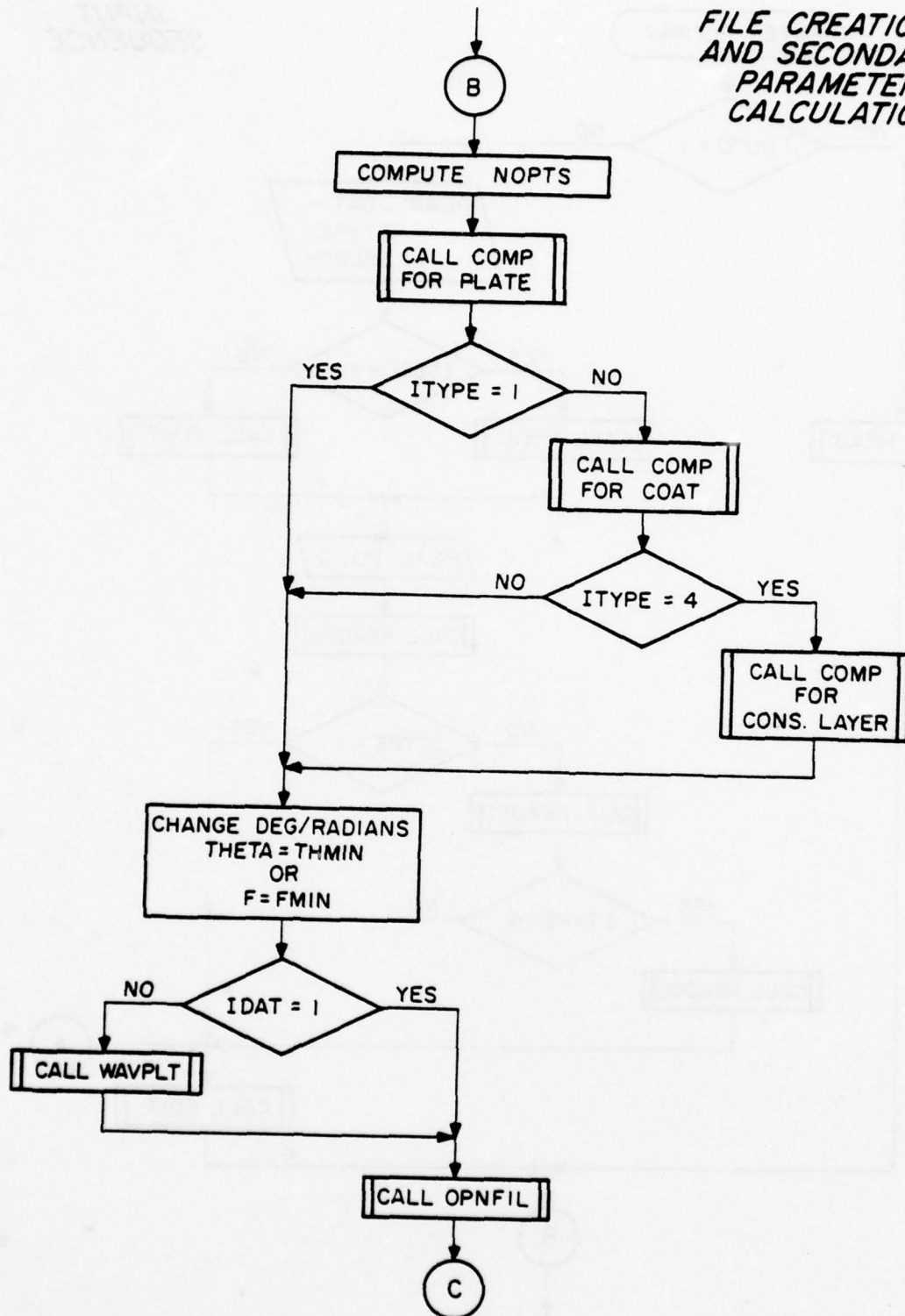
A 1

*INPUT  
SEQUENCE*



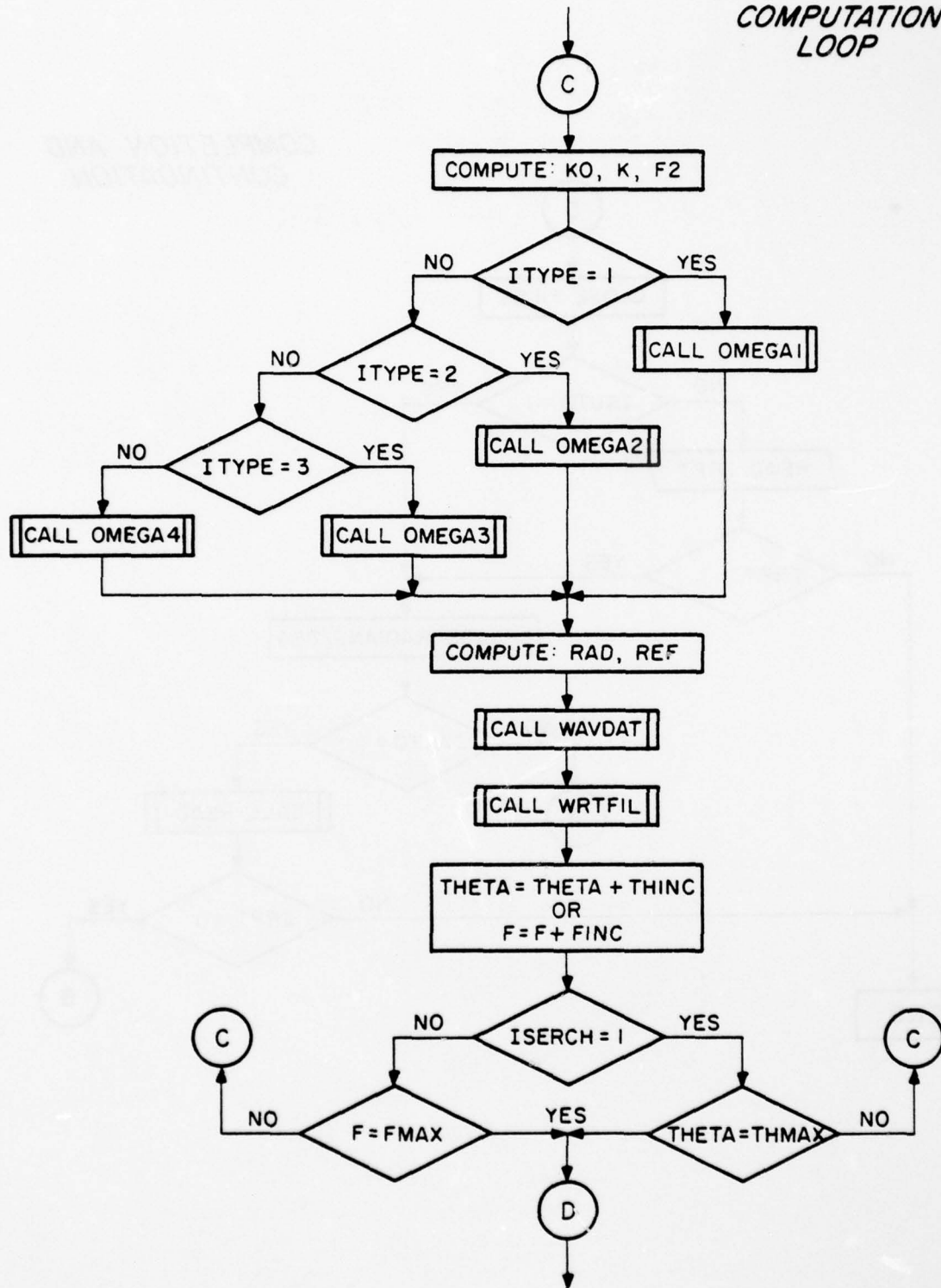
A 1

*FILE CREATION  
AND SECONDARY  
PARAMETER  
CALCULATION*

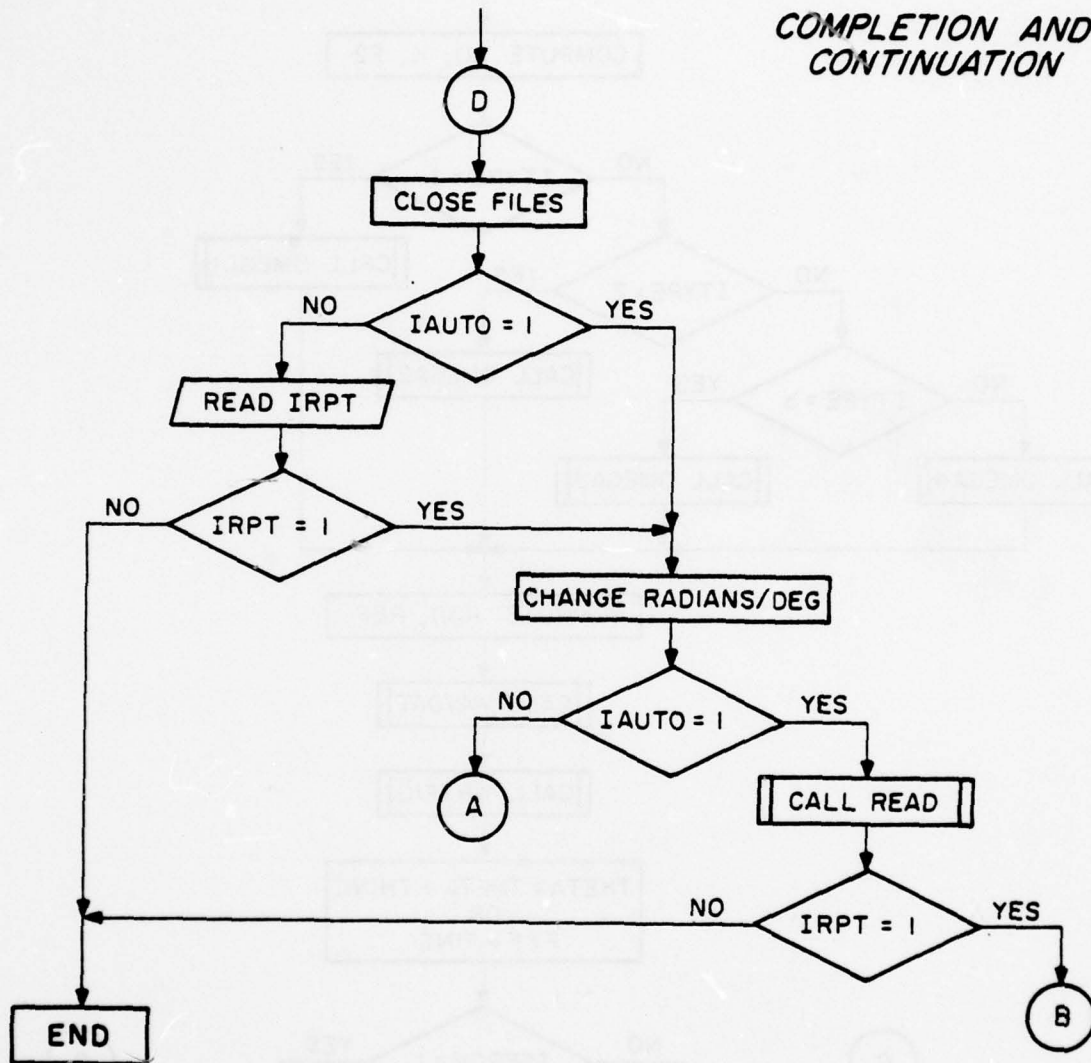


A 1

COMPUTATION  
LOOP





COMPLETION AND  
CONTINUATION

## PLTWAV OUTPUT EXAMPLE

WHAT FOLLOWS IS AN EXAMPLE OF THE NUMERICAL OUTPUT GENERATED BY 'PLTWAV'. THIS SET OF DATA REPRESENTS AN EMISSION ANGLE SEARCH FROM 12.27 TO 12.29 DEGREES FOR A SIMPLE STEEL PLATE.

## SIMPLE PLATE

## SEARCH THROUGH EMISSION ANGLE

## INPUT PARAMETERS: PLATE

## CONSTRAINED LAYER

## COATING

|                 | REAL         |  | COMPLEX |  | REAL |  | COMPLEX |  | REAL |  | COMPLEX |  |
|-----------------|--------------|--|---------|--|------|--|---------|--|------|--|---------|--|
|                 |              |  |         |  |      |  |         |  |      |  |         |  |
| DENSITY         | 0.000000E+00 |  |         |  |      |  |         |  |      |  |         |  |
| THICKNESS       | 0.000000E+00 |  |         |  |      |  |         |  |      |  |         |  |
| SHEAR MODULUS   | 0.000000E+00 |  |         |  |      |  |         |  |      |  |         |  |
| YOUNG'S MOD.    | 0.000000E+00 |  |         |  |      |  |         |  |      |  |         |  |
| POISSON'S RATIO | 0.000000E+00 |  |         |  |      |  |         |  |      |  |         |  |

## COMPUTED PARAMETERS:

|                | REAL         |  | COMPLEX |  | REAL |  | COMPLEX |  | REAL |  | COMPLEX |  |
|----------------|--------------|--|---------|--|------|--|---------|--|------|--|---------|--|
|                |              |  |         |  |      |  |         |  |      |  |         |  |
| MODIFIED SHEAR | 0.000000E+00 |  |         |  |      |  |         |  |      |  |         |  |
| FLEX. RIGIDITY | 0.000000E+00 |  |         |  |      |  |         |  |      |  |         |  |
| TIMOSHENKUS    | 0.000000E+00 |  |         |  |      |  |         |  |      |  |         |  |

## FLUID PARAMETERS:

FLUID SOUND SPEED = 0.144724E+04 METERS/SEC  
 FLUID DENSITY = 0.999700E+03 KG/METER\*\*3

ROMEGA=>THE REAL PART OF OMEGA  
 IOMEGA=>THE IMAGINARY PART OF OMEGA  
 MOMEGA=>THE MAGNITUDE OF OMEGA  
 AREF=>THE PHASE OF REFLECTION  
 MKRAD=>THE MAGNITUDE OF RADIATION  
 ARAD=>THE PHASE OF THE RADIATION

| THETA       | FREQ        | ROMEGA      | IOMEGA      | MOMEGA      | ADOMEGA     | MREF        | AREF        | MRAD        | ARAD        |
|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 0.12270E+02 | 0.64000E+05 | 0.19750E+01 | 0.00000E+00 | 0.19750E+01 | 0.00000E+00 | 0.10000E+01 | 0.95617E+00 | 0.44957E+00 | 0.17891E+03 |
| 0.12271E+02 | 0.64000E+05 | 0.18275E+01 | 0.00000E+00 | 0.18275E+01 | 0.00000E+00 | 0.10000E+01 | 0.10210E+01 | 0.47744E+00 | 0.17894E+03 |
| 0.12272E+02 | 0.64000E+05 | 0.16792E+01 | 0.00000E+00 | 0.16792E+01 | 0.00000E+00 | 0.10000E+01 | 0.10947E+01 | 0.50852E+00 | 0.17898E+03 |
| 0.12273E+02 | 0.64000E+05 | 0.15307E+01 | 0.00000E+00 | 0.15307E+01 | 0.00000E+00 | 0.10000E+01 | 0.11786E+01 | 0.54309E+00 | 0.17902E+03 |
| 0.12274E+02 | 0.64000E+05 | 0.13817E+01 | 0.00000E+00 | 0.13817E+01 | 0.00000E+00 | 0.10000E+01 | 0.12750E+01 | 0.58159E+00 | 0.17907E+03 |
| 0.12275E+02 | 0.64000E+05 | 0.12323E+01 | 0.00000E+00 | 0.12323E+01 | 0.00000E+00 | 0.10000E+01 | 0.13861E+01 | 0.62428E+00 | 0.17912E+03 |
| 0.12276E+02 | 0.64000E+05 | 0.10820E+01 | 0.00000E+00 | 0.10820E+01 | 0.00000E+00 | 0.10000E+01 | 0.15151E+01 | 0.67144E+00 | 0.17919E+03 |
| 0.12277E+02 | 0.64000E+05 | 0.93195E+00 | 0.00000E+00 | 0.93195E+00 | 0.00000E+00 | 0.10000E+01 | 0.16443E+01 | 0.72246E+00 | 0.17926E+03 |
| 0.12278E+02 | 0.64000E+05 | 0.78088E+00 | 0.00000E+00 | 0.78088E+00 | 0.00000E+00 | 0.10000E+01 | 0.18380E+01 | 0.77682E+00 | 0.17935E+03 |

| THETA       | FREQ        | ROMEGA       | IOMEGA      | MOMEGA      | ADOMEGA     | MREF        | AREF        | MRAD        | ARAD        |
|-------------|-------------|--------------|-------------|-------------|-------------|-------------|-------------|-------------|-------------|
| 0.12279E+02 | 0.64000E+05 | 0.62945E+00  | 0.00000E+00 | 0.62945E+00 | 0.00000E+00 | 0.10000E+01 | 0.20389E+01 | 0.83230E+00 | 0.17945E+03 |
| 0.12280E+02 | 0.64000E+05 | 0.47777E+00  | 0.00000E+00 | 0.47777E+00 | 0.00000E+00 | 0.10000E+01 | 0.22681E+01 | 0.88539E+00 | 0.17956E+03 |
| 0.12281E+02 | 0.64000E+05 | 0.32552E+00  | 0.00000E+00 | 0.32552E+00 | 0.00000E+00 | 0.10000E+01 | 0.25757E+01 | 0.93115E+00 | 0.17969E+03 |
| 0.12282E+02 | 0.64000E+05 | 0.17257E+00  | 0.00000E+00 | 0.17257E+00 | 0.00000E+00 | 0.10000E+01 | 0.28075E+01 | 0.96351E+00 | 0.17983E+03 |
| 0.12283E+02 | 0.64000E+05 | 0.19501E-01  | 0.00000E+00 | 0.19501E-01 | 0.00000E+00 | 0.10000E+01 | 0.31035E+01 | 0.97693E+00 | 0.17998E+03 |
| 0.12284E+02 | 0.64000E+05 | -0.13438E+00 | 0.00000E+00 | 0.13438E+00 | 0.00000E+00 | 0.10000E+01 | 0.17712E+03 | 0.96879E+00 | 0.13056E+00 |
| 0.12285E+02 | 0.64000E+05 | -0.28862E+00 | 0.00000E+00 | 0.28862E+00 | 0.00000E+00 | 0.10000E+01 | 0.17741E+03 | 0.94042E+00 | 0.27487E+00 |
| 0.12286E+02 | 0.64000E+05 | -0.44356E+00 | 0.00000E+00 | 0.44356E+00 | 0.00000E+00 | 0.10000E+01 | 0.17768E+03 | 0.89652E+00 | 0.40896E+00 |
| 0.12287E+02 | 0.64000E+05 | -0.59853E+00 | 0.00000E+00 | 0.59853E+00 | 0.00000E+00 | 0.10000E+01 | 0.17792E+03 | 0.84345E+00 | 0.52918E+00 |
| 0.12288E+02 | 0.64000E+05 | -0.75444E+00 | 0.00000E+00 | 0.75444E+00 | 0.00000E+00 | 0.10000E+01 | 0.17813E+03 | 0.78649E+00 | 0.63523E+00 |

A-3

RUNNING PLTWAV  
- INTERACTIVE -

MCR>RUN PLTWAV )

HOW DO YOU WISH TO RUN?

- 1 AUTOMATICALLY
- 2 INTERACTIVELY

TYPE 1 OR 2    2 )

WHAT TYPE OF DATA OUTPUT WOULD YOU LIKE?

- 1 NUMERICAL DATA FILES
- 2 PLOT FILES
- 3 BOTH

TYPE 1,2, OR 3    2 )

WHAT TYPE OF STRUCTURE DO YOU WANT TO ANALYZE?

- 1 SIMPLE PLATE
- 2 COMPOSITE WITH WELDED INTERFACE
- 3 COMPOSITE WITH SLIPPING INTERFACE
- 4 CONSTRAINED LAYER-WELDED INTERFACE

TYPE 1, 2, 3, OR 4    4 )

WHAT TYPE OF SEARCH?

- 1 THROUGH EMISSION ANGLE
- 2 THROUGH FREQUENCY

TYPE 1 OR 2    1 )

Note: 1), All underlined portions are User supplied  
2), ) means 'RETURN'

SOME INFORMATION IS NEEDED.

THE PARAMETERS CAN BE INPUT USING ANY FORMAT.  
THE COMPLEX PARAMETERS CAN BE SEPERATED INTO  
REAL AND IMAGINARY PARTS BY A COMMA.

|                             |                             |
|-----------------------------|-----------------------------|
| MINIMUM THETA=              | <u>0</u> )                  |
| MAXIMUM THETA=              | <u>90</u> )                 |
| THETA INCREMENT=            | <u>.25</u> )                |
| FREQUENCY=                  | <u>2E3</u> )                |
| FLUID DENSITY=              | <u>999.7</u> )              |
| FLUID SOUND SPEED=          | <u>1447.24</u> )            |
| THICKNESS OF PLATE=         | <u>.05</u> )                |
| DENSITY OF PLATE=           | <u>7782.4</u> )             |
| YOUNGS MOD. OF PLATE=       | <u>21.6E10</u> )            |
| SHEAR MOD. OF PLATE=        | <u>8.29E10</u> )            |
| THICKNESS OF COATING=       | <u>.05</u> )                |
| DENSITY OF COATING=         | <u>1310</u> )               |
| YOUNGS MOD. OF COATING=     | <u>7.102E8, 4.895E8</u> )   |
| SHEAR MOD. OF COATING=      | <u>2.3673E8, 1.6317E8</u> ) |
| THICKNESS OF CONS. LAYER=   | <u>.002</u> )               |
| DENSITY OF CONS. LAYER=     | <u>7782.4</u> )             |
| YOUNGS MOD. OF CONS. LAYER= | <u>21.6E10</u> )            |
| SHEAR MOD. OF CONS. LAYER=  | <u>8.29E10</u> )            |

Note: 1), All underlined portions are User supplied

2), ) means 'RETURN'



|    |                          |              |              |
|----|--------------------------|--------------|--------------|
| 1  | THETA MIN=               | 0.000000     |              |
| 2  | THETA MAX=               | 90.000000    |              |
| 3  | THETA INCREMENT=         | 0.250000     |              |
| 4  | FREQUENCY=               | 0.200000E+04 |              |
| 9  | FLUID SOUND SPEED=       | 0.144724E+04 |              |
| 10 | FLUID DENSITY=           | 0.999700E+03 |              |
| 11 | PLATE THICKNESS=         | 0.050000     |              |
| 12 | PLATE DENSITY=           | 0.778240E+04 |              |
| 13 | YOUNGS MOD. OF PLATE=    | 0.216000E+12 | 0.000000E+00 |
| 14 | SHEAR MOD. OF PLATE=     | 0.829000E+11 | 0.000000E+00 |
| 15 | COAT THICKNESS=          | 0.050000     |              |
| 16 | COAT DENSITY=            | 0.131000E+04 |              |
| 17 | YOUNGS MOD. OF COAT=     | 0.710200E+09 | 0.489500E+09 |
| 18 | SHEAR MOD. OF COAT=      | 0.236730E+09 | 0.163170E+09 |
| 19 | THICK. OF CONS. LAYER=   | 0.002000     |              |
| 20 | DENSITY OF CONS. LAYER = | 0.778240E+04 |              |
| 21 | YOUNGS OF CONS. LAYER =  | 0.216000E+12 | 0.000000E+00 |
| 22 | SHEAR OF CONS. LAYER =   | 0.829000E+11 | 0.000000E+00 |
| 23 | IDAT=                    | 2            |              |
| 24 | ITYPE=                   | 4            |              |
| 25 | ISERCH=                  | 1            |              |

IF THESE ARE CORRECT TYPE 0  
 TO MAKE A CORRECTION, TYPE THE NUMBER  
 TO THE LEFT OF THE INCORRECT PARAMETER  
0 )

Note: 1), All underlined portions are User supplied  
 2), ) means 'RETURN'

DO YOU WANT TO REPEAT THE SEARCH WITH  
A CHANGE IN VARIABLES?

TYPE 1 FOR YES, 0 FOR NO 1 )

|                             |                           |
|-----------------------------|---------------------------|
| 1 THETA MIN=                | 0.000000                  |
| 2 THETA MAX=                | 90.000000                 |
| 3 THETA INCREMENT=          | 0.250000                  |
| 4 FREQUENCY=                | 0.200000E+04              |
| 9 FLUID SOUND SPEED=        | 0.144724E+04              |
| 10 FLUID DENSITY=           | 0.999700E+03              |
| 11 PLATE THICKNESS=         | 0.050000                  |
| 12 PLATE DENSITY=           | 0.778240E+04              |
| 13 YOUNGS MOD. OF PLATE=    | 0.216000E+12 0.000000E+00 |
| 14 SHEAR MOD. OF PLATE=     | 0.829000E+11 0.000000E+00 |
| 15 COAT THICKNESS=          | 0.050000                  |
| 16 COAT DENSITY=            | 0.131000E+04              |
| 17 YOUNGS MOD. OF COAT=     | 0.710200E+09 0.489500E+09 |
| 18 SHEAR MOD. OF COAT=      | 0.236730E+09 0.163170E+09 |
| 19 THICK. OF CONS. LAYER=   | 0.002000                  |
| 20 DENSITY OF CONS. LAYER = | 0.778240E+04              |
| 21 YOUNGS OF CONS. LAYER =  | 0.216000E+12 0.000000E+00 |
| 22 SHEAR OF CONS. LAYER =   | 0.829000E+11 0.000000E+00 |
| 23 IDAT=                    | 2                         |
| 24 ITYPE=                   | 4                         |
| 25 ISERCH=                  | 1                         |

IF THESE ARE CORRECT TYPE 0  
TO MAKE A CORRECTION, TYPE THE NUMBER  
TO THE LEFT OF THE INCORRECT PARAMETER

19 )

19 THICK. OF CONS. LAYER= 0.002000 .0005 )

Note: 1), All underlined portions are User supplied

2), ) means 'RETURN'

```

1 THETA MIN=          0.000000
2 THETA MAX=          90.000000
3 THETA INCREMENT=    0.250000
4 FREQUENCY=          0.200000E+04
9 FLUID SOUND SPEED=  0.144724E+04
10 FLUID DENSITY=      0.999700E+03
11 PLATE THICKNESS=    0.050000
12 PLATE DENSITY=      0.778240E+04
13 YOUNGS MOD. OF PLATE= 0.216000E+12 0.000000E+00
14 SHEAR MOD. OF PLATE= 0.829000E+11 0.000000E+00
15 COAT THICKNESS=     0.050000
16 COAT DENSITY=       0.131000E+04
17 YOUNGS MOD. OF COAT= 0.710200E+09 0.489500E+09
18 SHEAR MOD. OF COAT= 0.236730E+09 0.163170E+09
19 THICK. OF CONS. LAYER= 0.000500
20 DENSITY OF CONS. LAYER = 0.778240E+04
21 YOUNGS OF CONS. LAYER = 0.216000E+12 0.000000E+00
22 SHEAR OF CONS. LAYER = 0.829000E+11 0.000000E+00
23 IDAT=              2
24 ITYPE=              4
25 ISERCH=             1

```

IF THESE ARE CORRECT TYPE 0  
 TO MAKE A CORRECTION, TYPE THE NUMBER  
 TO THE LEFT OF THE INCORRECT PARAMETER  
0 )

DO YOU WANT TO REPEAT THE SEARCH WITH  
 A CHANGE IN VARIABLES?

TYPE 1 FOR YES, 0 FOR NO 0 )  
 \*\*\*\* PLTWAV IS NOW FINISHED \*\*\*\*

Note: 1), All underlined portions are User supplied  
 2), ) means 'RETURN'

A-3 CONT.

RUNNING PLTWAV

- AUTOMATIC -

MCR>RUN PLTWAV )

HOW DO YOU WISH TO RUN?

- 1 AUTOMATICALLY
- 2 INTERACTIVELY

TYPE 1 OR 2 1 )

RUN NUMBER 1 IS COMPLETED  
RUN NUMBER 2 IS COMPLETED  
RUN NUMBER 3 IS COMPLETED  
RUN NUMBER 4 IS COMPLETED  
RUN NUMBER 5 IS COMPLETED  
RUN NUMBER 6 IS COMPLETED  
\*\*\*\* PLTWAV IS NOW FINISHED \*\*\*\*

Note: 1), All underlined portions are User supplied  
2), ) means 'RETURN'



## PLTWAV COMPILATION

THE COMPILER FOR FORTRAN 4 PLUS ON THE PDP 11/45 WITH THE RSX 11-D SYSTEM IS RUN USING THE 'F4P' COMMAND. THIS OPERATION TAKES THE SOURCE FILE AND CREATES AN OBJECT CODE IMAGE WITH THE SAME NAME. WHAT FOLLOWS IS A FILE CALLED 'PLTWAV.F4P', AND IS THE COMMAND FILE FOR COMPILING ALL OF THE ROUTINES USED BY 'PLTWAV'. TO INDICATE THIS FILE TO THE COMPILER, USE THE COMMAND STRING: '@PLTWAV.F4P' AFTER THE 'F4P' COMMAND HAS CALLED THE COMPILER. FOR EXAMPLE:

```
CONTROL C )
MCR>F4P )
F4P>@PLTWAV.F4P )
F4P>CONTROL Z ) TO EXIT
```

```
PLTWAV=PLTWAV/--SP/--RO/TR/CK
TKCLER=TKCLER/--RO/--SP/TR/CK
READ=READ/--RO/--SP/CK/TR
FDAT=FDAT/--RO/--SP/TR/CK
THDAT=THDAT/--RO/--SP/TR/CK
EDIT=EDIT/--RO/--SP/TR/CK
READPL=READPL/--RO/--SP/TR/CK
READCO=READCO/--RO/--SP/TR/CK
READCL=READCL/--RO/--SP/TR/CK
COMP=COMP/--RO/--SP/TR/CK
WAVPLT=WAVPLT/--RO/--SP/TR/CK
HEADER=HEADER/--RO/--SP/TR/CK
OPNFIL=OPNFIL/--RO/--SP/TR/CK
WAVDAT=WAVDAT/--RO/--SP/TR/CK
WRTFIL=WRTFIL/--RO/--SP/TR/CK
OMEGA1=OMEGA1/--RO/--SP/TR/CK
OMEGA2=OMEGA2/--RO/--SP/TR/CK
OMEGA3=OMEGA3/--RO/--SP/TR/CK
OMEGA4=OMEGA4/--RO/--SP/CK/TR
```

Note: 1), All underlined portions are User supplied

2), ) means 'RETURN'

## A-5

### PLTWAV TASK BUILDING

THE TASK BUILDING OPERATION ON THE RSX 11-D SYSTEM IS USED TO LINK THE OBJECT FILES THAT HAVE BEEN CREATED BY THE COMPILER. THIS ALLOWS THE USER TO OVERLAY THE ROUTINES AS OPPOSED TO THE MORE USUAL BATCH PROCESSING, INCREASING THE SPEED OF THE PROGRAM AND REDUCING ITS MEMORY REQUIREMENTS. WHAT FOLLOWS IS 1) THE COMMAND STRING FOR THE TKB OPERATION AND 2) THE COMMAND FILE 'PLTWAV.TKB' THAT THE STRING DIRECTS THE TASK BUILDER TO.

```
CONTROL C )
MCR>TKB)
TKB>@PLTWAV.TKB )
TKB>CONTROL Z) TO EXIT
```

```
PLTWAV,PLTWAV/SH/-SP=PLTWAV,TKCLER,FDAT,THDAT,EDIT,
READCO,READPL,COMP,WAUPLT,HEADER,OPNFIL,READCL,
WAVDAT,WRTFIL,OMEGA1,OMEGA2,OMEGA3,OMEGA4,READ
/
LIBR=OTSCOR:RO
UNITS=13
ACTFIL=13
ASG=TI:1:2
ASG=SY:3:4:5:7:9:11:12:13
ASG=SY:6:8:10
POOL=50
STACK=512
/
```

Note: 1), All underlined portions are User supplied  
2), ) means 'RETURN'

A-6

## PLTWAV COMMON

THE COMMON SECTION FOR 'PLTWAV' IS RATHER LARGE. FOR THIS REASON, A FILE CALLED 'PLTWAV.COM' WAS CREATED AND THE 'INCLUDE' STATEMENT WAS USED IN THE ROUTINES REQUIRING THE COMMON. WHAT FOLLOWS IS THE FILE 'PLTWAV.DAT':

```
C      COMMON IDAT, ITYPE, ISERCH, IRPT
COMMON FMIN, FMAX, FINC, THETA
COMMON THMIN, THMAX, THINC, F
COMMON RO, C, HPLAT, ROPLAT, EPLAT, GPLAT, VPLAT, DPLAT, KAPAPL
COMMON HCOAT, ROCOAT, ECOAT, GCOAT, VCOAT, DCOAT, KAPACO
COMMON HCONL, ROCONL, ECONL, GCONL, VCONL, DCONL, KAPACL
COMMON WAVDT(10), OMEGA

C      COMPLEX EPLAT, GPLAT, VPLAT, DPLAT, KAPAPL, GP
COMPLEX ECOAT, GCOAT, VCOAT, DCOAT, KAPACO, GC
COMPLEX ECONL, GCONL, VCONL, DCONL, KAPACL, GL
COMPLEX OMEGA, CXDUM, CXCOS, CX1, CX2, CXJ, REF, RAD

C      REAL K, KO
```

## PLTWAV LISTING

WRITTEN BY MARTIN D. RING AT THE NRL-USRD. AUG. 22.1978  
THIS IS THE MAIN PROGRAM PLTWAV.FTN

THE SUBROUTINES CALLED ARE LISTED HERE:

READ FOR I/O WHEN THE AUTOMATIC OPTION IS USED  
TKCLER CLEARS THE CRT SCREEN  
FDAT TAKES INPUT DATA WHEN FREQUENCY IS AN INDEPENDENT  
VARIABLE  
THDAT WHEN THETA--THE ANGLE OF EMISSION--IS AN IND. VARIABLE  
READCO INPUT DATA PERTAINING TO THE COATING  
READPL INPUT DATA PERTAINING TO THE PLATE  
READCL INPUT DATA PERTAINING TO THE CONSTRAINED LAYER  
EDIT TO CHECK THE INPUT SEQUENCE  
COMP TO COMPUTE MATERIAL PARAMETERS  
WAYPLT TO OPEN THE PLOT FILES USING HEADER  
OPNFIL TO OPEN THE DATA AND PLOT FILES  
OMEGA1 TO COMPUTE OMEGA FOR SIMPLE PLATE PROBLEMS  
OMEGA2 TO COMPUTE OMEGA FOR WELDED INTERFACE  
OMEGA3 TO COMPUTE OMEGA FOR SLIPPING INTERFACE  
OMEGA4 TO COMPUTE OMEGA FOR CONSTRAINED LAYER  
WAYDAT TO FILL AN ARRAY-WAYDT(10)  
WRTFIL TO WRITE PARTS OF WAYDT INTO FILES

A LIST OF PARAMETERS AND THEIR NAMES FOLLOWS:

|                                          |                     |
|------------------------------------------|---------------------|
| FREQUENCY. . . . .                       | .F HERTZ            |
| FLUID SOUND SPEED. . . . .               | .C METERS/SEC       |
| SHEAR MODULUS OF PLATE. . . . .          | .GPLAT NT/SQ METER  |
| COATING. . . . .                         | .GCOAT              |
| CONSTRAINED LAYER. . . . .               | .GCONL              |
| MODIFIED SHEAR MODULUS OF PLATE. . . . . | .GP                 |
| COATING. . . . .                         | .GC                 |
| CONS. LAYER. . . . .                     | .GL                 |
| DENSITY OF FLUID. . . . .                | .RD KG/METER CUBED  |
| PLATE. . . . .                           | .ROPLAT             |
| COATING. . . . .                         | .ROCOAT             |
| CONSTRAINED LAYER. . . . .               | .ROCONL             |
| THICKNESS OF PLATE. . . . .              | .HPLAT METERS       |
| COATING. . . . .                         | .HCOAT              |
| CONSTRAINED LAYER. . . . .               | .HCONL              |
| YOUNG'S MODULUS OF PLATE. . . . .        | .EPLAT NT/METER SQ. |
| COATING. . . . .                         | .ECOAT              |
| CONSTRAINED LAYER. . . . .               | .ECONL              |
| POISSONS RATIO OF PLATE. . . . .         | .VPLAT              |
| COATING. . . . .                         | .VCOAT              |
| CONSTRAINED LAYER. . . . .               | .VCONL              |
| EMISSION ANGLE. . . . .                  | .THETA DEG          |
| ELASTIC RESPONSE FUNCTION. . . . .       | .OMEGA              |





```

C CALL FDAT IF A FREQUENCY SEARCH IS DESIRED
C IF (ISERCH.EQ.2) CALL FDAT(FMIN,FMAX,FINC,THETA)
C CALL THDAT IF AN ANGLE SEARCH IS DESIRED
C IF (ISERCH.EQ.1) CALL THDAT(THMIN,THMAX,THINC,F)
C READ IN RO AND C
C WRITE(1,13)
C   13   FORMAT(' $FLUID DENSITY= ',11X)
C   100  READ(2,100)RO
C   100  FORMAT(F10.0)
C   14   WRITE(1,14)
C   14   READ(2,100)C
C   14   FORMAT(' $FLUID SOUND SPEED= ',7X)
C CALL READPL TO COLLECT PLATE DATA
C CALL READPL(HPLAT,ROPLAT,EPLAT,GPLAT)
C CALL READCO TO COLLECT COATING DATA
C IF (ITYPE.NE.1) CALL READCO(HCOAT,ROCOAT,ECOAT,GCOAT)
C CALL READCL TO COLLECT CONSTRAINING LAYER DATA
C IF (ITYPE.EQ.4) CALL READCL(HCONL,ROCONL,ECONL,GCONL)
C CALL EDIT TO CHECK THE INPUT DATA
C 500 CALL EDIT
C CALL READ IF AUTOMATICALLY RUNNING
C 501 IF (IAUTO.EQ.1) CALL READ(IZ)
C COMPUTE THE NUMBER OF POINTS
C 504 IF (ISERCH.EQ.1) NOPTS=(THMAX-THMIN)/THINC
C     IF (ISERCH.EQ.2) NOPTS=(FMAX-FMIN)/FINC
C COMP COMPUTES PLATE PARAMETERS
C CALL COMP(KAPAPL,GP,DPLAT,VPLAT,GPLAT,EPLAT,HPLAT,CX1,CX2)
C CALL COMP TO COMPUTE COAT PARAMETERS
C IF (ITYPE.NE.1) CALL COMP(KAPACO,GC,DCCOAT,VCCOAT,GCCOAT,
C   IECCOAT,HCCOAT,CX1,CX2)
C CALL COMP TOO COMPUTE CONS. LAYER PARAMETERS
C IF (ITYPE.EQ.4) CALL COMP(KAPACL,GL,DCONL,VCONL,GCONL,ECONL,
C   1,HCONL,CX1,CX2)
C IF (ITYPE.NE.1) BETA=HPLAT/HCOAT
C CHANGE ANGLES TO RADIAN
C THETA=THETA*0.0174532925
C THMIN=THMIN*0.0174532925
C THMAX=THMAX*0.0174532925
C THINC=THINC*0.0174532925
C

```

```

C INITIALIZE THE SEARCH
C
  IF (ISERCH.EQ.2) F=FMIN
  IF (ISERCH.EQ.1) THETA=THMIN
C
C SET UP THE HEADER INFORMATION
C
  IF (IDAT.NE.1) CALL WAVPLT (THMIN, THMAX, THINC, FMIN, FMAX, FINC
  1, ISERCH, NOPTS)
C
C OPEN THE DATA AND PLOT FILES
C
  CALL OPNFIL (GC, GP, GL)
C
C THIS LOOP DOES THE POINT CALCULATIONS
C
50  DO 51 M=1, NOPTS
    KO=2.*PI*F/KC
    K=KO*SIN (THETA)
    F2=(2.*PI*F)**2
C
C COMPUTE THE ELASTIC RESPONSE FUNCTION
C
    IF (ITYPE.EQ.1) CALL OMEGA1 (OMEGA, DPLAT, K, GP, HPLAT, ROPLAT
    1, F2, KO, RO)
    IF (ITYPE.EQ.2) CALL OMEGA2 (OMEGA, F2, HPLAT, HCOAT, BETA
    1, ROPLAT, ROCCAT, GP, GC, K, KO, DPLAT, DCOAT, RO)
    IF (ITYPE.EQ.3) CALL OMEGA3 (OMEGA, F2, HPLAT, HCOAT, ROPLAT
    1, ROCCAT, GP, GC, DPLAT, DCOAT, RO, K, KO)
    IF (ITYPE.EQ.4) CALL OMEGA4 (OMEGA, F2, HPLAT, HCOAT, BETA, ROPLAT
    1, ROCCAT, GP, GC, K, KO, DPLAT, DCOAT, RO, HCONL, DCONL, ROCONL)
C
C COMPUTE REFLECTED AND RADIATED SOUND
C
    CXCOS=CMPLX (COS (THETA), 0.)
    CXDUM=CX1/(CX1+CXJ*OMEGA*CXCOS)
    REF=CX1-CX2*KCXDUM
    RAD=CXCOS*CXDUM
C
C FILL AN ARRAY WITH THE INFORMATION
C
    CALL WAVDAT (THETA, F, OMEGA, REF, RAD, WAVDT)
C
C WRITE THE INFORMATION INTO THE FILES
C
    CALL WRTFIL (ISERCH, WAVDT, M, IDAT)
C
C INCREMENT THE SEARCH PARAMETER
C
    IF (ISERCH.EQ.1) THETA=THETA+THINC
    IF (ISERCH.EQ.2) F=F+FINC
51  CONTINUE
52  DO 53 I=3, 11
53  CLOSE (UNIT=I)
C
C CHECK TO SEE IF ANOTHER SEARCH IS WANTED WITH A CHANGE IN PARAMETERS
C
    ICOUNT=ICOUNT+1
    IF (IAUTO.EQ.1) WRITE (1, 300) ICOUNT
300  FORMAT (' RUN NUMBER ', I2, ' IS COMPLETED')
    IF (IAUTO.EQ.1) GO TO 301
    WRITE (1, 55)
    WRITE (1, 56)
    WRITE (1, 57)
    READ (2, 7) IRPT
    IF (IRPT.EQ.0) GO TO 58

```

```

C
C IF ANOTHER RUN. ANGLES ARE CHANGED BACK TO DEGREES
C
301 THETA=THETA*57.29577951
    THMIN=THMIN*57.29577951
    THMAX=THMAX*57.29577951
    THINC=THINC*57.29577951
C
C GO BACK TO EDIT TO MAKE THE PARAMETER CHANGE
C
    IF(IAUTO.EQ.1)CALL READ(IZ)
    IF(IRPT.EQ.0)GO TO 58
    IF(IAUTO.EQ.1)GO TO 504
    GO TO 588
55  FORMAT(//.' DO YOU WANT TO REPEAT THE SEARCH WITH')
56  FORMAT(' A CHANGE IN VARIABLES?'.//)
57  FORMAT(' $ TYPE 1 FOR YES, 0 FOR NO ')
58  WRITE(1,54)
54  FORMAT(' ***** PLTWAY IS NOW FINISHED *****')
    END

```



```

      SUBROUTINE TKCLR(LCO)
C
C THIS SUBROUTINE WILL CLEAR THE 4010 TERMINAL SCREEN.
C THIS SUBROUTINE IS ALSO MODIFIED TO CLEAR THE MINI-TEC
C TERMINAL SCREEN. (7 AUG 76)
C
C LCO IS THE LUN NUMBER ASSIGNED TO CO:
C
      BYTE BUFFO(2),MINI(2)
      INTEGER IPRM(6)

      DATA MESC/27/,MFF/12/
      DATA MINI/"34,"000/

C
C FIRST THE MINI-TEC
C
      CALL GETADR(IPRM,MINI)
      IPRM(2)=1
      CALL WTQIO("410,LCO,1,,,IPRM)

C
C NOW THE 4010
C
      BUFFO(1)=MESC
      BUFFO(2)=MFF

      CALL GETADR(IPRM,BUFFO(1))
      IPRM(2)=2

      CALL WTQIO("410,LCO,1,,,IPRM)

C
C NOW BEFORE RETURNING, DELAY ONE SECOND.
C
      CALL WAIT(1.2,M)
      RETURN
      END

```

```

      SUBROUTINE READ(IZ)
C
C THIS ROUTINE IS USED BY PLTWAV WHEN RUNNING IN THE AUTOMATIC MODE
C
C THE FILE 'PLTWAV.DAT' IS READ FOR DATA AND COMMANDS
C
C THE FILE 'NOTES.MDR' WILL GIVE ASSISTANCE IN WRITING THE DATA FILE
C
      INCLUDE 'PLTWAV.COM'
      IF(IZ.EQ.1)GO TO 100
      OPEN(UNIT=13,NAME='PLTWAV.DAT',TYPE='OLD')
      IZ=1
C
C SPECIFY DATA OUTPUT, STRUCTURE, AND SEARCH TYPE
C
      READ(13,104)IDAT
      READ(13,104)ITYPE
      READ(13,104)ISERCH
C
C SPECIFY SEARCH PARAMETERS
C
      IF(ISERCH.EQ.1)READ(13,106)THMIN
      IF(ISERCH.EQ.1)READ(13,106)THMAX
      IF(ISERCH.EQ.1)READ(13,106)THINC
      IF(ISERCH.EQ.1)READ(13,106)F
      IF(ISERCH.EQ.2)READ(13,106)FMIN
      IF(ISERCH.EQ.2)READ(13,106)FMAX
      IF(ISERCH.EQ.2)READ(13,106)FINC
      IF(ISERCH.EQ.2)READ(13,106)THETA
C
C SPECIFY FLUID PARAMETERS
C
      READ(13,106)RO
      READ(13,106)C
103   FORMAT(2F10.0)
C
C SPECIFY PLATE PARAMETERS
C
      READ(13,106)HPLAT
      READ(13,106)ROPLAT
      READ(13,103)EPLAT
      READ(13,103)GPLAT
C
C SPECIFY COATING PARAMETERS
C
      IF(ITYPE.NE.1)READ(13,106)HCOAT
      IF(ITYPE.NE.1)READ(13,106)ROCOAT
      IF(ITYPE.NE.1)READ(13,103)ECOAT
      IF(ITYPE.NE.1)READ(13,103)GCOAT
C
C SPECIFY CONSTRAINING LAYER PARAMETERS
C
      IF(ITYPE.EQ.4)READ(13,106)HCONL
      IF(ITYPE.EQ.4)READ(13,106)ROCONL
      IF(ITYPE.EQ.4)READ(13,103)ECONL
      IF(ITYPE.EQ.4)READ(13,103)GCONL
      RETURN
C
C THIS SECTION ONLY AFTER FIRST RUN
C
C IF NO SECOND RUN (OF MORE RUNS AT ALL) SIMPLY HAVE A ZERO '0'
C AS THE NEXT NUMBER IN 'PLTWAV.DAT'
C
100   READ(13,104)IRPT
      IF(IRPT.EQ.0)GO TO 108
C

```

C ICHANG IS THE SAME HERE AS IN 'EDIT' WITH THE ADDITION OF IDAT, ITYPE  
C AND ISERCH AT THE END OF THE LIST

C EXIT THE ROUTINE WITH ICHANG=0

```

107 READ(13,105) ICHANG
    IF(ICHANG.EQ.0) RETURN
104 FORMAT(11)
105 FORMAT(12)
    GO TO (1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18
1      1,19,20,21,22,23,24,25) ICHANG
1    READ(13,106) THMIN
    GO TO 107
106  FORMAT(F10.0)
2    READ(13,106) THMAX
    GO TO 107
3    READ(13,106) THINC
    GO TO 107
4    READ(13,106) F
    GO TO 107
5    READ(13,106) FMIN
    GO TO 107
6    READ(13,106) FMAX
    GO TO 107
7    READ(13,106) FINC
    GO TO 107
8    READ(13,106) THETA
    GO TO 107
9    READ(13,106) C
    GO TO 107
10   READ(13,106) RO
    GO TO 107
11   READ(13,106) HPLAT
    GO TO 107
12   READ(13,106) POPLAT
    GO TO 107
13   READ(13,103) EPLAT
    GO TO 107
14   READ(13,103) GPLAT
    GO TO 107
15   READ(13,106) HCOAT
    GO TO 107
16   READ(13,106) ROCOAT
    GO TO 107
17   READ(13,103) ECOAT
    GO TO 107
18   READ(13,103) GCOAT
    GO TO 107
19   READ(13,106) HCONL
    GO TO 107
20   READ(13,106) RCONL
    GO TO 107
21   READ(13,103) ECONL
    GO TO 107
22   READ(13,103) GCONL
    GO TO 107
23   READ(13,104) IDAT
    GO TO 107
24   READ(13,104) ITYPE
    GO TO 107
25   READ(13,104) ISERCH
    GO TO 107
108  CLOSE(UNIT=13)
    RETURN
    END

```

```

      SUBROUTINE FDATA(FMIN,FMAX,FINC,THETA)
C
C THIS ROUTINE PROVIDES DIALOGUE FOR INPUTTING FREQUENCY DATA
C WHEN A FREQUENCY SEARCH IS SPECIFIED FROM PLTWAV
C
      CALL TKCLER(1)
      WRITE(1,1)
      1  FORMAT(' SOME INFORMATION IS NEEDED.',///.
      1    ' THE PARAMETERS CAN BE INPUT USING ANY FORMAT.',///.
      2    ' THE COMPLEX PARAMETERS CAN BE SEPERATED INTO',///.
      3    ' REAL AND IMAGINARY PARTS BY A COMMA.',///.
      4    '$MINIMUM FREQUENCY=',7X)
      READ(2,10)FMIN
      WRITE(1,6)
      READ(2,10)FMAX
      WRITE(1,7)
      READ(1,10)FINC
      WRITE(1,8)
      READ(2,10)THETA
      6  FORMAT('$MAXIMUM FREQUENCY=',7X)
      7  FORMAT('$FREQUENCY INCREMENT=',5X)
      8  FORMAT('$INCEDECE ANGLE THETA=',3X)
      10 FORMAT(F10.0)
      RETURN
      END

```



```

      SUBROUTINE THDAT(THMIN,THMAX,THINC,F)
C
C THIS ROUTINE PROVIDES DIALOGUE FOR INPUTTING ANGLE DATA
C WHEN A ANGLE SEARCH IS SPECIFIED FROM PLTWAY
C
      CALL TKCLER(1)
      WRITE(1,1)
1      FORMAT(' SOME INFORMATION IS NEEDED.',///,
1          ' THE PARAMETERS CAN BE INPUT USING ANY FORMAT.',///,
2          ' THE COMPLEX PARAMETERS CAN BE SEPERATED INTO',///,
3          ' REAL AND IMAGINARY PARTS BY A COMMA.',///,
4          ' $MINIMUM THETA=',11X)
      READ(2,10) THMIN
      WRITE(1,6)
      READ(2,10) THMAX
      WRITE(1,7)
      READ(1,10) THINC
      WRITE(1,8)
      READ(2,10) F
6      FORMAT(' $MAXIMUM THETA=',11X)
7      FORMAT(' $THETA INCREMENT=',9X)
8      FORMAT(' $FREQUENCY=',15X)
10     FORMAT(F10.0)
      RETURN
      END

```

```

SUBROUTINE READPL(HPLAT,ROPLAT,EPLAT,GPLAT)
COMPLEX GPLAT,EPLAT

C
C
C THIS ROUTINE TAKES INPUT DATA PERTAINING TO THE PLATE
C WHEN CALLED BY PLTWAY
C
WRITE(1,1)
READ(2,10)HPLAT
WRITE(1,2)
READ(2,10)ROPLAT
WRITE(1,4)
READ(2,11)EPLAT
WRITE(1,3)
READ(2,11)GPLAT
1  FORMAT(' $THICKNESS OF PLATE= '.6X)
2  FORMAT(' $DENSITY OF PLATE= '.8X)
3  FORMAT(' $SHEAR MOD. OF PLATE= '.5X)
4  FORMAT(' $YOUNGS MOD. OF PLATE= '.4X)
10 FORMAT(F10.0)
11 FORMAT(2F10.0)
RETURN
END

```

```

SUBROUTINE READCO(HCOAT,ROCOAT,ECCOAT,GCOAT)
COMPLEX ECCOAT,GCOAT
C
C THIS ROUTINE TAKES INPUT DATA PERTAINING TO THE COATING
C WHEN CALLED BY PLTWAV
C
WRITE(1,1)
READ(2,10)HCOAT
WRITE(1,2)
READ(2,10)ROCOAT
WRITE(1,3)
READ(2,11)ECCOAT
WRITE(1,4)
READ(2,11)GCOAT
1  FORMAT('THICKNESS OF COATING=','.4X)
2  FORMAT('DENSITY OF COATING=','.6X)
3  FORMAT('YOUNGS MOD. OF COATING=','.2X)
4  FORMAT('SHEAR MOD. OF COATING=','.3X)
10 FORMAT(F10.0)
11 FORMAT(ZF10.0)
RETURN
END

```

```

SUBROUTINE READCL(HCONL,ROCONL,ECONL,GCONL)
COMPLEX GCONL,ECONL
C
C THIS ROUTINE TAKES INPUT DATA PERTAINING TO THE CONSTRAINED
C LAYER WHEN CALLED BY PLTWAV
C
WRITE(1,1)
READ(2,10)HCONL
WRITE(1,2)
READ(2,10)ROCONL
WRITE(1,4)
READ(2,11)ECONL
WRITE(1,3)
READ(2,11)GCONL
1  FORMAT('THICKNESS OF CONS. LAYER=',6X)
2  FORMAT('DENSITY OF CONS. LAYER=',8X)
3  FORMAT('SHEAR MOD. OF CONS. LAYER=',5X)
4  FORMAT('YOUNGS MOD. OF CONS. LAYER=',4X)
10 FORMAT(F10.0)
11 FORMAT(2F10.0)
RETURN
END

```



# SUBROUTINE EDIT

C THIS ROUTINE ALLOWS THE USER OF PLTWAY TO CHECK THE INPUT DATA  
C THROUGH INTERACTIVE DIALOGUE  
C  
C

```
C      INCLUDE 'PLTWAY.COM'
C
99      I=0
      CALL TKCLER(1)
      IF(1SERCH.EQ.2)GO TO 5
1      WRITE(1,101)THMIN
      IF(1.EQ.1)READ(2,200)THMIN
      IF(1.EQ.1)GO TO 99
2      WRITE(1,102)THMAX
      IF(1.EQ.1)READ(2,200)THMAX
      IF(1.EQ.1)GO TO 99
3      WRITE(1,103)THINC
      IF(1.EQ.1)READ(2,200)THINC
      IF(1.EQ.1)GO TO 99
4      WRITE(1,104)F
      IF(1.EQ.1)READ(2,200)F
      IF(1.EQ.1)GO TO 99
      GO TO 9
5      WRITE(1,105)FMIN
      IF(1.EQ.1)READ(2,200)FMIN
      IF(1.EQ.1)GO TO 99
6      WRITE(1,106)FMAX
      IF(1.EQ.1)READ(2,200)FMAX
      IF(1.EQ.1)GO TO 99
7      WRITE(1,107)FINC
      IF(1.EQ.1)READ(2,200)FINC
      IF(1.EQ.1)GO TO 99
8      WRITE(1,108)THETA
      IF(1.EQ.1)READ(2,200)THETA
      IF(1.EQ.1)GO TO 99
9      WRITE(1,109)C
      IF(1.EQ.1)READ(2,200)C
      IF(1.EQ.1)GO TO 99
10     WRITE(1,110)RC
      IF(1.EQ.1)READ(2,200)RC
      IF(1.EQ.1)GO TO 99
11     WRITE(1,111)HPLAT
      IF(1.EQ.1)READ(2,200)HPLAT
      IF(1.EQ.1)GO TO 99
12     WRITE(1,112)ROPLAT
      IF(1.EQ.1)READ(2,200)ROPLAT
      IF(1.EQ.1)GO TO 99
13     WRITE(1,113)EPLAT
      IF(1.EQ.1)READ(2,201)EPLAT
      IF(1.EQ.1)GO TO 99
14     WRITE(1,114)GPLAT
      IF(1.EQ.1)READ(2,201)GPLAT
      IF(1.EQ.1)GO TO 99
      IF(1TYPE.EQ.1)GO TO 26
15     WRITE(1,115)HCOAT
      IF(1.EQ.1)READ(2,200)HCOAT
      IF(1.EQ.1)GO TO 99
16     WRITE(1,116)ROCOAT
      IF(1.EQ.1)READ(2,200)ROCOAT
      IF(1.EQ.1)GO TO 99
17     WRITE(1,117)ECOAT
      IF(1.EQ.1)READ(2,201)ECOAT
      IF(1.EQ.1)GO TO 99
18     WRITE(1,118)GCOAT
      IF(1.EQ.1)READ(2,201)GCOAT
```

```

IF(I.EQ.1)GO TO 99
IF(ITYPE.NE.4)GO TO 26
19 WRITE(1,119)HCONL
IF(I.EQ.1)READ(2,200)HCONL
IF(I.EQ.1)GO TO 99
20 WRITE(1,120)ROCONL
IF(I.EQ.1)READ(2,200)ROCONL
IF(I.EQ.1)GO TO 99
21 WRITE(1,121)ECONL
IF(I.EQ.1)READ(2,201)ECONL
IF(I.EQ.1)GO TO 99
22 WRITE(1,122)GCONL
IF(I.EQ.1)READ(2,201)GCONL
IF(I.EQ.1)GO TO 99
26 WRITE(1,126)IDAT
IF(I.EQ.1)READ(2,203)IDAT
IF(I.EQ.1)GO TO 99
27 WRITE(1,127)ITYPE
IF(I.EQ.1)READ(2,203)ITYPE
IF(I.EQ.1)GO TO 99
28 WRITE(1,128)ISERCH
IF(I.EQ.1)READ(2,203)ISERCH
IF(I.EQ.1)GO TO 99
I=1
WRITE(1,23)
WRITE(1,24)
WRITE(1,25)
READ(2,202)ICHANG
IF(ICHANG.EQ.0)RETURN
GO TO(1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18
1,19,20,21,22,26,27,28)ICHANG
C
101 FORMAT($ 1 THETA MIN= ,F10.6,2X)
102 FORMAT($ 2 THETA MAX= ,F10.6,2X)
103 FORMAT($ 3 THETA INCREMENT= ,F10.6,2X)
104 FORMAT($ 4 FREQUENCY= ,E12.6,2X)
105 FORMAT($ 5 FREQ. MIN.= ,E12.6,2X)
106 FORMAT($ 6 FREQ. MAX.= ,E12.6,2X)
107 FORMAT($ 7 FREQ. INCREMENT= ,E12.6,2X)
108 FORMAT($ 8 THETA= ,F10.6,2X)
109 FORMAT($ 9 FLUID SOUND SPEED= ,E12.6,2X)
110 FORMAT($ 10 FLUID DENSITY= ,E12.6,2X)
111 FORMAT($ 11 PLATE THICKNESS= ,F10.6,2X)
112 FORMAT($ 12 PLATE DENSITY= ,E12.6,2X)
113 FORMAT($ 13 YOUNGS MOD. OF PLATE= ,2(E12.6,1X))
114 FORMAT($ 14 SHEAR MOD. OF PLATE= ,2(E12.6,1X))
115 FORMAT($ 15 COAT THICKNESS= ,F10.6,2X)
116 FORMAT($ 16 COAT DENSITY= ,E12.6,2X)
117 FORMAT($ 17 YOUNGS MOD. OF COAT= ,2(E12.6,1X))
118 FORMAT($ 18 SHEAR MOD. OF COAT= ,2(E12.6,1X))
119 FORMAT($ 19 THICK. OF CONS. LAYER= ,F10.6,2X)
120 FORMAT($ 20 DENSITY OF CONS. LAYER = ,E12.6,2X)
121 FORMAT($ 21 YOUNGS OF CONS. LAYER = ,2(E12.6,1X))
122 FORMAT($ 22 SHEAR OF CONS. LAYER = ,2(E12.6,1X))
126 FORMAT($ 23 IDAT= ,I1)
127 FORMAT($ 24 ITYPE= ,I1)
128 FORMAT($ 25 ISERCH= ,I1)
23 FORMAT(//, ' IF THESE ARE CORRECT TYPE 0')
24 FORMAT(' TO MAKE A CORRECTION. TYPE THE NUMBER')
25 FORMAT(' TO THE LEFT OF THE INCORRECT PARAMETER')
200 FORMAT(F10.0)
201 FORMAT(2F10.0)
202 FORMAT(I2)
203 FORMAT(I1)
END

```

```

C
C
C
C
C
C
SUBROUTINE COMP(KAPA,SG,D,V,G,E,H
1,CX1,CX2)
COMPLEX SG,D,E,G,V,CX1,CX2,KAPA
THIS ROUTINE COMPUTES SOME PLATE PARAMETERS WHEN CALLED BY PLTWAY
V=E/(CX2*G)-CX1
KAPA=CMPLX(.67,0.)+CMPLX(1.12,0.)*V
KAPA=KAPA/(CX1+V)
SG=(KAPA**2)*G
D=E*CMPLX(H**3,0.)
D=D/(CMPLX(12.,0.)*(CX1-V**2))
RETURN
END

```

```

C      SUBROUTINE WAVPLT (THMIN, THMAX, THINC, FMIN, FMAX, F INC, I SERCH, NOPTS)
C
C      BYTE NAMDAT(11)
C      DIMENSION IX(2), IY(2), IZ(2), IT(2)
C      INTEGER BLOCK(8)
C      EQUIVALENCE (THMI, IX(1)), (FMI, IY(1)), (THIN, IZ(1))
C      EQUIVALENCE (FIN, IT(1))
C
C      THIS CALLS HEADER FOR THE PLOT FILES USED BY PLTWAY
C
C      THMA=THMAX*57.29577951
C      THMI=THMIN*57.29577951
C      FMI=FMIN
C      FMA=FMAX
C      THIN=THINC*57.29577951
C      FIN=F INC
C      IF (I SERCH.EQ.2) BLOCK(2)=NOPTS*2
C      IF (I SERCH.EQ.1) BLOCK(2)=NOPTS*2
C      IF (I SERCH.EQ.2) BLOCK(4)=IY(1)
C      IF (I SERCH.EQ.2) BLOCK(5)=IY(2)
C      IF (I SERCH.EQ.2) BLOCK(6)=IT(1)
C      IF (I SERCH.EQ.2) BLOCK(7)=IT(2)
C      IF (I SERCH.EQ.1) BLOCK(4)=IX(1)
C      IF (I SERCH.EQ.1) BLOCK(5)=IX(2)
C      IF (I SERCH.EQ.1) BLOCK(6)=IZ(1)
C      IF (I SERCH.EQ.1) BLOCK(7)=IZ(2)
C      BLOCK(1)=0
C      BLOCK(3)=2
C      BLOCK(8)=-1
C      NAMDAT(1)='R'
C      NAMDAT(2)='O'
C      NAMDAT(3)='M'
C      NAMDAT(4)='E'
C      NAMDAT(5)='G'
C      NAMDAT(6)='A'
C      NAMDAT(7)='.'
C      NAMDAT(8)='P'
C      NAMDAT(9)='L'
C      NAMDAT(10)='T'
C      NAMDAT(11)=0
C
C      FIRST PLOT FILE = ROMEGA.PLT
C      CALL HEADER(NAMDAT, 10, 4, BLOCK)
C
C      NAMDAT(1)='I'
C
C      SECOND PLTO FILE = IOMEGA.PLT
C      CALL HEADER(NAMDAT, 10, 5, BLOCK)
C
C      NAMDAT(1)='M'
C
C      THIRD PLOT FILE = MOMEGA.PLT
C      CALL HEADER(NAMDAT, 10, 6, BLOCK)
C
C      NAMDAT(1)='A'
C
C      FOURTH PLOT FILE = AOMEGA.PLT
C      CALL HEADER(NAMDAT, 10, 7, BLOCK)
C
C      NAMDAT(1)='H'

```



```

      NAMDAT(2)='R'
      NAMDAT(3)='E'
      NAMDAT(4)='F'
      NAMDAT(5)='.'
      NAMDAT(6)='P'
      NAMDAT(7)='L'
      NAMDAT(8)='T'
      NAMDAT(9)=0
      NAMDAT(10)=0
C
C FIFTH PLOT FILE=MREF.PLT
C
C   CALL HEADER(NAMDAT,10.8,BLOCK)
C
C   NAMDAT(1)='A'
C
C SIXTH PLOT FILE = AREF.PLT
C
C   CALL HEADER(NAMDAT,10.9,BLOCK)
C
C   NAMDAT(1)='M'
C   NAMDAT(2)='R'
C   NAMDAT(3)='A'
C   NAMDAT(4)='D'
C
C SEVENTH PLOT FILE = MRAD.PLT
C
C   CALL HEADER(NAMDAT,10.10,BLOCK)
C
C   NAMDAT(1)='A'
C
C EIGHTH PLOT FILE = ARAD.PLT
C
C   CALL HEADER(NAMDAT,10.11,BLOCK)
C
C   RETURN
C   END

```



300  
40

WRITE (LN) INAME(M)  
IF (L.NE.-1) RETURN  
ITEM=-1  
WRITE (LN) ITEM  
CLOSE (UNIT=LN)  
RETURN  
END

SUBROUTINE OPNFIL(GC,GP,GL)

THIS ROUTINE OPENS A DATA FILE AND 8 PLOT FILES FOR PLTWAV

INCLUDE 'PLTWAV.COM'

```

OPEN(UNIT=3,NAME='WAVDT.DAT')
IF(IDAT.EQ.1)GO TO 22
OPEN(UNIT=4,NAME='ROMEGA.PLT',TYPE='OLD',ACCESS='APPEND',
1FORM='UNFORMATTED')
OPEN(UNIT=5,NAME='IOMEGA.PLT',TYPE='OLD',ACCESS='APPEND',
1FORM='UNFORMATTED')
OPEN(UNIT=6,NAME='MOMEGA.PLT',TYPE='OLD',ACCESS='APPEND',
1FORM='UNFORMATTED')
OPEN(UNIT=7,NAME='AOMEGA.PLT',TYPE='OLD',ACCESS='APPEND',
1FORM='UNFORMATTED')
OPEN(UNIT=8,NAME='MREF.PLT',TYPE='OLD',ACCESS='APPEND',
1FORM='UNFORMATTED')
OPEN(UNIT=9,NAME='AREF.PLT',TYPE='OLD',ACCESS='APPEND',
1FORM='UNFORMATTED')
OPEN(UNIT=10,NAME='MRAD.PLT',TYPE='OLD',ACCESS='APPEND',
1FORM='UNFORMATTED')
OPEN(UNIT=11,NAME='ARAD.PLT',TYPE='OLD',ACCESS='APPEND',
1FORM='UNFORMATTED')

```

WHAT FOLLOWS IS WRITTEN INTO WAVDT.DAT FOR REFERENCE AT LATER TIMES

```

22 IF(ITYPE.EQ.1)WRITE(3,1)
   IF(ITYPE.EQ.2)WRITE(3,2)
   IF(ITYPE.EQ.3)WRITE(3,3)
   IF(ITYPE.EQ.4)WRITE(3,23)
   IF(ISEPCH.EQ.1)WRITE(3,4)
   IF(ISEPCH.EQ.2)WRITE(3,5)
   WRITE(3,6)
   WRITE(3,31)
   WRITE(3,7)ROPLAT,ROCOAT,ROCONL
   WRITE(3,8)HPLAT,HCOAT,HCONL
   WRITE(3,9)GPLAT,GCOAT,GCONL
   WRITE(3,10)EPLAT,ECOAT,ECONL
   WRITE(3,11)VPLAT,VCOAT,VCONL
   WRITE(3,12)
   WRITE(3,13)GP,GC,GL
   WRITE(3,14)DPLAT,DCOAT,DCONL
   WRITE(3,15)KAPAPL,KAPACO,KAPACL
   WRITE(3,16)
   WRITE(3,17)C
   WRITE(3,18)RO
1   FORMAT('SIMPLE PLATE',/)
2   FORMAT('COMPOSITE PLATE WITH WELDED INTERFACE',/)
3   FORMAT('COMPOSITE PLATE WITH SLIPPING INTERFACE',/)
23  FORMAT('COMPOSITE PLATE, WELDED INTERFACE, WITH
      1 CONSTRAINED LAYER',/)
4   FORMAT('SEARCH THROUGH EMISSION ANGLE',/)
5   FORMAT('SEARCH THROUGH FREQUENCY',/)
6   FORMAT('INPUT PARAMETERS:',10X,'PLATE',24X,'COATING',
      122X,'CONSTRAINED LAYER',/)
51  FORMAT(21X,'REAL',9X,'COMPLEX',9X,'REAL',9X,'COMPLEX'
      1,9X,'REAL',9X,'COMPLEX',/)
7   FORMAT('DENSITY      RO= ',E12.6,17X,E12.6,17X,E12.6
      1,12X,' KG/METER**3')
8   FORMAT('THICKNESS    H= ',E12.6,17X,E12.6,17X,E12.6,13X,
      1,' METERS')
9   FORMAT('SHEAR MODULUS G= ',2(E12.6,1X),3X,2(E12.6,1X),3X
      1,2(E12.6,1X), ' NT/50 METER')

```



```

10  FORMAT(' YOUNGS MOD.      E= ',2(E12.6,1X),3X,2(E12.6,1X),3X
11  1.2(E12.6,1X), ' NT/50 METER')
12  FORMAT(' POISSONS RATIO  V= ',2(E12.6,1X),3X,2(E12.6,1X),3X
13  1.2(E12.6,1X))
14  FORMAT(' COMPUTED PARAMETERS: ',/)
15  FORMAT(' MODIFIED SHEAR  G= ',2(E12.6,1X),3X,2(E12.6,1X),3X
16  1.2(E12.6,1X), ' NT/50 METER')
17  FORMAT(' ALEX. RIGIDITY  D= ',2(E12.6,1X),3X,2(E12.6,1X),3X
18  1.2(E12.6,1X), ' NT METERS')
19  FORMAT(' TIMOSHENKOS  KAPA= ',2(E12.6,1X),3X,2(E12.6,1X),3X
20  1.2(E12.6,1X))
21  FORMAT(' FLUID PARAMETERS: ',/)
22  FORMAT(' FLUID SOUND SPEED = ',E12.6, ' METERS/SEC')
23  FORMAT(' FLUID DENSITY    = ',E12.6, ' KG/METER**3')
24  WRITE(3,19)
25  IF(IDAT.NE.2)WRITE(3,20)
26  FORMAT(' ROMEGA=>THE REAL PART OF OMEGA',/)
27  1.  ' IOMEGA=>THE IMAGINARY PART OF OMEGA',/
28  2.  ' MOMEGA=>THE MAGNITUDE OF OMEGA',/
29  3.  ' AOMEGA=>THE PHASE OF OMEGA',/
30  4.  ' MREF=>THE MAGNITUDE OF REFLECTION',/
31  5.  ' AREF=>THE PHASE OF THE REFLECTION',/
32  6.  ' MRAD=>THE MAGNITUDE OF RADIATION',/
33  7.  ' ARAD=>THE PHASE OF THE RADIATION',/
34  20  FORMAT(' THETA',3X,'FREQ',9X,'ROMEGA',7X,'IOMEGA',7X,'MOMEGA',
35  1.7X,'AOMEGA',7X,'MREF',9X,'AREF',9X,'MRAD',9X,'ARAD')
36  RETURN
37  END

```

מה שמחכה

```

      SUBROUTINE WRTFIL(ISERCH,WAVDT,IPTS,IDAT)
C
C THIS ROUTINE WRITES INTO ALL THE FILES FOR PLTWAV
C
      DIMENSION WAVDT(10)
      IF((IPTS/10)*10-IPTS)15,21,15
      IF(IDAT.NE.2)WRITE(3,14)
21  FORMAT(/,' THETA',8X,' FREQ',9X,' ROMEGA',7X,' IOMEGA',7X,
14  1,' MOMEGA',7X,' AOMEGA',7X,' MREF',9X,' AREF',9X,' MRAD',9X,' ARAD')
      IF(IDAT.NE.2)WRITE(3,10)(WAVDT(L),L=1,10)
15  FORMAT(10(E12.5,1X))
10  IF(IDAT.EQ.1)GO TO 22
      DO 20 ILUN=4,11
      WRITE(ILUN)WAVDT(ISERCH)
20  WRITE(ILUN)WAVDT(ILUN-1)
22  RETURN
      END

```

```

      SUBROUTINE OMEGA1(OMEGA,DPLAT,K,GP,HPLAT,ROPLAT,F2,KO,RO)
C
C COMPUTES ELASTIC RESPONSE FUNCTION FOR A SIMPLE PLATE
C WHEN CALLED BY PLTWAV
C
C   COMPLEX OMEGA,DPLAT,GP
C   REAL K,KO
C
C   OMEGA=DPLAT*CMPLX((K**2),0.)+GP*CMPLX(HPLAT,0.)
C
C   OMEGA=OMEGA-CMPLX(F2*ROPLAT*(HPLAT**3),0.)/CMPLX(12.,0.)
C
C   OMEGA=CMPLX(K**2,0.)*((GP*CMPLX(HPLAT,0.))**2)/OMEGA
C
C   OMEGA=OMEGA-GP*CMPLX(HPLAT*(K**2),0.)
C
C   OMEGA=OMEGA+CMPLX((HPLAT*ROPLAT*F2),0.)
C
C   OMEGA=OMEGA*CMPLX(KO,0.)/CMPLX(F2*RO,0.)
C
C   RETURN
C   END

```



```

      SUBROUTINE OMEGA2(OMEGA,F2,HPLAT,HCOAT,BETA,ROPLAT,ROCOAT
1.GP,GC,K,KO,DPLAT,DCOAT,RO)
C
C COMPUTES ELASTIC RESPONSE FUNCTION FOR THE WELDED INTERFACE
C WHEN CALLED BY PLTWAV
C
      COMPLEX OMEGA,GPLAT,GCOAT,GP,GC,DPLAT,DCOAT
      REAL K,KO
C
      OMEGA=CMPLX(-F2*(HPLAT**2)*HCOAT/12*(BETA*ROPLAT-ROCOAT),0.)
C
      OMEGA=OMEGA+CMPLX(HPLAT,0.)*(GP-CMPLX(BETA,0.)*GC)
C
      OMEGA=OMEGA+CMPLX(K**2,0.)*(DPLAT-CMPLX(BETA**2,0.)*DCOAT)
C
      OMEGA=(GP+GC)*(GP-GC)*CMPLX((K**2)*(HPLAT**2),0.)/OMEGA
C
      OMEGA=OMEGA-GP*CMPLX(((K**2)*HPLAT),0.)
C
      OMEGA=OMEGA-GC*CMPLX(((K**2)*HCOAT),0.)
C
      OMEGA=OMEGA+CMPLX(F2*HPLAT*ROPLAT+F2*HCOAT*ROCOAT,0.)
C
      OMEGA=OMEGA*CMPLX(KO/(F2*RO),0.)
C
      RETURN
      END

```

```

      SUBROUTINE OMEGA3(OMEGA,F2,HPLAT,HCOAT,ROPLAT,ROCOAT
1,GP,GC,DPLAT,DCOAT,RO,K,KO)
C
C THIS COMPUTES THE ELASTIC RESPONSE FUNCTION FOR SLIPPING INTERFACE
C WHEN CALLED BY PLTWAV
C
C COMPLEX OMEGA,GP,GC,DPLAT,DCOAT,ART,BART
C REAL K,KO
C
C ART=CMPLX(F2*ROCOAT*(HCOAT**3)/12.,0.)
C
C ART=GC*CMPLX(HCOAT,0.)+DCOAT*CMPLX(K**2,0.)-ART
C
C ART=CMPLX(K**2,0.)*((GC**2)*CMPLX(HCOAT**2,0.))/ART
C
C BART=CMPLX(F2*ROPLAT*(HPLAT**3)/12.,0.)
C
C BART=GP*CMPLX(HPLAT,0.)+DPLAT*CMPLX(K**2,0.)-BART
C
C BART=CMPLX(K**2,0.)*((GP**2)*CMPLX(HPLAT**2,0.))/BART
C
C OMEGA=ART+BART
C
C OMEGA=OMEGA-GP*CMPLX((K**2)*HPLAT,0.)
C
C OMEGA=OMEGA-GC*CMPLX((K**2)*HCOAT,0.)
C
C OMEGA=OMEGA+CMPLX(F2*(HPLAT*ROPLAT+HCOAT*ROCOAT),0.)
C
C OMEGA=OMEGA*CMPLX(KO/(F2+RO),0.)
C
C RETURN
C
C END

```

```

      SUBROUTINE OMEGA4(OMEGA,F2,HPLAT,HCOAT,BETA,ROPLAT,ROCOAT
1.GP,GC,K,KO,DPLAT,DCOAT,RO,HCONL,DCONL,ROCONL)
C
C COMPUTES ELASTIC RESPONSE FUNCTION FOR THE WELDED INTERFACE
C WHEN CALLED BY PLTJAY
C
      COMPLEX OMEGA,GPLAT,GCOAT,GP,GC,DPLAT,DCOAT,DCONL
      REAL K,KO
C
      OMEGA=CMPLX(-F2*(HPLAT**2)*HCOAT/12*(BETA*ROPLAT-ROCOAT),0.)
C
      OMEGA=OMEGA+CMPLX(HPLAT,0.)*(GP-CMPLX(BETA,0.)*GC)
C
      OMEGA=OMEGA+CMPLX(K**2,0.)*(DPLAT-CMPLX(BETA**2,0.)*DCOAT)
C
      OMEGA=OMEGA+DCONL*CMPLX(HPLAT/HCONL,0.)*(K**2)
C
      OMEGA=(GP+GC)*(GP-GC)*CMPLX((K**2)*(HPLAT**2),0.)/OMEGA
C
      OMEGA=OMEGA-GP*CMPLX((K**2)*HPLAT),0.)
C
      OMEGA=OMEGA-GC*CMPLX((K**2)*HCOAT),0.)
C
      OMEGA=OMEGA+CMPLX(F2*HPLAT*ROPLAT+F2*HCOAT*ROCOAT,0.)
C
      OMEGA=OMEGA+CMPLX(F2*HCONL*ROCONL,0.)
C
      OMEGA=OMEGA*CMPLX(KO/(F2*RO),0.)
C
      RETURN
      END

```

# B-1

## RUNNING TRACE

MCR>RUN TRACE )

A HOW MANY CURVES (1-5)? 5 )

SPECIFY PLOT FILE: DK1:AMRAD.PLT#1 )  
 SPECIFY PLOT FILE: DK1:AMRAD.PLT#2 )  
 SPECIFY PLOT FILE: DK1:AMRAD.PLT#3 )  
 SPECIFY PLOT FILE: DK1:AMRAD.PLT#4 )  
 SPECIFY PLOT FILE: DK1:AMRAD.PLT#5 )

SPECIFY ABSOLUTE SCALE LIMITS

XMIN= 0 )  
 XMAX= 90 )  
 YMIN= 0 )  
 YMAX= 1 )

RIGHT OR LEFT LABEL OPTION?

TYPE R,L,OR 0 FOR NONE R )

THE PAPER ALLIGNMENT MUST BE CHECKED

ANY LETTER WILL EXIT THIS ROUTINE

AENTER AN ORDERED PAIR CHECKPOINT 90,0 )

A ENTER AN ORDERED PAIR CHECKPOINT 0,1 )

ENTER AN ORDERED PAIR CHECKPOINT 6 )

A

AT 10 INCHES FULL SCALE THERE ARE  
 68.2 UNITS PER INCH. HOW MANY UNITS BELOW USUAL  
 DO YOU WISH THE LABEL TO BE? 0 )

AAAAAAAAAA

Note: The 'A's are printed as  
 the plotter turns on and off.

MCR>RUN TRACE )

HOW MANY CURVES (1-5)? 5 )

SPECIFY PLOT FILE: DK1:AMRAD.PLT#6 )  
 SPECIFY PLOT FILE: DK1:AMRAD.PLT#7 )  
 SPECIFY PLOT FILE: DK1:AMRAD.PLT#10 )  
 SPECIFY PLOT FILE: DK1:AMRAD.PLT#11 )  
 SPECIFY PLOT FILE: DK1:AMRAD.PLT#12 )

SPECIFY ABSOLUTE SCALE LIMITS

XMIN= 0 )  
 XMAX= 90 )  
 YMIN= 0 )  
 YMAX= 1 )

RIGHT OR LEFT LABEL OPTION?

TYPE R,L,OR 0 FOR NONE R )

THE PAPER ALLIGNMENT MUST BE CHECKED

ANY LETTER WILL EXIT THIS ROUTINE

AENTER AN ORDERED PAIR CHECKPOINT 6 )

AT 10 INCHES FULL SCALE THERE ARE  
 68.2 UNITS PER INCH. HOW MANY UNITS BELOW USUAL  
 DO YOU WISH THE LABEL TO BE? 136 )

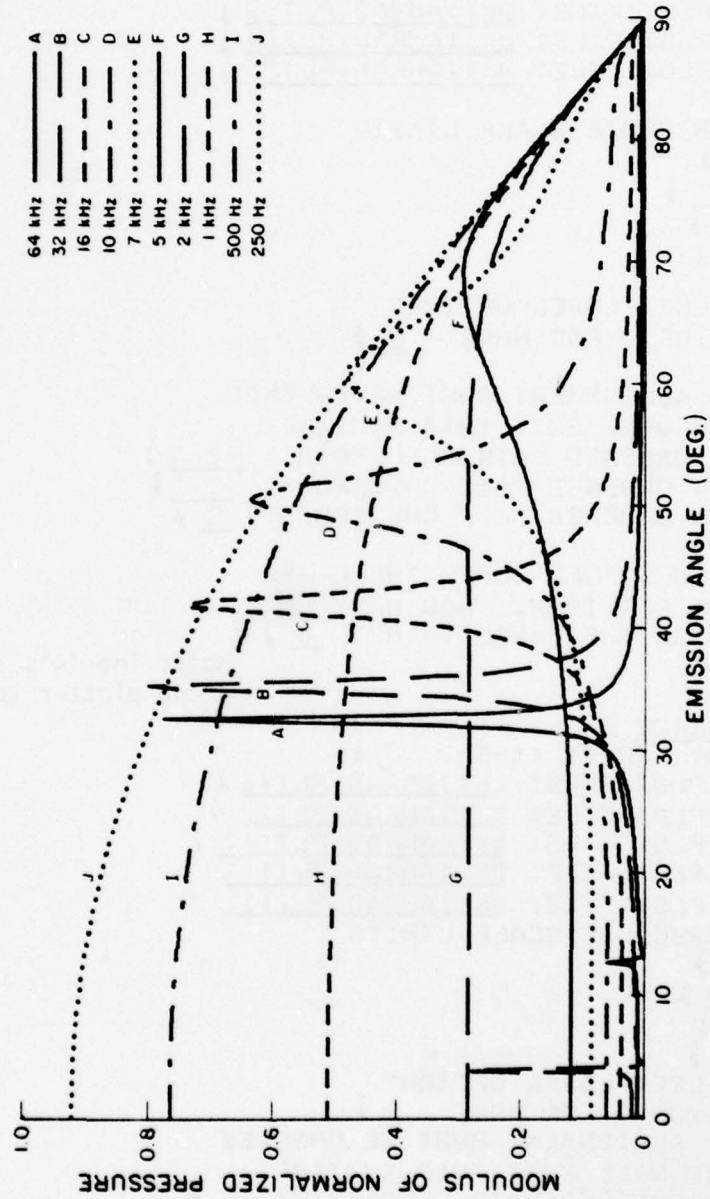
Note: 1), All underlined portions are User supplied

2), ) means 'RETURN'



B-2

# TRACE OUTPUT EXAMPLE



B-3

## TRACE

### COMPILATION AND TASKBUILDING

THE PLOTTER PROGRAM 'TRACE' MUST ALSO BE COMPILED AND TASK BUILT. WHAT FOLLOWS ARE 1) THE 'F4P' COMMAND FILE CALLED 'TRACE.F4P', AND 2) THE COMMAND FILE FOR THE 'TKB' OPERATION, CALLED 'TRACE.TKB'. THE METHOD OF CALLING THESE COMMAND FILES IS THE SAME AS FOR 'PLTWAV'.

```
TRACE.OBJ,TRACE.LST=TRACE.FTN/CK/TR/-SP/-RO
ARYFIL.OBJ,ARYFIL.LST=ARYFIL.FTN/CK/TR/-SP/-RO
RULE.OBJ,RULE.LST=RULE.FTN/CK/TR/-SP/-RO
ALIGN.OBJ,ALIGN.LST=ALIGN.FTN/CK/TR/-SP/-RO
SETDSH.OBJ,SETDSH.LST=SETDSH.FTN/CK/TR/-SP/-RO
PON.OBJ,PON.LST=PON.FTN/CK/TR/-SP/-RO
TPLOT.OBJ,TPLOT.LST=TPLOT.FTN/CK/TR/-SP/-RO
TKDASH.OBJ,TKDASH.LST=TKDASH.FTN/CK/TR/-SP/-RO
TERM.OBJ,TERM.LST=TERM.FTN/CK/TR/-SP/-RO
QIOB.OBJ,QIOB.LST=QIOB.FTN/CK/TR/-SP/-RO
LABEL.OBJ,LABEL.LST=LABEL.FTN/CK/TR/-SP/-RO
```

```
TRACE,TRACE/SH/-SP=TRACE,ARYFIL,RULE,ALIGN,SETDSH,TPLOT,TKDASH,
TERM,QIOB,PON,LABEL
```

/

```
LIBR=OTSCOR:RO
```

```
UNITS=6
```

```
ASG=TI:1:2:6
```

```
ASG=SY:3
```

/

# TRACE LISTING

64

```

        WRITE(1,24)
        READ(2,25)YMIN
        WRITE(1,25)
        READ(2,25)YMAX
22      FORMAT(' $ XMIN= ')
23      FORMAT(' $ XMAX= ')
24      FORMAT(' $ YMIN= ')
25      FORMAT(' $ YMAX= ')
26      FORMAT(F10.0)
C
C SPECIFY LABEL OPTION
C
        WRITE(1,27)
27      FORMAT(' RIGHT OR LEFT LABEL OPTION?',' /
1,      ' $ TYPE R,L,OR 0 FOR NONE ')
        READ(2,28)NN,OPT
28      FORMAT(0,2A1)
        OPT(NN+1)=0
C
C COMPUTE SCALE
C
        X0=0.
        XEND=1023.
        Y0=0.
        YEND=662.
        DELTAX=XMIN-XMAX
        DELX=-1023/DELTAX
        CX=XMIN*1023/DELTAX
C
C XVALUE=X*DELX+CX
C
        DELTAY=YMIN-YMAX
        DELY=-662/DELTAY
        CY=YMIN*662/DELTAY
C
C CHECK PAPER ALIGNMENT
C
        CALL ALIGN(DELX,X0,XEND,DELY,Y0,YEND,CX,CY)
C
C DO THE PLOTTING
C
        DO 100 J=1,NOCURV
        CALL TERM(3,0)
        CALL POF(6)
        DO 50 K=1,30
        IF(J.EQ.1)NAME(K)=NAME1(K)
        IF(J.EQ.2)NAME(K)=NAME2(K)
        IF(J.EQ.3)NAME(K)=NAME3(K)
        IF(J.EQ.4)NAME(K)=NAME4(K)
        IF(J.EQ.5)NAME(K)=NAME5(K)
50      CONTINUE
        IF(NAME(1).EQ.'0')GO TO 100
        IF(OPT(1).NE.'0')CALL LABEL(J,OPT,L)
        L=L+1
C
C ARYFIL FILLS 2 ARRAYS WITH SCALED DATA FROM THE PLOT FILE
C
        CALL ARYFIL(IARX,IARY,NAME,DELX,DELY,X0,XEND,Y0,YEND,N,CX,CY
1,XMIN,XMAX,YMIN,YMAX)
C
C SETDSH SETS UP THE PATTERN OF DASHES TO BE PLOTTED DEPENDING ON
C THE NUMBER OF CURVES.
C
        CALL SETDSH(DASH,NDASH,J)
C
C PON TURNS ON THE PLOTTER

```



```

C      CALL PON(6)
C
C      PLOT THE POINTS INDIVIDUALLY
C
      DO 100 M=1,N
      CALL TKDASH(IARX(M),IARY(M),M,DASH,NDASH)
100    CONTINUE
      CALL TERM(3.0)
      CALL POF(6)
      END

```

```

SUBROUTINE ARYFIL(IARX,IARY,NAM,DELX,DELY,X0,XEND,Y0
1,YEND,N,CX,CY,XMIN,XMAX,YMIN,YMAX)
C
C THIS ROUTINE FILLS AN X ARRAY AND A Y ARRAY FOR TRACE.PAK
C
  BYTE NAM(30)
  DIMENSION IARX(500),IARY(500)
  OPEN(UNIT=3,ERR=13,NAME=NAM,TYPE='OLD',READONLY,FORM=
1'UNFORMATTED')
  READ(3)IHEAD,XINIT,XDELT,ITERM
  DO 10 N=1,500
  READ(3,END=12)X
  READ(3,END=12)Y
  IF(X.GT.XMAX)X=XMAX
  IF(X.LT.XMIN)X=XMIN
  IF(Y.GT.YMAX)Y=YMAX
  IF(Y.LT.YMIN)Y=YMIN
  CALL RULE(X,Y,IX,IY,DELX,X0,XEND,DELY,Y0,YEND,CX,CY)
  IARX(N)=IX
  IARY(N)=IY
10  CONTINUE
12  CLOSE(UNIT=3)
  N=N-1
  RETURN
13  DO 20 N=1,20
  X=0
  Y=0
  CALL RULE(X,Y,IX,IY,DELX,X0,XEND,DELY,Y0,YEND)
  IARX(N)=IX
  IARY(N)=IY
20  CONTINUE
  CLOSE(UNIT=3)
  N=N-1
  RETURN
  END
  END

```

```

      SUBROUTINE RULE(X,Y,IX,IY,DELX,X0,XEND,DELY,Y0,YEND,CX,CY)
C
C THIS ROUTINE SCALES DATA FOR PLOT.PAK
C
      IX=X*DELX+CX
      IY=Y*DELY+CY
      IF(IX.GT.XEND)IX=XEND
      IF(IY.GT.YEND)IY=YEND
      IF(IX.LT.X0)IX=X0
      IF(IY.LT.Y0)IY=Y0
      RETURN
      END

```

```

      SUBROUTINE ALLIGN(DELX,X0,XEND,DELY,Y0,YEND,CX,CY)
C
C   THIS ROUTINE WILL AID IN CHECKING THE ALLIGNMENT OF THE PAPER ON
C   THE TEXTRONIX 4662 PLOTTER
C
      CALL ERRSET(64,...FALSE...FALSE...)
C
      WRITE(1,1)
1     FORMAT(' THE PAPER ALLIGNMENT MUST BE CHECKED')
      WRITE(1,3)
2     WRITE(1,4)
3     FORMAT(' ANY LETTER WILL EXIT THIS ROUTINE')
4     FORMAT('$ ENTER AN ORDERED PAIR CHECKPOINT ')
      READ(2,5,ERR=6)X,Y
5     FORMAT(2F10.0)
      CALL RULE(X,Y,IX,IY,DELX,X0,XEND,DELY,Y0,YEND,CX,CY)
      CALL PON(6)
      CALL TPLOT(IX,IY,-1)
      CALL TERM(3,0)
      CALL POFF(6)
      GO TO 2
6     RETURN
      END

```



```

      SUBROUTINE SETDASH(DASH,NDASH,J)
C
C   THIS ROUTINE SETS UP THE PATTERN OF BRIGHT AND DARK ARC SEGMENTS
C
      DIMENSION DASH(8)
      GO TO (10,20,30,40,50)J
C
C   SOLID LINE FOR CURVE #1
C
      10      NDASH=1
           DASH(1)=1005
           RETURN
C
C   LONG DASH FOR CURVE #2
C
      20      NDASH=2
           DASH(1)=50
           DASH(2)=30
           RETURN
C
C   SHORT DASH FOR CURVE #3
C
      30      NDASH=2
           DASH(1)=15
           DASH(2)=15
           RETURN
C
C   LONG DASH-SHORT DASH FOR CURVE #4
C
      40      NDASH=4
           DASH(1)=30
           DASH(2)=20
           DASH(3)=5
           DASH(4)=20
           RETURN
C
C   LONG-3 SHORT FOR CURVE #5
C
      50      NDASH=2
           DASH(1)=1
           DASH(2)=10
           RETURN
      END

```

```

SUBROUTINE TPL0T (IX,IY,M)

C      SUBROUTINE TO PLOT ON THE TEKTRONIX 4010 AND 613 DISPLAY
C      TERMINALS (AS CHOSEN IN "TERM" SUBROUTINE).
C      FORTRAN-IV BUFFERED VERSION.

C      VALUES TO PLOT: IX,IY
C      MODES TO PLOT: M>0 (BRIGHT), M=0 (DARK), M<0 (POINT)
C      LUN 6: THIS SUBROUTINE USES QIOB.
C      REMEMBER TO PURGE THE BUFFER WHEN DONE (WITH TERM).

      BYTE IOUT(6)
      I=0
      IOUT(1)=200
      IF (M.GT.0) GOTO 11

C      INITIAL PLOT. DARK PLOT. POINT PLOT--
10      I=I+1
      IOUT(1)="35

C      ALL MODES--SEPARATE COORDINATES INTO HIGH- AND LOW-ORDER BYTES
11      I=I+1
      IOUT(1)=IY/32+32
      I=I+1
      IOUT(1)=96+IY-32*(IY/32)
      I=I+1
      IOUT(1)=IX/32+32
      I=I+1
      IOUT(1)=64+IX-32*(IX/32)

      IF (M.GE.0) GOTO 20
      REINFORCE FOR POINT PLOT
12      I=I+1
      IOUT(1)=IOUT(I-1)

C      EXECUTE QIO AND RETURN
20      CALL QIOB ("610.6.24.0,IOUT,I,ISW)
      CALL WAITR (24)

      RETURN
      END

```

```

C      TKDASH.FTN      J.D.GEORGE OCTOBER 1975
C
C THE PURPOSE OF SUBROUTINE TKDASH IS TO PLOT A CURVE AS A SERIES OF
C ALTERNATING BRITE AND DARK LINE SEGMENTS OF ARC LENGTHS SPECIFIED
C BY THE USER
C
C      SUBROUTINE TKDASH(IX,IY,N,DASH,NDASH)
C
C      IX,IY   ARE SCREEN OR PAPER COORDINATES
C
C      N       IS THE NUMBER OR INDEX OF THE POINT IX,IY
C              N=1. IS TREATED SEPERATELY, N.GE.1
C
C      DASH    IS AN ARRAY OF SCREEN COORDINATE ARC LENGTHS
C              FOR ALTERNATELY BRITE AND DARK LINE SEGMENTS
C              ODD INDICES ARE BRITE SEGMENTS
C              EVEN INDICES ARE DARK SEGMENTS
C              I.E.
C                   1       1       2       3       4
C                   DASH(1)  10      10      2      10
C
C                   BRITE    DARK    BRITE    DARK
C
C      NDASH   IS THE LENGTH OF THE DASH ARRAY
C              4 SHOULD PROVIDE A WIDE RANGE OF SYMBOLS
C              TO FORCE ALTERNATE BRITE-DK LINE SEGMENTS
C              NDASH IS EVEN
C              FOR SOLID LINE USE NDASH = 1 & DASH(1)=LARGE#
C
C      *****
C      SUBROUTINES REQUIRED:TPLOT
C      *****
C
C      SUBROUTINE TKDASH(IX,IY,N,DASH,NDASH)
C      DIMENSION DASH(NDASH)
C      DATA ZERO/D.0/
C      IF(N.GT.1)GOTO 100
C
C      C THE FIRST POINT INITIALIZES THINGS
C
C      XLAST=IX
C      YLAST=IY
C      LASTDK=1
C      IDASH=1
C      OLDDPC=ZERO
C      CALL TPLOT(IX,IY,0)
C      RETURN
C
C      C ENTRY FOR N.GT.1
C
C      100   CONTINUE
C           X=IX
C           Y=IY
C
C      C THE CODE BELOW IS REPEATED UNTIL HAVE PLOTTED SEGMENTS TO
C      C POINT IX,IY
C
C      200   CONTINUE
C           DX=X-XLAST
C           DY=Y-YLAST
C           APC=SQRT(DX*DX+DY*DY)
C           IF(APC.EQ.ZERO)GOTO 1000

```

```

C THE PATH DEPENDS ON WHETHER ARC EXTENDS BEYOND THE NEXT
C LINE SEGMENT SPECIFIED IN DASH(IDASH)
C
C     IF((OLDARC+ARC).GE.(DASH(IDASH)))GOTO 300
C THE ARC TERMINATES WITHIN THE CURRENT LINE SEGMENT
C
C     XINC=DX
C     YINC=DY
C     OLDARC=OLDARC+ARC
C     GOTO 400
C
C THE ARC TERMINATES AT OR BEYOND THE CURRENT LINE SEGMENT
C
C 300 CONTINUE
C     XINC=DX*(DASH(IDASH)-OLDARC)/ARC
C     YINC=DY*(DASH(IDASH)-OLDARC)/ARC
C     OLDARC=ZERO
C
C 400 CONTINUE
C     X0=XLAST+XINC
C     Y0=YLAST+YINC
C
C IF IDASH IS EVEN PLOT DARK VECTOR
C IF IDASH IS ODD PLOT BRITE VECTOR
C
C MODIFY TO NOTE THE TRANSITION FROM LITE TO DARK
C MOVE TO EDGE WITH DK VECTOR, THEN PUT DOWN DK VECTOR AT EDGE
C
C FOR DK VECTOR SKIP PLOTTING UNTIL SENSE LITE-TO-DK TRANSITION
C
C     IDARK=MOD(IDASH,2)
C     IX0=X0
C     IY0=Y0
C     IF(IDARK.EQ.0)GOTO 410
C     IF(LASTDK.EQ.IDARK)GOTO 405
C     IXLAST=XLAST
C     IYLAST=YLAST
C     CALL TPLOT(IXLAST,IYLAST,0)
C     CALL TPLOT(IXLAST,IYLAST,1)
C 405 CONTINUE
C     CALL TPLOT(IX0,IY0,IDARK)
C 410 LASTDK=IDARK
C
C SETUP FOR NEXT POINT
C
C     XLAST=X0
C     YLAST=Y0
C
C REPEAT PLOTTING UNTIL ARC TERMINATES WITHIN A
C SEGMENT OF DASH
C
C I.E. OLDARC.NE.ZERO
C
C     IF(OLDARC.NE.ZERO)GOTO 1000
C     IDASH=MOD(IDASH,NDASH)+1
C     GOTO 200
C
C EXIT
C
C 1000 CONTINUE
C     RETURN
C     END

```



```

C      SUBROUTINE PON (LUN)
      SUBROUTINE TO TURN ON OR OFF THE TEKTRONIX 4662 PLOTTER.

      BYTE PLON(3), PLOFF(3)
      INTEGER IPRM(6)
      DATA PLON/27.65,69/PLOFF/27.65,70/

      CALL GETADR (IPRM, PLON)
      IPRM(2)=3
      CALL QIO ("410,LUN,24,...IPRM,")
      CALL WAITR (24)
      RETURN

      ENTRY POFF
      CALL GETADR (IPRM, PLOFF)
      IPRM(2)=3
      CALL QIO ("410,LUN,24,...IPRM,")
      CALL WAITR (24)
      RETURN

      END

```

```

SUBROUTINE TERM(K,L)

C THIS SUBROUTINE WILL MANIPULATE THE TERMINAL--
C K=0, L=0 ERASE SCREEN
C K=1, L=0 COPY SCREEN
C K=2, L=0 RETURN TO ALPHA MODE
C K=3, L=0 PURGE THE QIO BUFFER
C K=8, L=0 IMPLEMENT MULTIPLEXER
C WHERE B IS BOARD SELECT NUMBER 0-3
C WHERE C IS CONTROL NUMBER TERMINAL(1), A(2), B(3), C(4)
C (COMBINATIONS OF TERMINALS ARE ALLOWED)

C THIS PARTICULAR VERSION IS FOR USE WITH BUFFERED
C PLOTTING, AND EVERY CALL TO TERM WILL PURGE THE BUFFER.

BYTE IOUT(3)

I=2
IOUT(1)="33 ESCAPE

IF (L.NE.0) GOTO 10
KX=K+1
GOTO (2,3,5,40),KX
1 IOUT(2)="14 CLEAR THE SCREEN
GOTO 30
2 IOUT(2)="27 COPY THE SCREEN
GOTO 30
3 IOUT(1)="37 RETURN TO ALPHA MODE
I=1
GOTO 30
5

C PREPARE ASCII CHARACTERS FOR MUX BOARD AND CONTROL NUMBERS
10 IOUT(2)=K+"60
IOUT(3)=2***(L-1)+"60
I=3

C OUTPUT THE CONTROL SEQUENCE
30 CALL QIOS ("610.6.24.0,IOUT,1,ISW)
C AND PURGE THE BUFFER
40 CALL QIOP ("610.6.24.0,IDAT,0,ISW)

C PAUSE A MOMENT IF SCREEN IS BEING CLEARED
IF ((K+L).NE.0) RETURN
CALL WAIT (1.2,M)
RETURN

END

```

```

      SUBROUTINE LABEL(J,OPT,L)
C
C THIS ROUTINE WILL DRAW A LINE SEGMENT IN THE RIGHT OR LEFT
C CORNER OF THE GRAPH FOR TRACE.FTN THE LINE TYPE WILL BE THE
C SAME AS THE CURVE BEING DRAWN
C
      BYTE OPT(2)
      DIMENSION IARX(120),IARY(120),DASH(8)
      IF(OPT(1).EQ.'L') IARX(1)=30
      IF(OPT(1).EQ.'R') IARX(1)=873
      IF(L.EQ.1)WRITE(1,5)
6      FORMAT(' AT 10 INCHES FULL SCALE THERE ARE',/
1.' 68.2 UNITS PER INCH. HOW MANY UNITS BELOW USUAL',/
2.'S DO YOU WISH THE LABEL TO BE? ')
      IF(L.EQ.1)READ(2,7)K
7      FORMAT(I3)
      DO 5 N=2,120
5      IARX(N)=IARX(N-1)+1
      GO TO (10,20,30,40,50)L
10     DO 11 N=1,120
11     IARY(N)=668-K
      GO TO 60
20     DO 21 N=1,120
21     IARY(N)=641-K
      GO TO 60
30     DO 31 N=1,120
31     IARY(N)=614-K
      GO TO 60
40     DO 41 N=1,120
41     IARY(N)=586-K
      GO TO 60
50     DO 51 N=1,120
51     IARY(N)=559-K
60     CALL GETDSH(DASH,NDASH,J)
      CALL PON(6)
      DO 61 N=1,120
      CALL TKDASH(IARX(N),IARY(N),N,DASH,NDASH)
61     CONTINUE
      CALL TERM(3,0)
      CALL POF(6)
      RETURN
      END

```