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THREE-DIMENSIONAL PERSPECTIVE PICTURES

by

PORTER SCOBEY

AOL COMPUTER NOTE 1971-4-C

SEPTEMBER 1971

PROGRAMMED BY

THE CANADIAN COMMITTEE OF OCEANOGRAPHY

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CANADA

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ABSTRACT

This computer note describes a program which can be used to draw three-dimensional pictures of a single-valued surface over a region containing either randomly spaced data or gridded data. Stereo pictures may also be drawn, using either two-color superimposed plots or separate plots to be viewed through a stereoscope.

THREE-DIMENSIONAL PERSPECTIVE PICTURES

Table of Contents

1. General Description

This program plots a perspective picture of a single-valued surface Z(X,Y) defined over a rectangular grid in X and Y.

The data may be given as a set of points XP(K), YP(K), ZP(K) for K=1,2,...,N for N points placed arbitrarily over the region of the grid (and to be interpolated onto the grid), or as already gridded data. This will be referred to in subsequent discussion as OPTION I.

There is also an option which allows the user to insert his own coding to generate the surface Z(X,Y). This will be referred to in subsequent discussion as OPTION II.

The program came originally from JOHN TAYLOR of Marine Sciences Branch in Ottawa.

2. DATA CARD FORMATS

In a single computer run any number of pictures can be made. Each picture requires seven types of data (types 0 to 6). Data types 1 to 6 control various sections of the program such as grid construction, contouring and so on. Type 0 merely controls the reading of types 1 to 6.

DATA TYPE 0

This data consists of one card containing the six parameters KD1,KD2,KD3,KD4,KD5,KD6 in FORMAT(6I1). If KDI is greater than or equal to 1 then DATA TYPE I will be read in. If KDI=0 then DATA TYPE I should be ommitted and data from the previous picture will be used.

For example, if KD1=0 for the second picture then the title card for this picture should be ommitted and the title will be the same as the title for the first picture of the run.

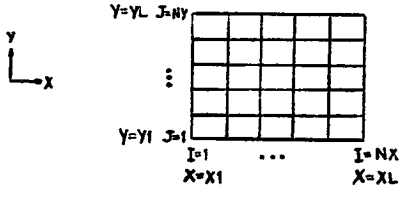
NOTE: The last card of any data deck should be a card of DATA TYPE 0 in which the first 6 columns are all zeros.

DATA TYPE 1

This data consists of one card containing any title of up to 80 characters for the picture. This title is 0.2 inch high and 0.5 inch below the bottom of the picture.

DATA TYPE 2

This data consists of one card containing the parameters NX,NY, X1,Y1,XL,YL,CAY,NSM in FORMAT(2I5,5F10.0,I5). These parameters supply information on construction of the grid surface Z. In the following parameter descriptions refer to the figure below which illustrates the grid Z(X,Y) (or Z(I,J)).



NX, NY — These parameters give the number of grid points in the X and Y directions respectively. (Maximum = 50 X 50).

X1, Y1, XL, YL — These are the coordinates of the lower left and upper right corners of the grid. Distance here is measured in what may be called data units (i.e. any unit convenient to the user). All other length-type inputs are in the same units except X1PL,Y1PL,XLPL and YLPL which are in inches.

NOTE: The user must keep in mind that the units of Z will be these "data units" as well and the value of ZMAG in DATA TYPE 4 must be chosen accordingly.

CAY — This parameter determines the type of interpolation used to fill in the grid Z from an arbitrarily spaced set of data points.

If CAY=0, LAPLACIAN interpolation is used. The resulting surface tends to have rather sharp peaks or dips at the data points (somewhat like a trampoline with poles pushed up into it). There is, however, no chance of spurious peaks appearing in regions devoid of data.

As CAY is increased, SPLINE interpolation predominates over the LAPLACIAN and the surface passes more smoothly through the data points. In this case the surface is somewhat like a lattice of flexible beams constrained to pass through the data points. The possibility of spurious peaks and steep extrapolations in areas lacking in data increases with CAY. By adjusting CAY properly, a trade-off between smoothness and avoidance of spurious peaks can be obtained. CAY=5 or CAY=10 often gives a good surface.

A relaxation procedure is used to perform the interpolation onto the grid. Each data point is shifted to the nearest grid intersection before the procedure is begun. An average ZP value is used if two or more data points are nearest the same grid intersection.

If CAY=-1, the interpolation is bypassed (as well as the smoothing, blanking and data marking routines). In this case the user is expected to supply coding to read or generate the grid surface (see OPTION II under How to Run the Program).

NSM This is the number of LAPLACIAN smoothings to be applied to the grid Z after the interpolation is done. This is useful for removing sharp peaks, or noise, from the surface, while leaving large scale trends undisturbed.

DATA TYPE 3

There are two possibilities here:

OPTION I - If this option is being used, then CAY is greater than or equal to zero and the data points XP(K),YP(K),ZP(K) for K=1,2,...,N are read in one point per card in FORMAT(3E10.3). The end of the set of data points is indicated by XP(N+1)=10.**35. In other words the last card of the data set should contain 1.E35 (right-justified) in its first 10 columns.

The points XP,YP,ZP are the set from which the surface is interpolated. Any point not falling over the surface of the grid is ignored. (Maximum number of randomly spaced points = 100).

If the user calls for data to be read in, this data must be placed in the DATA TYPE 3 spot. For example, the entire grid Z(I,J), I=1,2,...,NX; J=1,2,...,NY may be read from cards.

OPTION II - If this option is being used, then CAY=-1.and the user is expected to have inserted coding between statements 310 and 399 in the main program to generate the surface grid Z(I,J). (See OPTION II under section 3 for how to insert the coding). Areas of the grid to be left blank must be set to 10.**35. All grid points are automatically initialized to this value when OPTION II is used.

NOTE: Control passes to statement 309 only if KD3 is greater than 0.

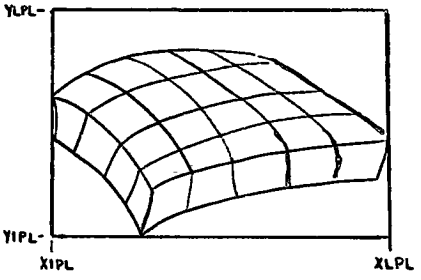
DATA TYPE 4

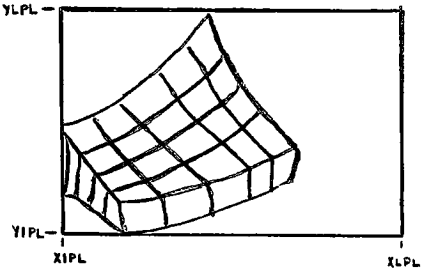
This data consists of two cards giving information on the position of the picture and the labelling of data points.

CARD1 - X1PL,Y1PL,XLPL,YLPL,LABPT FORMAT(4F10.0,10X,I5)
CARD2 - ZBASE,ZMAG,R,THETA,PHI FORMAT(5F10.0)

A discussion of the parameters follows:

X1PL, Y1PL, XLPL, YLPL — These are the coordinates in inches relative to the starting position of the pen (which is taken to be (-1.,-1.)) of the lower left and upper right corners of the rectangular space on the plotter in which the picture is to be drawn. Usually the picture cannot touch all four sides of the allotted rectangle and is justified to the lower left as shown in the examples below:





LABPT — This parameter governs the method of labelling the data points according to the following scheme:

LABPT>0	Mark and label data points using LABPT digits after the decimal point.
LABPT=-1	Omit the decimal point.
LABPT=-2	Mark data points but omit labels.
LABPT=-3	Omit data points altogether.

Each data point is marked at its closest grid point, and the value of the data point is adjusted correspondingly so that the label of a data point may not be its exact value as read in.

NOTE: If any data point is hidden by any portion of the surface it is not shown (See EXAMPLE 1).

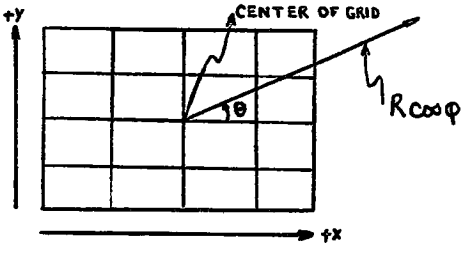
ZBASE — All pictures are drawn on a boxlike base. ZBASE is the height (Z value) of this base. Blanked portions of the grid are drawn in at level ZBASE. It is usually a good idea to set ZBASE less (greater) than the lowest (highest) point of the surface to get a nice looking picture.

ZMAG The Z values of the surface are magnified by a factor ZMAG about ZBASE. ZMAG may be positive or negative. ZMAG should be used to adjust, if necessary, the Z values so that they will be compatible with the data units of the XY coordinates.

R This is the distance of the point of view from the centre of the object consisting of the surface and its base. The centre is taken to be (AVERAGE(X1,XL),AVERAGE(Y1,YL), ZBASE).

THETA This is the longitude of the point of view in degrees. THETA is zero along the positive X-axis and increases counterclockwise. (See figure below).

PHI This is the latitude of the point of view in degrees. It varies from -90 to 90. (See figure below).



DATA TYPE 5

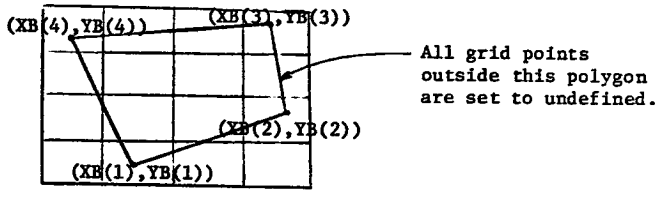
This data consists of the set of contour levels ZLEV(K) for K=1,2,...,NLEV where NLEV is the number of levels. The values appear one per card in FORMAT(E10.3). The set is ended by a card containing ZLEV(NLEV+1)=10.**35. If no contours are desired use this ending card only. There is no provision for the labelling of contours.

DATA TYPE 6

This data consists of a set of cards defining in sequence the vertices XB(K),YB(K), K=1,2,...,NB of the blanking polygon where NB is the number of vertices. The vertices appear one

point per card in FORMAT (2E10.3). The set is ended by a card on which XB(NB+1)=10.**35. If no blanking is desired use this last card only.

All grid points exterior to the blanking polygon are set to undefined (10.**35), as shown in the diagram below.



NOTE: 1) Blanking is useful for cutting out areas of the grid containing no data, where spurious extrapolations and peaks can occur.

2) For best results each side of the blanking polygon should be at least one grid space distant from the actual boundary of the region over which the user would like the surface to be drawn. This should prevent any accidental blanking out of data points and may help to smooth out the edges of the picture.

DATA SUMMARY SHEET

DATA FORMATS

DATA TYPE	PARAMETERS	FORMAT
0	KD1,KD2,KD3,KD4,KD5,KD6	(6I1)
1	IT(20)	(20A4)
2	NX,NY,X1,Y1,XL,YL,CAY,NSM	(2I5,5F10.0,I5)
3	XP,YP,ZP(one set/card) (If CAY=-1.0 use OPTION II under Section 3)	(3E10.3)
4A)	X1PL,Y1PL,XLPL,YLPL,LABPT	(4F10.0,10X,I5)
B)	ZBASE,ZMAG,R,THETA,PHI	(5F10.0)
5	ZLEV (one/card) (last ZLEV = 10.**35)	(E10.3)
6	XB,YB(one set/card) (last XB = 10.**35	(2E10.3)

DATA DESCRIPTION

KD1...KD6 { = 0 use previous set of data (all zeros = EOJ)
{ ≥ 0 read in new data

IT = title of plot (80 characters or less)

NX,NY = number of grid points in the X and Y directions respectively

X1,Y1,XL,YL = lower left and upper right corners of grid in data units

CAY { = 0. LAPLACE interpolation used to get grid Z.
{ > 0. as CAY is increased, SPLINE interpolation predominates
{ =-1. if interpolation is not needed.

NSM = number of Laplacian smoothings to apply to the grid Z.

XP,YP,ZP = the set of N data points (in data units)

Z = array of height values in data units (Z = 10.**35 if undefined)

X1PL,Y1PL,XLPL,YLPL = lower left and upper right corners of space on the plotter into which the picture will fit (in inches)

ZBASE = base level of the figure being plotted.

ZMAG = magnification of Z to be used.

R,THETA,PHI = point of vision relative to (AV(X1,XL),AV(Y1,YL), ZBASE)

R = radius in data units

THETA = longitude in degrees (zero along the X axis)

PHI = latitude in degrees

LABPT
- $\geq$ 0 number of digits after the decimal on data point labels
- =-1 omit decimal in data point labels
- =-2 omit labels on data points
- =-3 omit data points altogether

ZLEV = array of contour levels to be drawn (there are NLEV levels)

XB,YB = a series of NB points defining the vertices of a closed polygon (in data units); grid points outside the polygon are blanked (i.e. set to 10.**35)

3. HOW TO RUN THE PROGRAM

The program has been placed on a COSY disk file and may be called up and run by the user under either OPTION I or OPTION II as described below.

OPTION I - Under this option the COSY file is compiled unchanged and the user must supply in his data deck the Z values to be used in the construction of the surface. The program is loaded and run by the following sequence of control cards:

```
7
9SEQUENCE,
7
9JOB,
7
9FET,SCOBEY,COSY/THREE-D PICTURES,512
7
9OPEN,10
7
9COSY
THREED   DECK/     I=10,H=54
         ENDCOSY/
7
9FORTRAN,I=54,X
7
9EQUIP,01=60,03=61
7
9EQUIP,51=MT      (or 7 9EQUIP,51=TP for paper tape)
7
9LOAD,56
7
9RUN
     data deck
7 7
8 8
```

OPTION II - Under this option the COSY file has changes inserted (to compute the grid values Z(I,J))before compilation. The program is loaded and run by the following sequence of control cards:

```
7
9SEQUENCE,
7
9JOB,
7
9FET,SCOBEY,COSY/THREE-D PICTURES,512
7
9OPEN,10
7
9COSY
         INSERT/   128
    FORTRAN coding to generate Z(I,J) grid values (see example 5
    in section 5)
THREED   DECK/     I=10,H=54,R
         ENDCOSY/
```

```
7
9FORTRAN,I=54,X
7
9EQUIP,01=60,03=61
7
9EQUIP,51=MT      (or 9EQUIP,51=TP for paper tape)
7
9LOAD,56
7
9RUN
     data deck
7 7
8 8
```

NOTE: 1) The parameter R on the DECK/ card causes the FORTRAN coding inserted by the user to be printed out on the line printer.

2) Any statement numbers in the FORTRAN coding used to generate the Z(I,J) grid values must be greater than 310 and less than 399.

3) OPTION I and OPTION II can be combined in a single run (as was done in producing EXAMPLES 1 to 5) but if this is done only one picture can be done under OPTION II and all others must have their grid data read in.

4. STEREO PICTURES

Stereo pictures can be produced by two methods. In the first method (METHOD I below) two pictures of the same surface can be superimposed (i.e. drawn relative to the same origin) with longitude theta differing by two or three degrees. The two superimposed pictures can be done in green and red ink and then viewed through coloured glasses. In the second method (METHOD II below) the pictures can be plotted separately (again with longitude theta differing by two or three degrees) and viewed through a stereoscope.

It is important to remember that if stereo pictures (i.e. pairs of pictures) are being produced then only stereo pictures can be produced in that particular run. That is, stereo pictures and non-stereo pictures cannot both be produced in the same run.

For each stereo-pair of pictures to be produced there must be two sets of input data. The first set of data is prepared in the usual way as described in Section 2. The second set of data is the same as the first except for data type 1 and data type 4. Data type 1 in the second set should consist of a blank card to insure that the title is not overwritten in another colour of ink. Data type 4 of the second data set should be the same as data type 4 of the first set except that on the second card the longitude parameter theta should be two or three degrees greater than theta in the first set of data.

The following two job control card sequences permit the production of stereo pictures by either one or the other of the two methods described above:

METHOD I

```
7
9SEQUENCE,
7
9JOB,
7
9FET,SCOBEY,COSY/THREE-D PICTURES,512
7
9OPEN,10
7
9COSY
        DELETE/    205
      IF(NPIC-(NPIC/2)*2)1070,1070,1020
        DELETE/    272
      IF(NPIC-(NPIC/2)*2)1340,1340,1330
1330  CALL PLOT(-1.,-1.,-3)
      GO TO 2000
1340  CALL PLOT(XLPL+3.,-1.,-3)
THREED   DECK/      I=10,H=54,R
        ENDCOSY/
```

```
7
9FORTRAN,I=54,X
7
9EQUIP,01=60,03=61
7                                    7
9EQUIP,51=MT  (or 9EQUIP,51=TP for paper tape)
7
9LOAD,56
7
9RUN
     data deck
7 7
8 8
```

METHOD II

```
7
9SEQUENCE,
7
9JOB,
7
9FET,SCOBEY,COSY/THREE-D PICTURES,512
7
9OPEN,10
7
9COSY
        DELETE/    205
      IF(NPIC-(NPIC/2)*2)1070,1070,1020
THREED  DECK/      I=10,H=54,R
        ENDCOSY/
7
9FORTRAN,I=54,X
7
9EQUIP,01=60,03=61
7                                    7
9EQUIP,51=MT  (or 9EQUIP,51=TP for paper tape)
7
9LOAD,56
7
9RUN
 data deck
7 7
8 8
```

NOTE: 1) If the user employs METHOD I to produce stereo pictures then he should specify PLTLS (or PLOTLS for paper tape) on his job description card for the PDP-8.

2) If the user employs METHOD II to produce stereo pictures then he should specify PLTL (or PLOTL for paper tape) on his job description card for the PDP-8.

3) The number of plots specified should be 2N where N is the number of stereo pictures, since there are two plots for each stereo picture.

4) Regardless of whether METHOD I or METHOD II is used, the PDP-8 operator need not reposition the pen at any

time after the plotting has begun. If METHOD I is being used, each new stereo pair is automatically positioned 3 inches to the right of the previous pair by PLTLS (or PLOTLS). If METHOD II is being used each picture (including each half of each stereo-pair) is begun 6 inches to the right of the previous picture. The pictures can then be cut out and viewed through a stereoscope. The proper size of picture for this method is best determined by trial and error.

5) When doing a series of stereo pictures according to METHOD I (i.e. using superimposed pictures of different colours) the first picture of each pair to be plotted (the one with the algebraically lesser value of longitude theta) should be plotted in green india ink, while the second picture (the one with the algebraically greater value of longitude theta) should be plotted in red india ink. If the picture is then viewed through coloured glasses (red for the left eye and green for the right), all lines will appear black and the three-dimensional effect should be obvious. Depending on the individual, it may be necessary to adjust the distance of the picture and/or the coloured glasses from the eye of the observer for best results. To obtain the above colors the user should specify on his PDP-8 job description card that odd-numbered plots be done in green and even-numbered plots in red.

5. EXAMPLES - DATA INPUT, PRINTER AND PLOTTER OUTPUT

All input data is printed out according to type. Any data points not falling over the area of the grid are noted on the printer.

A record is kept of each iteration in the relaxation procedure used to interpolate from the data points onto the grid Z. The relaxation factor W, an estimate of the largest root of the iteration matrix, and the maximum change in Z over all grid points relative to the range of Z are printed at each iteration. The process is continued until the estimated error in Z is less than 1% of the Z range or until 100 iterations are done.

Seven sample pictures are included to illustrate the features of the program. The data needed to produce these pictures is listed preceding the pictures, and the printer output for one example (EXAMPLE 6) is also given. The first four pictures use the same data but different options.

NOTE: Each new picture is a separate plot on the plotter tape and is shifted 3 inches from the right edge of the previous picture.

EXAMPLE 1 - Here Laplacian interpolation (CAY=0) is used and the surface is seen to peak sharply at many of the data points. The data points are both marked and labelled (except for those not visible). Note that each data point has been moved to the nearest grid intersection. (The XP,YP,ZP arrays have, of course, not been touched.).

EXAMPLE 2 - This is the same as EXAMPLE 1 except that the surface has been smoothed (NSM=2), reducing the sharp peaks, and the data points have been left off.

EXAMPLE 3 - Here SPLINE interpolation predominates (CAY=10.) and the surface is much smoother and more satisfactory.

EXAMPLE 4 - This is the same as EXAMPLE 3 except that contours have been included and a corner of the grid containing no data has been blanked out. Data points are marked but not labelled.

EXAMPLE 5 - In this example CAY = -1. and user code has been inserted between statements numbered 310 and 399 in

the mainline program to generate the function $Z(X,Y) = X^2-Y^2$ over a 21X21 grid. One quadrant has been blanked out by filling all points in it with Z(I,J)=10.**35.

EXAMPLE 6 - This example is a three-dimensional picture of the contour data used in the example given in Section 2.50.50 of the computer center users' manual, which describes the use of GPCP (General Purpose Contouring Program), and may be compared with that example.

EXAMPLE 7 - This is a stereo pair of the same data used in Example 6, plotted using METHOD I above. Due to the difficulty of reproducing multicolour plots this example does not appear in this write-up but is on display in the Computer Center and may be viewed with the accompanying coloured glasses.

The following pages contain the data input for all seven examples. EXAMPLES 1 to 5 were done in a single computer run, while EXAMPLE 6 and EXAMPLE 7 were each done in a separate computer run. The printer output for EXAMPLE 6 is included.

DATA INPUT FOR ALL EXAMPLES

```
***** DATA FOR EXAMPLES 1 THROUGH 5 *****

123400
EXAMPLE 1-HIEBERTS DATA CAY=0 NSM=0
   16   16 110.      120.      185.      195.      0.0              0
148.       125.      140.
122.       131.      145.
143.       145.      152.
158.       149.      146.
115.       155.      155.
135.       157.      173.
155.       165.      156.
185.       168.      145.
165.       170.      157.
135.       172.      154.
112.       181.      145.
175.       182.      170.
153.       183.      143.
149.       186.      140.
182.       193.      145.
1.0000E+35
0.0        0.0       7.5       7.5                    -1
130.       1.0       1000.     -45.      45.
120400
EXAMPLE 2-HIEBERTS DATA CAY=0 NSM=2
   16   16 110.      120.      185.      195.      0.               2
0.0        0.0       7.5       7.5                    -3
130.       1.0       1000.     -45.      45.
120400
EXAMPLE 3-HIEBERTS DATA CAY=10 NSM=0
   16   16 110.      120.      185.      195.      10.              0
0.0        0.0       7.5       7.5                    -1
130.       1.0       1000.     -45.      45.
100456
EXAMPLE 4-CAY=10 NSM=0 BLANKING INCLUDED
0.0        0.0       7.5       7.5                    -2
130.       1.0       1000.     -45.      45.
140.          -1
145.          -1
150.          -1
155.          -1
160.          -1
165.          -1
170.          -1
1.0000E+35
105.       115.
158.       115.
158.       143.
167.       143.
167.       162.
190.       162.
190.       200.
105.       200.
1.0000E+35
```

```
123456
EX 5 Z=X**2-Y**2 ONE QUAD BLANKED
   21    21 0.          0.          20.          20.          -1.
         0.          0.           5.           5.
     -100.           .1          75.         -35.          55.
     -100.
      -50.
        0.
       50.
1.0000E+35
1.0000E+35
000000
```

***** DATA FOR EXAMPLE 6 *****

```
123456
EXAMPLE 6 CAY=10 NSM=2
   33    31          0.           0.          32.          30.          10.     2
       0.0         28.0         250.
       2.1         25.0         300.
       4.0         20.0         350.
       4.2         16.2         400.
       4.1         12.2         300.
       6.0          6.5         450.
       8.1          0.3         400.
      20.0          2.4         400.
      16.0          4.3         250.
      15.9          9.8         400.
      15.8         16.1         300.
      16.0         22.2         350.
      16.0         28.0         450.
      26.2         16.2         450.
      32.0         28.0         250.
     1.E35
         0.           0.           7.           7.                   -1
       230.           .1         100.         -45.          45.
300.
350.
400.
     1.E35
7.           -1.
20.          -1.
32.          27.
32.          29.
0.           29.
0.           27.
     1.E35
000000
```

```
          ***** DATA FOR EXAMPLE 7 *****

123456
EXAMPLE 7 CAY=10 NSM=2
   33   31          0.          0.         32.         30.         10.     2
        0.0        28.0        250.
        2.1        25.0        300.
        4.0        20.0        350.
        4.2        16.2        400.
        4.1        12.2        300.
        6.0         6.5        450.
        8.1         0.3        400.
       20.0         2.4        400.
       16.0         4.3        250.
       15.9         9.8        400.
       15.8        16.1        300.
       16.0        22.2        350.
       16.0        28.0        450.
       26.2        16.2        450.
       32.0        28.0        250.
     1.E35
        0.          0.          7.          7.                     -1
      230.          .1        100.        -45.         45.
300.
350.
400.
     1.E35
7.          -1.
20.         -1.
32.         27.
32.         29.
0.          29.
0.          27.
     1.E35
100400

        0.          0.          7.          7.                     -1
      230.          .1        100.        -42.         45.
000000
```

PRINTER OUTPUT FOR EXAMPLE 6

```
3-D PICTURE NO.   1          1 2 3 4 5 6


DATA TYPE 1     EXAMPLE 6 CAY=10 ASP=2

DATA TYPE 2        33   31              0              0    3.20000E 01    3.00000E 01     10.00    2

DATA TYPE 3         1              0    2.80000E 01    2.90000E 02
DATA TYPE 3         2    2.10000E 00    2.90000E 01    3.00000E 02
DATA TYPE 3         3    4.00000E 00    2.00000E 01    3.50000E 02
DATA TYPE 3         4    4.20000E 00    1.62000E 01    4.00000E 02
DATA TYPE 3         5    4.10000E 00    1.22000E 01    3.00000E 02
DATA TYPE 3         6    6.00000E 00    6.90000E 00    4.50000E 02
DATA TYPE 3         7    8.10000E 00    3.00000E-01    4.00000E 02
DATA TYPE 3         8    2.00000E 01    2.40000E 00    4.00000E 02
DATA TYPE 3         9    1.60000E 01    4.30000E 00    2.50000E 02
DATA TYPE 3        10    1.59000E 01    1.80000E 00    4.00000E 02
DATA TYPE 3        11    1.98000E 01    1.61000E 01    3.00000E 02
DATA TYPE 3        12    1.60000E 01    2.22000E 01    3.50000E 02
DATA TYPE 3        13    1.60000E 01    2.80000E 01    4.50000E 02
DATA TYPE 3        14    2.62000E 01    1.62000E 01    4.50000E 02
DATA TYPE 3        15    3.20000E 01    2.80000E 01    2.90000E 02
DATA TYPE 3        16    1.00000E 35              0              0

DATA TYPE 4              0          0  7.0000E 00  7.0000E 00  2.3000E 02  1.0000E-01  1.0000E 02  -45.0   45.0  0  0 -1

DATA TYPE 5         1    3.00000E 02    0
DATA TYPE 5         2    3.50000E 02    0
DATA TYPE 5         3    4.00000E 02    0
DATA TYPE 5         4    1.00000E 35    0

DATA TYPE 6         1    7.00000E 00   -1.00000E 00
DATA TYPE 6         2    2.00000E 01   -1.00000E 00
DATA TYPE 6         3    3.20000E 01    2.70000E 01
DATA TYPE 6         4    3.20000E 01    2.90000E 01
DATA TYPE 6         5              0    2.90000E 01
DATA TYPE 6         6              0    2.70000E 01
DATA TYPE 6         7    1.00000E 35              0

SUBROUTINE ZGRID

   1  h= 1.000000  ROOT=  .107875  DZMAX/ZRANGE= .4791926
   2  h= 1.000000  ROOT=  .432314  DZMAX/ZRANGE= .2911044
   3  h= 1.000000  ROOT=  .935643  DZMAX/ZRANGE= .1689600
   4  h= 1.000000  ROOT=  .661707  DZMAX/ZRANGE= .0845312
   5  h= 1.000000  ROOT=  .736239  DZMAX/ZRANGE= .0524564
   6  h= 1.000000  ROOT=  .794581  DZMAX/ZRANGE= .0373552
   7  h= 1.000000  ROOT=  .850236  DZMAX/ZRANGE= .0371527
   8  h= 1.000000  ROOT=  .856700  DZMAX/ZRANGE= .0276273
   9  h= 1.000000  ROOT=  .882120  DZMAX/ZRANGE= .0256981
```

10	h= 1.000000E	ROOT=	.896689	DZMAX/ZRANGE=	.0234880
11	h= 1.000000E	ROOT=	.912457	DZMAX/ZRANGE=	.0213435
12	h= 1.000000E	ROOT=	.924094	DZMAX/ZRANGE=	.0195362
13	h= 1.000000E	ROOT=	.931534	DZMAX/ZRANGE=	.0179552
14	h= 1.000000	ROOT=	.937049	DZMAX/ZRANGE=	.0165526
15	h= 1.000000	ROOT=	.940484	DZMAX/ZRANGE=	.0170645
16	h= 1.000000	ROOT=	.942932	DZMAX/ZRANGE=	.0164767
17	h= 1.000000E	ROOT=	.944806	DZMAX/ZRANGE=	.0158323
18	h= 1.000000E	ROOT=	.946350	DZMAX/ZRANGE=	.0151555
19	h= 1.000000E	ROOT=	.947716	DZMAX/ZRANGE=	.0144624
20	h= 1.000000E	ROOT=	.949000	DZMAX/ZRANGE=	.0137674
21	h= 1.539431	ROOT=	1.545394	DZMAX/ZRANGE=	.0181318
22	h= 1.539431	ROOT=	.928703	DZMAX/ZRANGE=	.0177258
23	h= 1.539431	ROOT=	.926532	DZMAX/ZRANGE=	.0169606
24	h= 1.539431	ROOT=	.926229	DZMAX/ZRANGE=	.0160867
25	h= 1.539431	ROOT=	.926431	DZMAX/ZRANGE=	.0150015
26	h= 1.539431	ROOT=	.926347	DZMAX/ZRANGE=	.0137985
27	h= 1.539431	ROOT=	.928831	DZMAX/ZRANGE=	.0124874
28	h= 1.539431	ROOT=	.929873	DZMAX/ZRANGE=	.0112876
29	h= 1.539431	ROOT=	.931794	DZMAX/ZRANGE=	.0103447
30	h= 1.539431	ROOT=	.934219	DZMAX/ZRANGE=	.0093226
31	h= 1.539431	ROOT=	.937394	DZMAX/ZRANGE=	.0082859
32	h= 1.539431	ROOT=	.941030	DZMAX/ZRANGE=	.0072740
33	h= 1.539431	ROOT=	.944243	DZMAX/ZRANGE=	.0063132
34	h= 1.539431	ROOT=	.947406	DZMAX/ZRANGE=	.0054829
35	h= 1.539431	ROOT=	.950770	DZMAX/ZRANGE=	.0052814
36	h= 1.539431	ROOT=	.953752	DZMAX/ZRANGE=	.0052100
37	h= 1.539431	ROOT=	.956385	DZMAX/ZRANGE=	.0051089
38	h= 1.539431	ROOT=	.958681	DZMAX/ZRANGE=	.0049863
39	h= 1.539431	ROOT=	.960606	DZMAX/ZRANGE=	.0048815
40	h= 1.539431	ROOT=	.962124	DZMAX/ZRANGE=	.0047739
41	h= 1.761241	ROOT=	1.323413	DZMAX/ZRANGE=	.0063271
42	h= 1.761241	ROOT=	.952479	DZMAX/ZRANGE=	.0060066
43	h= 1.761241	ROOT=	.958723	DZMAX/ZRANGE=	.0059146
44	h= 1.761241	ROOT=	.956009	DZMAX/ZRANGE=	.0057400
45	h= 1.761241	ROOT=	.958558	DZMAX/ZRANGE=	.0054841
46	h= 1.761241	ROOT=	.960908	DZMAX/ZRANGE=	.0053007
47	h= 1.761241	ROOT=	.963583	DZMAX/ZRANGE=	.0051249
48	h= 1.761241	ROOT=	.962041	DZMAX/ZRANGE=	.0050437
49	h= 1.761241	ROOT=	.959838	DZMAX/ZRANGE=	.0049130
50	h= 1.761241	ROOT=	.961234	DZMAX/ZRANGE=	.0047434
51	h= 1.761241	ROOT=	.962770	DZMAX/ZRANGE=	.0045061
52	h= 1.761241	ROOT=	.963050	DZMAX/ZRANGE=	.0043234
53	h= 1.761241	ROOT=	.962625	DZMAX/ZRANGE=	.0040055
54	h= 1.761241	ROOT=	.963337	DZMAX/ZRANGE=	.0037946
55	h= 1.761241	ROOT=	.965325	DZMAX/ZRANGE=	.0036676
56	h= 1.761241	ROOT=	.965030	DZMAX/ZRANGE=	.0034540
57	h= 1.761241	ROOT=	.965360	DZMAX/ZRANGE=	.0032215
58	h= 1.761241	ROOT=	.967358	DZMAX/ZRANGE=	.0030267
59	h= 1.761241	ROOT=	.968199	DZMAX/ZRANGE=	.0031055
60	h= 1.761241	ROOT=	.966709	DZMAX/ZRANGE=	.0031851
61	h= 1.850366E	ROOT=	1.053937	DZMAX/ZRANGE=	.0035308
62	h= 1.850366E	ROOT=	.970563	DZMAX/ZRANGE=	.0035161
63	h= 1.850366E	ROOT=	.975779	DZMAX/ZRANGE=	.0036062
64	h= 1.850366E	ROOT=	.976468	DZMAX/ZRANGE=	.0037058
65	h= 1.850366E	ROOT=	.977934	DZMAX/ZRANGE=	.0038065
66	h= 1.850366E	ROOT=	.979551	DZMAX/ZRANGE=	.0038836
67	h= 1.850366E	ROOT=	.981869	DZMAX/ZRANGE=	.0039165
68	h= 1.850366E	ROOT=	.981034	DZMAX/ZRANGE=	.0039414
69	h= 1.850366E	ROOT=	.979544	DZMAX/ZRANGE=	.0039520
70	h= 1.850366E	ROOT=	.981403	DZMAX/ZRANGE=	.0039412
71	h= 1.850366E	ROOT=	.980925	DZMAX/ZRANGE=	.0038998

```
  72   h= 1.850366   ROOT=   .981739   DZMAX/ZRANGE= .0038456
  73   h= 1.850366   ROOT=   .981287   DZMAX/ZRANGE= .0037630
  74   h= 1.850366   ROOT=   .981101   DZMAX/ZRANGE= .0036484
  75   h= 1.850366   ROOT=   .980236   DZMAX/ZRANGE= .0035045
  76   h= 1.850366   ROOT=   .979091   DZMAX/ZRANGE= .0033436
  77   h= 1.850366   ROOT=   .979094   DZMAX/ZRANGE= .0031703
  78   h= 1.850366   ROOT=   .979305   DZMAX/ZRANGE= .0029914
  79   h= 1.850366   ROOT=   .979212   DZMAX/ZRANGE= .0027949
  80   h= 1.850366   ROOT=   .979910   DZMAX/ZRANGE= .0025937
  81   h= 1.905667   ROOT= 1.094378   DZMAX/ZRANGE= .0025688
  82   h= 1.905667   ROOT=   .980203   DZMAX/ZRANGE= .0025085
  83   h= 1.905667   ROOT=   .982580   DZMAX/ZRANGE= .0024968
  84   h= 1.905667   ROOT=   .982885   DZMAX/ZRANGE= .0024888
  85   h= 1.905667   ROOT=   .982293   DZMAX/ZRANGE= .0024443
  86   h= 1.905667   ROOT=   .982038   DZMAX/ZRANGE= .0024455
  87   h= 1.905667   ROOT=   .983570   DZMAX/ZRANGE= .0024216
  88   h= 1.905667   ROOT=   .983908   DZMAX/ZRANGE= .0023920
  89   h= 1.905667   ROOT=   .984803   DZMAX/ZRANGE= .0023429
  90   h= 1.905667   ROOT=   .984529   DZMAX/ZRANGE= .0023028
  91   h= 1.905667   ROOT=   .985820   DZMAX/ZRANGE= .0022657
  92   h= 1.905667   ROOT=   .987518   DZMAX/ZRANGE= .0022457
  93   h= 1.905667   ROOT=   .987131   DZMAX/ZRANGE= .0022007
  94   h= 1.905667   ROOT=   .988424   DZMAX/ZRANGE= .0021877
  95   h= 1.905667   ROOT=   .988208   DZMAX/ZRANGE= .0021288
  96   h= 1.905667   ROOT=   .987753   DZMAX/ZRANGE= .0020766
  97   h= 1.905667   ROOT=   .988932   DZMAX/ZRANGE= .0020352
  98   h= 1.905667   ROOT=   .987346   DZMAX/ZRANGE= .0019891
  99   h= 1.905667   ROOT=   .988384   DZMAX/ZRANGE= .0019389
 100   h= 1.905667   ROOT=   .989406   DZMAX/ZRANGE= .0018882

SUBROUTINE SMOOTH


SUBROUTINE XLINES


SUBROUTINE YLINES


SUBROUTINE BLINES

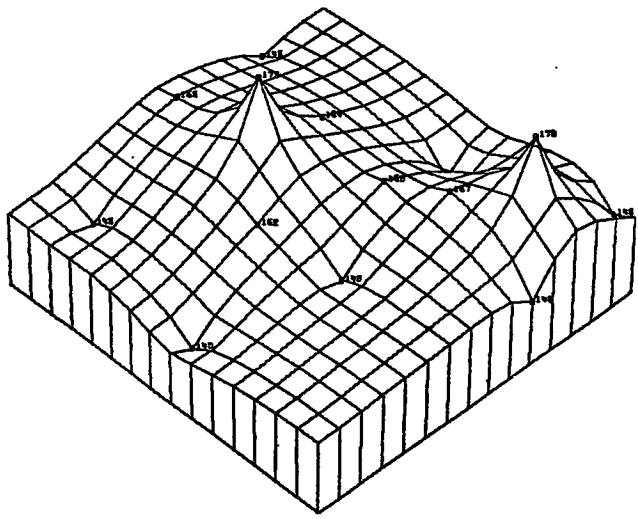

SUBROUTINE CON3D


SUBROUTINE DATA3D
```

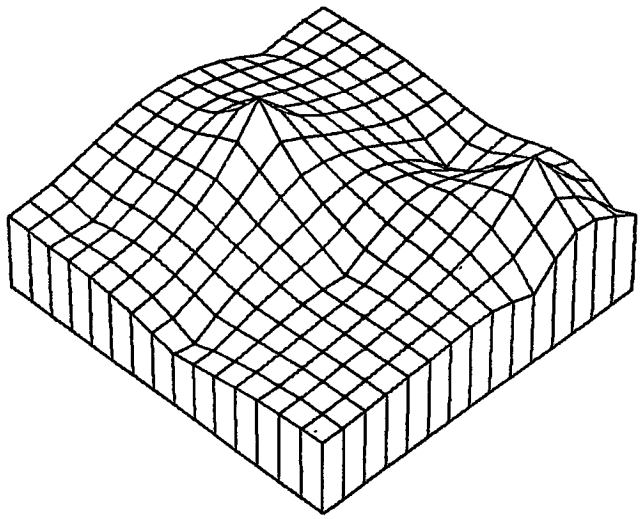
```
3-D PICTURE NO.    2              0 0 0 0 0 0

I FTN6 0060  STOP
TIME     004.88 MIN
```

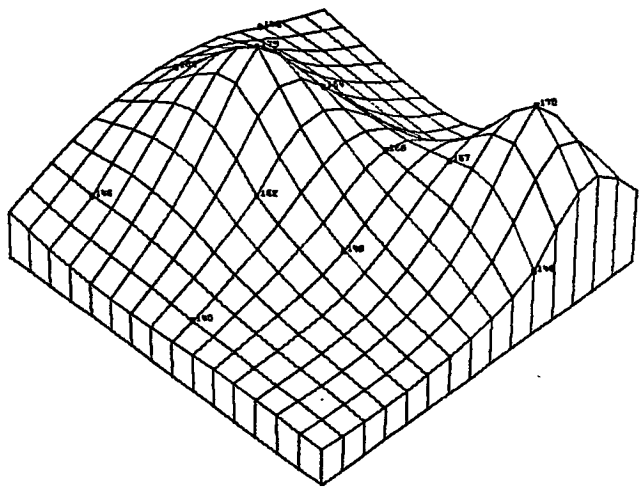
PLOTTER OUTPUT FOR EXAMPLES 1 TO 6
(see EXAMPLE 7 on display in the Computer Centre)



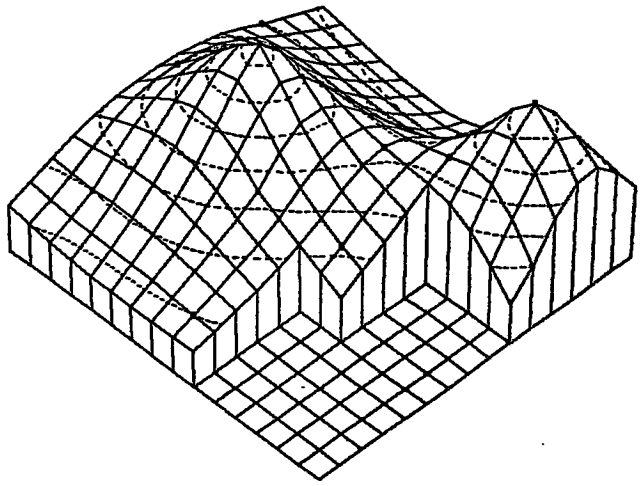
EXAMPLE 1-HIBBERTS DATA CAY=0 NSM=0



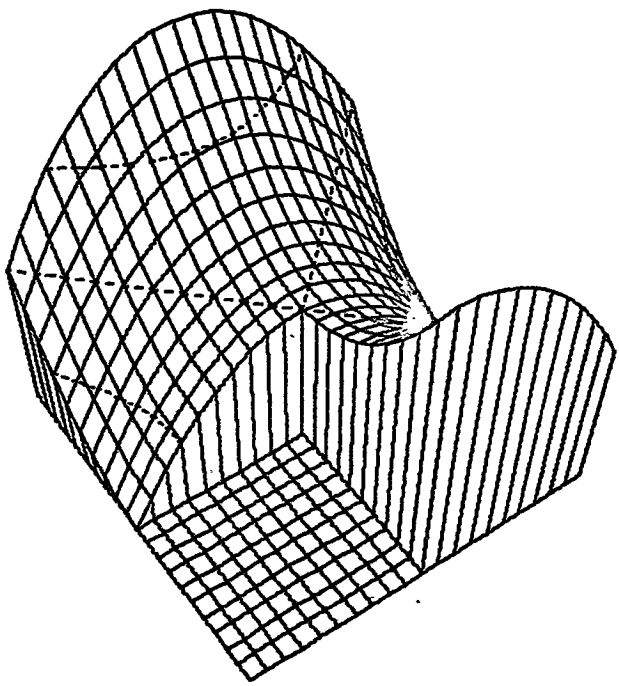
EXAMPLE 2-HIBBERTS DATA CAY=0 NSM=2



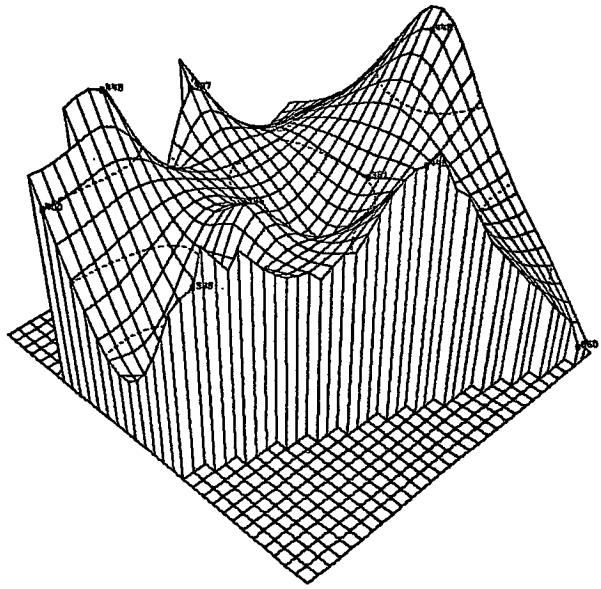
EXAMPLE 3-HIBBERTS DATA CAY=10 NSM=0



EXAMPLE 4-CAY=10 NSM=0 BLANKING INCLUDED



EX 5 Z=X**2-Y**2 ONE QUAD BLANKED



EXAMPLE 6 CAY=10 NSM=2

6. PROGRAM LISTING

The following pages contain a listing of the mainline program and non-system subroutines used to produce three-dimensional pictures.

NOTE: The numbering of the cards corresponds to the numbering of the COSY file on disk corresponding to the following FET card:

```
7
9FET,SCOBEY,COSY/THREE-D PICTURES,512
```

```
                                MS FORTRAN (4.0)/PSOS          30/08/71

      PROGRAM G10638                                                        00001
C     SECOND SAMPLE DRIVER FOR PERSPECTIVE PICTURES  (INCL COMPUTES)        00002
C                                                                           00003
C     AN ARRAY Z(I,J) OF HEIGHTS IS READ IN , OR GENERATED INTERNALLY ,     00004
C     OR INTERPOLATED FROM ARBITRARY DATA PTS(BY COMBINED LAPLACE-SPLINE    00005
C     INTERPOLATION) .  THE PROJECTION OF THE SURFACE  FROM ANY POINT       00006
C     OF VIEW IS PLOTTED                                                    00007
C     SEE JOURNAL OF ACM APRIL 1968 VOL 15 NO 2 PAGE 153                    00008
C                                                                           00009
C     INPUT                                                                 00010
C     0) NC1,NO2,NO3,NO4,NC5,NO6    FMT(6I1)                                00011
C     1) IT(1 ... 20)    FMT(20A4)                                          00012
C     2) NX,NY,X1,Y1,XL,YL,CAY,NSM     FMT(2I5,5F10.0,I5)                 00013
C     3) XF,YF,ZP  ONE SET/CARD  LAST XP=10**35  FMT NC. 304  (OR IF CAY    00014
C        =-1. INSERT CODING BETWEEN 300 AND 399 TO GENERATE Z(1..NX,1..N    00015
C     4)   X1PL,Y1PL,XLPL,YLPL,LSP,IPER,LABPT  FMT(4F10.0,3I5)              00016
C     4B) ZBASE,ZMAG,R,THETA,PHI    FMT(5F10.0)                           00017
C     5)   ZLEV,LABEL  ONE SET/CARD  LAST ZLEV=10**35  FMT(E10.3,I5)       00018
C     6)   XB,YB  ONE SET/CARD  LAST XB=10**35  FMT(2E10.3)                 00019
C                                                                           00020
C     DATA DESCRIPTION                                                      00021
C     NC1 ... NC6 =0  USE PREV SET OF DATA  (ALL ZEROS = EOJ)               00022
C                 GT 0   READ IN NEW DATA                                   00023
C     IT = TITLE OF PLOT (80 OR LESS CHARACTERS)                            00024
C     NX,NY = NO. OF GRID PTS IN X AND Y DIRECTIONS                         00025
C     X1,Y1,XL,YL = LO.LEFT AND UP.RT CORNERS OF GRID IN DATA UNITS         00026
C     CAY = 0.   LAPLACE INTERP. USED TO GET GRID Z.                        00027
C         GT 0.   AS CAY IS INCREASED SPLINE INTERP. PREDOMINATES.          00028
C         = -1. WHEN INTERPOLATION NOT NEEDED                               00029
C     NSM = NO. OF LAPLACIAN SMOOTHINGS TO APPLY TO Z.                      00030
C     XF,YF,ZP = THE SET OF N DATA POINTS (IN DATA UNITS)                   00031
C     Z = ARRAY OF HEIGHT VALUES   (UNDEFINED Z=10**35)                     00032
C     X1PL,Y1PL,XLPL,YLPL = LO.LFT AND UP.RT CORNERS OF SPACE ON PLOTTER    00033
C                           FOR THE PICTURE TO FIT INTO (INCHES)            00034
C     ZBASE = BASE LEVEL OF THE FIGURE BEING PLOTTED.                       00035
C     ZMAG = MAGNIFICATION OF Z TO BE USED.                                 00036
C     R,THETA,PHI = POINT OF VISION RELATIVE TO AV(X1,XL),AV(Y1,YL),ZBAS    00037
C                   R = RADIUS IN DATA UNITS                                00038
C                   THETA = LONG (DEGREES)  (ZERO ALONG X AXIS)             00039
C                   PHI = LAT (DEGREES)                                     00040
C     LSP   NOT IMPLEMENTED   LEAVE BLANK                                   00041
C     IPER   NOT IMPLEMENTED  LEAVE BLANK                                   00042
C     LABPT  GE 0 NO. DIGITS AFTER DECIMAL ON DATA PT LABELS                00043
C            = -1  OMIT DECIMAL IN DATA POINT LABELS                        00044
C            = -2  OMIT LABELS ON DATA POINTS                               00045
C            = -3  OMIT DATA POINTS ALL TOGETHER                            00046
C     ZLEV = ARRAY OF CONTOUR LEVELS TO BE DRAWN (THERE ARE NLEV LEVELS)    00047
C     LABEL   NOT IMPLEMENTED  LEAVE BLANK                                  00048
C     XB,YB = A SERIES OF NB POINTS DEFINING THE VERTICES OF A CLOSED       00049
C             POLYGON.GRID PTS OUTSIDE POLY ARE BLANKED (SET TO 10**35)     00050
C                                                                           00051
      COMMON Z(50,50)                                                       00052
      DIMENSION INTZ(2,50,50)                                               00053
      EQUIVALENCE(Z(1),INTZ(1))                                             00054
      COMMON XP(101),YP(101),ZP(101)                                        00055
      COMMON ZLEV(51),LABEL(51),XB(51),YB(51)                               00056
      COMMON IBUFF(500),IT(20)                                              00057
C                                                                           00058
C*************************************************************************  00059
      KR=1                                                                  00060
```

```
      LP=3                                                              00061
      MT=13                                                             00062
      N=0                                                               00063
      NLEV=0                                                            00064
      NB=6                                                              00065
      LSPC=1                                                            00066
      BIG=.9E35                                                         00067
      CALL PLOTS(IBUFF,500,MT)                                          00068
C     CALL PLOTS(IBUFF,500)                                             00069
      DO 2000 NPIC=1,1000                                               00070
C                                                                       00071
C     READ IN DATA                                                      00072
C*4*********************************************************************00073
C                                                                       00074
      READ(KR,50) KD1,KD2,KD3,KD4,KD5,KD6                               00075
50    FORMAT(6I1)                                                       00076
      KDSUM=KD1+KD2+KD3+KD4+KD5+KD6                                     00077
      WRITE(LP,55) NPIC,KD1,KD2,KD3,KD4,KD5,KD6                         00078
55    FORMAT(16H13-D PICTURE NO. I4,10X 6I2 //)                         00079
      IF(NDSUM)60,60,70                                                 00080
60    CALL PLOT(0.,0.,999)                                              00081
      STOP                                                              00082
70    CONTINUE                                                          00083
C                                                                       00084
C     DATA TYPE 1   TITLE OF PLOT                                       00085
C*********************************************************************00086
C                                                                       00087
      IF(KD1)170,170,110                                                00088
 110  READ(KR,120) (IT(I),I=1,20)                                       00089
 120  FORMAT(20A4)                                                      00090
      WRITE(LP,130) (IT(I),I=1,20)                                      00091
 130  FORMAT(// 12H DATA TYPE 1 5X 20A4)                                00092
C110  READ(KR,120) (IT(I),I=1,14)                                       00093
C120  FORMAT(13A6,A2)                                                   00094
C     WRITE(LP,130) (IT(I),I=1,14)                                      00095
C130  FORMAT(// 12H DATA TYPE 1 5X 13A6,A2)                             00096
170   CONTINUE                                                          00097
C                                                                       00098
C     DATA TYPE 2   GRID CONSTRUCTION INFORMATION                       00099
C*********************************************************************00100
C                                                                       00101
      IF(KD2)270,270,210                                                00102
210   READ(KR,220)NX,NY,X1,Y1,XL,YL,CAY,ASM                             00103
220   FORMAT(2I5,5F10.0,I5)                                             00104
      WRITE(LP,230) NX,NY,X1,Y1,XL,YL,CAY,NSM                           00105
230   FORMAT(// 12H DATA TYPE 2 5X 2I5,4E19.5,F10.2,I5)                 00106
270   CONTINUE                                                          00107
C                                                                       00108
C     DATA TYPE 3  THE DATA POINTS   (IF Z GENERATION IF CAY=-1.)       00109
C*********************************************************************00110
C                                                                       00111
      IF(KD3)395,399,301                                                00112
301   IF(CAY+.1)309,309,302                                             00113
302   WRITE(LP,303)                                                     00114
303   FORMAT(//)                                                        00115
      DO 306 K=1,1000                                                   00116
      READ(KR,304) XP(K),YP(K),ZP(K)                                    00117
304   FORMAT(3E10.3)                                                    00118
      WRITE(LP,306) K,XP(K),YP(K),ZP(K)                                 00119
306   FORMAT(12H DATA TYPE 3 5X I5,3E15.5)                              00120
      IF(XP(K)-BIG)308,395,399                                          00121
308   N=K                                                               00122
```

```
309   CONTINUE                                                          00123
C                                                                       00124
      DO 310 I=1,50                                                     00125
      DO 310 J=1,50                                                     00126
310   Z(I,J)=1.E35                                                      00127
C                                                                       00128
399   CONTINUE                                                          00129
C                                                                       00130
C     DATA TYPE 4   PLOTTING INFORMATION                                00131
C*********************************************************************  00132
C                                                                       00133
      IF(KD4)490,490,410                                                00134
410   READ(KR,420) X1PL,Y1PL,XLPL,YLPL,LSF,IPER,LABFT                   00135
420   FORMAT(4F10.0,3I5)                                                00136
      READ(KR,425) ZBASE,ZMAG,R,THETA,PHI                               00137
425   FORMAT(5F10.0)                                                    00138
      WRITE(LP,430)X1PL,Y1PL,XLPL,YLPL,ZBASE,ZMAG,R,THETA,PHI,          00139
     2             LSF,IPER,LABFT                                       00140
430   FORMAT(// 12H DATA TYPE 4 5X 7E12.4,2F7.1 ,3I3 )                  00141
490   CONTINUE                                                          00142
C                                                                       00143
C     DATA TYPE 5   CONTOUR LEVELS                                      00144
C*********************************************************************  00145
C                                                                       00146
      IF(KC5) 550,550,510                                               00147
510   WRITE(LP,515)                                                     00148
515   FORMAT(//)                                                        00149
      DO 530 LEV=1,51                                                   00150
      READ(KR,520) ZLEV(LEV),LABEL(LEV)                                 00151
520   FORMAT(E10.3,I5)                                                  00152
      WRITE(LP,525) LEV,ZLEV(LEV),LABEL(LEV)                            00153
525   FORMAT(   12H DATA TYPE 5 5X I5,E15.5,I5)                         00154
      IF(ZLEV(LEV)-BIG)530,540,540                                      00155
530   CONTINUE                                                          00156
      STOP                                                              00157
540   NLEV=LEV-1                                                        00158
550   CONTINUE                                                          00159
C                                                                       00160
C     DATA TYPE 6   BLANKING INFORMATION                                00161
C*********************************************************************  00162
C                                                                       00163
      IF(KD6)699,699,601                                                00164
601   WRITE(LP,602)                                                     00165
602   FORMAT(//)                                                        00166
      DO 630 K=1,51                                                     00167
      READ(KR,620) XB(K),YB(K)                                          00168
620   FORMAT(2E10.3)                                                    00169
      WRITE(LP,625) K,XB(K),YB(K)                                       00170
625   FORMAT(12H DATA TYPE 6 5X I5,2E15.5)                              00171
      IF(XB(K)-BIG)630,630,640                                          00172
630   CONTINUE                                                          00173
640   NB=K-1                                                            00174
699   CONTINUE                                                          00175
C                                                                       00176
C     INITIALIZE                                                        00177
C*********************************************************************  00178
C                                                                       00179
      NXM1=NX-1                                                         00180
      NYM1=NY-1                                                         00181
      DX= (XL-X1)/NXM1                                                  00182
      DY= (YL-Y1)/NYM1                                                  00183
      IF((DY+.1)970,970,910                                             00184
910   IF(KD2+KD3+KD6)970,970,920                                        00185
```

```
920   IN=999                                                                  00186
      DO 950 I=1,NX                                                           00187
      X=X1+(I-1)*DX                                                           00188
      DO 950 J=1,NY                                                           00189
      Y=Y1+(J-1)*DY                                                           00190
      Z(I,J)=0.                                                               00191
      CALL INSIDE(X,Y,XB,YB,NB,IN)                                            00192
      IF(IN)940,940,950                                                       00193
940   Z(I,J)=1.E39                                                            00194
950   CONTINUE                                                                00195
      CALL ZGRID(Z,NX,NY,X1,Y1,DX,DY,XP,YP,ZP,N,CAY,RELAX)                    00196
      CALL SMOOTH(Z,NX,NY,NSP)                                                00197
C     CALL ZGRID(Z,NX,NY,X1,Y1,DX,DY,XP,YP,ZP,N,CAY,RELAX)                    00198
C     CALL SMOOTH(Z,NX,NY,NSM)                                                00199
970   CONTINUE                                                                00200
C                                                                             00201
C     SET UP THE PROJECTION ROUTINE                                           00202
C                                                                             00203
      CALL PROJ(R,THETA,PHI,(XL+X1)*.5,(YL+Y1)*.5,1)                          00204
C     IF(NPIC-(NPIC/2)*2)1070,1070,1020                                       00205
1020  CALL PROJ(ZBASE,ZMAG,0.,0.,1.,2)                                        00206
C                                                                             00207
      X1PIC=0.                                                                00208
      Y1PIC=0.                                                                00209
      XLPIC=0.                                                                00210
      YLPIC=0.                                                                00211
C                                                                             00212
      DO 1050  I=1,NX                                                         00213
      X= X1+DX*(I-1)                                                          00214
      DO 1050  J=1,NY                                                         00215
      Y= Y1+DY*(J-1)                                                          00216
      Z1J = Z(I,J)                                                            00217
      IF(Z1J-BIG) 1040,1030,1030                                              00218
1030  Z1J = ZBASE                                                             00219
1040  CALL PROJ(X,Y,Z1J,XPIC,YPIC,0)                                          00220
      IF((I-1)*(I-NX))1044,1042,1044                                          00221
1042  CALL PROJ(X,Y,ZBASE,XPICB,YPICB,0)                                      00222
1044  X1PIC = AMIN1(X1PIC,XPIC,XPICB)                                         00223
      Y1PIC = AMIN1(Y1PIC,YPIC,YPICB)                                         00224
      XLPIC = AMAX1(XLPIC,XPIC,XPICB)                                         00225
1050  YLPIC = AMAX1(YLPIC,YPIC,YPICB)                                         00226
C                                                                             00227
      SCLX =(XLPL-X1PL)/(XLPIC-X1PIC)                                         00228
      SCLY =(YLPL-Y1PL)/(YLPIC-Y1PIC)                                         00229
      SCL = AMIN1(SCLX,SCLY)                                                  00230
      XCPL=X1PL-X1PIC*SCL                                                     00231
      YCPL=Y1PL-Y1PIC*SCL                                                     00232
1070  CALL PROJ(ZBASE,ZMAG,XCPL,YCPL,SCL,2)                                   00233
C                                                                             00234
C     SET UP THE VISIBILITY ROUTINE                                           00235
C                                                                             00236
      CALL VISIBL(X1,Y1,XL,NX,1)                                              00237
      CALL VISIBL(YL,ZBASE,ZMAG,NY,2)                                         00238
      CALL VISIBL(R,THETA,PHI,NAN,3)                                          00239
      CALL VISIBL((XL+X1)*.5,(YL+Y1)*.5,ZBASE,NAN,4)                          00240
      DO 1100 I=1,NX                                                          00241
      X=X1+DX*(I-1)                                                           00242
      DO 1100 J=1,NY                                                          00243
      IF(Z(I,J))1077,1075,1077                                                00244
1075  Z(I,J)=1.E-35                                                           00245
1077  Y=Y1+DY*(J-1)                                                           00246
      ISEE=999                                                                00247
```

```
      ZIJ=Z(I,J)                                                        00248
      IF(ZIJ-BIG)1090,1080,1080                                         00249
 1080 ZIJ=ZBASE                                                         00250
 1090 CALL VISIBL(X,Y,ZIJ,ISEE,0)                                       00251
      IF(IABS(INTZ(2,I,J))-2)1095,1100,1100                             00252
 1095 INTZ(2,I,J)=ISIGN(2,INTZ(2,I,J))                                  00253
 1100 INTZ(2,I,J)=(INTZ(2,I,J)/2)*2+ISEE                               00254
C                                                                       00255
C     PLOT CLT THE PICTURE.                                             00256
C*************************************************************        00257
C                                                                       00258
      CALL SYMBCL(X1PL,Y1PL-.9,.2,II,0.,80)                             00259
C     CALL SYMBL4(X1PL,Y1PL-.5,.2,IT,0.,80)                             00260
      CALL XLINES(Z,NX,NY,X1,Y1,XL,YL,ZBASE,LSPC)                       00261
      CALL YLINES(Z,NX,NY,X1,Y1,XL,YL,ZBASE,LSPC)                       00262
C     CALL BLINES(Z,NX,NY,X1,Y1,XL,YL,ZBASE)                            00263
C     CALL CON3C(Z,NX,NY,X1,Y1,CX,DY,ZLEV,LABEL,NLEV,LSP)               00264
      CALL BLINES(Z,NX,NY,X1,Y1,XL,YL,ZBASE)                            00265
      CALL CON3C(Z,NX,NY,X1,Y1,CX,DY,ZLEV,LABEL,NLEV,LSP)               00266
      IF(CAY+.1)1320,1320,1310                                          00267
 1310 CONTINUE                                                          00268
C     CALL DATA3D(Z,NX,NY,X1,Y1,DX,DY,XP,YP,ZP,N,LABPT)                 00269
      CALL DATA3D(Z,NX,NY,X1,Y1,DX,DY,XP,YP,ZP,N,LABPT)                 00270
 1320 CONTINUE                                                          00271
      CALL PLOT(XLPL+3.,0.,-3)                                          00272
C                                                                       00273
 2000 CONTINUE                                                          00274
      END                                                               00275
```

PROGRAM VARIABLES

00135	BIG	00146	KC4	00130	NLEV	00300	SCLY	00163	Y1		
00171	CAY	00147	KC5	00310	NMN	00224	THETA	00296	Y1PIC		
00234	DX	00150	KC6	00140	NPIC	00241	X	00205	Y1PL		
00236	DY	00151	KCSUM	00173	NSM	00161	X1	00306	YCPL		
00155	I	00120	KK	00157	NX	00254	X1PIC	00167	YL		
00240	IA	00215	LABPT	00232	NXM1	00203	X1PL	00262	YLPIC		
00214	IPER	00230	LEV	00160	NY	00304	XCPL	00211	YLPL		
00314	ISEE	00122	LF	00233	NYM1	00165	XL	00270	YPIC		
00177	J	00213	LSP	00226	PHI	00260	XLPIC	00274	YPICB		
00176	K	00132	LSPC	00222	R	00207	XLPL	00216	ZBASE		
00143	KC1	00124	MT	00245	RELAX	00266	XPIC	00264	ZIJ		
00144	KC2	00126	N	00302	SCL	00272	XPICB	00220	ZMAG		
00145	KC3	00131	NB	00276	SCLX	00243	Y				

COMMON VARIABLES

13913	IEUFF	13114	LABEL	11610	XP	12122	YP	12746	ZLEV
00000	INTZ	13177	XB	13349	YB	00000	Z	12434	ZP
14477	IT								

STATEMENT NUMBERS

50	00000	270	00634	410	00762	540	01137	920	01260	1070	01614
55	00002	301	00641	420	00093	550	01142	940	01321	1079	01707
60	00503	302	00646	425	00056	601	01147	990	01324	1077	01712
70	00512	303	00041	430	00060	602	00106	970	01370	1080	01732
110	00517	304	00042	490	01056	620	00107	1020	01411	1090	01734
120	00012	306	00044	510	01063	625	00111	1030	01461	1095	01754
130	00014	308	00716	515	00072	630	01211	1040	01463	1100	01764
170	00557	309	00727	520	00073	640	01221	1042	01504	1310	02108
210	00564	310	00734	525	00076	655	01224	1044	01514	1320	02125

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  220   00023        399   00755        530   01128        910   01252        1050   01533        2000   02140
  230   00027
```

FORTRAN DIAGNOSTIC RESULTS FOR G10638

NULL STATEMENT NUMBERS
1070 1020

G10638 P 02160 C 14523 D 00000

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                                  MS FORTRAN (4.0)/PSCS          30/08/71

      SUBROUTINE VISIBL(XP,YP,ZP,ISEE,IND)                                  00276
C                                                                           00277
C     ISEE = 1 IF  PT(XP,YP,ZP) IS VISIBLE                                  00278
C          = 0 OTHERWISE                                                    00279
C     PRELIMINARY CALLS TO SET UP VISIBL ...                                00280
C        1) CALL VISIBL(X1,Y1,XL,DX,1)                                      00281
C        2) CALL VISIBL(YL,ZBASE,ZMAG,DY,2)                                 00282
C        3) CALL VISIBL(R,THETA,PHI,ICLPMY,3)                               00283
C        4) CALL VISIBL(XC,YC,ZC,ICLPMY,4)                                  00284
C     THE ARRAY Z MUST BE COMMON TO VISIBL AND MAINLINE.                    00285
C     ON NORMAL CALLS TO VISIBL USE IND = 0 .                               00286
C     X1,Y1,XL,YL = LOWER LEFT AND UPPER RT CORNERS OF GRID IN DATA UNIT    00287
C     Z(1...NX,1...NY) = HGTS OF PTS ON GRID.   (UNDEFINED PTS = 10**35)    00288
C     (R,THETA,PHI) = FOCAL PT VECTOR.                                      00289
C     (XC,YC,ZC) = BASE PT OF FOCAL PT VECTOR.                              00290
C     ZBASE = BASE LEVEL OF THE SCENE BEING VIEWED.                         00291
C     ZMAG = SCALING FACTOR OF Z ABOUT ZC.                                  00292
C                                                                           00293
      COMMON Z(50,50)                                                       00294
      DIMENSION INTZ(2,50,50)                                               00295
      EQUIVALENCE(Z(1),INTZ(1))                                             00296
      IF(IND-1)10,3100,5                                                    00297
5     IF(IND-3)3200,3300,3400                                               00298
C                                                                           00299
C     INITIALIZE                                                            00300
C                                                                           00301
10    LBELC = 0                                                             00302
      LABOV = 0                                                             00303
      XPF = XP-XP                                                           00304
      YPF = YP-YP                                                           00305
      ZPF = ZP-ZP                                                           00306
C                                                                           00307
C     CHECK IF VISIBILITY ALREADY DETERMINED.                               00308
C*************************************************************************00309
C                                                                           00310
      IF(ISEE-999)15,35,15                                                  00311
15    XX=(XP-X1)/DX                                                         00312
      I=XX+1.5                                                              00313
      DELX=ABS(XX-I+1)                                                      00314
      IF(DELX-.01)20,20,35                                                  00315
20    YY=(YP-Y1)/DY                                                         00316
      J=YY+1.5                                                              00317
      DELY=ABS(YY-J+1)                                                      00318
      IF(DELY-.01)25,25,35                                                  00319
25    ZIJ=Z(I,J)                                                            00320
      IF(ZIJ-BIG)30,30,28                                                   00321
28    ZIJ=ZBASE                                                             00322
30    DEL2=ABS(ZIJ-ZP)                                                      00323
      IF(DEL2-ZINC)32,32,35                                                 00324
32    ISEE=INTZ(2,I,J)-(INTZ(2,I,J)/2)*2                                    00325
      ISEE=IABS(ISEE)                                                       00326
      RETURN                                                                00327
35    ISEE=0                                                                00328
C                                                                           00329
C     INTERSECTIONS WITH LINES X=CONST.   FIRST GET END POINTS.             00330
C*************************************************************************00331
C                                                                           00332
      XXYJ=XF                                                               00333
      XXYL=XF                                                               00334
      IF(YPF)40,50,40                                                       00335
```

```
 40     XXY1=XP+(Y1-YP)*XPF/YPF                                          00336
        XXYL=XP+(YL-YP)*XPF/YPF                                          00337
 50     IF(XPF)70,400,60                                                 00338
 C                                                                       00339
 60     IA = (XP-X1)/DX + 1.99                                           00340
        XXMAX = AMAX1(XXY1,XXYL)                                         00341
        XB =  AMIN1(XL,XP,XXMAX)                                         00342
        IB = (XB-X1)/DX + 1.01                                           00343
        GO TO 80                                                         00344
 C                                                                       00345
 70     IB = (XP-X1)/DX + 1.01                                           00346
        XXMIN = AMIN1(XXY1,XXYL)                                         00347
        XA = AMAX1(X1,XF,XXMIN)                                          00348
        IA = (XA-X1)/DX + 1.99                                           00349
 80     IF(IB-IA)400,90,90                                               00350
 C                                                                       00351
 C      CHECK EACH POINT FOR ABOVE OR BELOW LINE OF VISION               00352
 C                                                                       00353
 90     DO 350 I=IA,IB                                                   00354
        XI= X1+ DX*(I-1)                                                 00355
        YI= YP + (XI-XP)*YPF/XPF                                         00356
        FJ = (YI-Y1)/DY+1.0                                              00357
        J=F..+SIGN(.01,YPF)                                              00358
        J=MAX0(J,1)                                                      00359
        J=MIN0(J,NYM1)                                                   00360
        FRAC=FJ-J                                                        00361
 C                                                                       00362
        ZLINE = ZF + ZPF*(XI-XF)/XPF                                     00363
        IF(ABS(XI-XP)/DX-.01)91,108,108                                  00364
 91     ISCND=I + IFIX(SIGN(1.1,XPF))                                    00365
 92     IF((ISCND-1)*(ISCND-NX))94,94,350                                00366
 94     ZTEST=ZBASE                                                      00367
        IF(Z(I,J)+Z(I,J+1)-BIG)96,100,100                                00368
 96     IF(Z(ISCND,J)+Z(ISCND,J+1)-2*BIG)98,100,100                      00369
 98     ZTEST=Z(I,J)*(1.-FRAC)+Z(I,J+1)*FRAC                             00370
 100    IF(ABS(ZLINE-ZTEST)-ZINC) 350, 350,102                           00371
 102    IF(ZLINE-ZTEST) 200, 350, 190                                    00372
 108    CONTINUE                                                         00373
        IF(Z(I,J)+Z(I,J+1)-BIG)110,160,160                               00374
 110    ZSURF = Z(I,J)*(1.-FRAC) +Z(I,J+1)*FRAC                          00375
        IF(ABS(ZLINE-ZSURF)-ZINC) 160,160,130                            00376
 130    IF(ZLINE-ZSURF)150,160,140                                       00377
 140    LABOV = 1                                                        00378
        GO TO 160                                                        00379
 150    LBELO = 1                                                        00380
 160    IF((I-1)*(I-NX))170,180,170                                      00381
 170    IF(Z(I-1,J)+Z(I-1,J+1)-2*BIG)175,180,180                         00382
 175    IF(Z(I+1,J)+Z(I+1,J+1)-2*BIG)300,180,180                         00383
 180    IF(ABS(ZLINE-ZBASE)-ZINC)200,300,189                             00384
 185    IF(ZLINE-ZBASE)200,300,190                                       00385
 190    LABOV = 1                                                        00386
        GO TO 300                                                        00387
 200    LBELO = 1                                                        00388
 300    IF(LBELO+LABOV-1)350,350,2000                                    00389
 350    CONTINUE                                                         00390
 400    CONTINUE                                                         00391
 C                                                                       00392
 C      INTERSECTIONS WITH LINES Y=CONST.     FIRST GET END POINTS.      00393
 C*************************************************************************00394
 C                                                                       00395
        YYX1=YF                                                          00396
        YYXL=YF                                                          00397
```

```
      IF(XPF)1040,1050,1040                                              00398
1040  YYX1 = YP + (X1-XP)*YPF/XPF                                        00399
      YYXL = YP + (XL-XP)*YPF/XPF                                        00400
1050  IF(YPF) 1070,1400,1060                                             00401
C                                                                        00402
1060  JA= (YP-Y1)/DY +1.99                                               00403
      YYMAX=AMAX1(YYX1,YYXL)                                             00404
      YB = AMIN1(YL,YF,YYMAX)                                            00405
      JB = (YB-Y1)/DY + 1.01                                             00406
      GO TO 1080                                                         00407
C                                                                        00408
1070  JB = (YP-Y1)/DY + 1.01                                             00409
      YYMIN = AMIN1(YYX1,YYXL)                                           00410
      YA = AMAX1(Y1,YF,YYMIN)                                            00411
      JA = (YA-Y1)/DY +1.99                                              00412
1080  IF(JB-JA)1400,1090,1090                                            00413
C                                                                        00414
C     LOOK AT EACH POINT TO SEE IF IT IS ABOVE OR BELOW LINE OF VISIBA.  00415
C                                                                        00416
1090  DO 1390 J=JA,JB                                                    00417
      YJ=Y1 + DY*(J-1)                                                   00418
      XJ= XP + (YJ-YP)*XPF/YPF                                           00419
      FI = (XJ-X1)/DX+1.0                                                00420
      I=FJ+SIGN(.01,XPF)                                                 00421
      I= MAX0(I,1)                                                       00422
      I= MIN0(I,NXM1)                                                    00423
      FRAC = FI-I                                                        00424
C                                                                        00425
      ZLINE = ZP + ZPF * (Y-YP)/YPF                                      00426
      IF(ABS(YJ-YP)/DY-.01)1091,1108,1108                                00427
1091  JSCND=J + IFIX(SIGN(1.1,YPF))                                      00428
1092  IF((JSCND-1)*(JSCND-NY))1094,1094,1350                             00429
1094  ZTEST=ZBASE                                                        00430
      IF(Z(I,J)+Z(I+1 ,J)-BIG)1096,1100,1100                             00431
1096  IF(Z(I,JSCND)+Z(I+1,JSCND)-F2*BIG)1098,1100,1100                   00432
1098  ZTEST=Z(I,J)*(1.-FRAC)+Z(I+1,J)*FRAC                               00433
1100  IF(ABS(ZLINE-ZTEST)-ZINC)1350,1350,1102                            00434
1102  IF(ZLINE-ZTEST)1200,1350,1190                                      00435
1108  CONTINUE                                                           00436
      IF(Z(I,J)+Z(I+1,J)-BIG)1110,1180,1180                              00437
1110  ZSURF = Z(I,J)*(1.-FRAC) +Z(I+1,J)*FRAC                            00438
      IF(ABS(ZLINE-ZSURF)-ZINC)1160,1160,1130                            00439
1130  IF(ZLINE-ZSURF)1150,1160,1140                                      00440
1140  LABOV = 1                                                          00441
      GO TO 1160                                                         00442
1150  LBELO = 1                                                          00443
1160  IF((J-1)*(J-NY))1170,1180,1170                                     00444
1170  IF(Z(I,J-1)+Z(I+1,J-1)-F2BIG)1175,1180,1180                        00445
1175  IF(Z(I,J+1)+Z(I+1,J+1)-F2BIG)1300,1180,1180                        00446
1180  IF(ABS(ZLINE-ZBASE)-ZINC)1300,1300,1185                            00447
1185  IF(ZLINE-ZBASE)1200,1300,1190                                      00448
1190  LABOV = 1                                                          00449
      GO TO 1300                                                         00450
1200  LBELO = 1                                                          00451
1300  IF(LBELO+LABOV-1) 1350,1350,2000                                   00452
1350  CONTINUE                                                           00453
1400  ISEE = 1                                                           00454
2000  RETURN                                                             00455
C                                                                        00456
C                                                                        00457
C     INITIAL SET UP OF ROUTINE VISIBL.                                  00458
C*************************************************************************00459
```

```
C                                                                       00460
3100  XI= XP                                                            00461
      YI= YP                                                            00462
      XL= ZP                                                            00463
      NX= ISEE                                                          00464
      RETURN                                                            00465
C                                                                       00466
3200  YL = XP                                                           00467
      ZBASE = YP                                                        00468
      ZPAG = ZP                                                         00469
      NY = ISEE                                                         00470
      RETURN                                                            00471
C                                                                       00472
3300  R= XP                                                             00473
      THETA = YP                                                        00474
      PHI = ZP                                                          00475
      RETURN                                                            00476
C                                                                       00477
3400  XC= XP                                                            00478
      YC= YP                                                            00479
      ZC= ZP                                                            00480
C                                                                       00481
      LP=3                                                              00482
      PI = 3.1415926                                                    00483
      BIG = .9E39                                                       00484
      FZ=1.0                                                            00485
      FZ=1.0                                                            00486
      FZBIG=FZ*BIG                                                      00487
      NXM1=NX-1                                                         00488
      NYM1=NY-1                                                         00489
      DX = (XL-XI)/NXM1                                                 00490
      DY = (YL-YI)/NYM1                                                 00491
      THR = THETA*PI/180.                                               00492
      PHR = PHI*PI/180.                                                 00493
      ZF = ZC + R*SIN(PHR)/ZMAG                                         00494
      RHO = R*COS(PHR)                                                  00495
      XF = RHO*COS(THR) + XC                                            00496
      YF = RHO*SIN(THR) + YC                                            00497
C                                                                       00498
      ZMIN=ZBASE                                                        00499
      ZMAX=ZBASE                                                        00500
      DO  3500  I =1,NX                                                 00501
      DO  3500  J =1,NY                                                 00502
      IF( Z(I,J)-BIG) 3490,3500,3500                                    00503
3490  ZMIN = AMIN1(Z(I,J),ZMIN)                                         00504
      ZMAX = AMAX1(Z(I,J),ZMAX)                                         00505
3500  CONTINUE                                                          00506
      ZRANGE = ZMAX-ZMIN                                                00507
      ZINC = ZRANGE*.0001                                               00508
C                                                                       00509
      RETURN                                                            00510
      END                                                               00511
```

PROGRAM VARIABLES

00053	BIG	00046	J	00227	RHO	00064	XDY1	00145	YYXL
00033	DELX	00147	JA	00176	THETA	00066	XDYL	00099	ZBASE
00046	DELY	00154	JE	00223	THR	00041	Y1	00208	ZC
00057	DELZ	00170	JSCAC	00024	X1	00157	YA	00017	ZF
00026	DX	00004	LABCV	00110	XA	00152	YE	00050	ZIJ
00043	CY	0000.	LDELC	00077	XB	00104	YC	00061	ZINC
00135	FZ	00210	LP	00202	XC	00013	YF	00125	ZLINE

00141	FIBIG	00132	NX	00007	XF	00114	YI	00172	ZMAG		
00165	FI	00167	NXM1	00112	XI	00161	YJ	00233	ZMAX		
00120	FJ	00171	NY	00163	XJ	00070	YL	00231	ZMIN		
00123	FSAC	00122	NYM1	00101	XL	00011	YPF	00015	ZPF		
00032	I	00200	PHI	00005	XPF	00037	YY	00235	ZRANGE		
00074	IA	00225	PHR	00022	XX	00150	YYPAX	00137	ZSURF		
00105	IE	00213	PI	00075	XXMAX	00156	YYPIN	00133	ZTEST		
00131	ISCAD	00174	R	00106	XXMIN	00143	YYX1				

COMMON VARIABLES

00000	INTZ	00000	Z

STATEMENT NUMBERS

5	00321	70	00547	130	01015	400	01117	1100	01374	1199	01523
10	00326	80	00574	140	01022	1040	01130	1102	01405	1200	01526
15	00350	90	00601	150	01025	1050	01144	1102	01412	1300	01530
20	00377	91	00671	160	01027	1060	01190	1110	01422	1350	01536
25	00426	92	00702	170	01040	1070	01176	1130	01444	1400	01546
28	00436	94	00713	175	01047	1080	01223	1140	01451	2000	01550
30	00440	96	00724	180	01056	1050	01230	1150	01454	3100	01591
32	00452	98	00734	185	01067	1051	01320	1160	01456	3200	01562
35	00467	100	00745	190	01074	1052	01331	1170	01467	3300	01573
40	00501	102	00756	200	01077	1094	01342	1178	01476	3400	01602
50	00515	108	00762	300	01101	1056	01353	1180	01505	3490	01717
60	00521	110	00773	350	01107	1058	01363	1185	01516	3500	01739

FORTRAN DIAGNOSTIC RESULTS FOR VISIBL

NULL STATEMENT NUMBERS
1092 92

VISIBL F 02074 C 11610 D 00000

```
                                MS FORTRAN (4.0)/PSCS          30/06/71

      SUBROUTINE ZGRID(Z,NX,NY,X1,Y1,DX,DY,XP,YP,ZP,N,CAYIN,RELAXN)      00512
C     SETS UP SQUARE GRID FOR CONTOURING , GIVEN ARBITRARILY PLACED      00513
C     DATA POINTS. LAPLACE INTERPOLATION IS USED.                        00514
C     THE METHOD USED HERE WAS LIFTED DIRECTLY FROM NOTES LEFT BY        00515
C     MR IAN CRAIN FORMERLY WITH THE COMP.SCIENCE DIV.                   00516
C     INFO ON RELAXATION SCHM OF LAPLACE EQN SUPPLIED BY DR T PERTY.     00517
C     FORTRAN II   OCEANOGRAPHY/EPR   DEC/68   JCT                       00518
C                                                                        00519
C     Z = 2-D ARRAY OF HGTS TO BE SET UP. POINTS OUTSIDE REGION TO BE    00520
C     CONTOURED SHOULD BE INITIALIZED TO 10**35 . YOU MIGHT SET THE      00521
C     REST OF Z TO 0.0 .                                                 00522
C     NX,NY = MAX SUBSCRIPTS OF Z IN X AND Y DIRECTIONS .                00523
C     X1,Y1 = COORDINATES OF Z(1,1)                                      00524
C     DX,DY = X AND Y INCREMENTS .                                       00525
C     XP,YP,ZP = ARRAYS GIVING POSITION AND HGT OF EACH DATA POINT.      00526
C     N = SIZE OF ARRAYS XP,YP AND ZP .                                  00527
C                                                                        00528
C     MODIFICATION FEB/69   TO GET SPECIFIED RESULTS A PORTION OF THE    00529
C     BIAP EQN  WAS ADDED TO THE LAPLACE EQN GIVING                      00530
C     DELTA2X(Z)*DELTA2Y(Z) - K(DELTA4X(Z)+DELTA4Y(Z)) = 0 .             00531
C     K=0 GIVES PURE LAPLACE SOLUTION.  K=INF. GIVES PURE SPLINE SOLUTIO 00532
C     CAYIN = K = AMOUNT OF SPLINE EQN (BETWEEN 0 AND INF.)              00533
C     RELAXN = RELAX PARAM W (BETWEEN 1. AND 2.)  NOT USED               00534
C                                                                        00535
C**********************************************************************  00536
C                                                                        00537
      DIMENSION Z(50,2)                                                  00538
      DIMENSION IWORK(101)                                               00539
      DIMENSION XP(2),YP(2),ZP(2)                                        00540
      LP=3                                                               00541
      WRITE(LP,10)                                                       00542
10    FORMAT(/// 17H SUBROUTINE ZGRID / )                                00543
      ARNG=20                                                            00544
      PI=3.1415926                                                       00545
      BIG=.9E35                                                          00546
      CAY=CAYIN                                                          00547
C                                                                        00548
C     GET ZBASE WHICH WILL MAKE ALL ZP VALUES POSITIVE BY AT LEAST       00549
C     .25(ZMAX-ZMIN) AND FILL IN GRID WITH ZEROS.                        00550
C**********************************************************************  00551
C                                                                        00552
      ZMIN=ZP(1)                                                         00553
      ZMAX=ZP(1)                                                         00554
      DO 20 K=2,N                                                        00555
      IF(ZP(K)-ZMAX)14,14,12                                             00556
12    ZMAX=ZP(K)                                                         00557
14    IF(ZP(K)-ZMIN)16,20,20                                             00558
16    ZMIN=ZP(K)                                                         00559
20    CONTINUE                                                           00560
      ZRANGE=ZMAX-ZMIN                                                   00561
      ZBASE=-ZMIN+.25*ZRANGE                                             00562
      ZLL=ZBASE+ZMAX                                                     00563
      ZLL20=ZLL*20.                                                      00564
      ZLL400=ZLL*400.                                                    00565
      DO 40 I=1,NX                                                       00566
      DO 40 J=1,NY                                                       00567
      IF(Z(I,J)-BIG)30,40,40                                             00568
30    Z(I,J)=0.                                                          00569
40    CONTINUE                                                           00570
C                                                                        00571
```

```
C     AFFIX EACH POINT ZP TO NEAREST GRID PT. TAKE AVG IF MORE THAN      00572
C     ONE NEAR PT.  ADD ZBASE PLUS 10*ZRANGE AND MAKE NEGATIVE.          00573
C     INITIALLY SET EACH UNSET GRID PT TO VALUE OF NEAREST KNOWN PT      00574
C*****************************************************************      00575
C                                                                        00576
      DO 110 K=1,N                                                       00577
      I=(XP(K)-X1)/DX+1.5                                                00578
      IF(I*(NX+1-I))70,70,60                                             00579
60    J=(YP(K)-Y1)/DY+1.5                                                00580
      IF(J*(NY+1-J))70,70,90                                             00581
70    WRITE(LP,80) K,XP(K),YP(K),ZP(K)                                   00582
80    FORMAT(1X 29HPOINT OUT OF RANGE K,X,Y,Z =  I5,3E15.6)              00583
      GO TO 110                                                          00584
90    IF(Z(I,J)-ZUL400)100,110,110                                       00585
100   Z(I,J)=Z(I,J)+ZP(K)+ZBASE+ZLL20                                   00586
110   CONTINUE                                                           00587
C                                                                        00588
      NFG=0                                                              00589
      DO 150 I=1,NX                                                      00590
      DO 150 J=1,NY                                                      00591
      IF(Z(I,J)-BIG)130,150,150                                          00592
130   NIJ=Z(I,J)/ZUL20                                                   00593
      IF(NIJ)145,145,140                                                 00594
140   Z(I,J)=-Z(I,J)/NIJ+ZLL20 -10.*ZRANGE                               00595
      GO TO 150                                                          00596
145   Z(I,J)=-1.E35                                                      00597
      NFG=NFG+1                                                          00598
150   CONTINUE                                                           00599
C                                                                        00600
      DO 199 ITER=1,NFNG                                                 00601
      NNEW=0                                                             00602
      DO 197 I=1,NX                                                      00603
      DO 197 J=1,NY                                                      00604
      IF(Z(I,J)+BIG)152,192,192                                          00605
152   IF(J-1)162,162,153                                                 00606
153   IF(JPNEW)154,154,162                                               00607
154   ZIJM=ABS(Z(I,J-1))                                                 00608
      IF(ZIJM-BIG)195,162,162                                            00609
162   IF(I-1)172,172,163                                                 00610
163   IF(IPNEW(J))164,164,172                                            00611
164   ZIJM=ABS(Z(I-1,J))                                                 00612
      IF(ZIJM-BIG)195,172,172                                            00613
172   IF(J-NY)173,182,182                                                00614
173   ZIJM=ABS(Z(I,J+1))                                                 00615
      IF(ZIJM-BIG)195,182,182                                            00616
182   IF(I-NX)183,192,192                                                00617
183   ZIJM=ABS(Z(I+1,J))                                                 00618
      IF(ZIJM-BIG)195,192,192                                            00619
192   IPNEW(J)=0                                                         00620
      JPNEW=0                                                            00621
      GO TO 197                                                          00622
195   IPNEW(J)=1                                                         00623
      JPNEW=1                                                            00624
      Z(I,J)=ZIJM                                                        00625
      NNEW=NNEW+1                                                        00626
197   CONTINUE                                                           00627
      IF(NNEW)200,200,199                                                00628
199   CONTINUE                                                           00629
200   CONTINUE                                                           00630
      DO 202 I=1,NX                                                      00631
      DO 202 J=1,NY                                                      00632
      ABZ=ABS(Z(I,J))                                                    00633
```

```
      IF(ABZ-BIG)202,201,201                                            00634
201   Z(I,J)=ABZ                                                        00635
202   CONTINUE                                                          00636
C                                                                       00637
C     IMPROVE THE NON-DATA POINTS BY APPLYING POINT OVER-RELAXATION     00638
C     USING THE LAPLACE-SPLINE EQUATION  (CARRES METHOD IS USED)        00639
C*****************************************************************    00640
      DZRMSP=ZRANGE                                                     00641
      RELAX=1.0                                                         00642
      EPS=.01                                                           00643
      ITMAX=100                                                         00644
      DO 2100 ITER=1,ITMAX                                              00645
      DZRMS=0.                                                          00646
      DZMAX=0.                                                          00647
      DO 2000 I=1,NX                                                    00648
      DO 2000 J=1,NY                                                    00649
      Z00=Z(I,J)                                                        00650
      IF(Z00-BIG)205,2000,2000                                          00651
205   IF(Z00)2000,208,208                                               00652
208   WGT=0.                                                            00653
      ZSUM=0.                                                           00654
C                                                                       00655
500   IM=0                                                              00656
      IF(I-1)570,570,510                                                00657
510   ZIM=ABS(Z(I-1,J))                                                 00658
      IF(ZIM-BIG)530,570,570                                            00659
530   IM=1                                                              00660
      WGT=WGT+1.                                                        00661
      ZSUM=ZSUM+ZIM                                                     00662
      IF(I-2)570,570,540                                                00663
540   ZIMM=ABS(Z(I-2,J))                                                00664
      IF(ZIMM-BIG)560,570,570                                           00665
560   WGT=WGT+CAY                                                       00666
      ZSUM=ZSUM-CAY*(ZIMM-2.*ZIM)                                       00667
570   IF(NX-I)700,700,580                                               00668
580   ZIP=ABS(Z(I+1,J))                                                 00669
      IF(ZIP-BIG)600,700,700                                            00670
600   WGT=WGT+1.                                                        00671
      ZSUM=ZSUM+ZIP                                                     00672
      IF(IM)620,620,610                                                 00673
610   WGT=WGT+4.*CAY                                                    00674
      ZSUM=ZSUM+2.*CAY*(ZIM+ZIP)                                        00675
620   IF(NX-I-1)700,700,630                                             00676
630   ZIPP=ABS(Z(I+2,J))                                                00677
      IF(ZIPP-BIG)650,700,700                                           00678
650   WGT=WGT+CAY                                                       00679
      ZSUM=ZSUM-CAY*(ZIPP-2.*ZIP)                                       00680
700   CONTINUE                                                          00681
C                                                                       00682
1500  JM=0                                                              00683
      IF(J-1)1570,1570,1510                                             00684
1510  ZJM=ABS(Z(I,J-1))                                                 00685
      IF(ZJM-BIG)1530,1570,1570                                         00686
1530  JM=1                                                              00687
      WGT=WGT+1.                                                        00688
      ZSUM=ZSUM+ZJM                                                     00689
      IF(J-2)1570,1570,1540                                             00690
1540  ZJMM=ABS(Z(I,J-2))                                                00691
      IF(ZJMM-BIG)1560,1570,1570                                        00692
1560  WGT=WGT+CAY                                                       00693
      ZSUM=ZSUM-CAY*(ZJMM-2.*ZJM)                                       00694
1570  IF(NY-J)1700,1700,1580                                            00695
```

```
1560  ZJP=ABS(Z(I,J+1))                                                 00696
      IF(ZJP-BIG)1600,1700,1700                                         00697
1600  NGT=NGT+1.                                                        00698
      ZSUM=ZSUM+ZJP                                                     00699
      IF(JM)1620,1620,1610                                              00700
1610  NGT=NGT+4.*CAY                                                    00701
      ZSUM=ZSUM+2.*CAY*(ZJP+ZJM)                                        00702
1620  IF(NY-1-J)1700,1700,1630                                          00703
1630  ZJPP=ABS(Z(I,J+2))                                                00704
      IF(ZJPP-BIG)1690,1700,1700                                        00705
1690  NGT=NGT+CAY                                                       00706
      ZSUM=ZSUM-CAY*(ZJPP-2.*ZJP)                                       00707
1700  CONTINUE                                                          00708
C                                                                       00709
      DZ=ZSUM/NGT-Z00                                                   00710
      DZRMS=DZRMS+DZ*DZ                                                 00711
      DZMAX=AMAX1(ABS(DZ),DZMAX)                                        00712
      Z(I,J)=Z00+DZ*RELAX                                               00713
2000  CONTINUE                                                          00714
      DZRMS=SQRT(DZRMS/NPG)                                             00715
      RTRMS=DZRMS/DZRMSP                                                00716
      DZRMSP=DZRMS                                                      00717
      DZMAXF=DZMAX/ZRANGE                                               00718
      WRITE(LP,2050) ITER,RELAX,RTRMS,DZMAXF                            00719
2050  FORMAT(15,4H  W=F9.6, 7H  RCCT=F9.6, 15H  DZMAX/ZRANGE= F9.7 )    00720
      IF(ITER-20*(ITER/20))2100,2060,2100                               00721
2060  WC=RTRMS+1.                                                       00722
      IF(RELAX-1.-RTRMS)2065,2060,2060                                  00723
2065  IF(RTRMS-.999 ) 2070,2100,2100                                    00724
2070  TPY=(RTRMS+RELAX-1.)/RELAX                                        00725
      RTJSQ=TPY*TPY/RTRMS                                               00726
      DEN=1.+SQRT(1.-RTJSQ)                                             00727
      WC=2./DEN                                                         00728
2080  CONTINUE                                                          00729
      RELAX=WC-.25*(2.-WC)                                              00730
      IF(     DZMAXF/(1.-RTRMS)-EPS)2120,2120,2100                      00731
2100  CONTINUE                                                          00732
2120  CONTINUE                                                          00733
C                                                                       00734
C*************************************************************************00735
      DO 2500 I=1,NX                                                    00736
      DO 2500 J=1,NY                                                    00737
      IF(Z(I,J)-BIG)2400,2500,2500                                      00738
2400  Z(I,J)=ABS(Z(I,J))-BASE-10.*ZRANGE                                00739
2500  CONTINUE                                                          00740
      RETURN                                                            00741
      END                                                               00742
```

PROGRAM VARIABLES

00275	AEZ	00292	I	00263	NIJ	00320	NGT	00346	ZJP
00217	BIG	00324	IP	00271	NNEW	00316	Z00	00350	ZJPP
00221	CAY	00040	IPAEW	00261	NPG	00236	ZBASE	00225	ZMAX
00370	DEN	00270	ITER	00207	NRNG	00273	ZJM	00223	ZMIN
00392	DZ	00311	ITMAX	00213	PI	00325	ZJP	00232	ZRANGE
00314	DZMAX	00253	J	00303	RELAX	00327	ZJPP	00322	ZSUM
00356	DZMAXF	00341	JM	00366	RTJSQ	00333	ZJP	00240	ZUL
00312	DZRMS	00272	JPAEW	00354	RTRMS	00337	ZJPP	00244	ZUL25
00277	DZRMSP	00227	K	00364	TPY	00342	ZJP	00250	ZUL400
00307	EPS	00205	LP	00260	WC	00344	ZMP		

STATEMENT NUMBERS

10	00000	110	00662	173	01093	500	01269	700	01452	1650	01625
12	00465	130	00706	182	01066	510	01274	1500	01453	1700	01640
14	00470	140	00717	183	01073	530	01307	1510	01462	2000	01665
16	00476	145	00732	192	01106	540	01324	1530	01475	2050	00023
20	00501	150	00746	195	01114	560	01337	1540	01512	2060	01750
30	00543	152	00776	197	01127	570	01352	1560	01525	2065	01761
40	00546	153	01002	199	01152	580	01357	1570	01540	2070	01766
60	00606	154	01006	200	01161	600	01372	1580	01548	2080	02011
70	00625	162	01021	201	01201	610	01404	1600	01560	2100	02032
80	00607	163	01026	202	01204	620	01416	1610	01572	2120	02041
90	00645	164	01032	205	01255	630	01424	1620	01604	2400	02054
100	00693	172	01046	208	01661	650	01437	1630	01612	2500	02070

FORTRAN DIAGNOSTIC RESULTS FOR ZGRID

NULL STATEMENT NUMBERS
1500 500

ZGRID F 02302 C 00000 D 00000

```
                                MS FORTRAN (4.0)/PSCS          30/08/71

      SUBROUTINE SMOOTH(Z,NX,NY,NSM)                                    00743
C     GIVEN ARRAY Z(I,J),I=1,NX , J=1,NY   AND NSP=0,1,2,3 ...          00744
C     LAPLACIAN SMOOTHING IS APPLIED TO Z NSM TIMES BY MEANS OF THE     00745
C     OPERATION Z=Z + .25*(AV(ZX,ZS,ZE,ZW)-Z) .                         00746
C     THE SWEEP IS ALTERNATELY SW TO NE AND NE TO SW.                   00747
C     ZXX AND ZYY ARE ASSUMED TO BE ZERO AT EDGES                       00748
C     UNUSED POINTS IN Z SHOULD BE .GE. 10**35 .                        00749
C     CDC MACROGRAPHY ENR    CGT/69    VERSION NO. 2  IMPROVED EDGING   00750
      DIMENSION Z(50,2)                                                 00751
      LP=2                                                              00752
      WRITE(LP,10)                                                      00753
10    FORMAT(/// 18H SUBROUTINE SMOOTH / )                              00754
      IF(NSM)400,400,20                                                 00755
20    BIG=.9E35                                                         00756
      R=.25/4.                                                          00757
      DO 330 IT=1,NSM                                                   00758
      ITODD=IT-(IT/2)*2                                                 00759
      DO 300 II=1,NX                                                    00760
      I=ITODD*II+(1-ITODD)*(NX+1-II)                                    00761
      IINIP=(I-1)*(NX-I)                                                00762
      DO 300 JJ=1,NY                                                    00763
      J=ITODD*JJ+(1-ITODD)*(NY+1-JJ)                                    00764
      ZIJ=Z(I,J)                                                        00765
      IF(ZIJ-BIG)210,210,300                                            00766
210   DEL2=0.                                                           00767
      IF(IINTP)230,230,215                                              00768
215   DEL2X=Z(I-1,J)+Z(I+1,J)-ZIJ-ZIJ                                   00769
      IF(DEL2X-BIG)220,230,230                                          00770
220   DEL2=DEL2X                                                        00771
230   IF((J-1)*(NY-J))250,250,235                                       00772
235   DEL2Y=Z(I,J-1)+Z(I,J+1)-ZIJ-ZIJ                                   00773
      IF(DEL2Y-BIG)240,250,250                                          00774
240   DEL2=DEL2+DEL2Y                                                   00775
250   Z(I,J)=ZIJ+DEL2*R                                                 00776
300   CONTINUE                                                          00777
330   CONTINUE                                                          00778
400   RETURN                                                            00779
      END                                                               00780

 PROGRAM VARIABLES

00013  BIG          00046  DEL2Y        00031  IINTP        00033  J            00021  R
00041  DEL2         00030  I            00023  IT           00038  JJ           00034  ZIJ
00043  DEL2X        00027  II           00025  ITODD        00007  LP

 STATEMENT NUMBERS

  10  00000      210  00201      220  00222      235  00235      250  00253      330  00279
  20  00106      215  00207      230  00224      240  00250      300  00260      400  00304

          FORTRAN DIAGNOSTIC RESULTS FOR   SMOOTH

  SMOOTH    P  00360 C   00000 D    00000
NO ERRORS
```

```
      SUBROUTINE XLINES(Z,NX,NY,X1,Y1,XL,YL,ZBASE,LSPC)                 00781
C                                                                       00782
C     DRAW LINES ALONG THE SURFACE IN X DIRECTION.                      00783
C                                                                       00784
      DIMENSION Z(80,2)                                                 00785
      LP=3                                                              00786
      WRITE(LP,1050)                                                    00787
 1050 FORMAT(/// 16H SUBROUTINE XLINES /)                               00788
      NXM1=NX-1                                                         00789
      NYM1=NY-1                                                         00790
      DX =(XL-X1)/NXM1                                                  00791
      DY =(YL-Y1)/NYM1                                                  00792
      BIG = .9E38                                                       00793
      JODD = 0                                                          00794
      DO 1300 J=1,NY,LSPC                                               00795
      YJ = Y1 + DY*(J-1)                                                00796
      JODD = 1-JODD                                                     00797
      JEVEN =1-JODD                                                     00798
C                                                                       00799
      DO 1300 II =1,NXM1                                                00800
      I= JODD*II + JEVEN*(NX+1-II)                                      00801
      INXT = I +JODD-JEVEN                                              00802
      XI = X1 +DX*(I-1)                                                 00803
      XNXT= X1+DX*(INXT-1)                                              00804
      ZIJ = Z(I,J)                                                      00805
      ZNXT = Z(INXT,J)                                                  00806
      IF(II-1) 1100,1100,1140                                           00807
 1100 CALL PLOTP(XI,YJ,ZBASE,13)                                        00808
      IF(ZIJ-BIG)1120,1140,1140                                         00809
 1120 CALL PLOTP(XI,YJ,ZIJ,12)                                          00810
C                                                                       00811
 1140 IF(ZIJ-BIG)1160,1210,1210                                         00812
 1160 IF(ZNXT-BIG)1220,1190,1190                                        00813
 1190 CALL PLOTP(XI,YJ,ZBASE,12)                                        00814
 1210 CALL PLOTP(XNXT,YJ,ZBASE,12)                                      00815
      IF(ZNXT-BIG)1220,1230,1230                                        00816
 1220 CALL PLOTP(XNXT,YJ,ZNXT,12)                                       00817
C                                                                       00818
 1230 IF(II+1-NX)1300,1250,1250                                         00819
 1250 IF(ZNXT-BIG)1260,1300,1300                                        00820
 1260 CALL PLOTP(XNXT,YJ,ZBASE,12)                                      00821
 1300 CONTINUE                                                          00822
      RETURN                                                            00823
      END                                                               00824
```

PROGRAM VARIABLES

00022	BIG	00032	II	00004	JODD	00013	NYM1	00027	YJ		
00014	DX	00034	INXT	00007	LP	00035	XI	00041	ZIJ		
00016	DY	00026	J	00011	NXM1	00037	XNXT	00044	ZNXT		
00033	I	00031	JEVEN								

STATEMENT NUMBERS

1050	00000	1120	00243	1160	00256	1210	00271	1230	00312	1260	00325
1100	00230	1140	00251	1190	00263	1220	00304	1250	00320	1300	00333

FORTRAN DIAGNOSTIC RESULTS FOR XLINES

```
   XLINES      F    00431  C    00000 D      00000
NO ERRORS
```

```
      SUBROUTINE YLINES(Z,NX,NY,X1,Y1,XL,YL,ZBASE,LSPC)                 00825
C                                                                       00826
C     DRAW LINES ALONG SURFACE IN Y DIRECTION                           00827
C                                                                       00828
      DIMENSION Z(50,2)                                                 00829
      LP=1                                                              00830
      WRITE(LP,50)                                                      00831
50    FORMAT(/// 18H SUBROUTINE YLINES /)                               00832
      NXM1= NX-1                                                        00833
      NYM1= NY-1                                                        00834
      DX = (XL-X1)/NXM1                                                 00835
      DY = (YL-Y1)/NYM1                                                 00836
      BIG = .9E35                                                       00837
      ICOC = 0                                                          00838
      DO 300  I  =1,NX,LSPC                                             00839
      ICOC = 1-1000                                                     00840
      IEVEN= 1-1000                                                     00841
      XI = X1 + DX*(I-1)                                                00842
C                                                                       00843
      DO 300 JJ = 1,NYM1                                                00844
      J = 1000*JJ + IEVEN*(NY+1-JJ)                                     00845
      JNXT = J + 1000 - IEVEN                                           00846
      YJ = Y1 + DY*(J-1)                                                00847
      YNXT = Y1 + DY*(JNXT-1)                                           00848
      ZIJ = Z(I,J)                                                      00849
      ZNXT = Z(I,JNXT)                                                  00850
C                                                                       00851
      IF(JJ-1)100,100,140                                               00852
100   CALL PLCTF(XI,YJ,ZBASE,13)                                        00853
      IF(ZIJ-BIG)120,140,140                                            00854
120   CALL PLOTP(XI,YJ,ZIJ,12)                                          00855
C                                                                       00856
140   IF(ZIJ-BIG)160,210,210                                            00857
160   IF(ZNXT-BIG)220,190,190                                           00858
190   CALL PLOTF(XI,YJ,ZBASE,12)                                        00859
210   CALL PLOTF(XI,YNXT,ZBASE,12)                                      00860
      IF(ZNXT-BIG)220,230,230                                           00861
220   CALL PLOTP(XI,YNXT,ZNXT,12)                                       00862
C                                                                       00863
230   IF(JJ+1-NY)300,250,250                                            00864
250   IF(ZNXT-BIG) 260,300,300                                          00865
260   CALL PLOTF(XI,YNXT,ZBASE,12)                                      00866
300   CONTINUE                                                          00867
      RETURN                                                            00868
      END                                                               00869
```

PROGRAM VARIABLES

00022	BIG	00027	IEVEN	00034	JNXT	00013	NYM1	00037	YNXT		
00014	DX	00024	ICOC	00007	LP	00030	XI	00041	ZIJ		
00016	DY	00032	J	00011	NXM1	00035	YJ	00044	ZNXT		
00026	I	00032	JJ								

STATEMENT NUMBERS

50	00000	120	00243	160	00256	210	00271	230	00312	260	00325
100	00230	140	00251	190	00263	220	00304	250	00320	300	00333

FORTRAN DIAGNOSTIC RESULTS FOR YLINES

```
   YLINES      F    00431  C     00000 D      00000
NO ERRORS
```

```
                                    MS FORTRAN (4.0)/PSCS          30/06/71

      SUBROUTINE BLINES(Z,NX,NY,X1,Y1,XL,YL,ZB)                          00870
C     PLOTS BOUNDARY OF THE BASE AND VARIOUS VERTICAL LINES.             00871
C                                                                        00872
      DIMENSION Z(50,2)                                                  00873
      LP=3                                                               00874
      WRITE(LP,10)                                                       00875
10    FORMAT(////18H SUBROUTINE BLINES  /)                               00876
      NXM1=NX-1                                                          00877
      NYM1=NY-1                                                          00878
      DX=(XL-X1)/NXM1                                                    00879
      DY=(YL-Y1)/NYM1                                                    00880
      BIG=.9E35                                                          00881
      F2=2.0                                                             00882
      F2=1.0                                                             00883
      TWOBIG=F2*BIG                                                      00884
C                                                                        00885
C     MAIN LOOP OVER ALL POINTS OF GRID.                                 00886
C************************************************************************00887
C                                                                        00888
      DO 400 I=1,NXM1                                                    00889
      DO 400 JJ=1,NYM1                                                   00890
      J=JJ                                                               00891
      IF(1-2*(I/2))60,70,60                                              00892
70    J=NY-JJ                                                            00893
60    CONTINUE                                                           00894
      XI=X1+DX*(I-1)                                                     00895
      YJ=Y1+DY*(J-1)                                                     00896
      Z00=Z(I,J)                                                         00897
      Z01=Z(I,J+1)                                                       00898
      Z11=Z(I+1,J+1)                                                     00899
      Z10=Z(I+1,J)                                                       00900
C                                                                        00901
100   IF(Z00+Z01-BIG)102,110,110                                         00902
102   IF(I-1)104,108,104                                                 00903
104   IF(Z(I-1,J)+Z(I-1,J+1)-TWOBIG)106,108,108                          00904
106   IF(Z10+Z11-TWOBIG)110,110,108                                      00905
108   CALL PLOTF(XI,YJ,ZB,13)                                            00906
      CALL PLOTF(XI,YJ+DY,ZB,12)                                         00907
C                                                                        00908
110   IF(Z00+Z10-BIG)112,120,120                                         00909
112   IF(J-1)114,118,114                                                 00910
114   IF(Z(I,J-1)+Z(I+1,J-1)-TWOBIG)116,116,118                          00911
116   IF(Z01+Z11-TWOBIG)120,120,118                                      00912
118   CALL PLOTF(XI,YJ,ZB,13)                                            00913
      CALL PLOTF(XI+DX,YJ,ZB,12)                                         00914
C                                                                        00915
120   IF(F2-1.5)140,140,121                                              00916
C                                                                        00917
121   IF(Z00+Z11-BIG)122,130,130                                         00918
122   IF(Z10+Z01-BIG)130,124,124                                         00919
124   IF(Z10+Z01-2.*BIG)126,126,130                                      00920
126   CALL PLOTF(XI,YJ,ZB,13)                                            00921
      CALL PLOTF(XI+DX,YJ+DY,ZB,12)                                      00922
C                                                                        00923
130   IF(Z10+Z01-BIG)132,140,140                                         00924
132   IF(Z00+Z11-BIG)140,134,134                                         00925
134   IF(Z00+Z11-2.*BIG)136,136,140                                      00926
136   CALL PLOTF(XI,YJ+DY,ZB,13)                                         00927
      CALL PLOTF(XI+DX,YJ,ZB,12)                                         00928
C                                                                        00929
```

```
140   IF(J-NYM1)150,142,150                                              00930
142   IF(Z10+Z11-BIG)144,150,150                                         00931
144   CALL PLCTF(XI+DX,YJ,ZE,13)                                         00932
      CALL PLCTF(XI+DX,YJ+DY,ZB,12)                                      00933
C                                                                        00934
150   IF(J-NYM1)160,152,160                                              00935
152   IF(Z01+Z11-BIG)154,160,160                                         00936
154   CALL PLCTF(XI,YJ+DY,ZE,13)                                         00937
      CALL PLCTF(XI+DX,YJ+DY,ZB,12)                                      00938
C                                                                        00939
160   IF(F2-1.5)165,260,260                                              00940
C                                                                        00941
165   NL=0                                                               00942
210   IF(Z00-BIG)220,215,215                                             00943
215   NL=NL+1                                                            00944
      IC=1+1                                                             00945
      JC=J+1                                                             00946
220   IF(Z01-BIG)230,225,225                                             00947
225   NL=NL+1                                                            00948
      IC=1+1                                                             00949
      JC=J                                                               00950
230   IF(Z11-BIG)240,235,235                                             00951
235   NL=NL+1                                                            00952
      IC=I                                                               00953
      JC=J                                                               00954
240   IF(Z10-BIG)250,245,245                                             00955
245   NL=NU+1                                                            00956
      IC=I                                                               00957
      JC=J+1                                                             00958
250   IF(NU-1)260,255,260                                                00959
255   XIC=X1+DX*(IC-1)                                                   00960
      YJC=Y1+DY*(JC-1)                                                   00961
      CALL PLCTF(XIC,YJC,ZB    ,13)                                      00962
      CALL PLOTP(XIC,YJC,Z(IC,JC),12)                                    00963
260   CONTINUE                                                           00964
400   CONTINUE                                                           00965
      RETURN                                                             00966
      END                                                                00967
```

PROGRAM VARIABLES

00022	BIG	00063	IC	00061	NL	00040	X1	00044	Z00		
00014	DX	00036	J	00011	NYM1	00065	XIC	00047	Z01		
00016	DY	00064	JC	00013	NYM1	00042	YJ	00053	Z10		
00026	F2	00035	JJ	00032	TWOBIG	00067	YJC	00051	Z11		
00034	I	00007	LP								

STATEMENT NUMBERS

10	00000	108	00302	121	00379	136	00469	180	00607	235	00662
70	00220	110	00321	122	00403	140	00507	165	00614	240	00673
80	00224	112	00327	124	00411	142	00514	210	00616	245	00700
100	00252	114	00334	126	00420	144	00522	215	00623	250	00712
102	00260	116	00342	130	00442	150	00547	220	00626	255	00717
104	00265	118	00351	132	00450	152	00554	225	00643	260	00752
106	00274	120	00370	134	00456	154	00562	230	00655	400	00753

FORTRAN DIAGNOSTIC RESULTS FOR 0LINES

```
NULL STATEMENT NUMBERS
     210          100

  BLINES      P   01101  C    00000 D     00000
```

```
                                    MS FORTRAN (4.0)/PSCS          30/08/71

      SUBROUTINE CON3C (Z,NX,NY,X1,Y1,DX,DY,ZLEV,LABEL,NLEV,LSI)          00960
C     PLOTS CONTOURS OF ARRAY Z ON 3-C PICTURE.                           00965
C     PATTERNED AFTER U OF CHICAGO CONTOUR ROUTINES SUPPLIED BY T PLETY.  00970
C     CDC-3100     JDT CDEAN(GRAPHY/EMR     DEC/68                       00971
C                                                                         00972
C     INPUTS                                                            00973
C     Z = ARRAY OF HGTS TO BE CONTOURED,MUST BE DIMENSIONED SAME AS       00974
C        IN MAIN. POINTS WHERE Z UNDEFINED SHOULD BE .GE. 10**35 .        00975
C     NX,NY = NO. OF PTS IN X AND Y DIRECTIONS. THE 1ST SUB. IS X AND     00976
C        GOES  RIGHT , THE END IS Y AND GOES UPWARD.                      00977
C     X1,Y1 = COORDS. OF PT(1,1) IN DATA UNITS                            00978
C     DX,DY = X AND Y SPACING IN DATA UNITS                               00979
C     ZLEV = ARRAY OF CONTOUR LEVELS.                                     00980
C     LABEL = ARRAY OF INFO. ON LABELS TO GO ON CONTOURS.                 00981
C             0,1,2,3 ... NUMBER OF DIGITS AFTER DECIMAL.                 00982
C             -1  SUPPRESS DECIMAL ON CONTOUR LABELS.                     00983
C             -2  SUPPRESS LABELS ON CONTOURS.                            00984
C          NOTE... LABEL IS NOT IMPLEMENTED HERE                          00985
C     NLEV = NO. OF CONTOUR LEVELS.                                       00986
C     LSI = SPACING OF LABELS ALONG CONTOURS IN INCHES (ROUGHLY)          00987
C           NOTE ... LSI IS NOT IMPLEMENTED HERE.                         00988
C     PLOTS MUST BE OPENED AND CLOSED EXTERNAL TO THIS ROUTINE BY CALLS   00989
C     OF THE FORM ...                                                     00990
C        CALL PLOTS(BUFFER,LENGTH,LUN)    OPENS PLOT                    00991
C        CALL PLOT(X RIGHT EDGE , 0.,-3)          CLOSE PLOT             00992
C        CALL PLOT(0.,0.,999)    FINAL END OF PLOT TAPE                  00993
C                                                                         00994
C*************************************************************************00995
C                                                                         00996
      DIMENSION Z(50,50)                                                  00997
      DIMENSION ZLEV(2),LABEL(2)                                          00998
      DIMENSION XC(6),YC(6)                                               00999
C                                                                         01000
C     INITIALIZE.                                                         01001
C*************************************************************************01002
C                                                                         01003
      LF=2                                                                01004
      WRITE(LP,10)                                                        01005
10    FORMAT(///18H SUBROUTINE CON3C   /)                                 01006
      IF(NLEV)450,450,15                                                  01007
15    NFL=3                                                               01008
      NXM1=NX-1                                                           01009
      NYM1=NY-1                                                           01010
      BIG=.9E35                                                           01011
      THRESH=BIG*2.                                                       01012
      PI=3.1415926                                                        01013
      F2=2.0                                                              01014
      F1=1.0                                                              01015
      NCONT=4.1-F2                                                        01016
C                                                                         01017
C     MAIN LOOP OVER ALL POINTS OF GRID.                                  01018
C*************************************************************************01019
C                                                                         01020
      DO 400 I=1,NXM1                                                     01021
      DO 400 JJ=1,NYM1                                                    01022
      J=J.                                                                01023
      IF(I-2*(I/2))80,70,80                                               01024
70    J=NY-JJ                                                             01025
80    CONTINUE                                                            01026
      X1=X1+DX*(I-1)                                                      01027
```

```
      YJ=Y1+DY*(J-1)                                                    01028
      Z00=Z(I,J)                                                        01029
      Z01=Z(I,J+1)                                                      01030
      Z11=Z(I+1,J+1)                                                    01031
      Z10=Z(I+1,J)                                                      01032
C                                                                       01033
C     INITIALIZE CONTOUR(I,J) AND SKIP IF NO LINES.                     01034
C*****************************************************************    01035
C                                                                       01036
      CALL ZCORN(ZLEV,NPL,NL,XC,YC,Z00,Z01,Z11,Z10,NCOR)                01037
      IF(NCOR-NCORT)400,400,290                                         01038
290   CONTINUE                                                          01039
C                                                                       01040
C     DO FOR EACH CONTOUR LEVEL.                                        01041
C*****************************************************************    01042
C                                                                       01043
      DO 370 LEV=1,NLEV                                                 01044
      CALL ZLEVEL(ZLEV(LEV),NPL,NL,XC,YC,Z00,Z01,Z11,Z10,NCOR)          01045
      IF(NL)370,370,300                                                 01046
300   DO 360 IL=1,NL                                                    01047
      IPLL=NPL*IL                                                       01048
      IPL1=IPLL-NPL+1                                                   01049
      IPL2=IPL1+1                                                       01050
C                                                                       01051
C     PLOT CONTOUR LINES.                                               01052
C*****************************************************************    01053
C                                                                       01054
      CALL PLOTF(XI+XC(IPL1)*DX,YJ+YC(IPL1)*DY,ZLEV(LEV),13)            01055
      CALL PLOTF(XI+XC(IPL2)*DX,YJ+YC(IPL2)*DY,ZLEV(LEV),32)            01056
      CALL PLOTF(XI+XC(IPLL)*DX,YJ+YC(IPLL)*DY,ZLEV(LEV),32)            01057
360   CONTINUE                                                          01058
370   CONTINUE                                                          01059
400   CONTINUE                                                          01060
450   RETURN                                                            01061
      END                                                               01062
```

PROGRAM VARIABLES

00047	BIG	00115	IPLL	00067	NCORT	00097	PI	00076	YJ
00061	FZ	00072	J	00111	NL	00053	TOLEIG	00100	Z00
00070	I	00071	JJ	00041	NPL	00007	XC	00103	Z01
00114	IL	00113	LEV	00042	NXM1	00074	XI	00107	Z10
00116	IPL1	00037	LP	00044	NYM1	00023	YC	00109	Z11
00117	IPL2	00112	NCOR						

STATEMENT NUMBERS

10	00000	70	00300	290	00253	360	00506	406	00525	450	00543
15	00321	80	00304	300	00401	370	00515				

FORTRAN DIAGNOSTIC RESULTS FOR CONTR

```
 CONTR      F   00640  C    00000 D     00000
NO ERRORS
```

```
                                    MS FORTRAN (4.0)/PSCS          30/08/71

      SUBROUTINE CON3D (Z,NX,NY,X1,Y1,CX,CY,ZLEV,LABEL,NLEV,LSI)          00960
C     PLOTS CONTOURS OF ARRAY Z ON 3-D PICTURE.                           00965
C     PATTERNED AFTER U OF CHICAGO CONTOUR ROUTINES SUPPLIED BY T PLOTY.  00970
C     CDC-3100    JOY CDEANOGRAPHY/EMR     DEC/68                       00971
C                                                                         00972
C     INPUTS                                                            00973
C     Z = ARRAY OF HGTS TO BE CONTOURED,MUST BE DIMENSIONED SAME AS       00974
C        IN MAIN. POINTS WHERE Z UNDEFINED SHOULD BE .GE. 10**35 .        00975
C     NX,NY = NO. OF PTS IN X AND Y DIRECTIONS. THE 1ST SUB. IS X AND     00976
C        GOES  RIGHT , THE 2ND IS Y AND GOES UPWARD.                      00977
C     X1,Y1 = COORDS. OF PT(1,1) IN DATA UNITS                            00978
C     CX,CY = X AND Y SPACING IN DATA UNITS                               00979
C     ZLEV = ARRAY OF CONTOUR LEVELS.                                     00980
C     LABEL = ARRAY OF INFO. ON LABELS TO GO ON CONTOURS.                 00981
C             0,1,2,3 ... NUMBER OF DIGITS AFTER DECIMAL.                 00982
C             -1  SUPRESS DECIMAL ON CONTOUR LABELS.                      00983
C             -2  SUPRESS LABELS ON CONTOURS.                             00984
C          NOTE... LABEL IS NOT IMPLEMENTED HERE                          00985
C     NLEV = NO. OF CONTOUR LEVELS.                                       00986
C     LSI = SPACING OF LABELS ALONG CONTOURS IN INCHES (ROUGHLY)          00987
C          NOTE ... LSI IS NOT IMPLEMENTED HERE.                          00988
C     PLOTS MUST BE OPENED AND CLOSED EXTERNAL TO THIS ROUTINE BY CALLS   00989
C     OF THE FORM ...                                                     00990
C        CALL PLOTS(BUFFER,LENGTH,LUN)    OPENS PLOT                    00991
C        CALL PLOT(X RIGHT EDGE , 0.,-3)          CLOSE PLOT             00992
C        CALL PLOT(0.,0.,999)    FINAL END OF PLOT TAPE                  00993
C                                                                         00994
C*************************************************************************00995
C                                                                         00996
      DIMENSION Z(50,50)                                                  00997
      DIMENSION ZLEV(2),LABEL(2)                                          00998
      DIMENSION XC(6),YC(6)                                               00999
C                                                                         01000
C     INITIALIZE.                                                         01001
C*************************************************************************01002
C                                                                         01003
      LP=2                                                                01004
      WRITE(LP,10)                                                        01005
10    FORMAT(///18H SUBROUTINE CON3D   /)                                 01006
      IF(NLEV)450,450,15                                                  01007
15    NFL=3                                                               01008
      NXM1=NX-1                                                           01009
      NYM1=NY-1                                                           01010
      BIG=.9E35                                                           01011
      THRESH=BIG*2.                                                       01012
      PI=3.1415926                                                        01013
      F2=2.0                                                              01014
      F1=1.0                                                              01015
      NCORT=4.1-F2                                                        01016
C                                                                         01017
C     MAIN LOOP OVER ALL POINTS OF GRID.                                  01018
C*************************************************************************01019
C                                                                         01020
      DO 400 I=1,NXM1                                                     01021
      DO 400 JJ=1,NYM1                                                    01022
      J=J.                                                                01023
      IF(I-2*(I/2))80,70,80                                               01024
70    J=NY-JJ                                                             01025
80    CONTINUE                                                            01026
      X1=X1+CX*(I-1)                                                      01027
```

```
      YJ=Y1+DY*(J-1)                                                    01028
      Z00=Z(I,J)                                                        01029
      Z01=Z(I,J+1)                                                      01030
      Z11=Z(I+1,J+1)                                                    01031
      Z10=Z(I+1,J)                                                      01032
C                                                                       01033
C     INITIALIZE CONTOUR(I,J) AND SKIP IF NO LINES.                     01034
C*********************************************************************01035
C                                                                       01036
      CALL ZCORN(ZLEV,NPL,NL,XC,YC,Z00,Z01,Z11,Z10,NCOR)                01037
      IF(NCOR-NCORT)400,400,290                                         01038
290   CONTINUE                                                          01039
C                                                                       01040
C     DO FOR EACH CONTOUR LEVEL.                                        01041
C*********************************************************************01042
C                                                                       01043
      DO 370 LEV=1,NLEV                                                 01044
      CALL ZLEVEL(ZLEV(LEV),NPL,NL,XC,YC,Z00,Z01,Z11,Z10,NCOR)          01045
      IF(NL)370,370,300                                                 01046
300   DO 360 IL=1,NL                                                    01047
      IPLL=NPL*IL                                                       01048
      IPL1=IPLL-NPL+1                                                   01049
      IPL2=IPL1+1                                                       01050
C                                                                       01051
C     PLOT CONTOUR LINES.                                               01052
C*********************************************************************01053
C                                                                       01054
      CALL PLOTF(XI+XC(IPL1)*DX,YJ+YC(IPL1)*DY,ZLEV(LEV),13)            01055
      CALL PLOTF(XI+XC(IPL2)*DX,YJ+YC(IPL2)*DY,ZLEV(LEV),32)            01056
      CALL PLOTF(XI+XC(IPLL)*DX,YJ+YC(IPLL)*DY,ZLEV(LEV),32)            01057
360   CONTINUE                                                          01058
370   CONTINUE                                                          01059
400   CONTINUE                                                          01060
450   RETURN                                                            01061
      END                                                               01062
```

PROGRAM VARIABLES

00047	BIG	00115	IPLL	00067	NCORT	00097	PI	00076	YJ
00061	FI	00072	J	00111	NL	00093	TWOBIG	00100	Z00
00070	I	00071	JJ	00041	NPL	00007	XC	00103	Z01
00114	IL	00113	LEV	00042	NXM1	00074	XI	00107	Z10
00116	IPL1	00037	LP	00044	NYM1	00023	YC	00105	Z11
00117	IPL2	00112	NCOR						

STATEMENT NUMBERS

10	00000	70	00300	290	00253	360	00506	400	00525	450	00543
15	00231	80	00304	300	00401	370	00515				

FORTRAN DIAGNOSTIC RESULTS FOR CON3D

CON3D F 00640 C 00000 D 00000
NO ERRORS

```
                                    MS FORTRAN (4.0)/PSCS          30/08/71

      SUBROUTINE DATA3D(Z,NX,NY,X1,Y1,DX,DY,XP,YP,ZP,N,LABPT)              01062
C     PLOTS DATA PTS ON 3-D FIGURE                                         01064
C                                                                          01065
C     XP,YP,ZP = ARRAYS OF POSITIONS AND HGTS OF DATA PTS (DATA UNITS)     01066
C     N = SIZE OF XP,YP,ZP.                                                01067
C     LABPT = 0,1,2,3... NUM. FIGS. AFTER DEC. IN DATA PT LABELS           01068
C           = -1  OMIT DECIMAL                                             01069
C           = -2 OMIT LABELS ON DATA POINTS                                01070
C           = -3  OMIT DATA POINTS ALTOGETHER                              01071
C                                                                          01072
      DIMENSION Z(50,2)                                                    01073
      DIMENSION XP(2),YP(2),ZP(2)                                          01074
      LP=3                                                                 01075
      WRITE(LP,10)                                                         01076
 10   FORMAT(/// 19H SUBROUTINE DATA3D  /)                                01077
      BIG=.9E35                                                            01078
      IF(LABPT+3) 220,220,190                                              01079
 190  DO 210 K=1,N                                                         01080
      I=(XP(K)-X1)/DX+1.5                                                  01081
      IF(1*(NX+1-I))210,210,191                                            01082
 191  J=(YP(K)-Y1)/DY+1.5                                                  01083
      IF(1.*(NY+1-J))210,210,192                                           01084
 192  IF(Z(I,J)-BIG)193,210,210                                            01085
 193  XPK=X1+(I-1)*DX                                                      01086
      YPK=Y1+(J-1)*DY                                                      01087
      CALL VISIBL(XPK,YPK,Z(I,J),ISEE,0)                                   01088
      IF(ISEE)210,210,195                                                  01089
 195  CALL PROJ(XPK,YPK,Z(I,J),XPIC,YPIC,0)                                01090
      CALL SYMBOL(XPIC -.02,YPIC -.03,.06,1H*,0.,1)                        01091
      CALL SYMBOL(XPIC -.02,YPIC -.03,.06,1HO,0.,1)                        01092
      IF(LABPT+2)220,210,200                                               01093
 200  CALL NUMBER(XPIC +.05,YPIC ,.07,Z(I,J),0.,LABPT)                     01094
 210  CONTINUE                                                             01095
 220  RETURN                                                               01096
      END                                                                  01097

  PROGRAM VARIABLES

 00013   BIG          00030   ISEE         00019   K            00028   XPIC         00034   YPIC
 00021   I            00022   J            00007   LP           00024   XPK          00026   YPK


  STATEMENT NUMBERS

   10   00000       191   00152       193   00177       210   00308       220   00323       190   00331
  192   00171       195   00231


            FORTRAN DIAGNOSTIC RESULTS FOR   DATA3D


  DATA3D     P   00425  C    00000 D     00000
NO ERRORS
```

```
                                MS FORTRAN (4.0)/PS05          30/08/71

      SUBROUTINE INSIDE(X,Y,XB,YB,NB,IND)                                  01096
C     GIVEN A POINT X,Y AND THE SERIES XB(K),YB(K) (K=1...NB) DEFINING     01099
C     VERTICES OF A CLOSED POLYGON.  IND IS SET TO 1 IF THE POINT IS IN    01100
C     THE POLYGON AND 0 IF OUTSIDE.  EACH TIME A NEW SET OF BOUND POINTS   01101
C     IS INTRODUCED IND SHOULD BE SET TO 999 ON INPUT.                     01102
C     IT IS BEST TO DO A SERIES OF Y FOR A SINGLE FIXED X.                 01103
C     METHOD ... A COUNT IS MADE OF THE NO. OF TIMES THE BOUNDARY CUTS     01104
C     THE MERIDIAN THRU (X,Y) SOUTH OF (X,Y).   AN ODD COUNT INDICATES     01105
C     THE POINT IS INSIDE , EVEN INDICATES OUTSIDE.                        01106
C     SEE A LONG WAY FROM EUCLID BY CONSTANCE REID  P 174 .                01107
C     CLEARCGRAPHY EMR   OCT/69                                            01108
C                                                                          01109
      DIMENSION XB(2),YB(2),YC(20)                                         01110
      IF(NB)10,10,20                                                       01111
10    IND=1                                                                01112
      RETURN                                                               01113
20    IF(IND-999)30,40,30                                                  01114
30    IF(X-XPREV)40,300,40                                                 01115
C                                                                          01116
40    XPREV=X                                                              01117
      NC=0                                                                 01118
      DO 200 K=1,NB                                                        01119
      KP1=K+1-K*(K/NB)                                                     01120
      KK=K                                                                 01121
      IF(XB(K)-XB(KP1))60,200,50                                           01122
50    KK=KP1                                                               01123
60    KE=K+KP1-KK                                                          01124
      IF(X-XB(KE))80,90,200                                                01125
80    IF(X-XB(KK))200,200,90                                               01126
90    NC=NC+1                                                              01127
      SLOPE=(YB(KE)-YB(KK))/(XB(KE)-XB(KK))                                01128
      YC(NC)=YB(KK)+(X-XB(KK))*SLOPE                                       01129
200   CONTINUE                                                             01130
C                                                                          01131
300   IND=0                                                                01132
      IF(NC)340,340,310                                                    01133
310   DO 330 K=1,NC                                                        01134
      IF(YC(K)-Y)320,330,330                                               01135
320   IND=1-IND                                                            01136
330   CONTINUE                                                             01137
340   RETURN                                                               01138
      END                                                                  01139

 PROGRAM VARIABLES

00056   K           00057   KP1         00094   NC          00052   XPREV       00000   YC
00061   KE          00060   KK          00062   SLOPE

 STATEMENT NUMBERS

   10   00154       40   00171       80   00241      200   00274      310   00312      330   00329
   20   00157       50   00222       90   00247      300   00304      320   00322      340   00339

            FORTRAN DIAGNOSTIC RESULTS FOR   INSIDE


  INSIDE     P  00424  C   00000 D    00000
NO ERRORS
```

```
                                    MS FORTRAN (4.0)/PSOS          30/08/71

      SUBROUTINE PLOTP(X,Y,Z,IPOS1N)                                          01140
C     IPOS = 2   MOVE TO  PROJ(X,Y,Z) WITH PEN DOWN.                          01141
C          = 3   MOVE TO  PROJ(X,Y,Z)  WITH PEN UP.                           01142
C          =12   DRAW IN THE VISIBLE PORTION OF THE LINE TO PROJ(X,Y,Z).      01143
C                IF NONE VISIBLE,DO NOTHING. THE LINE SHOULD BE SPECIFIED     01144
C                ENOUGH TO CONTAIN AT MOST ONE VISIBLE AND ONE INVISIBLE      01145
C                PORTION. IPOS ON PREVIOUS CALL MUST HAVE BEEN 12 OR 13.      01146
C          =13   MOVE TO PROJ(X,Y,Z) WITH PEN UP IF VISIBLE. OTHERWISE        01147
C                DO NOTHING.                                                  01148
C          =22   SAME AS 12 ONLY HEAVY LINE.                                  01149
C          =32   SAME AS 12 ONLY DOTTED LINE.                                 01150
C     ROUTINES VISIBL AND PROJ MUST BE SET UP BEFORE ANY CALLS TO PLOTP.      01151
C                                                                             01152
C     IPOS=2 OR 3                                                             01153
C                                                                             01154
      LP=3                                                                    01155
      IPOS=IPOS1N                                                             01156
      CALL PROJ(X,Y,Z,XPIC,YPIC,0)                                            01157
7     IF(IPOS-10)10,10,20                                                     01158
10    CALL PLOT(XPIC,YPIC,IPOS)                                               01159
      RETURN                                                                  01160
C                                                                             01161
C     IPOS=12 OR 13                                                           01162
C                                                                             01163
20    ITYPE=IPOS/10                                                           01164
      IPOS=10*IPOS-ITYPE*10                                                   01165
      CALL VISIBL(X,Y,Z,ISEE,0)                                               01166
50    IF(IPOS-13)80,60,60                                                     01167
C                                                                             01168
C     IPOS = 13                                                               01169
C                                                                             01170
60    IF(ISEE)500,500,70                                                      01171
70    CALL PLOTAY(XPIC,YPIC,3,0)                                              01172
      GO TO 500                                                               01173
C                                                                             01174
C     IPOS = 12                                                               01175
C     BOTH END POINTS VISIBLE OR NEITHER VISIBLE.                             01176
C                                                                             01177
80    IF(ISEEB+ISEE-1)500,100,90                                              01178
90    CALL PLOTAY(XPIC,YPIC,2,ITYPE)                                          01179
      GO TO 500                                                               01180
C                                                                             01181
C     ONE END ONLY VISIBLE. BINARY SEARCH FOR EDGE OF BARRIER.                01182
C                                                                             01183
100   XL=XB                                                                   01184
      YL=YB                                                                   01185
      ZL=ZB                                                                   01186
      ISEEL=ISEEB                                                             01187
      XU=X                                                                    01188
      YU=Y                                                                    01189
      ZU=Z                                                                    01190
      ISEEU=ISEE                                                              01191
      DO 140 I=1,10                                                           01192
      XP=(XL+XU)*.5                                                           01193
      YP=(YL+YU)*.5                                                           01194
      ZP=(ZL+ZU)*.5                                                           01195
      CALL VISIBL(XP,YP,ZP,ISEEP,0)                                           01196
      IF(ISEEL+ISEEP-1)130,120,130                                            01197
120   XL=XP                                                                   01198
      YL=YP                                                                   01199
      ZL=ZP                                                                   01200
```

```
      ISEEU=ISEEM                                                       01201
      GO TO 140                                                         01202
  130 XL=>M                                                             01203
      YL=YM                                                             01204
      ZL=ZM                                                             01205
      ISEEL=ISEEM                                                       01206
  140 CONTINUE                                                          01207
C                                                                       01208
      CALL PROJ(XM,YM,ZM,XMPIC,YMPIC,0)                                 01209
      CALL PLOTAY(XMPIC,YMPIC,2+ISEE,ITYPE)                             01210
      IF(ISEE)900,500,150                                               01211
  150 CALL PLOTAY(XPIC,YPIC,2,ITYPE)                                    01212
C                                                                       01213
C     SET UP END POINT FOR NEXT CALL                                    01214
C                                                                       01215
  500 XE=X                                                              01216
      YE=Y                                                              01217
      ZE=Z                                                              01218
      XEPIC=XPIC                                                        01219
      YEPIC=YPIC                                                        01220
      ISEEE=ISEE                                                        01221
      RETURN                                                            01222
      END                                                               01223
```

PROGRAM VARIABLES

00043	I	00042	ISEEU	00046	XM	00063	YEPIC	00036	YU		
00002	IFCS	00011	ITYPE	00095	XMPIC	00023	YL	00031	ZE		
00012	ISEE	00000	LP	00003	XPIC	00050	YP	00027	ZL		
00014	ISEEE	00021	XE	00034	XU	00097	YPPIC	00052	ZM		
00033	ISEEL	00061	XEPIC	00025	YE	00005	YPIC	00040	ZU		
00054	ISEEP	00017	XL								

STATEMENT NUMBERS

7	00103	50	00136	80	00156	100	00173	130	00257	150	00323
10	00110	60	00143	90	00164	120	00246	140	00267	900	00331
20	00116	70	00147								

FORTRAN DIAGNOSTIC RESULTS FOR PLOTP

NULL STATEMENT NUMBERS
50 7

PLOTP P 00410 C 00000 D 00000

```
                                MS FORTRAN (4.0)/PSOS          30/08/71

      SUBROUTINE PROJ(X,Y,Z,XPIC,YPIC,IND)                              01224
C     PROJECT POINT X,Y,Z ONTO POINT XPIC,YPIC OF PROJECTION PLANE.     01225
C     PICKUP R,THETA,PHI,XCENT,YCENT ON 1ST PREL. CALL WITH IND=1.      01226
C     PICKUP ZCENT,ZMAG,XCPL,YCPL,SCL  ON 2ND PREL. CALL WITH IND=2.    01227
C     USE IND=0 FOR ALL NORMAL CALLS.                                   01228
C     FOCAL PT=PT(XCENT,YCENT,ZCENT) + PT(R,THETA,PHI)                  01229
C     PROJ.. PLANE AT PT(XCENT,YCENT,ZCENT) + PT(R-1,THETA,PHI)         01230
C     THE R VECTOR SPEARS THE PICTURE AT XCPL,YCPL IN PICTURE COORDS.   01231
C     SCL PICTURE UNITS ARE NEEDED TO MAKE ONE DATA UNIT.               01232
C     ALL 2 VALUES ARE SCALED BY ZMAG  ABOUT ZCENT AS ORIGIN.           01233
C                                                                       01234
      IF(IND-1)1000,100,200                                             01235
C                                                                       01236
C     INITIAL SET UP OF RCLTIVE PRO.                                    01237
C*********************************************************************  01238
C                                                                       01239
100   R=X                                                               01240
      THETA=Y                                                           01241
      PHI=Z                                                             01242
      XCENT=XPIC                                                        01243
      YCENT=YPIC                                                        01244
C                                                                       01245
      PI=3.1415926                                                      01246
      THR=THETA*PI/180.                                                 01247
      PHR=PHI*PI/180.                                                   01248
      CT=COS(THR)                                                       01249
      ST=SIN(THR)                                                       01250
      CP=COS(PHR)                                                       01251
      SP=SIN(PHR)                                                       01252
      A1=CP*CT                                                          01253
      A2=CP*ST                                                          01254
      A3=SP                                                             01255
      B1=-ST                                                            01256
      B2=CT                                                             01257
      C1=-SP*CT                                                         01258
      C2=-SP*ST                                                         01259
      C3=CP                                                             01260
      RETURN                                                            01261
C                                                                       01262
C                                                                       01263
200   ZCENT=X                                                           01264
      ZMAG=Y                                                            01265
      XCPL=Z                                                            01266
      YCPL=XPIC                                                         01267
      SCL=YPIC                                                          01268
      RETURN                                                            01269
C                                                                       01270
C     NORMAL ENTRY POINT                                                01271
C*********************************************************************  01272
C                                                                       01273
1000  XT=X-XCENT                                                        01274
      YT=Y-YCENT                                                        01275
      ZT=(Z-ZCENT)*ZMAG                                                 01276
C                                                                       01277
      XR=A1*XT+A2*YT+A3*ZT                                              01278
      YR=B1*XT+B2*YT                                                    01279
      ZR=C1*XT+C2*YT+C3*ZT                                              01280
C                                                                       01281
      DENOM=R-XR                                                        01282
      XPIC=YR/DENOM                                                     01283
```

```
      XPIC=XCPL+XPIC*SCL                                                01284
      YPIC=ZR/DENOM                                                     01285
      YPIC=YCPL+YPIC*SCL                                                01286
      RETURN                                                            01287
      END                                                               01288
```

PROGRAM VARIABLES

00035	A1	00053	C3	00001	R	00007	XCENT	00077	YR
00037	A2	00031	CF	00069	SCL	00061	XCPL	00071	YT
00041	A3	00025	CT	00033	SP	00075	XR	00095	ZCENT
00043	B1	00103	DEACP	00027	ST	00067	XT	00057	ZMAG
00045	B2	00005	PPI	00003	THETA	00011	YCENT	00101	ZR
00047	C1	00023	PPR	00021	THR	00063	YCPL	00073	ZT
00051	C2	00015	PI						

STATEMENT NUMBERS

100	00114	200	00201	1000	00214

FORTRAN DIAGNOSTIC RESULTS FOR PROJ

```
 PROJ       F   00361  C    00006 D     00000
NO ERRORS
```

```
                                MS FORTRAN (4.0)/PSCS          30/08/71

      SUBROUTINE ZLEVEL(ZLEV,NPL,NL,XC,YC,Z00,Z01,Z11,Z10,NKCR)              01285
C     THIS ROUTINE FINDS POINTS DEFINING CONTOUR LINES AT A GIVEN HEIGHT     01290
C     WITHIN AN ELEMENTARY SQUARE.                                           01291
C                                                                            01292
C     INPUT    Z00,Z01,Z11,Z10    THESE ARE HEIGHTS AT THE FOUR CORNERS      01293
C                  OF THE SQUARE. THEY MUST BE GIVEN IN AN INITIAL CALL      01294
C                  TO ZCORN. IF ANY CORNER IS UNDEFINED, A VALUE OF          01295
C                  1.E35 OR GREATER SHOULD BE ENTERED.                       01296
C              ZLEV       HEIGHT OF CONTOUR REQUIRED.                       01297
C              NPL        NUMBER OF POINTS TO BE RETURNED IN EACH CONTOUR   01298
C                  LINE. SHOULD BE AT LEAST 2.                               01299
C                                                                            01300
C     OUTPUT   NL         NUMBER OF CONTOUR LINES FOUND (0,1 OR 2)           01301
C              NKCR       NO. OF CORNERS OF SQ. CONTAINING VALID DATA.       01302
C              XC,YC      THESE ARRAYS WILL CONTAIN THE POINTS DEFINING      01303
C                  THE CONTOUR LINES. THE FIRST CONTOUR WILL OCCUPY THE      01304
C                  FIRST NPL LOCATIONS OF XC AND YC. IF A SECOND LINE        01305
C                  EXISTS IT WILL OCCUPY POSITIONS NPL+1 TO 2*NPL.           01306
C                  POINTS WILL BE EQUALLY SPACED IN EITHER X OR Y            01307
C                  DEPENDING ON WHICH HAS THE LARGER RANGE.                  01308
C                                                                            01309
C     THE WARPED PLANE TECHNIQUE IS USED AS DESCRIBED ON PAGES 40-42 OF      01310
C     IBM STAMPEDE MANUAL.                                                   01311
C     FORTRAN II    OCEANOGRAPHY/EMR    SEPT/68                          01312
C**********************************************************************    01313
      DIMENSION XC(2),YC(2),X(4),Y(4),Z(4),IFI(4)                            01314
      NPLM1=NPL-1                                                            01315
      IFI(1)=1                                                               01316
      IFI(2)=NPL                                                             01317
      IFI(3)=NPL+1                                                           01318
      IFI(4)=NPL*2                                                           01319
C                                                                            01320
C     RETURN IF NO CONTOUR LINES.  MAKE SURE NO CORNER EXACTLY AT            01321
C     CONTOUR HEIGHT.                                                        01322
C**********************************************************************    01323
      NL=0                                                                   01324
      IF(NKCR-2) 1000,1000,5                                                 01325
5     ZC=ZLEV                                                                01326
      DO 20 K=1,NKCR                                                         01327
      IF(ZC-Z(K)) 20,10,20                                                   01328
10    ZC=ZC*1.000001                                                         01329
      IF(ZC)20,15,20                                                         01330
15    ZC=ZINC                                                                01331
20    CONTINUE                                                               01332
      IF(ZC-ZMAX)30,1000,1000                                                01333
30    IF(ZC-ZMIN)1000,1000,40                                                01334
40    CONTINUE                                                               01335
C                                                                            01336
C     GET END POINTS OF CONTOUR LINES ON SIDES OF SQUARE (OR TRIANGLE)       01337
C**********************************************************************    01338
      NEP=0                                                                  01339
      DO 60 K=1,NKCR                                                         01340
      KP1=K+1-NKCR*(K/NKCR)                                                  01341
      IF((Z(K)-ZC)*(Z(KP1)-ZC)) 50,60,60                                     01342
50    NEP=NEP+1                                                              01343
      IF=IFI(NEP)                                                            01344
      FRAC=(ZC-Z(K))/(Z(KP1)-Z(K))                                           01345
      XC(IF)=X(K)+(X(KP1)-X(K))*FRAC                                         01346
      YC(IF)=Y(K)+(Y(KP1)-Y(K))*FRAC                                         01347
60    CONTINUE                                                               01348
```

```
      NL=NEP/2                                                          01345
      IF(NL-1) 1000,100,80                                              01350
C                                                                       01351
C     IF THERE ARE FOUR END POINTS PUT THEM IN PROPER ORDER FOR THE      01352
C     CONTOUR LINES.                                                    01353
C*********************************************************************  01354
80    D2=ABS(XC(NPL)-XC(1))                                             01355
      D4=ABS(XC(2*NPL)-XC(1))                                           01356
      IF(D2-D4)90,90,85                                                 01357
85    XCNPL=XC(NPL)                                                     01358
      YCNPL=YC(NPL)                                                     01359
      XC(NPL)=XC(2*NPL)                                                 01360
      YC(NPL)=YC(2*NPL)                                                 01361
      XC(2*NPL)=XCNPL                                                   01362
      YC(2*NPL)=YCNPL                                                   01363
90    CONTINUE                                                          01364
C                                                                       01365
C     FILL IN INTERIOR POINTS OF CONTOURS.                              01366
C*********************************************************************  01367
100   IF(NPL-2) 1000,1000,110                                           01368
110   DO 200 L=1,NL                                                     01369
      IL=NPL*L                                                          01370
      I1=IL-(NPL-1)                                                     01371
      I2=I1+1                                                           01372
      ILM1=IL-1                                                         01373
      DXC=(XC(IL)-XC(I1))/NPLM1                                         01374
      DYC=(YC(IL)-YC(I1))/NPLM1                                         01375
      IF(NKCR-3) 1000,120,140                                           01376
120   DO 130 I=I2,ILM1                                                  01377
      XC(I)=XC(I1)+DXC*(I-I1)                                           01378
130   YC(I)=YC(I1)+DYC*(I-I1)                                           01379
      GO TO 200                                                         01380
140   IF(ABS(DYC)-ABS(DXC))150,150,170                                  01381
150   DO 160 I=I2,ILM1                                                  01382
      XL(I)=XC(I1)+DXC*(I-I1)                                           01383
160   YC(I)=(ZC-Z00-CCNB*XC(I))/(CCNA+CCNC*XC(I))                       01384
      GO TO 200                                                         01385
170   DO 180 I=I2,ILM1                                                  01386
      YC(I)=YC(I1)+DYC*(I-I1)                                           01387
180   XC(I)=(ZC-Z00-CCNA*YC(I))/(CCNB+CCNC*YC(I))                       01388
200   CONTINUE                                                          01389
      RETURN                                                            01390
C                                                                       01391
C                                                                       01392
C     FILL IN X,Y,Z AT CORNERS OF SQUARE.                               01393
C*********************************************************************  01394
      ENTRY ZCORN                                                       01395
C     ENTRY ZCORN(ZLEV,NPL,AL,XC,YC,Z00,Z01,Z11,Z10,NKCR)               01396
      X0=0.                                                             01397
      Y0=0.                                                             01398
      DX=1.                                                             01399
      DY=1.                                                             01400
      K=0                                                               01401
      BIG=.9E35                                                         01402
      IF(Z00-BIG)505,505,510                                            01403
505   K=K+1                                                             01404
      X(K)=X0                                                           01405
      Y(K)=Y0                                                           01406
      Z(K)=Z00                                                          01407
510   IF(Z01-BIG) 515,515,520                                           01408
515   K=K+1                                                             01409
      X(K)=X0                                                           01410
```

```
      Y(K)=Y0+DY                                                        01411
      Z(K)=Z01                                                          01412
  520 IF(Z11-BIG) 530,530,540                                           01413
  530 K=K+1                                                             01414
      X(K)=X0+DX                                                        01415
      Y(K)=Y0+DY                                                        01416
      Z(K)=Z11                                                          01417
  540 IF(Z10-BIG) 550,550,560                                           01418
  550 K=K+1                                                             01419
      X(K)=X0+DX                                                        01420
      Y(K)=Y0                                                           01421
      Z(K)=Z10                                                          01422
  560 NKOR=K                                                            01423
      IF(1-KCR-2)1000,1000,570                                          01424
  570 CONTINUE                                                          01425
C                                                                       01426
C     GET VARIOUS PARAMETERS.                                           01427
C*********************************************************************01428
      ZMIN=Z(1)                                                         01429
      ZMAX=Z(1)                                                         01430
      DO 640 K=2,NKOR                                                   01431
      IF(Z(K)-ZMIN)600,620,620                                          01432
  600 ZMIN=Z(K)                                                         01433
  620 IF(Z(K)-ZMAX) 640,640,630                                         01434
  630 ZMAX=Z(K)                                                         01435
  640 CONTINUE                                                          01436
      ZINC=(ZMAX-ZMIN)*0.000001                                         01437
      IF(1-KCR-3) 1000,1000,650                                         01438
  650 CONA=Z01-Z00                                                      01439
      CONB=Z10-Z00                                                      01440
      CONC=Z00+Z11-Z01-Z10                                              01441
 1000 RETURN                                                            01442
      END                                                               01443
```

PROGRAM VARIABLES

00130	BIG	00076	DXC	00072	IL	00053	NEF	00067	YCNPL
00106	CONA	00124	DY	00075	ILM1	00034	NFLP1	00020	Z
00104	CONB	00100	DYC	00055	IP	00000	X	00040	ZC
00110	CONC	00056	FRAC	00030	IPI	00114	X0	00045	ZINC
00060	D2	00103	I	00042	K	00069	XCNFL	00047	ZMAX
00062	D4	00073	I1	00094	KP1	00010	Y	00091	ZMIN
00122	D5	00074	I2	00071	L	00116	Y0		

STATEMENT NUMBERS

5	00274	50	00372	110	00517	170	00666	520	01014	600	01103
10	00306	60	00427	120	00562	180	00700	530	01021	620	01106
15	00319	80	00450	130	00574	200	00724	540	01036	630	01114
20	00317	85	00473	140	00614	505	00760	550	01043	640	01117
30	00334	90	00511	150	00627	510	00773	560	01057	650	01140
40	00341	100	00512	160	00641	515	01000	570	01066	1000	01193

FORTRAN DIAGNOSTIC RESULTS FOR ZLEVEL

ZLEVEL F 01335 C 00000 D 00000
NO ERRORS

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                                MS FORTRAN (4.0)/PSOS          30/08/71

      SUBROUTINE PLOTAY(XB,YB,ICS,ITYPE)                                  01444
C     PLOTS A LINE FROM PRESENT POINT TO POINT XB,YB (IN INCHES)          01445
C     ICS=2 PEN UP                                                        01446
C        =2 PEN DOWN                                                      01447
C     ITYPE=0 OR 1 ORDINARY LINE                                          01448
C          =2 HEAVY LINE                                                  01449
C          =3 DOTTED LINE                                                 01450
C     MUST BE INITIALIZED BY CALL TO PLOTAY WITH PEN UP.                  01451
C     CDE/NCGRAPHY/EMR   DECEMBER 1985.                                   01452
C                                                                         01453
      IF(ICS-3)5,10,5                                                     01454
5     IF(ITYPE-2)10,20,30                                                 01455
C                                                                         01456
C     ORDINARY LINE   ITYPE=0 OR 1.                                       01457
C                                                                         01458
10    CALL PLOT(XB,YB,ICS)                                                01459
      GO TO 100                                                           01460
C                                                                         01461
C     HEAVY LINE   ITYPE=2                                                01462
C                                                                         01463
20    DX=XB-XA                                                            01464
      DY=YB-YA                                                            01465
      DS=SQRT(DX*DX+DY*DY)+.001                                           01466
      DXD=DX*.01/DS                                                       01467
      DYD=DY*.01/DS                                                       01468
      CALL PLOT(XB,YB,2)                                                  01469
      CALL PLOT(XB+DYD,YB-DXD,2)                                          01470
      CALL PLOT(XA+DYD,YA-DXD,2)                                          01471
      CALL PLOT(XA-DYD,YA+DXD,2)                                          01472
      CALL PLOT(XB-DYD,YB+DXD,2)                                          01473
      CALL PLOT(XB,YB,2)                                                  01474
      GO TO 100                                                           01475
C                                                                         01476
C     DOTTED LINE   ITYPE=3                                               01477
C                                                                         01478
30    SX=XB-XA                                                            01479
      SY=YB-YA                                                            01480
      S=SQRT(SX*SX+SY*SY)+.001                                            01481
      NSEG=(S+.05)*10.                                                    01482
      NSEG=MAX0(NSEG,1)                                                   01483
      DX=SX/NSEG                                                          01484
      DXD=DX*.25                                                          01485
      DX3D=DX*.75                                                         01486
      DY=SY/NSEG                                                          01487
      DYD=DY*.25                                                          01488
      DY3D=DY*.75                                                         01489
      DO 35 K=1,NSEG                                                      01490
      XK=XA+DX*(K-1)                                                      01491
      YK=YA+DY*(K-1)                                                      01492
      CALL PLOT(XK+DXD,YK+DYD,2)                                          01493
      CALL PLOT(XK+DX3D,YK+DY3D,3)                                        01494
35    CALL PLOT(XK+DX,YK+DY,2)                                            01495
      GO TO 100                                                           01496
C                                                                         01497
C     SAVE POINT A FOR NEXT TIME                                          01498
C                                                                         01499
100   XA=XB                                                               01500
      YA=YB                                                               01501
      RETURN                                                              01502
      END                                                                 01503
```

PROGRAM VARIABLES

00014	DS	00042	DXQ	00050	DYQ	00024	SX	00055	XK
00002	DX	00006	DY	00054	K	00026	SY	00010	YA
00046	DX3Q	00052	DY3Q	00036	NSEG	00004	XA	00057	YK
00020	DXQ	00022	CYQ	00030	S				

STATEMENT NUMBERS

5	00070	10	00075	20	00103	30	00223	35	00345	100	00367

FORTRAN DIAGNOSTIC RESULTS FOR FLCTNY

FLCTNY F 00447 C 00000 D 00000
NO ERRORS

```
                                MS FORTRAN (4.0)/PSCS          30/08/71

      SUBROUTINE PLOTS(IBUF,NLOC,LOEV)                                  01504
      IF(ISW-1)2,1,2                                                    01505
1     CALL ENDPLOT(20)                                                  01506
2     CALL AXISXY(20,40.0,20.0,0.0,40.0,20.0,-1.,-1.,-1.,-1.)           01507
      ISW=1                                                             01508
      RETURN                                                            01509
      END                                                               01510

  PROGRAM VARIABLES

00001   ISW

  STATEMENT NUMBERS

    1   00022          2   00025

          FORTRAN DIAGNOSTIC RESULTS  FOR   PLOTS


   PLOTS      F   00104  C    00000 D     00000
NO ERRORS
TIME    002.63 MIN
EQUIP,01=60,03=61
EQUIP,51=MT
LOAD,5E
RUN
```

SUBF

33304	SENSWTCH	33365	LCCF	33567	PCWRF	34132	XTCI	34361	TAPEHAND
34754	BUFFER	35464	WMATXINC	35523	NRC	35645	NRC	35757	TYPLOLT.
36210	NWR	36272	RAAR	36341	MTRFER	36551	TINFRR	37106	MILCCFRR
37564	MTCER	37604	CACER	37645	CPCER	37760	CPNRINS	40050	FRCFR
40627	CHARTF	40666	C1CSPLOT	40705	C1OSCFLT	41563	CRIVJE01	42566	RLNRS
42645	PLCT	43132	SYMBOL	44076	NUMBER	44476	MTCRFT	44520	WRITET
46205	PLATZ	47013	BCCCLT	50561	FLCATF	50610	EXTREMA2	50676	C6CERRCR
51143	EXTREMA1	51245	AESF	51255	SIGNF	51272	SINCOS	51305	SCRTF
52076	PAUSE	52163	CIC.MSIC	52600	CONTRCL	53021	FORMAT	54111	BCCINP
55222	PLOTNY	55671	ZLEVEL	57226	PRGJ	57607	PLCTF	60217	INSIDE
61270	CON3D	62130	BLINES	63231	YLINES	63662	XLINES	64311	SPCCTF
67175	VISIBL	71271	G10E30						

ENTR

33317	SSWTCH	33365	ALCC10	33370	ALCC	33577	C1CEXRR	33567	PCWRF
34507	C8CREMAC	34626	UNITS7	35314	LENGTHF	34754	C8CELFIN	36204	TN.EXIT
36177	TN.CIC	36214	TN.CUT	36205	TN.REJ1	36210	TN.REJ2	36164	T.NCTACY
36216	NWR	36471	WRITEMAR	37506	PRGNAME	37561	MESS013	37556	MESS012
37550	MESS010	37545	MESS009	37542	MESS008	37537	MESS007	37534	MESS006
37475	ACTION	37347	MTEXIT2	37231	WMATIS11	37333	MTEXIT	37106	MILCCFRR
36341	MTRFRR	36450	NPCHECK	37505	MKR2	37504	MKR1	35757	TYPEQLT.
40175	CICFE.	40221	STATBUF	40025	STNPIPS	40002	CICCALL	37760	CPNRTN
40104	REJECT	40222	MESSAGE	40043	BEGRTN	40213	STCRELFF	40011	CALLSTAT
40034	STCFTFRT	40214	RTNENT	40037	INDX3	40117	INCX33	40250	FRCFR
37604	CRDER .	37571	MTCER	37564	MTOERRR	37356	SLMCHECK	37426	TAB.SRCH
37532	SRF	35523	NRC	40625	SCARLST1	40273	SCARAP	40666	C1CSPLCT
42277	RPT4.4	42216	HOCKROS	42557	CODEIND	41571	CRIVER07	41563	DRIVER06
42566	REACS	43062	WHERE	42627	LEADER	33304	SSWTCHF	34132	C1CEXRI
34363	C8CEACKS	34477	C8CEAFIL	34762	C8QELFCT	42605	WRITES	34632	UNITSTF
44670	WRITET	40753	C1CSCPLT	45623	XYMOVE	45130	FERRALMB	45367	LABLE
45277	ISC	45540	TICK	46775	LABELY	46774	LBEELX.	46777	IY
47006	C1CRLSN	46704	PLCTXY	47474	LEDZER.F	47213	LEC2ER.I	47113	C2CLGCTC
50561	FLCATF	50632	XMINOF	50616	AMIN0	50624	XMAXOF	50610	AMAX0
50610	MAXOF	51073	XFIXF	51165	MIN1	51157	MAX1	51165	XMIN1F
51151	MIN1F	51143	MAX1F	51245	XABSF	51245	AESF	51255	XSIGNF
51272	COSF	51300	SINF	51605	SQRTF	51073	FIXF	52040	C1CSTRR
52015	C1QSTIR	51760	C1CSBXR	51747	C1QACXR	51766	C1QCVIR	51766	C1CSBIR
52011	C1CSBRX	51771	C1CACRX	51737	C1QMLFI	52116	C8CFALSE	52407	C8CEOFRC
52560	C8QFOTAB	40266	SCAR	53362	RAARREJ	53517	C8CCLITE	53001	C8CPSIC
53420	C8QFJMES	53376	C8CCCNVT	53445	PWRTBL	52716	C8CARRAY	52676	C8CIOTAB
52600	C8GENTRY	50757	C9CERRCR	53521	C8C1FRMT	53556	C8CFCRPT	52652	C8CIOSET
53115	C8CECITS	50676	C8CERRCR	52163	CIO.MSIC	53443	PWRTBL0	52754	C8CIOERR
53407	C8CECCNT	36272	RAAR	54211	C8CLGINC	46205	AXISXY	45306	EXCPLCT
44135	NUMBER	56137	ZLEVEL	56625	ZCCRN	57674	PLCTF	51605	SQRT
51733	C1CSBRI	52026	C1CSTRI	51272	COS	51300	SIN	51673	IFIX
50624	MAXO	51255	SIGN	51245	ABS	51763	C1QMLIR	51743	C1CCVRI
54223	C8QLGINR	52076	C8CSTCP	47573	C8QENCOT	47120	C6CLGCTI	47013	C8CINCCT
54216	C8QLGINI	54112	C8CINGIN	60755	DATA3C	61505	CCN3C	62267	BLINES
63770	XLINES	43135	SYMBOL	51255	ISIGN	51245	IAES	67507	VISIBL
51151	AMIN1	57333	PROJ	64405	SNCCTF	65324	ZGRID	60365	INSIDE
55131	PLCTS	71666	G10E38	01340	SEL	11500	FCFECXS	1310C	LST
11142	SETCLCCK	05106	RSTCREQ	05075	RSTCRE	02135	FFT	13590	RIC
12411	RDCRF1	12467	PERRADD	11477	ACEXIT	03617	MSIC.SF	0514E	MSICFLG
12465	MIFCRADD	12440	MIELF	12470	MIBKADD	13373	MEMORY	13271	LCCS
14670	LOADER	13626	LENGROT	13151	EST	11063	EJNT.	11047	EJNT.
13272	CIT.RTN	13324	CIT	11210	CIP	10106	CIC3.01	10240	CIC3.2
13231	BRNT	13541	BNJ.	13360	BKRUNFLG	1147E	BKEXIT	12466	BERRADD
13324	ALGCPT	13033	AET	00025	ACCCLNTS	11500	AENCRPAL		

COMP

14363	31105

```
DATA
    NONE

EXTA
    NONE

(MEMCRY) =    31106      (MEMCRYE) =    33303
```