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XSECT: A COMPUTER CODE FOR GENERATING

FUSELAGE CROSS SECTIONS - USER'S MANUAL

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SUMMARY

A computer code, XSECT, has been·developed to generate
fuselage cross sections from a given area distribution and wing
definition. The cross sections are generated to match the wing
definition while conforming to the area requirement. An iterative
procedure is used to generate each cross section. Fuselage area
balancing may be included in this procedure if desired.

The code is intended as an aid for engineers who must first
design a wing under certain aerodynamic constraints and then
design a fuselage for the wing such that the constraints remain
satisfied. This report contains the information necessary for
accessing and executing the code, which is written in FORTRAN to
execute on the Cyber 170 series computers (NOS operating system)
and produces graphical output for a Tektronix 4014 CRT. The LRC
graphics software is used in combination with the interface
between this software and the PLOT 10 software.

INTRODUCTION

Computer code XSECT produces a digital fuselage description in the arbitrary geometry Harris or wave-drag format (ref. 1) using a given area distribution and a wing description. The cross sections are generated to have the area defined by the area distribution and to match the wing description out to a user-defined wing-body junction point. In general, the generated cross sections are circular except for a stub or indentation to fit the wing description; however, a noncircular shape, specifically, a circle with a circular vertical lobe, may be produced to represent a cockpit. The circular cross sections may be produced with or without fuselage area balancing. Fuselage area balancing means that when progressing from one cross section to the next along the fuselage, the change in fuselage area above the wing is equal to the change in fuselage area below the wing (refer to ref. 2).

DISCUSSION

Since there are two types of cross sections, circular and noncircular, and the circular cross sections may be generated with or without area balancing, there are three methods for processing a cross section. These three methods are described in the following sections.

PROCESSING A CIRCULAR CROSS SECTION WITHOUT AREA BALANCING

To generate the points to describe a particular cross section, the program must compute the value of the radius (R) of a circle whose combined areas above and below the wing will equal the desired fuselage area (refer to figure 1). The center of the circle is located at either the wing root camber line or the fuselage camber line defined in the wave-drag file. The value of R is computed iteratively. First, upper and lower limits are computed for R using geometric criteria. Then an initial estimate is made for R, the fuselage area is computed using this estimate, and the computed fuselage area is compared to the desired fuselage area. If the computed area is close enough to the desired area, the current value of R is used to generate the digital description of the fuselage. If not, a new estimate is made for R and the fuselage area is again computed and compared to the desired area. This iterative process is repeated until the fuselage area computed is close enough to the desired fuselage area and, therefore, the correct value of R is found.

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(NOTE: For circular fuselage cross sections that do not intersect the wing, no iteration is needed since

$$R = \sqrt{\text{fuselage area}/\pi} \quad ,)$$

PROCESSING A CIRCULAR CROSS SECTION WITH AREA BALANCING

Processing circular cross sections that intersect the wing using area balancing involves a double iteration. Not only must the correct value of R be found, but the center (ZC) of the circle must be located so that the balancing is achieved (refer to figure 2). First an initial estimate is made for ZC and the iterations to find R for the desired fuselage area are performed. After R is found, the area balancing criterion is checked. If this criterion is not satisfied, a new estimate for ZC is made, R is found, and again, the balancing criterion is checked. This iterative procedure continues until the correct value of ZC is found.

PROCESSING THE NONCIRCULAR SHAPE

The noncircular shape may be generated for a group of cross sections to represent a cockpit area. The shape consists of a circle with a circular vertical lobe (refer to figure 3). To exercise the cockpit option, the user must define where the cockpit begins and ends, the upper surface profile of the cockpit ($Z_{MAX}(x)$), and a constant that controls the location of the center of the upper circle (vertical lobe) with respect to the center of the main circle. $Z_{MAX}(x)$ may be defined by typing in the values or by using the crosshair cursor to trace the shape.

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The cross sections behind the cockpit are processed first and this processing determines the center (ZC) of each of the cockpit stations. To compute R for a given cockpit station, upper and lower limits for R are first computed using geometric criteria. Then, an initial estimate is made for R and the center of the lobe (Z_2) is computed using equation 1, shown in figure 3. Next, the radius of the lobe (R_2) is computed using equation 2, also shown in figure 3. The shape is now defined and its area may be computed and checked. If the area is not close enough to the desired area, a new estimate is made for R, a new shape is determined by the process described above, and a new area is computed and checked. This continues until the computed area is correct and, therefore, the desired value of R is found.

(NOTE: Unlike the circular cross sections, even cross sections that do not intersect the wing require iteration to find R since R cannot be defined in terms of the desired area by a simple equation.)

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DESCRIPTION OF PROGRAM USE

INPUT DATA

The input data are provided by the user in a wave-drag geometry input file. The file should contain a wing description and the fuselage description should be that of a circular fuselage. The circular fuselage is specified by $J2 = -1$ which indicates that the fuselage will be described by cross-sectional areas. This wave-drag file is used as input to a preprocessing program (Q2650) which defines necessary wing cross-sectional data at fuselage locations determined by the XFUS locations in the wave-drag file. These data are written by Q2650 to TAPE7 along with a list of the x locations of the cross sections, the fuselage areas at each of the x locations, and the camber ordinates at each x location. The procedure file to run XSECT takes care of this step for the user.

ACCESSING AND RUNNING THE PROGRAM

The procedure file to run the program resides on user number 723796N. To access the procedure file, type

GET,XSECTP/UN•723796N

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The contents of XSECTP are shown below:

```
.PROC,XSECTP,R1,T5,T7.
.1   R1=1 - FIRST RUN FOR THIS CONFIGURATION.
.1   R1<>1 - NOT FIRST RUN FOR THIS CONFIGURATION.
.1   T5 - ORIGINAL WAVE DRAG FILE.
.1   T7 - FILE OF CROSS SECTION DATA FOR T5.
.1        EITHER PRODUCED AND SAVED BY THIS
.1        PROCEDURE FILE (R1=1) OR EXISTS ON
.1        USER'S ACCOUNT (R1<>1).
GET,TAPE5=T5.
GET,XSECTB/UN=723796N.
SETTL(500)
.1    IF FIRST RUN, GENERATE TAPE7 AND SAVE.
IFE,(R1.EQ.1),LABEL1.
GET,CBC/UN=723796N.
CBC(TAPE5)
RETURN,TAPE6,TAPE9,TAPE10,TAPE12.
REWIND,TAPE5,TAPE7.
SAVE,TAPE7=T7.
.1    IF NOT FIRST RUN, GET TAPE7.
ELSE,LABEL1.
GET,TAPE7=T7.
ENDIF,LABEL1.
.1    EXECUTE PROGRAM.
XSECTB.
```

To run the program for a particular configuration for the first time, type

XSECTP,1,FILE1,FILE2

The 1 indicates that this is the first run for this configuration. FILE1 is the name of the permanent file on the users account on which the wave-drag input data resides. Since this wave drag file is being processed for the first time, program Q2650 is run to get the digital cross-sectional data (TAPE7). FILE2 is the name of the permanent file on the users account on which these data will be saved. If this particular configuration needs to be processed again, the digital cross-sectional data from the first run may be re-used since it has been saved on FILE2. This saves time since program Q2650 need not be run prior to program XSECT. To use this option, type

XSECTP,2,FILE1,FILE2

where the 2 indicates this is not the first run for this configuration. FILE1 is the permanent file on which the wave drag data resides, and FILE2 is the permanent file on which the digital cross-sectional data have been saved.

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OUTPUT FILES PRODUCED BY XSECT

The following output files are produced by program XSECT and
exist as local files after program execution is complete.

TAPE8 – contains the digital description of the fuselage cross
sections in wave drag format. (See figures 6 and 10 for
examples.)

TAPE10 – table of information about each cross section. One line
is entered in the table for each cross section produced.
The entries occur in the order that the cross sections
are generated. (See figures 5 and 9 for examples.)

SAVPVF – the plot vector file containing a plot of each cross
section generated. The plots are on the file in the
order that the cross sections were produced. This plot
vector file may be viewed using PLIST. To use PLIST,
make sure SAVPVF is a local file and type

```
GET,PLIST/UN-LIBRARY
PLIST
```

PLIST gives instructions on how to view the plots in
random or sequential order. (See figures 4 and 8 for
example plots.)

TAPE9 – traces the iterations used to find the radius of each
cross section (used for debugging during program
development).

TAPE11 – traces the iterations used to find the correct center of
each cross section when area balancing (used for
debugging during program development).

CONCLUDING REMARKS

A computer code has been developed to produce a digital fuselage description in the arbitrary geometry wave-drag format using a given area distribution and a wing description. This code is designed to automate a process which has been performed manually in the past. Since the results of a particular attempt at a fuselage fit are available much more quickly by using the automated process, the user has time to make several attempts and select the best rather than being forced to accept the first satisfactory results.

APPENDIX A - EXAMPLES OF PROGRAM EXECUTION

The following examples explain the interactive prompts and possible user responses required by running a very simple case of the program (Example 1) and a complicated case (Example 2). These cases can be repeated at the terminal as indicated.

All questions requiring a yes-no response should be answered by typing "Y" for yes and "N" for no.

User responses are checked for validity whenever possible so that typing errors should not abnormally terminate the program. An invalid response will either cause the question to be repeated or a default option to be taken.

EXAMPLE 1

Example 1 illustrates program execution for a very simple case. It requires the least user input from the terminal. The wing described in the wave-drag file is defined to the center line, no area balancing is requested, and the cockpit option is not requested. The specific input files used for this case are the wave-drag file, MACK, and the cross-sectional data file, QINP1. The user may repeat this example by typing

```
GET,MACK,QINP1,XSECTP/UN=723796N
SAVE,MACK,QINP1
XSECTP,2,MACK,QINP
```

The first input required is the wing-body junction point (Y_{JCT}). This y value is chosen so that all of the wing-fuselage from $y = 0$ to $y = Y_{JCT}$ will be included in the digital fuse-lage description. Y_{JCT} must be one of the wing y leading-edge values defined in the wave-drag file.

```
INPUT WING-BODY JUNCTION PT (YJCT)
? 6.
```

Next, the user indicates how the wing and fuselage are defined.

1.-Wing defined from $y = 0$,   2.-Wing defined from $y = 0$

    fuselage area includes   fuselage area includes

    area to be placed around   area of wing to Y_{JCT}

    wing   – fus area   – fus area
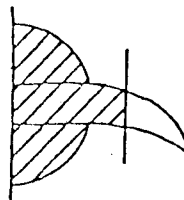
3.-Wing defined from $y = (Y_{JCT})$,

    fuselage area includes all

    area out to (Y_{JCT}) – fus area
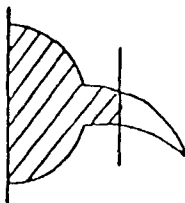
```
ENTER TYPE OF INPUT
  1 - UING DEF FROM Y=0, FUS AREA NOT INCLUDING UING
  2 - UING DEF FROM Y=0, FUS AREA INCLUDES UING TO Y=YJCT
  3 - UING DEF FROM Y=YJCT, FUS AREA INCLUDES UING TO Y=YJCT
? 1
```

The fuselage type is selected next.

```
INPUT FUSELAGE TYPE
  1 - CIRCULAR
  2 - CIRCULAR UITH VERTICAL LOBE FOR COCKPIT
? 1
```

The data just entered are echoed to the screen and the user is

asked if it is okay to continue. To change a response to any of

the previous questions, the user answers "NO" and the questions

are repeated. Otherwise, a "YES" response causes program

execution to continue.

```
UING-BODY JCT PT =   6.000
INPUT IS TYPE 1
FUSELAGE DESIRED IS TYPE  1

OKAY TO CONTINUE? (Y/N)
? Y
```

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Next, the screen is erased and a table is displayed listing each
cross section by x station number and its corresponding x loca-
tion. The user should make a hard copy of this table since cross
sections are referred to by x station number in the future. A
carriage return will cause program execution to continue. The
screen will be erased before the next input prompt.

X STATION NO.	X
1	0.000
2	5.000
3	10.000
4	15.000
5	20.000
6	25.000
7	30.000
8	35.000
9	40.000
10	45.000
11	50.000
12	55.000
13	60.000
14	65.000
15	70.000
16	75.000
17	80.000
18	85.000
19	90.000
20	95.000
21	100.000
22	105.000
23	110.000
24	115.000
25	120.000
26	125.000
27	130.000
28	135.000
29	140.000
30	145.000
31	150.000
32	155.000
33	160.000
34	165.000
35	170.000
36	175.000
37	180.000
38	185.000
39	190.000
40	195.000
41	200.000
42	205.000
43	210.000
44	215.000
45	220.000
46	225.000
47	230.000
48	235.000
49	240.000
50	245.000
51	250.000
52	255.000
53	260.000
54	265.000
55	270.000
56	275.000
57	280.000
58	285.000
59	290.000
60	294.000

PLEASE MAKE HARD COPY FOR FUTURE REFERENCE
HIT CR TO CONTINUE
?

At this point, the user must indicate whether or not area balancing is desired.

```
DO YOU WISH TO AREA BALANCE? (Y/N)
? N
```

By selecting no area balancing, the user is required to indicate how the fuselage cross sections should be centered. They may be centered at the wing-root camber line or they may be centered at the ZFUS locations defined in the wave-drag file. By selecting option 1 below, cross sections ahead of and behind the wing are centered to follow the fuselage camber of the input file but are adjusted so there is no discontinuity at the first and last wing station.

```
HOW DO YOU WANT CROSS SECTIONS CENTERED?
   1 - TO FOLLOW WING CAMBER
   2 - TO FOLLOW CAMBER OF FUSELAGE IN INPUT FILE
? 1
```

Again, the user is asked if it is okay to continue. If not, the option to request area balancing is repeated. If so, processing continues.

```
OKAY TO CONTINUE? (Y/N)
? Y
```

The user now indicates the total number of points desired to describe each fuselage cross section. The minimum is 8 and the maximum is 30.

```
ENTER TOTAL NO. OF PTS TO DESCRIBE EACH CROSS SECTION (MIN 8, MAX 30)
? 20
```

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Next, the user indicates how these points should be distributed around the cross section. First, how many points should be placed on the part of the fuselage above the wing? This number includes the point located at the wing-body intersection. The minimum is 3: 1 for the wing-body intersection, 1 for the top point, and at least 1 point in between.

```
ENTER NO. ABOVE WING, INCLUDING PT OF INTERSECTION OF WING & FUS (MIN 3)
? 6
```

Next, how many points should be placed on the upper wing surface? This number does <u>not</u> include the wing-body intersection point, but <u>does</u> include the point at the wing-body junction point (Y_{JCT}). The minimum number is 1.

```
ENTER NO. ON UPPER WING, INCLUDING PT AT Y=YJCT (MIN 1)
? 4
```

Next, the user indicates the number of points to be placed on the lower wing surface, following the same directions as those for the upper wing surface, and then the number of points on the part of the fuselage below the wing, following the same directions as those for the fuselage above the wing.

```
ENTER NO. ON LOWER WING, INCLUDING PT AT Y=YJCT (MIN 1)
? 4
ENTER NO. BELOW WING, INCLUDING PT OF INTERSECTION OF WING & FUS (MIN 3)
? 6
```

Each response is checked for violation of the minimum and/or maximum. If the number entered is invalid, the question is repeated. · Also, if the sum of the distribution of points around the fuselage does not equal the total number of points requested, the following message is displayed and the sequence of questions repeated.

```
     SUM OF PTS DISTRIBUTED NOT = TOTAL PTS
     !!! TRY AGAIN!
```

After valid data have been entered, the data are echoed and the user must again indicate whether or not it is okay to continue.

```
     TOTAL FUS PTS = 20 DISTRIBUTED
     ABOVE WING (UPPER FUS)  6
    .UPPER WING  4
     LOWER WING  4
     BELOW WING (LOWER FUS)  6


     OKAY TO CONTINUE? (Y/N)
   ? Y
```

A "NO" response requires that all of the number of points information be re-entered and a "YES" response causes the screen to be erased and the processing of each cross section to begin.

As a cross section is completed, a message is displayed on the screen so the user can keep track of the processing. The cross sections will probably not be processed in sequential order. (The order of processing depends on the options selected and the location of the leading and trailing edges of the wing.)

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```
X STATION NO.    4 COMPLETE
X STATION NO.    5 COMPLETE
X STATION NO.    6 COMPLETE
X STATION NO.    7 COMPLETE
X STATION NO.    8 COMPLETE
X STATION NO.    9 COMPLETE
X STATION NO.   10 COMPLETE
X STATION NO.   11 COMPLETE
X STATION NO.   12 COMPLETE
X STATION NO.   13 COMPLETE
X STATION NO.   14 COMPLETE
X STATION NO.   15 COMPLETE
                 .
                 .
                 .
X STATION NO.   55 COMPLETE
X STATION NO.   56 COMPLETE
X STATION NO.   57 COMPLETE
X STATION NO.   58 COMPLETE
X STATION NO.   59 COMPLETE
X STATION NO.   60 COMPLETE
X STATION NO.    3 COMPLETE
X STATION NO.    2 COMPLETE
X STATION NO.    1 COMPLETE

PROGRAM EXECUTION COMPLETE
```

After execution is complete, the output files described pre-
viously exist as local files.   Figure 4 shows 3 examples of the
cross sectional plots contained on the plot vector file SAVPVF.
An example of TAPE10, the table of cross section information, is
shown in figure 5, and TAPE8, the digital description of the cross
sections in wave-drag format, is shown in figure 6.

EXAMPLE 2

Example 2 illustrates program execution for a complicated case. It requires a considerable amount of user input from the terminal. The wing is defined only to the wing-body junction point ($Y_{JCT} = 25.926$ in this case). Both the area balancing and cockpit options are requested. The input files used for this case are the wave-drag file, F16AM, and the cross-sectional data file, F16AMX. The user may repeat this example by typing

```
GET,F16AM,F16AMX,XSECTP/UN=723796N
SAVE,F16AM,F16AMX
XSECTP,2,F16AM,F16AMX
```

The user enters Y_{JCT}, type of wing-fuselage data, and type of fuselage desired as in example 1. This time, input type 3 and fuselage type 2 are selected.

```
INPUT WING-BODY JUNCTION PT (YJCT)
? 25.926

ENTER TYPE OF INPUT
   1 - WING DEF FROM Y=0, FUS AREA NOT INCLUDING WING
   2 - WING DEF FROM Y=0, FUS AREA INCLUDES WING TO Y=YJCT
   3 - WING DEF FROM Y=YJCT, FUS AREA INCLUDES WING TO Y=YJCT
? 3

INPUT FUSELAGE TYPE
   1 - CIRCULAR
   2 - CIRCULAR WITH VERTICAL LOBE FOR COCKPIT
? 2

WING-BODY JCT PT = 25.926
INPUT IS TYPE 3
FUSELAGE DESIRED IS TYPE  2

OKAY TO CONTINUE? (Y/N)
? Y
```

Again, a table of x station numbers and corresponding x values is displayed.

```
 X STATION NO.       X

       1            -38.000
       2            -25.000
       3            -12.500
       4              0.000
       5             12.500
       6             25.000
       7             37.500
       8             50.000
       9             62.500
      10             75.000
      11             87.500
      12            100.000

              .
              .
              .

      40            437.500
      41            450.000
      42            462.500
      43            475.000
      44            487.500
      45            500.000
      46            512.000
      47            524.200
      48            535.000
      49            540.080
```

PLEASE MAKE HARD COPY FOR FUTURE REFERENCE
HIT CR TO CONTINUE
?

Since the wing is not defined to the center line, the definition must be extended by the program to $y = 0$ so fuselage cross sections with wing stub will have some way of matching the wing definition at $y = Y_{JCT}$. The user must guide this extension.

First, the number of additional airfoils desired in the extended definition is specified. This number includes an airfoil located at $y = 0$. The user may select from 1 to 6 additional airfoils.

ENTER NO. OF AIRFOILS TO EXTEND WING DEF TO Y=0, INCLUDING Y=0
(1 <= NO. OF AIRFOILS <= 6)
? 1

Next, the user indicates how the leading-edge x and y values and

chord length for each airfoil should be defined. The user may

type in the values or have the program extrapolate the values

linearly using the first two airfoils defined in the original wing

definition.

```
ENTER HOW TO DEFINE X, Y AND C VALUES
   1 - PROGRAM EXTRAPOLATES VALUES FROM GIVEN DEF
   2 - USER INPUT X, Y AND C FOR EACH AIRFOIL
? 2
```

By selecting option 2, the x and y leading-edge values and chord

length for the one additional airfoil requested must be entered.

```
AFTER EACH PROMPT ENTER X, Y AND C, BEGINNING WITH Y=0
EX - 0.,0.,50.
? 62.824,0.,441.511
```

At this point, the leading- and trailing-edge extensions are

computed. The slope, $\frac{dy}{dx}$, of the extended part of the leading edge

can never be negative and the slope of the extended part of the

trailing edge can never be positive. These restrictions result

from the method used in the program to extend the wing definition

to y = 0. The restricting conditions are checked, and if either

is violated, the following message is displayed and the leading

and trailing edges will automatically be extended straight across

to y = 0 using the x values of the leading and trailing edges at

the first original airfoil (airfoil defined at y = Y_{JCT}).

```
LEADING EDGE OR TRAILING EDGE EXTENSION INVALID
PROGRAM WILL EXTEND DEFINITIONS STRAIGHT ACROSS
```

Whether or not the extended edges are invalid, the user is asked if it is okay to continue.

```
OKAY TO CONTINUE? (Y/N)
? Y
```

A "YES" answer accepts the computed extended definition and processing continues. A "NO" answer enables the user to again select how to define the leading and trailing edges.

If option 1 to define the leading-edge values and chord lengths is selected, no additional input is required. The extension of the leading and trailing edges is computed. The slopes are checked as in option 2 and if either is invalid, no message is printed but both the leading and trailing edges are automatically extended straight across to $y = 0$ using the x values of the leading and trailing edges at the first original airfoil. Next, the leading-edge definition is checked for extension beyond the fuselage nose. If this occurs, the following message is displayed.

```
LEADING EDGE BEYOND FUSELAGE NOSE
OKAY TO CONTINUE? (Y/N)
? N
```

By answering "NO" to "OKAY TO CONTINUE?", the following message is displayed

```
*** YOU MUST ENTER X, Y AND C'S
```

and instructions indicating how to input the leading edge values and chord lengths are displayed (same prompts as when option 2 is selected). In other words, the extrapolation of the x and y values of the leading edge has produced a wing whose definition

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extends beyond the fuselage nose. If this is not acceptable, the user must define the leading edge. If it is acceptable, a "YES" response to "OKAY TO CONTINUE?" causes processing to continue. The trailing edge is checked for extension past the tail of the fuselage in a similar manner.

Once the x and y values of the leading and trailing edges have been computed and accepted, the user determines how the z definition (camber) of the extended wing should be computed. The thickness distribution of the first original airfoil is used and there are two ways of defining the camber.

```
ENTER HOW TO EXTEND WING CAMBER
   1 - TO FOLLOW FUS CAMBER FROM INPUT
   2 - TO FOLLOW CAMBER DEF OF AIRFOIL AT Y=YJCT
? 1
```

Option 1 causes the airfoil at $y = 0$ to follow the camber definition of the fuselage from the original input (ZFUS values). The camber value for airfoils between $y = 0$ and the airfoil at Y_{JCT} is linearly interpolated between the two airfoils. Option 2 causes all extended airfoils to have the same camber definition as the airfoil at Y_{JCT}.

Since a fuselage with a cockpit section has been selected, some information about the noncircular cross sections to represent the cockpit is needed.

First, the constant that is used to control the placement of ZC is entered. (See Processing the Noncircular Shape.) A value of 0.8 is suggested, but any valid number may be used between

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0.1 and 1.4 (the input will be checked). This constant will be

used in the processing of every cockpit cross section.

```
    ENTER CONSTANT CONTROLLING VERTICAL POSITION
    OF COCKPIT (.1<CONSTANT<1.4 - TRY .8)
    ? .8
```

Next, the x station numbers of the cross sections where the

cockpit should begin and end are entered.

```
    ENTER BEGINNING, ENDING STATION FOR COCKPIT
    ? 7,16
```

The program checks that there is at least one cross section

between the beginning and ending stations. If not, the following

message is displayed and the question is repeated.

```
    NO X STATIONS BETWEEN COCKPIT BEGINNING AND ENDING STATIONS
```

Also, the program checks that the cockpit ending station is less

than or equal to the wing ending station. If not, the following

message is displayed and the question is repeated.

```
    WING ENDS BEFORE COCKPIT ENDS
```

Finally, the cockpit information is echoed and the user indicates

whether or not it is okay to continue. By answering "NO", the

constant and beginning and ending cockpit stations may be re-

entered. A "YES" answer will cause processing to continue.

```
    8 COCKPIT STATIONS BETWEEN STATION NO.   7 X =   37.50
    AND STATION NO. 16 X =  160.00
    OKAY TO CONTINUE? (Y/N)
    ? Y
```

Next, the user indicates whether or not area balancing is desired.

```
DO YOU WISH TO AREA BALANCE? (Y/N)
? Y
```

By answering yes, further input is required. The user now selects the key station. This is the cross section that must be processed first to initiate the area balancing.

```
ENTER NO. OF KEY STATION
? 20
```

The key station number is checked to insure that the wing is defined at that cross section. If not, the following message is displayed and the question is repeated.

```
THERE IS NO WING DEFINED AT KEY STATION NO.   2
*** TRY AGAIN!
```

Since the cockpit option was selected, the program also checks that the key station is not located in the cockpit area. It can be located at the cockpit ending station but not before. If this restriction is violated, the following message is displayed and the key station number must be re-entered.

```
KEY STATION CANNOT BE LOCATED IN COCKPIT AREA
*** TRY AGAIN!
```

Next, the user enters the percentage of the fuselage area that should be located above the wing at the key station.

```
ENTER PERCENT AREA ABOVE WING (0.0<PERCENT<100.0)
? 60.
```

If this number is not between 0.0 and 100.0, the question is repeated. The percentage of area required below the wing is computed (100 - percentage above) and the data are echoed to the screen. A "NO" response causes the option to request area balancing to be repeated. A "YES" response causes processing to continue.

```
BALANCING UITH KEY STATION NO.  20 X = 200.00
PERCENT ABOUE = 60.0000    PERCENT BELOU = 40.0000
OKAY TO CONTINUE? (Y/N)
? Y
```

As in the first example, the user enters the total number of points to describe each cross section, followed by how the points should be distributed on the different parts of the cross section.

```
ENTER TOTAL NO. OF PTS TO DESCRIBE EACH CROSS SECTION (MIN 10, MAX 30)
? 20

ENTER NO. ABOUE UING, INCLUDING PT OF INTERSECTION OF UING & FUS (MIN 5)
? 8

ENTER NO. ON UPPER UING, INCLUDING PT AT Y=YJCT (MIN 1)
? 4

ENTER NO. ON LOUER UING, INCLUDING PT AT Y=YJCT (MIN 1)
? 4

ENTER NO. BELOU UING, INCLUDING PT OF INTERSECTION OF UING & FUS (MIN 3)
? 4
```

Notice that the minimum number of points for the fuselage above the wing has increased to five (therefore, the overall minimum has increased to ten). This is because the cockpit option has been selected and more points are needed to represent the vertical lobe. One point is allowed for the top point, one for the intersection point of the two circles, one for the wing-body intersection point, and one on each circular arc. The user specifies how these upper fuselage points should be distributed

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between the upper lobe (cockpit) and the part of the main circle that is above the wing. The points on the cockpit include the top point and the intersection point of the two circles and at least one point in between these two.

```
HOW TO DIVIDE UPPER FUS PTS FOR COCKPIT STATIONS?
ENTER NO. ON COCKPIT (MIN 3)
? 4
```

The points on the main body include the wing-body intersection point and at least one point between this intersection point and the intersection point of the two circles.

```
ENTER NO. ON MAIN BODY (MIN 2)
? 4
```

If the sum of this distribution is not equal to the number of points requested above the fuselage, the following mesage is displayed and the distribution must be re-entered.

```
DISTRIBUTION OF UPPER FUS PTS HAS INCORRECT SUM
```

Finally, the overall point distribution and the upper fuselage point distribution are printed and the user is asked if it is okay to continue.

```
TOTAL FUS PTS - 20 DISTRIBUTED
ABOVE WING (UPPER FUS)   8
UPPER WING   4
LOWER WING   4
BELOW WING (LOWER FUS)   4

UPPER FUS PTS DISTRIBUTED
   4 ON COCKPIT
   4 ON BODY

OKAY TO CONTINUE? (Y/N)
? Y
```

A "NO" answer requires that the number of points information be re-entered. A "YES" response causes a screen erasure and continuation of processing.

At this point, the cross sections behind (and possibly ahead of) the cockpit are processed and a message is displayed to the screen as each cross section is completed.

```
X STATION NO.  20 COMPLETE
X STATION NO.  19 COMPLETE
X STATION NO.  18 COMPLETE
X STATION NO.  17 COMPLETE
X STATION NO.  16 COMPLETE
X STATION NO.  21 COMPLETE
X STATION NO.  22 COMPLETE
X STATION NO.  23 COMPLETE
X STATION NO.  24 COMPLETE
X STATION NO.  25 COMPLETE
X STATION NO.  26 COMPLETE
X STATION NO.  27 COMPLETE
X STATION NO.  28 COMPLETE
X STATION NO.  29 COMPLETE
X STATION NO.  30 COMPLETE

              •

              •

              •

X STATION NO.  45 COMPLETE
X STATION NO.  46 COMPLETE
X STATION NO.  47 COMPLETE
X STATION NO.  48 COMPLETE
X STATION NO.  49 COMPLETE
X STATION NO.   7 COMPLETE
X STATION NO.   6 COMPLETE
```

After these cross sections have been processed, the screen is erased and the upper surface profile of the cockpit area must be defined before the cockpit stations can be processed.

Now, a table of the cross sections to be processed with the vertical lobe is printed. This is a list of the cross sections between the beginning and ending stations (since the beginning and ending stations are processed as circular cross sections). The user then selects one of the two options for defining Z_{MAX}.

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```
THE FOLLOWING CROSS SECTIONS LIE BETWEEN THE COCKPIT
BEGINNING AND ENDING STATIONS AND REQUIRE THE UPPER
SURFACE PROFILE (ZMAX) TO BE INPUT

     NO.       X SECTION NO.      X

      1              8           50.00
      2              9           62.50
      3             10           75.00
      4             11           87.50
      5             12          100.00
      6             13          112.50
      7             14          125.00
      8             15          150.00
HOW DO YOU WANT TO DEFINE ZMAX?
   1 - TYPE IN Z VALUES
   2 - USE CROSSHAIR CURSOR TO SELECT POINTS
? 1
```

By selecting option 1, the user must numerically input the

value of Z_{MAX} for each cross section.

```
AFTER EACH PROMPT, ENTER ZMAX VALUE FOR
EACH COCKPIT STATION, BEGINNING WITH NO. 1
? 12.029
? 17.636
? 23.399
? 27.604
? 30.310
? 31.498
? 30.875
? 28.694
```

As each value is entered, the program checks that Z_{MAX} is above

the wing upper surface at that cross section. If not, the

following message is displayed and the Z_{MAX} value for that cross

section must be re-entered.

```
ZMAX REQUESTED < WING UPPER SURFACE
ZMAX = -15.000 WING = -1.1833
RE-ENTER ZMAX FOR THIS CROSS SECTION
```

A similar check is made to insure that Z_{MAX} is above the center

of the fuselage (ZC) at that cross section and a similar message

is displayed if Z_{MAX} is less than ZC. After all the Z_{MAX}

values have been entered, they are listed and the user is asked if

it is okay to continue. A "NO" response allows the user to select

the other option and/or re-enter the cockpit data. A "YES"

response causes the cockpit stations to be processed.

```
CURRENT UPPER SURFACE VALUES
     NO.      ZMAX
      1      12.029
      2      17.636
      3      23.399
      4      27.604
      5      30.310
      6      31.498
      7      30.875
      8      28.694

OKAY TO CONTINUE? (Y/N)
? Y
```

By selecting option 2, interactive graphics is used to input

the upper surface profile. First, a side view of the entire con-

figuration (except the cockpit area) is displayed on the upper

portion of the screen. A box is drawn around the cockpit area and

1 or 2 stations on either side of this area. This boxed-in area

is then enlarged and displayed on the lower portion of the

screen. Vertical dashed lines are drawn on the enlargement to

indicate the location of the cross sections requiring a Z_{MAX}

value. These cross sections are labeled by station number and the

x value at that station (refer to figure 7-a). Then, the cross-

hair cursor appears on the screen. Beginning with the leftmost

cross section, the cursor is positioned to trace the upper surface

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of the cockpit. When the cursor is in the proper position for the

first cross section, the user types "x" and the point is read.

The value is checked for Z_{MAX} > wing surface and Z_{MAX} > ZC as

in option 1, and if either condition is violated, a message is

displayed and the user must re-enter that point. If the point is

okay, a plus is drawn at the point and the cursor re-appears,

ready to accept the next point (refer to figure 7-b). This

continues until the entire upper surface is defined. After the

last point is accepted, a dashed line is drawn connecting the

Z_{MAX} values, as in figure 7-c. Then the terminal bell rings and

the user types a carriage return to continue program execution.

After the carriage return, the screen is erased and the Z_{MAX}

values that were entered are listed. If it is okay to continue,

the cockpit stations will be processed. If not, the user may

select the other option and re-enter the Z_{MAX} values or the

Z_{MAX} values may be re-entered using this option again.

```
X STATION NO.        X           ZMAX

        8           50.00       12.0291
        9           62.50       17.6361
       10           75.00       23.3989
       11           87.50       27.6041
       12          100.00       30.0961
       13          112.50       31.4979
       14          125.00       30.8749
       15          150.00       28.6944

OKAY TO CONTINUE? (Y/N)
? Y
```

Again, a message is displayed as the processing of each cross section is complete.

```
X STATION NO.    15 COMPLETE
X STATION NO.    14 COMPLETE
X STATION NO.    13 COMPLETE
X STATION NO.    12 COMPLETE
X STATION NO.    11 COMPLETE
X STATION NO.    10 COMPLETE
X STATION NO.     9 COMPLETE
X STATION NO.     8 COMPLETE
X STATION NO.     7 COMPLETE
X STATION NO.     6 COMPLETE
X STATION NO.     5 COMPLETE
X STATION NO.     4 COMPLETE
X STATION NO.     3 COMPLETE
X STATION NO.     2 COMPLETE
X STATION NO.     1 COMPLETE

PROGRAM EXECUTION COMPLETE
```

After execution is complete, the output files produced by the program exist as local files. Examples of the cross section plots produced on the plot vector file SAVPVF are shown in Figure 8. Figures 8 (a) and (b) show cross sections in the cockpit area and (c) and (d) show cross sections behind the cockpit. TAPE10 is illustrated in figure 9 and TAPE8 in figure 10.

APPENDIX B - SPECIAL ERROR CONDITIONS

Explained in this section are special error conditions that will either stop program execution or require responses from the user before execution can continue.

WHEN AREA BALANCING CRITERION CANNOT BE SATISFIED

This problem occurs when the fuselage area is decreasing and there is not enough area left above or below the wing to satisfy the required decrease. The program will issue warning messages indicating that balancing cannot be achieved, and will offer the user options for continuing processing.

Shown below is a warning message that results from a preliminary check on the remaining upper and lower areas and the required decrease in upper and lower area to achieve balancing.

```
*** CURRENT X STATION NO. •  41 ,   X •  450.00

BALANCING REQUIREMENT UNABLE TO BE SATISFIED
NECESSARY CHANGE ABOVE • CHANGE BELOW •   -4.300
BEST BALANCE POSSIBLE IS CHANGE ABOVE •     -8.559 CHANGE BELOW •     -.042

HOW DO YOU WANT TO CONTINUE?
   1 - ATTEMPT BEST POSSIBLE BALANCE
   2 - SELECT NEW KEY STATION AND/OR INITIAL BALANCE
       CONDITION AND START OVER
   3 - START OVER WITHOUT AREA BALANCING
   4 - STOP PROGRAM
? 1
```

The cross section being processed is identified for all messages. In this case, the total area should decrease by 8.6, meaning that the upper and lower areas should each decrease by 4.3. However, the amount of area below the wing in the previous cross section is 0.042 so the closest possible balance would decrease the lower area by 0.042 and place the rest of the

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decrease above the wing. As a result of this preliminary check, one of four options may be taken.

Under the first option, the program attempts to process the cross section and, after doing so, prints a message indicating why the balancing failed (during what part of processing) and information about the balance that was achieved.

There are four possible reasons why balancing failed, two indicating that the program has run out of area below the wing - "BALANCING FAILED BECAUSE FUSELAGE SHIFTED TOO HIGH" and "BALANCING FAILED BECAUSE MINIMUM LOWER AREA REACHED" and two indicating that the program has run out of area above the wing - "BALANCING FAILED BECAUSE FUSELAGE SHIFTED TOO LOW" and "BALANCING FAILED BECAUSE MINIMUM UPPER AREA REACHED". There are two messages for each case because there are two areas in the processing where failure may be detected. The messages about the fuselage being shifted too high or low indicate that ZC was shifted too far from the wing during processing to produce the required total area. The messages about minimum upper or lower area being reached indicate that after the maximum number of iterations allowed to find ZC, an upper or lower bound for ZC was found and the iterations have run up against one of these bounds. All of these conditions provide the user with the same information about the best balance that was achieved and the same options for continuing processing, as shown in the following example.

```
***  CURRENT X STATION NO. •   41 ,   X •   450.00

BALANCING FAILED BECAUSE FUSELAGE SHIFTED TOO HIGH

BEST BALANCE ACHIEVED IS
CHANGE ABOVE •    -7.142 CHANGE BELOW •    -.037 ACCURACY •     .31
AREA ABOVE • 1129.074 AREA BELOW •    .006
    1 - ACCEPT BALANCING ACHIEVED AND CONTINUE
    2 - SELECT NEW KEY STATION AND/OR INITIAL BALANCE
        CONDITION AND START OVER
    3 - START OVER WITHOUT AREA BALANCING
    4 - STOP PROGRAM
 ? 1
```

Again, the current cross section is identified. The computed

changes in upper and lower area are given along with the accuracy

(error tolerance criterion) that was computed. Also, the actual

areas above and below are given. The first option allows the user

to accept these processing results and move on to the next cross

section. The remaining options are the same as those for the pre-

liminary check and selecting one of them produces the same

results.

Under the second option, the user selects a new key station

and/or initial balance condition and area balancing processing is

restarted. First, the current balancing conditions are displayed.

```
KEY STATION •  30
PERCENT AREA ABOVE •  95.00  BELOW •   5.00
```

Next, the number of the new key station must be entered (as in

this case, the key station may remain the same).

```
ENTER NO. OF NEW KEY STATION
? 30
```

Next, the new distribution of area for the key station must be

specified by entering the percentage of fuselage area desired

above the wing. A hint is given indicating whether the percentage

should be increased or decreased (based on the assumption that the

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key station has not been changed). The user may choose to change

the key station and leave the requested distribution unchanged.

```
    (TRY DECREASING PERCENT AREA ABOVE FOR KEY STATION)
    ENTER NEW PERCENT AREA ABOVE WING (0.0<PERCENT<100.0)
    ? 90.
```

The new conditions are displayed and the user responds "YES" if it

is okay to continue. A "NO" answer enables the user to reenter

the balancing conditions.

```
    BALANCING WITH KEY STATION NO.  30 X = 325.00
    PERCENT ABOVE =  90.00    PERCENT BELOW =  10.00
    OKAY TO CONTINUE? (Y/N)
    ? Y
```

If option 3 is chosen, the program will reprocess the

configuration from the beginning as if area balancing had not been

selected. Therefore, the user must indicate how the fuselage

cross sections should be centered.

```
    HOW DO YOU WANT CROSS SECTIONS CENTERED?
      1 - TO FOLLOW WING CAMBER
      2 - TO FOLLOW CAMBER OF FUSELAGE IN INPUT FILE
    ? 1
```

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Following a screen erasure, the cross sections are processed.

The last option stops program execution in case the user does not wish to continue processing. The following message is displayed.

```
111 CURRENT X STATION NO. • 15 ,   X • 150.00
    PROGRAM STOPPED BY USER REQUEST
```

WHEN R CANNOT BE COMPUTED FOR A GIVEN CROSS SECTION

The generation of both circular and double lobe shapes involves computing the value of R – the radius of the circle (or main body on the double lobe shape) that produces the shape with the required area. In some cases, the correct value of R cannot be found. This happens because upper and lower bounds on the value of R are computed using geometric criteria and the value of R that produces the correct area does not lie within these limits. In fact, in some cases, the upper limit is computed to be less than the lower limit. Since this represents the case of a cross section that is geometrically impossible to process the program is stopped with the following message.

```
AREA REQUIREMENT CANNOT BE SATISFIED
LOWER BOUND ON R >• UPPER BOUND ON R
CENTER OF FUSELAGE PROBABLY TOO FAR FROM WING
OR BAD COCKPIT PARAMETERS
```

This problem has occurred on circular cross sections ahead of or behind the wing where the fuselage was balanced to an extreme and on double lobe cross sections where the combination of parameters controlling the shape produced an impossible situation.

If the limits for the value of R are normal (upper bound greater than lower bound) the iteration scheme to compute R is performed. If, after the maximum number of iterations to find R, the value that produces the desired area has not been found, it is usually because the iteration has been bounded by the geometric limits on R and the correct value of R lies outside of these limits. When this occurs, the following message is displayed.

```
AREA REQUIREMENT NOT SATISFIED WITHIN DESIRED ACCURACY
X STATION NO.  15  X •  150.00
 AREA DESIRED • 1839.600 AREA COMPUTED • 2332.059 ACCURACY • 26.77 PERCENT
 RADIUS •   21.21760
 UPPER BOUND ON RADIUS •    38.19167
 LOWER BOUND ON RADIUS •    21.21760
 IS THIS AREA ACCEPTABLE? (Y/N)
 ? N
```

This informs the user of the area produced by the best possible value of R and the percent error between this area and the desired area. It also informs the user of which limit restricted the proper value of R from being computed. If the accuracy is small enough, the user may wish to accept this computation and move on to the next cross section by responding "YES" to "IS THIS AREA ACCEPTABLE?". In this case, the digital description is generated using these values. If the area produced is not acceptable and the cross section is circular, nothing can be done to improve the computation so a "NO" response causes program execution to stop with the following message.

```
PROGRAM STOPPED BY USER REQUEST
```

If the area produced is not acceptable and the cross section is a cockpit station (double lobe), then it may be possible to change some of the parameters defining the shape to allow the correct value of R to be found. In this case, a "NO" response generates the following prompt.

```
SELECT AN OPTION
    1 - CHANGE PARAMETERS ON THIS SECTION AND TRY AGAIN
    2 - RE-ENTER ENTIRE PROFILE (ZMAX) OF COCKPIT AND TRY AGAIN
    3 - STOP PROGRAM
? 1
```

By selecting option 1, the user may change either the value of Z_{MAX} for this cross section or the value of the constant used on this cross section (the original value of the constant will be restored before processing the next cross section). The new value may be entered by the user or the program can compute the new value.

If the user chooses to enter a new value for Z_{MAX}, the program provides the hint that decreasing Z_{MAX} might produce better results.

```
WHICH PARAMETER TO CHANGE?
    1 - ZMAX
    2 - CONSTANT CONTROLLING POSITION OF CENTER OF COCKPIT CIRCLE
? 1
 DO YOU WANT TO INPUT CHANGE OR USE PROGRAM DEFAULTS?
    1 - INPUT CHANGE
    2 - USE PROGRAM DEFAULT
? 1
. CURRENT ZMAX •    50.495
 ENTER NEW ZMAX
 (TRY DECREASING ZMAX)
? 45..
```

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Using this lower value of Z_{MAX}, the program reprocesses the cross section but the results still are not good enough and the following message is displayed.

```
AREA REQUIREMENT NOT SATISFIED WITHIN DESIRED ACCURACY
X STATION NO.  15  X =  150.00
AREA DESIRED = 1839.600 AREA COMPUTED = 1893.514 ACCURACY =  2.93 PERCENT
RADIUS =  19.60002
UPPER BOUND ON RADIUS =   32.69644
LOWER BOUND ON RADIUS =   19.60002
IS THIS AREA ACCEPTABLE? (Y/N)
? Y
```

Since the accuracy is within 3 percent, the user chooses to accept these computations so that processing can move to the next cross section and the completion message is displayed for this cross section.

```
X STATION NO.  15 COMPLETE
```

The next illustration is an example of the user choosing to use the program default for changing Z_{MAX}. The default option increases or decreases (according to which limit restricted R) Z_{MAX} by ten percent of the value of R.

```
AREA REQUIREMENT NOT SATISFIED WITHIN DESIRED ACCURACY
X STATION NO.  13  X -  112.50
AREA DESIRED - 1934.500 AREA COMPUTED - 3589.105 ACCURACY - 85.53 PERCENT
RADIUS -   27.53071
UPPER BOUND ON RADIUS -   44.05129
LOWER BOUND ON RADIUS -   27.53071
IS THIS AREA ACCEPTABLE? (Y/N)
? N
SELECT AN OPTION
  1 - CHANGE PARAMETERS ON THIS SECTION AND TRY AGAIN
  2 - RE-ENTER ENTIRE PROFILE (ZMAX) OF COCKPIT AND TRY AGAIN
  3 - STOP PROGRAM
? 1
WHICH PARAMETER TO CHANGE?
  1 - ZMAX
  2 - CONSTANT CONTROLLING POSITION OF CENTER OF COCKPIT CIRCLE
? 1
DO YOU WANT TO INPUT CHANGE OR USE PROGRAM DEFAULTS?
  1 - INPUT CHANGE
  2 - USE PROGRAM DEFAULT
? 2
CURRENT ZMAX -   61.000
NEW ZMAX -  58.247
```

The change produced by the program is not enough so the processing

fails again.

```
AREA REQUIREMENT NOT SATISFIED WITHIN DESIRED ACCURACY
X STATION NO.  13  X -  112.50
AREA DESIRED - 1934.500 AREA COMPUTED - 3231.895 ACCURACY - 67.07 PERCENT
RADIUS -   26.00122
UPPER BOUND ON RADIUS -   44.05129
LOWER BOUND ON RADIUS -   26.00122
IS THIS AREA ACCEPTABLE? (Y/N)
? N
```

At this point, the user decides to enter a new value for the

constant so the program gives the hint that increasing the

constant may produce better results.

```
SELECT AN OPTION
  1 - CHANGE PARAMETERS ON THIS SECTION AND TRY AGAIN
  2 - RE-ENTER ENTIRE PROFILE (ZMAX) OF COCKPIT AND TRY AGAIN
  3 - STOP PROGRAM
? 1
WHICH PARAMETER TO CHANGE?
  1 - ZMAX
  2 - CONSTANT CONTROLLING POSITION OF CENTER OF COCKPIT CIRCLE
? 2
DO YOU WANT TO INPUT CHANGE OR USE PROGRAM DEFAULTS?
  1 - INPUT CHANGE
  2 - USE PROGRAM DEFAULT
? 1
CURRENT CONSTANT -    .50
ENTER NEW CONSTANT
(TRY INCREASING CONSTANT)
? .95
```

The increased value of 0.95 still is not good enough and the

processing fails for the third time.

```
AREA REQUIREMENT NOT SATISFIED WITHIN DESIRED ACCURACY
X STATION NO.  13  X •  112.50
AREA DESIRED • 1934.500 AREA COMPUTED • 2954.005 ACCURACY • 52.70 PERCENT
RADIUS •   24.00113
UPPER BOUND ON RADIUS •   44.05129
LOWER BOUND ON RADIUS •   24.00113
IS THIS AREA ACCEPTABLE? (Y/N)
? N
```

The user now chooses to use the program default for changing

the constant. The default option increases or decreases

(according to which limit restricted R) the constant by 0.1.

```
SELECT AN OPTION
   1 - CHANGE PARAMETERS ON THIS SECTION AND TRY AGAIN
   2 - RE-ENTER ENTIRE PROFILE (ZMAX) OF COCKPIT AND TRY AGAIN
   3 - STOP PROGRAM
? 1
WHICH PARAMETER TO CHANGE?
   1 - ZMAX
   2 - CONSTANT CONTROLLING POSITION OF CENTER OF COCKPIT CIRCLE
? 2
DO YOU WANT TO INPUT CHANGE OR USE PROGRAM DEFAULTS?
   1 - INPUT CHANGE
   2 - USE PROGRAM DEFAULT
? 2
CURRENT CONSTANT •   .95
NEW CONSTANT • 1.05
```

If the value of the constant is too close to the limits of 0.1 and

1.4 to be changed by 0.1, one of the following messages is

displayed and the option to select which parameter to change is

repeated.

```
CENTER CANNOT BE POSITIONED HIGHER
TRY CHANGING ZMAX
```

                   or

```
CENTER CANNOT BE POSITIONED LOWER
TRY CHANGING ZMAX
```

Returning to the example, the new constant of 1.05 still is not

satisfactory and the processing fails for the fourth time.

```
AREA REQUIREMENT NOT SATISFIED WITHIN DESIRED ACCURACY
X STATION NO.  13  X = 112.50
AREA DESIRED = 1934.500 AREA COMPUTED = 2794.039 ACCURACY = 44.43 PERCENT
RADIUS =   22.83034
UPPER BOUND ON RADIUS =   42.54745
LOWER BOUND ON RADIUS =   22.83034
IS THIS AREA ACCEPTABLE? (Y/N)
? N
```

At this point, the user decides that the area is still not

acceptable and selects to change the entire upper surface profile

of the cockpit area.

```
SELECT AN OPTION
   1 - CHANGE PARAMETERS ON THIS SECTION AND TRY AGAIN
   2 - RE-ENTER ENTIRE PROFILE (ZMAX) OF COCKPIT AND TRY AGAIN
   3 - STOP PROGRAM
? 2
```

The new profile data will be entered in the same manner it was

entered the first time. If the user chooses to type in the Z_{MAX}

values, the current values will be listed first. If the option to

use the crosshair cursor is selected, the current profile will be

drawn on the blowup with a dashed line before the cursor appears

to accept the new input.

If the user does not wish to attempt to change the parameters to solve the problem, option 3 may be selected to stop program execution. The following message is displayed.

PROGRAM STOPPED BY USER REQUEST

OTHER ERRORS THAT STOP PROGRAM EXECUTION

The following errors occur during the processing of the cross sections and cause program execution to stop. Along with the error message, information identifying the cross section currently being processed is given

*** CURRENT X STATION NO. = _____ , X = _____

ERROR	EXPLANATION
NO WING DEFINITION IN INPUT FILE	Self-explanatory ($J1=0$ in wave-drag file)
Y_{JCT} NOT A VALUE IN YWING ARRAY	Y_{JCT} selected is not located at a semi-span station defined in the wing definition
EXTENSION OF WING TO CENTER HAS AREA > AREA DESIRED FOR FUS	the extended wing definition used up all of the fuselage area from the area distribution.

WING ENTIRELY LOCATED ON UPPER LOBE

a cockpit station is being generated and R has been found. When preparing to generate the digital description, it is discovered that both wing surfaces intersect the shape on the upper lobe and this is not allowed. To remedy this, try changing the balancing requested before the cockpit is processed or try changing the cockpit parameters.

REFERENCES

1. Harris, R. V., Jr.: An Analysis and Correlation of Aircraft Wave Drag, NASA TM X-947, March 1964.

2. Dollyhigh, Samuel M.; Morris, Odell A.; and Adams, Mary S.: Experimental Effects of Fuselage Camber on Longitudinal Aerodynamic Characteristics of a Series of Wing-Fuselage Configurations at a Mach number of 1.41. NASA TM X-3411, 1976.
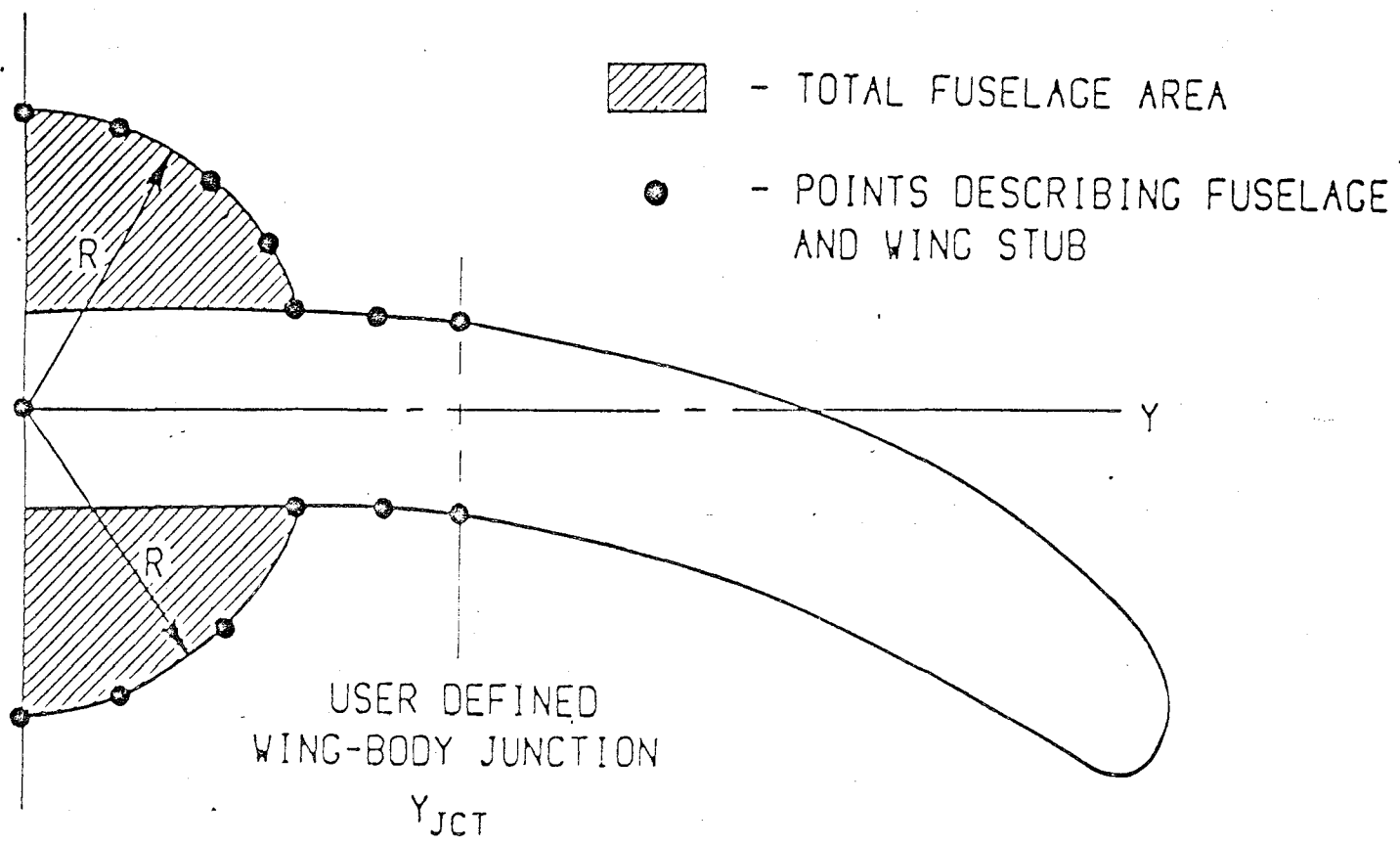
Figure 1. - Circular cross section without area balancing.

SOLUTION

SELECT R AND Z_C SO THAT

1. $A_U + A_L - A_{TOT}$

2. $\dfrac{dA_U}{dx} = \dfrac{dA_L}{dx}$
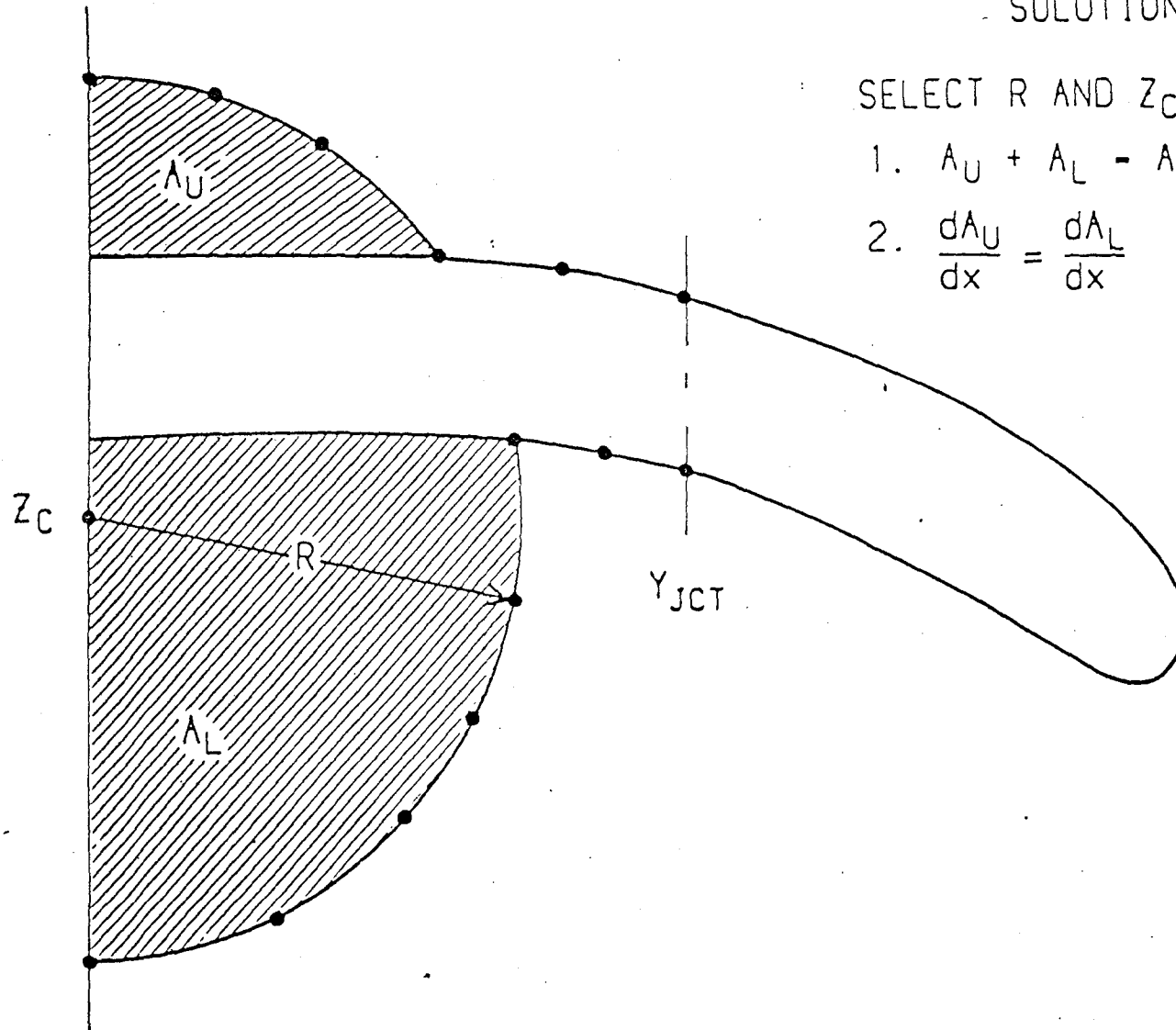
Figure 2. - Circular cross section with area balancing.

Z_{MAX}

Z_2 — R_2

$R_2 = Z_{MAX} - Z_2$ (equation 2)

Z_c — R

$Z_{MAX}(x)$

CIRCULAR

NON-CIRCULAR

CIRCULAR

IBEG

IEND
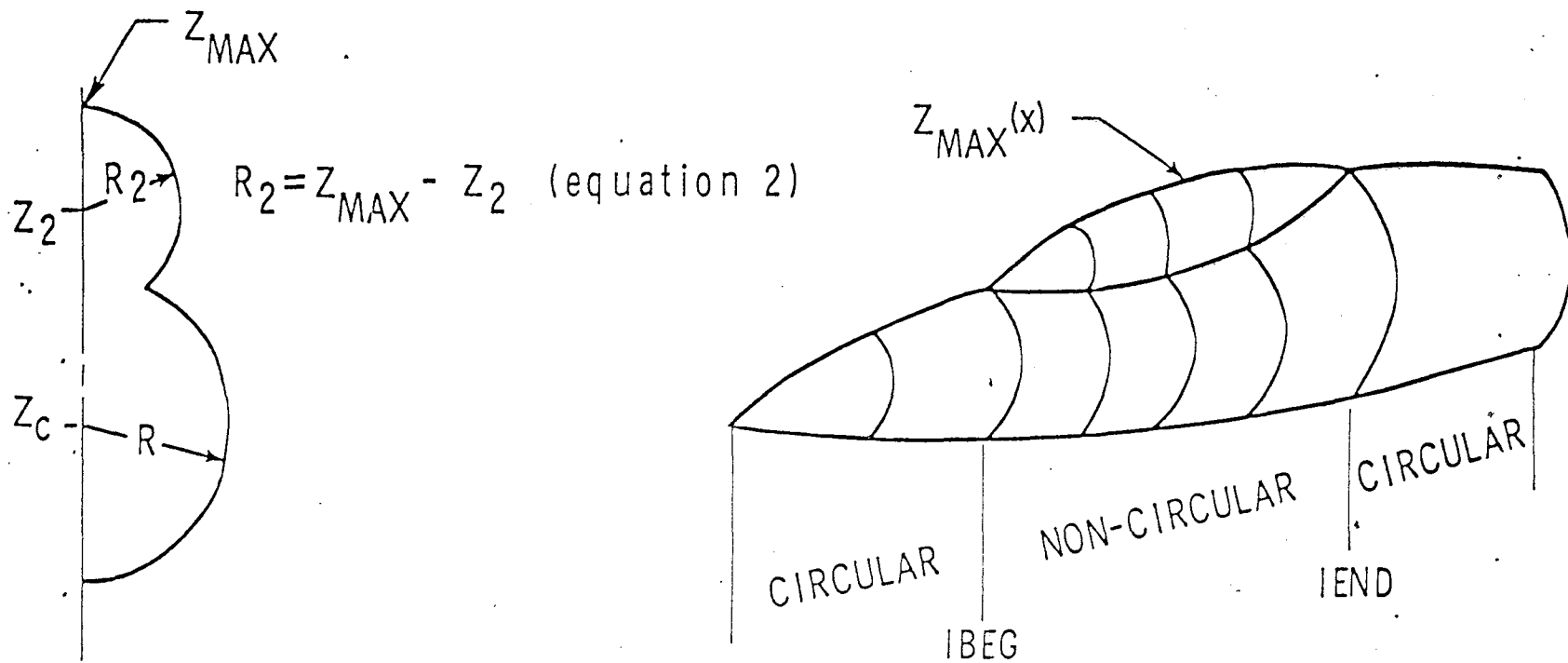
USER INPUT

- BEGINNING AND ENDING COCKPIT STATIONS

- UPPER SURFACE PROFILE $Z_{MAX}(x)$

- $Z_2 = Z_c + R \times \underline{CONST}$ (equation I)

Figure 3. - Noncircular shape option.
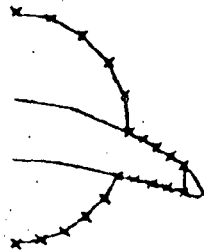
X STATION NO. 7 , X = 30.0

(a) Cross section located at fuselage station 7.

Figure 4. - Typical cross section plots found on SAVPVF (Example 1).

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X STATION NO. 28 , X = 135.0

(b) Cross section located at fuselage station 28.

Figure 4. – Continued.

X STATION NO. 43 , X = 210.0

(c) Cross section located at fuselage station 43.

Figure 4. - Concluded.

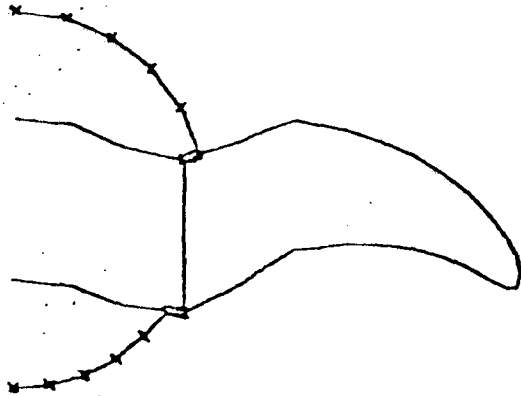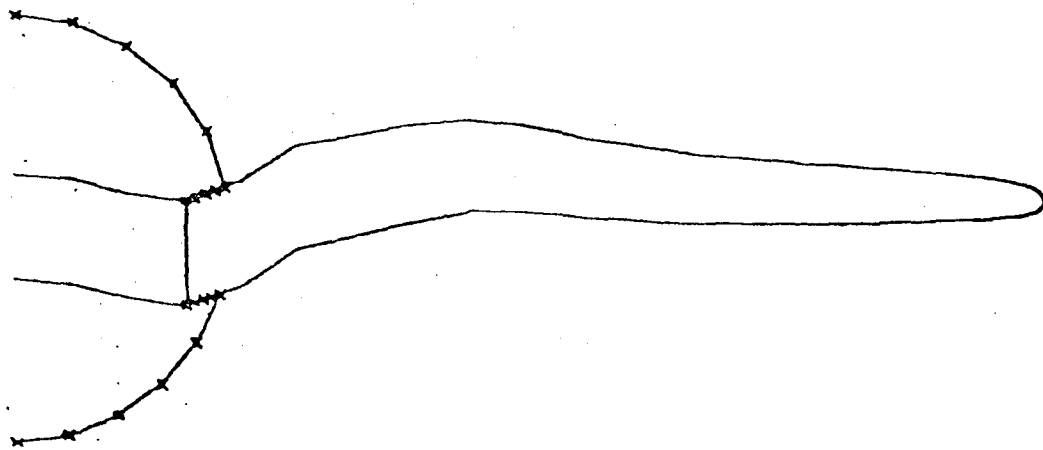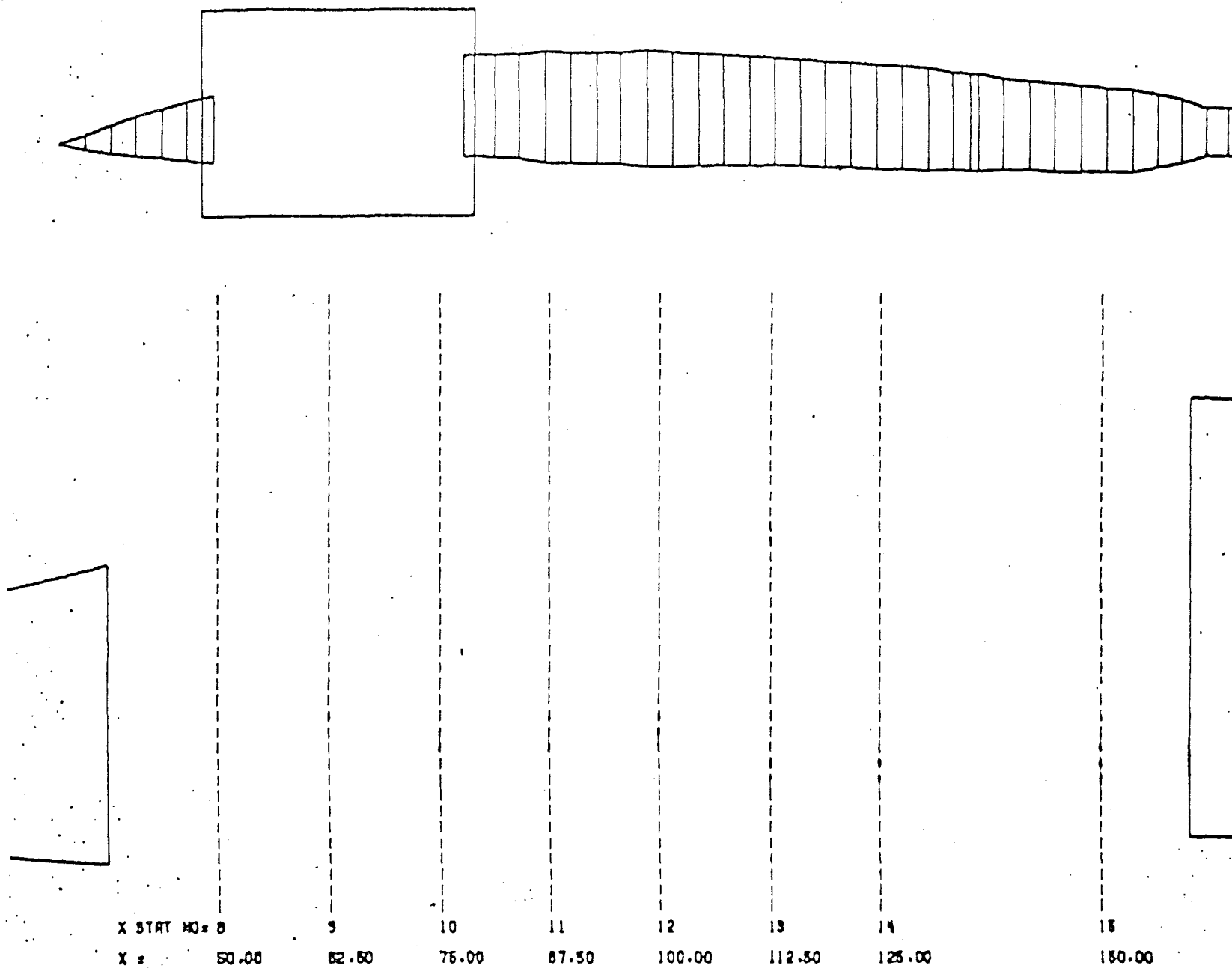| X	UPPER FUSELAGE AREA	LOWER FUSELAGE AREA	TOTAL FUSELAGE AREA	WING AREA TO Y-YJCT	TOTAL AREA	RADIUS	CENTER	UPPER INTERSECTION Y	UPPER INTERSECTION Z	LOWER INTERSECTION Y	LOWER INTERSECTION Z
15.00	10.6764	8.6069	19.2833	3.2501	22.5334	3.6517	-.0980	2.6288	-.4584	8.5437	-.7704
20.00	16.8101	12.9653	29.7755	8.5903	38.3858	3.4195	-.2265	3.3962	-.6244	3.2335	-1.3386
25.00	20.0737	15.0422	35.1159	15.0617	50.1775	3.8490	-.3746	3.8365	-.8139	3.5815	-1.8167
30.00	21.2330	15.5166	36.7497	21.2008	57.9504	4.0654	-.5402	4.0128	-.8872	3.7119	-2.2462
35.00	22.1901	15.9383	38.1284	26.6245	64.7529	4.2981	-.7333	4.8981	-.7177	3.8342	-8.6756
40.00	22.2341	15.7528	37.9869	31.4758	69.4627	4.4316	-.9453	4.4872	-.7469	3.8786	-3.0892
45.00	22.6753	15.6988	38.3742	35.8925	74.2667	4.5782	-1.1615	4.5649	-.8123	3.9204	-3.5117
50.00	22.5369	15.2995	37.8364	40.1269	77.9633	4.6839	-1.3853	4.6618	-.9012	3.9356	-3.9249
55.00	22.4726	15.0822	37.5548	43.8180	81.3728	4.7347	-1.6343	4.7398	-.9840	3.9480	-4.3374
60.00	22.4716	14.8074	37.2791	47.2980	84.5771	4.8797	-1.8834	4.8170	-1.1038	3.9531	-4.7441
65.00	22.6119	14.7379	37.3498	50.4884	87.8382	4.9835	-2.1455	4.9027	-1.2518	3.9723	-5.1548
70.00	22.4291	14.4358	36.8649	53.2838	90.1486	5.0494	-2.4150	4.9453	-1.3942	3.9597	-5.5483
75.00	22.6332	14.3563	36.9895	55.9563	92.9458	5.1399	-2.6852	5.0213	-1.5873	3.9722	-5.9471
80.00	23.1212	14.5998	37.7210	58.2214	95.9424	5.2433	-2.9694	5.1076	-1.7845	4.0105	-6.3469
85.00	23.7885	14.9036	38.6921	60.2792	98.9713	5.3497	-3.2536	5.2044	-1.9986	4.0683	-6.7275
90.00	24.7139	15.4069	40.1208	62.1513	102.2721	5.4704	-3.5420	5.3130	-2.2390	4.1480	-7.1685
95.00	26.0713	16.2671	42.3384	63.6692	106.0076	5.6092	-3.8354	5.4445	-2.4860	4.2661	-7.4774
100.00	27.5161	17.1528	44.6689	65.0577	109.7267	5.7476	-4.1289	5.5800	-2.7511	4.3901	-7.8385
105.00	29.1073	18.2014	47.3087	66.1691	113.4778	5.8857	-4.4236	5.7171	-3.0252	4.5155	-8.1987
110.00	30.7744	19.3361	50.1105	67.0396	117.1501	6.0193	-4.7186	5.8497	-3.2999	4.6510	-8.5396
115.00	32.5536	20.5225	53.0761	67.7890	120.8651	6.1531	-5.0136	5.9875	-3.5958	4.7882	-8.8781
120.00	34.5861	21.8708	56.4569	68.2081	124.6650	6.2872	-5.3088	6.1124	-3.8365	4.9274	-9.2135
125.00	36.9366	23.4857	60.4223	68.4946	128.9068	6.4355	-5.6038	6.2487	-4.0642	5.1007	-9.5276
130.00	39.5727	25.3419	64.9147	68.5756	133.4902	6.5913	-5.8935	6.3962	-4.3015	5.2758	-9.8446
135.00	42.1424	27.3118	69.4542	68.3931	137.8473	6.7059	-6.1811	6.5322	-4.5373	5.4424	-10.1540
140.00	44.9959	29.5125	74.5084	68.1356	142.6439	6.8914	-6.4680	6.6779	-4.7661	5.6300	-10.4422
145.00	48.0018	31.8688	79.8705	67.5680	147.4385	7.0416	-6.7475	6.8220	-5.0060	5.8040	-10.7347
150.00	50.8869	34.3064	85.1933	66.8432	152.0366	7.1822	-7.0270	6.9558	-5.2377	5.9787	-11.0069
155.00	53.8562	36.7597	90.6159	66.0010	156.6169	7.3167	-7.2995	7.0879	-5.4839	6.2323	-11.1325
160.00	56.4595	39.0992	95.5586	64.8581	160.4168	7.4238	-7.5651	7.1948	-5.7253	6.4342	-11.2684
165.00	58.6672	41.2573	99.9244	63.6553	163.5798	7.5087	-7.8343	7.2805	-5.9937	6.6124	-11.3885
170.00	61.3205	43.5468	104.8673	62.1986	167.0660	7.5990	-8.0825	7.3760	-6.2551	6.7822	-11.5499
175.00	64.8428	46.7500	111.5928	60.5518	172.1445	7.7278	-8.3331	7.5075	-6.5409	7.0010	-11.6054
180.00	67.8203	48.9800	116.0003	58.8409	174.8412	7.7894	-8.5254	7.5759	-6.7740	7.1347	-11.7109
185.00	66.9096	49.4846	116.3942	56.8063	173.2005	7.7383	-8.8394	7.5383	-7.0914	7.1098	-11.8944
190.00	67.1274	50.4441	117.5715	54.7167	172.2882	7.7044	-9.0932	7.5164	-7.4405	7.1231	-12.0295
195.00	68.9650	52.6247	121.5897	52.4291	174.0188	7.7373	-9.3371	7.5593	-7.6868	7.2185	-12.1227
200.00	69.7537	54.0038	123.7575	49.9172	173.6747	7.7164	-9.5765	7.6517	-7.9926	7.2435	-12.2052
205.00	69.4066	54.4592	123.8658	47.3836	171.2495	7.6416	-9.8165	7.4923	-8.3134	7.2137	-12.3378
210.00	68.5663	54.7862	123.3525	44.5127	167.8652	7.5431	-10.0597	7.4093	-8.6454	7.1519	-12.4573
215.00	66.7184	54.3978	121.1162	41.5879	162.7041	7.3983	-10.3034	7.2789	-8.9791	7.0543	-12.5323
220.00	65.7120	54.6529	120.3659	38.5135	158.8784	7.2875	-10.5376	7.1820	-9.3418	6.9898	-12.5992
225.00	62.6113	52.9978	115.6091	35.1873	150.7964	7.0654	-10.7654	6.9781	-9.6578	6.8014	-12.6789
230.00	59.9666	51.7154	111.6815	31.8609	143.5425	6.8632	-10.9932	6.7915	-10.0438	6.6386	-12.7342
235.00	57.5922	50.8040	108.3962	28.2098	136.6048	6.6678	-11.2135	6.6115	-10.3412	6.4845	-12.7664
240.00	55.7044	50.3804	106.0848	24.4885	130.5733	6.4964	-11.4336	6.4507	-10.6842	6.3593	-12.7614
245.00	55.4227	51.2326	106.6554	20.6587	127.3141	6.4015	-11.6404	6.3657	-10.9649	6.3070	-12.7364
250.00	50.9059	47.8543	98.7602	16.5535	115.3137	6.0645	-11.8258	6.0427	-11.3119	5.9978	-12.7829
255.00	47.3890	45.1993	92.5992	12.4484	104.9675	5.7686	-12.0111	5.7538	-11.5979	5.7331	-12.6499
260.00	40.3469	39.2646	79.6116	8.0654	87.6769	5.2543	-12.1903	5.2459	-11.8936	5.2403	-12.5734
265.00	27.3747	27.1044	54.4791	3.5858	58.0648	4.2622	-12.3679	4.2604	-12.2452	4.2585	-12.5442
270.00			32.1700			3.2000	-12.4979				
275.00			26.4200			2.9000	-12.6179				
280.00			20.0300			2.5250	-12.6879				
285.00			9.2900			1.7196	-12.6779				
290.00			1.9600			.7899	-12.6479				
294.00			0.0000			0.0000	-12.5479				
10.00			1.1400			1.6097	.0120				
5.00			1.4500			.6794	.0120				
0.00			0.0000			0.0000	.0120				

END OF FILE
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Figure 5. - TAPE10 produced by running Example 1.

```
0.000000.000000.000000.000000.000000.000000.000000.000000.000000.00000    Y    1
0.000000.000000.000000.000000.000000.000000.000000.000000.000000.00000    Y    1
 .01198 .01198 .01198 .01198 .01198 .01198 .01198 .01198 .01198 .01198    Z    1
 .01198 .01198 .01198 .01198 .01198 .01198 .01198 .01198 .01198 .01198    Z    1
0.00000 .17609 .34014 .48095 .58888 .65656 .65656 .65656 .65656 .65656    Y    2
 .67336 .67336 .67336 .67336 .66478 .57973 .42801 .22706 .00000           Y    2
-.6674 -.6442 -.5761 -.4679 -.3268 -.1626 -.1626 -.1626 -.1626 -.1626     Z    2
-.0782 -.0782 -.0782 -.0782 -.0782  .1520  .3662  .5396  .6523  .6914     Z    2
0.00000 .41721 .805911.139521.395261.555621.555621.555621.555621.55562    Y    3
1.595431.595431.595431.595431.595431.575091.373591.01411 .53799 .00000    Y    3
-1.5977-1.5427-1.3814-1.1249 -.7907 -.4016 -.4016 -.4016 -.4016 -.4016    Z    3
-.2017 -.2017 -.2017 -.2017 -.2017  .3438  .8512 1.2620 1.5291 1.6217     Z    3
0.00000 .687291.327611.877192.298472.562652.885173.297693.530213.85273    Y    4
3.852733.546603.240482.934352.628232.594722.262781.67060 .886260.00000    Y    4
-2.7497-2.6591-2.3934-1.9709-1.4203 -.7794 -.8734 -.9689-1.0630-1.1569    Z    4
-1.1569 -.9740 -.7914 -.6179 -.4500  .4487 1.2845 1.9612 2.4012 2.5537    Z    4
0.00000 .839041.626792.315062.861793.233543.673254.112964.552674.99238    Y    5
4.992384.593344.194313.795273.396233.336422.900182.136751.132240.00000    Y    5
-3.6459-3.5414-3.2342-2.7430-2.0981-1.3386-1.4637-1.5939-1.7460-1.8279    Z    5
-1.8279-1.4094-1.0865 -.8332 -.6244  .5226 1.5851 2.4432 3.0001 3.1930    Z    5
0.00000 .904971.759212.514803.129493.568544.176404.784275.392136.00000    Y    6
6.000005.459124.918254.377373.836503.729513.219432.361401.248150.00000    Y    6
-4.2234-4.1155-3.7979-3.2883-2.6153-1.8167-1.9725-2.1368-2.3599-2.4750    Z    6
-2.3971-1.7896-1.3524 -.9888 -.6839  .5769 1.7349 2.6650 3.2665 3.4745    Z    6
0.00000 .923311.798842.581293.239173.711904.283934.855955.427986.00000    Y
6.000005.520705.041404.562104.082803.920213.356262.448681.294400.00000    Y
-4.6256-4.5199-4.2083-3.7069-3.0416-2.3694-2.5155-2.6784              Y
-1.8723-1.5335-1.2322 -.9310 -.6872  .6099 1.7893 2.73
0.00000 .939561.833662.639083.316843.834174.375
6.000005.574525.149034.723554.298074.0
-5.0314-4.9274-4.6296-4.1257-3.46                                    Z    53
-1.5951-1.3235-1.1200 -.0                                          Z    53
0.00000 .937551.8                                    ...36.00000   Y    54
6.000005.6                                        ...81.293730.00000  Y    54
-5                                            ...08-12.473-12.437-12.401  Z    54
                                             ...08 -9.803 -8.891 -8.307 -8.106  Z    54
                                          ...73.197273.197273.197273.19727  Y    55
                                     ...03.198683.019812.555991.85098 .971320.00000  Y    55
                                  ...18-14.442-13.587-12.630-12.630-12.630-12.630  Z    55
                               ...06-12.406-12.406-12.406-11.439-10.573 -9.888 -9.449 -9.298  Z    55
                          ...00 .873291.665502.343092.726862.897482.897482.897482.89748  Y    56
2.898762.898762.898762.898762.898762.736662.316331.67743 .884240.00000    Y    56
-15.518-15.383-14.992-14.380-13.605-12.738-12.738-12.738-12.738-12.738    Z    56
-12.534-12.534-12.534-12.534-11.659-10.252 -9.855 -9.718                   Z    56
0.00000 .760381.450172.005032.374312.522862.522862.522862.522862.52286    Y    57
2.523982.523982.523982.523982.523982.382842.016851.46055 .766440.00000    Y    57
-15.213-15.096-14.755-14.222-13.547-12.792-12.792-12.792-12.792-12.792    Z    57
-12.615-12.615-12.615-12.615-11.853-11.169-10.628-10.282-10.163            Z    57
0.00000 .51784 .987611.365691.616981.718151.718151.718151.718151.71815    Y    58
1.718911.718911.718911.718911.718911.622791.37354 .99468 .521970.00000    Y    58
-14.398-14.318-14.086-13.723-13.263-12.749-12.749-12.749-12.749-12.749    Z    58
-12.628-12.628-12.628-12.628-12.628-12.109-11.643-11.275-11.039-10.958    Z    58
0.00000 .23786 .45364 .62730 .74272 .78919 .78919 .78919 .78919 .78919    Y    59
 .78954 .78954 .78954 .78954 .78954 .74539 .63090 .45688 .239750.00000    Y    59
-13.438-13.401-13.295-13.128-12.917-12.681-12.681-12.681-12.681-12.681    Z    59
-12.625-12.625-12.625-12.625-12.625-12.387-12.173-12.004-11.895-11.858    Z    59
0.000000.000000.000000.000000.000000.000000.000000.000000.000000.00000    Y    60
0.000000.000000.000000.000000.000000.000000.000000.000000.000000.00000    Y    60
-12.548-12.548-12.548-12.548-12.548-12.548-12.548-12.548-12.548-12.548    Z    60
-12.548-12.548-12.548-12.548-12.548-12.548-12.548-12.548-12.548-12.548    Z    60
END OF FILE
77
```

Figure 6. - TAPE8 produced by running Example 1.

X STAT NO= 8   9   10   11   12   13   14   15

X =   50.00   62.50   75.00   87.50   100.00   112.50   125.00   150.00

(a) Before user input.

Figure 7. - Graphically defining Z_{MAX} (Example 2).

accepted points

X START NO= 8	9	10	11	12	13	14	15
X = 50.00	62.50	75.00	87.50	100.00	112.50	125.00	150.00
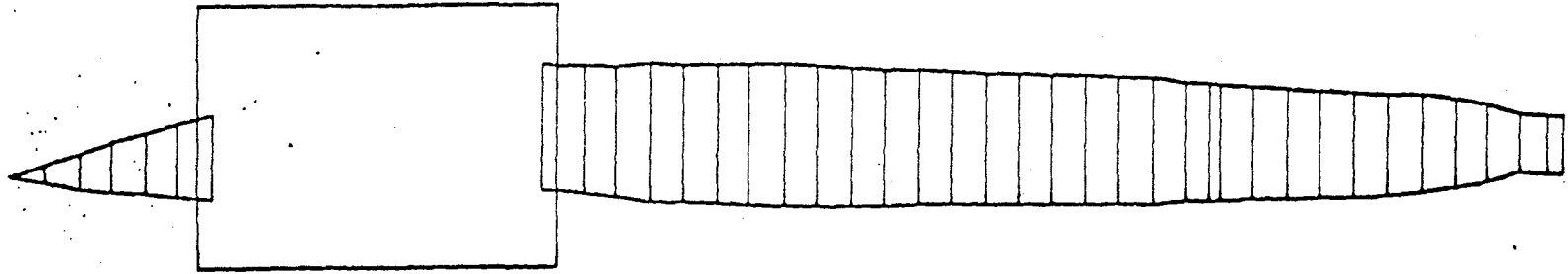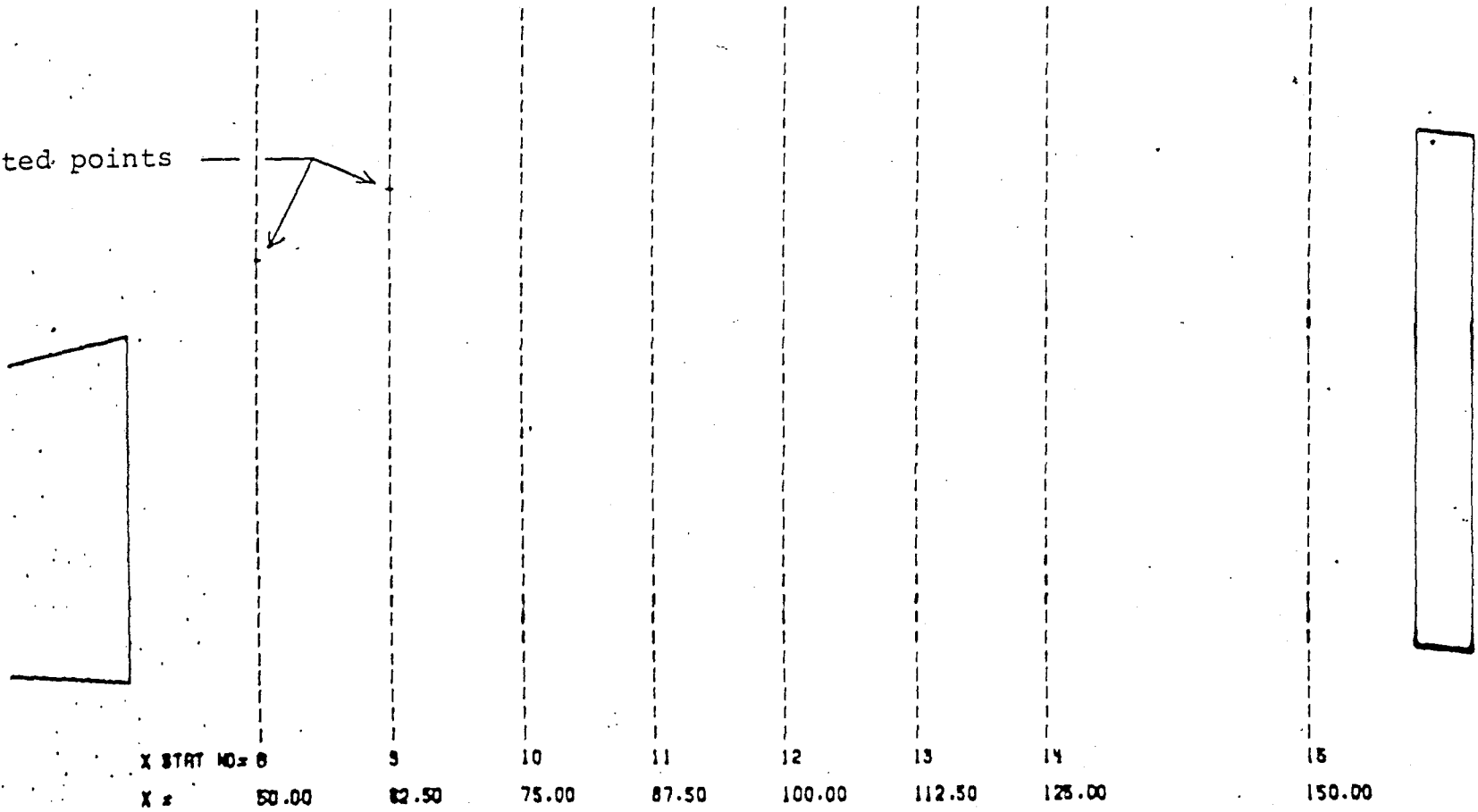
(b) During user input.

Figure 7. - Continued.

X STAT NO= 8 9 10 11 12 13 14 15

X = 50.00 62.50 75.00 87.50 100.00 112.50 125.00 150.00
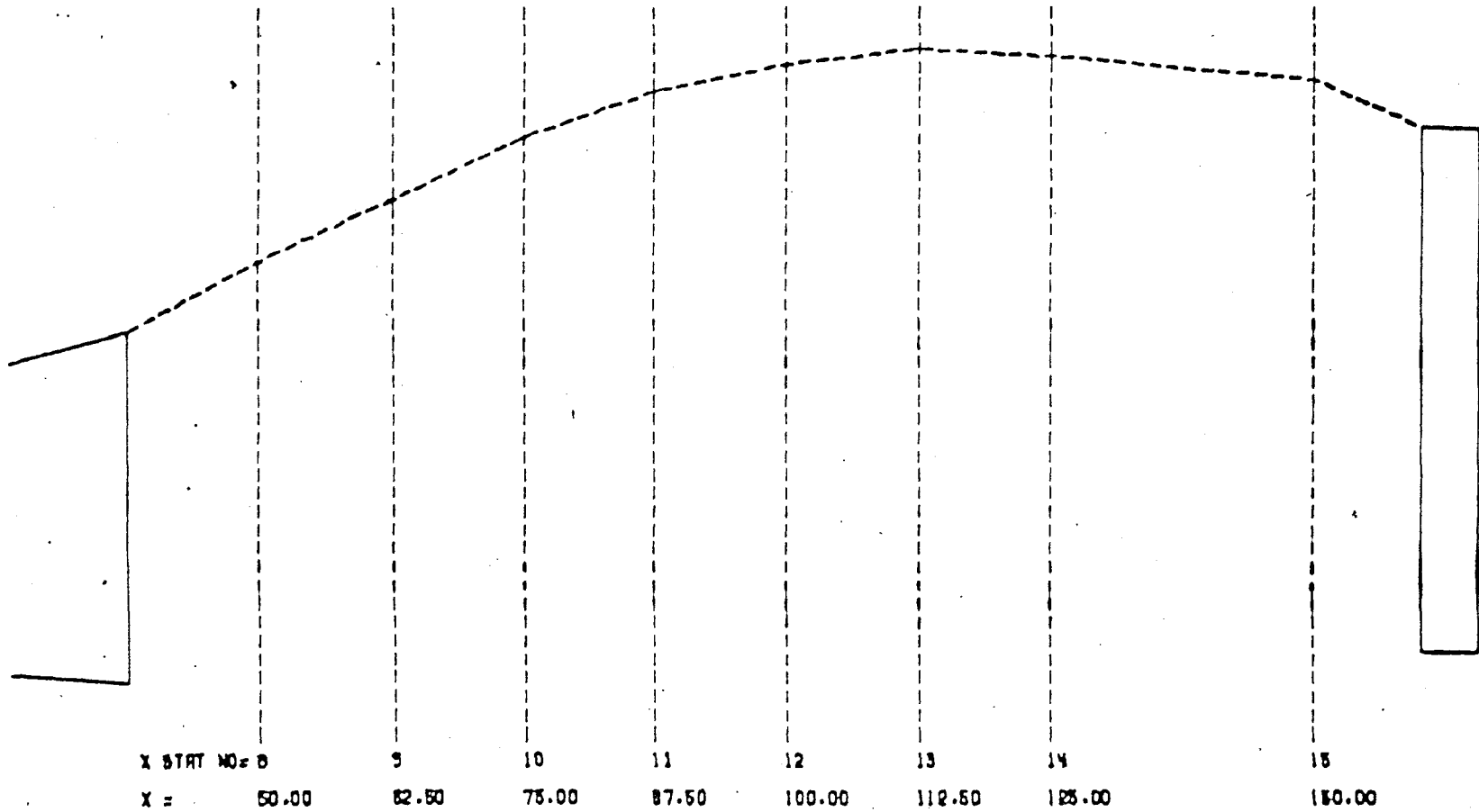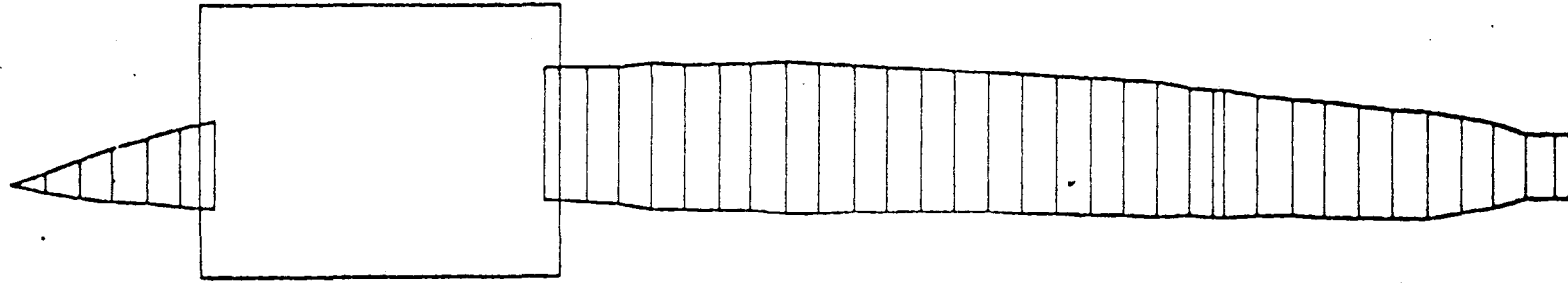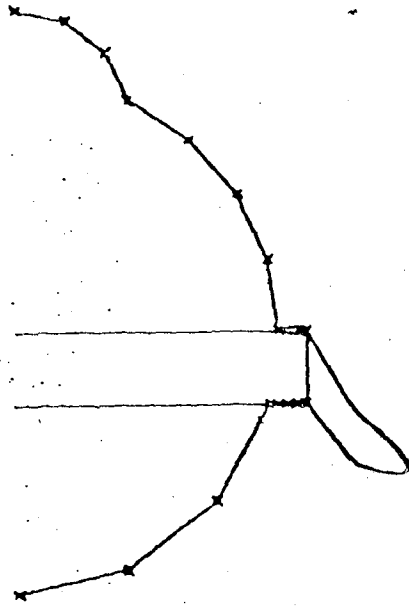
(c) After user input.

Figure 7. - Concluded.

X STATION NO. 8 , X = 50.0

(a) Cross section located at fuselage station 8.
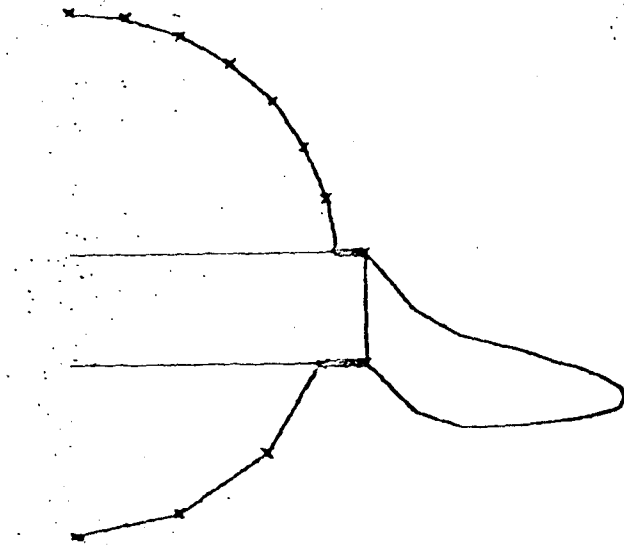
Figure 8. - Typical cross-section plots found on SAVPVF (Example 2).

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X STATION NO. 12 , X = 100.0

(b) Cross section located at fuselage station 12.
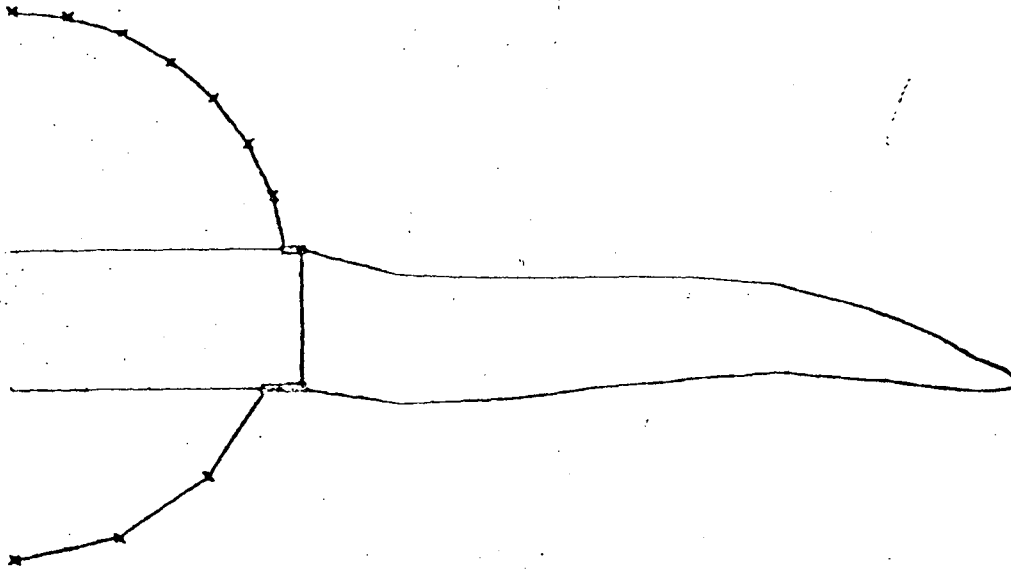
Figure 8. - Continued.

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X STATION NO. 16 . X = 160.0

(c) Cross section located at fuselage station 16.

Figure 8. – Continued.

X STATION NO. 30 . X = 325.0

(d) Cross section located at fuselage station 30.

Figure 8. - Concluded.

X	UPPER FUSELAGE AREA	LOWER FUSELAGE AREA	TOTAL FUSELAGE AREA	WING AREA TO Y=YJCT	TOTAL AREA	RADIUS	CENTER	UPPER INTERSECTION Y	Z	LOWER INTERSECTION Y	Z
200.00	905.3234	604.7307	1510.0540	599.7053	2109.7593	25.8568	-.2373	25.7059	2.5527	24.3221	-9.0130
187.50	815.7171	513.5345	1329.2516	578.5002	1907.7518	24.3611	.1798	24.2447	2.5577	23.7246	-8.5990
175.00	811.6396	507.9521	1319.5917	553.0927	1872.6844	24.1098	.4328	24.0189	2.5282	23.5324	-8.1445
165.50	780.4990	478.0396	1258.5386	535.5240	1794.8626	23.5100	.6554	23.4370	2.5465	21.9286	-7.8215
160.00	790.3888	485.9759	1276.3647	525.5883	1801.9530	23.5817	.7513	23.5168	2.4089	22.0392	-7.8375
212.50	896.3717	596.6092	1492.9809	613.9905	2106.9714	25.8329	-.4483	25.6662	2.4109	24.3469	-9.3603
225.00	895.9198	594.6930	1490.6128	628.2760	2118.8888	25.9151	-.8494	25.7340	2.4092	24.2846	-9.7075
237.00	914.4647	613.1224	1527.5870	641.9898	2169.5768	26.2777	-.8960	26.0944	2.2084	24.6329	-10.0409
250.00	945.0089	641.0144	1586.0233	650.2136	2236.2370	26.7482	-1.1762	26.5924	1.7068	25.1161	-10.3764
262.50	926.9358	623.7096	1550.6453	656.6563	2207.3016	26.5442	-1.4111	26.3617	1.6963	24.8684	-10.6933
275.00	889.2484	585.8672	1475.1156	663.0989	2138.2144	26.0460	-1.6011	25.8259	1.7780	24.2871	-11.0103
287.50	863.7965	560.9723	1424.7688	665.7155	2090.4843	25.6942	-1.8565	25.4730	1.5082	23.8838	-11.3395
300.00	839.1726	534.7664	1373.9389	659.9599	2033.8989	25.2725	-2.1700	25.0640	1.0697	23.4239	-11.6581
312.50	823.3124	518.4873	1341.7996	654.2043	1996.0040	24.9874	-2.5120	24.7889	.6311	23.1219	-11.9856
325.00	807.1849	501.9063	1309.0912	648.4488	1957.5400	24.6948	-2.8516	24.5065	.1926	22.8104	-12.3132
337.50	806.1935	501.3009	1307.4944	625.5818	1933.0762	24.5215	-3.3600	24.3599	-.5497	22.7085	-12.6145
350.00	809.9218	504.2460	1314.1679	597.9317	1912.0996	24.3793	-3.9020	24.2482	-1.3769	22.6547	-12.9984
362.50	810.6253	505.1284	1315.7537	570.2816	1886.0353	24.1988	-4.4475	24.0946	-2.2041	22.5596	-13.2024
375.00	820.1282	515.4500	1335.5782	538.7282	1874.3064	24.1333	-5.0491	24.0548	-3.1009	22.6088	-13.4906
387.50	823.3070	520.2472	1343.8842	495.4318	1839.3160	23.8996	-5.7304	23.8510	-4.2069	22.5097	-13.7617
400.00	757.8348	453.6500	1211.4848	449.0108	1660.4956	22.5382	-6.2475	22.5213	-5.3749	21.1504	-14.0343
403.95	765.5392	463.2185	1228.7577	413.3828	1642.1405	22.4366	-6.8928	22.4300	-6.2585	21.1713	-14.2308
412.50	762.9366	458.6539	1221.5905	399.2510	1620.8416	22.2830	-6.9733	22.2800	-6.6489	21.0410	-14.3987
425.00	719.7137	415.5011	1135.2148	346.7089	1481.9237	21.2200	-7.5794	21.2177	-7.8893	20.0334	-14.5758
437.50	721.5284	415.4423	1136.9707	293.0706	1430.0413	20.8793	-8.2895	20.8600	-9.1879	19.8252	-14.8400
450.00	716.2791	411.6114	1127.8905	238.7712	1366.6618	20.4490	-9.0061	20.3958	-10.4795	19.5247	-15.0843
462.50	706.6088	401.8641	1108.4730	184.4489	1292.9218	19.9354	-9.6651	19.8257	-11.7537	19.1193	-15.3109
475.00	688.9511	384.7486	1073.6996	130.1725	1203.8722	19.2944	-10.2239	19.1044	-12.9531	18.5693	-15.4636
487.50	667.3275	363.1256	1030.4531	75.2325	1105.6856	18.5762	-10.6766	18.2601	-14.0890	17.9283	-15.5399
500.00	599.5610	296.2606	895.8216	19.3724	915.1940	17.0188	-10.8650	16.4500	-15.1367	16.3471	-15.5103
512.00			685.6000			14.7727	-10.6750				
524.20			391.4000			11.1618	-10.8450				
535.00			387.4000			11.1046	-11.0250				
540.08			392.3000			11.1818	-11.1450				
150.00	852.9282	478.4662	1331.3945	506.4531	1837.8475	23.4871	1.1413	23.4495	2.4708	21.9192	-7.2965
125.00	1037.7327	508.3069	1546.0398	435.0812	1981.1208	24.7104	3.0213	24.6922	2.0708	22.8768	-6.3200
112.50	1017.5807	523.0210	1540.6017	393.0316	1933.6333	24.1382	2.4413	24.1280	1.7407	22.6735	-5.8392
100.00	940.8114	559.6227	1500.4341	341.9955	1842.4296	23.3330	1.0613	23.3322	1.2524	22.4362	-5.3432
87.50	784.3690	578.4253	1362.7943	283.8407	1646.6350	21.5489	-1.3287	21.4589	.6390	21.2618	-4.8351
75.00	605.9236	575.8051	1181.7287	204.9875	1386.7162	19.2260	-4.1487	18.8379	-.3054	19.2256	-4.2588
62.50			1139.6561			18.1595	-6.8887				
50.00			958.0125			17.1457	-8.5887				
37.50			775.0100			15.7066	-9.8887				
25.00			596.7800			13.7826	-11.0287				
12.50			425.4100			11.6367	-12.1887				
0.00			269.4700			9.8615	-13.4387				
-12.50			134.5200			6.5438	-14.7887				
-25.00			35.8500			3.3781	-15.9187				
-38.00			0.0000			0.0000	-16.9887				

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77

Figure 9. — TAPE10 produced by running Example 2.

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0.000000.000000.000000.000000.000000.000000.000000.000000.000000.00000      Y    1
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-16.989-16.989-16.989-16.989-16.989-16.989-16.989-16.989-16.989-16.989      Z    1
0.000001.683462.919643.378023.378023.378023.378023.378023.309893.30989      Y    2
3.309893.309893.309893.115472.802172.381951.870851.80838 .66471 .00000      Y    2
-19.197-18.747-17.519-15.838-15.838-15.838-15.838-15.838-15.143-15.143      Z    2
-15.143-15.143-15.143-14.513-13.932-13.423-13.006-12.896-12.505-12.441      Z    2
0.000003.261005.654426.543526.543526.543526.543526.411556.41155            Y    3
6.411556.411556.411556.034935.428054.614053.623992.495661.27210 .00000      Y    3
-21.332-20.462-18.082-14.826-14.826-14.826-14.826-14.826-13.481-13.481      Z    3
-13.481-13.481-13.481-12.259-11.134-10.149 -9.344 -8.740 -8.370 -8.245      Z    3
0.000004.615438.002959.261339.261339.261339.261339.261339.074549.07454     Y    4
9.074549.074549.074548.541597.682556.530465.129193.532211.80045 .00000      Y    4
-22.700-21.468-18.100-13.492-13.492-13.492-13.492-13.492-11.587-11.587      Z    4
-11.587-11.587-11.587 -9.859 -8.266 -6.872 -5.727 -4.877 -4.354 -4.177      Z    4
 0.0000 5.799110.055411.636511.636511.636511.636511.636511.401811.4018      Y    5
11.401811.401811.401810.7321 9.6528 8.2053 6.4446 4.4381 2.2622 .0000       Y    5
-23.825-22.277-18.045-12.255-12.255-12.255-12.255-12.255 -9.863 -9.863      Z    5
 -9.863 -9.863 -9.863 -7.690 -5.690 -3.937 -2.500 -1.432 -.774 -.552        Z    5
 0.0000 6.868511.969713.782413.782413.782413.782413.782413.504413.5044      Y    6
13.504413.504413.504412.711211.4329 9.7184 7.6331 5.2565 2.6794 .0000       Y    6
-24.811-22.978-17.966-11.108-11.108-11.108-11.108-11.108 -8.274 -8.274      Z    6
 -8.274 -8.274 -8.274 -5.701 -3.331 -1.256 .447 1.712 2.491 2.73            Z
 0.0000 7.827313.572115.706215.706215.706215.706215.706215.380      Y
15.389515.389515.389514.485513.028811.0750 8.6986 5.90                 Y
-25.595-23.506-17.794 -9.979 -9.979 -9.979 -9.0                        Z
 -6.749 -6.749 -6.749 -3.817 -1.117   1                               41
0.0000 8.544514.815817.145517                                     Y   42
16.799716.799716.799715                                           Y   42
-25.734-23.454-17                                                 Z   42
 -5.161 -6                                     5.348 3.029 9.792 10.279   Z   42
a                                      22.247624.086825.926025.926024.2196  Y  43
                                     18.141616.009912.9246 9.0694 4.6739 0.0000  Y  43
                             15.464-15.464-15.464-15.464-15.464-12.953-12.953  Z  43
                       3-12.953 -8.245 -3.655 .544 4.102 6.806 8.496 9.078  Z   43
              7.833314.205617.928319.927721.928625.926025.926024.0895    Y    44
22.093020.176618.260118.535717.651615.863012.6945 8.9317 4.6101 0.0000     Y    44
-29.253-27.520-22.646-15.540-15.540-15.540-15.540-15.540-14.089-14.089      Z    44
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 0.0000 7.094112.895416.347118.741821.136523.531325.926023.5570            Y    45
21.188018.819016.458017.010716.417514.710712.0061 8.4872 4.3926 0.0000      Y    45
-27.816-26.266-21.899-15.510-15.510-15.510-15.510-15.510-15.137-15.137      Z    45
-15.137-15.137-15.137-10.742 -6.352 -2.263 1.246 3.937 5.629 6.206          Z    45
 0.0000 6.160711.198814.196314.196314.196314.196314.196314.285714.2857      Y    46
14.285714.285714.285714.772614.257512.775318.4265 7.3706 3.8147 .0000       Y    46
-25.448-24.102-20.389-14.761-14.761-14.761-14.761-14.761-14.437-14.437      Z    46
-14.437-14.437-14.437-10.620 -6.807 -3.257 -.210 2.128 3.597 4.098          Z    46
 0.0000 4.6549 8.461510.726310.726310.726310.726310.726310.793910.7939     Y    47
10.793910.793910.793911.161816.7725 9.6526 7.8780 5.5690 2.8822 .0000       Y    47
-22.007-20.990-18.124-13.932-13.932-13.932-13.932-13.932-13.687-13.687      Z    47
-13.687-13.687-13.687-10.804 -7.923 -5.240 -2.938 -1.172 -.062 .317         Z    47
 0.0000 4.6310 8.418210.671410.671410.671410.671410.671410.738610.7386     Y    48
10.738610.738610.738611.104610.7173 9.6032 7.8378 5.5404 2.8676 .0000       Y    48
-22.130-21.118-18.267-14.097-14.097-14.097-14.097-13.853-13.853             Z    48
-13.853-13.853-13.853-10.984 -8.118 -5.449 -3.158 -1.401 -.297 .080         Z    48
 0.0000 4.6632 8.476610.745510.745510.745510.745510.745510.813210.8132     Y    49
10.813210.813210.813211.181710.7918 9.6899 7.9081 5.5789 2.8874 .0000       Y    49
-22.327-21.308-18.437-14.239-14.239-14.239-14.239-14.239-13.992-13.992      Z    49
-13.992-13.992-13.992-11.104 -8.218 -5.530 -3.224 -1.454 -.342 .037         Z    49
END OF FILE
77
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Figure 10. - TAPE8 produced by running Example 2.

1. Report No. NASA TM-83218	2. Government Accession No.	3. Recipient's Catalog No.
4. Title and Subtitle XSECT: A Computer Code for Generating Fuselage Cross Sections - User's Manual		5. Report Date February 1982
		6. Performing Organization Code
7. Author(s) Kathy R. Ames		8. Performing Organization Report No.
9. Performing Organization Name and Address NASA Langley Research Center Hampton, VA 23665		10. Work Unit No. 505-43-23-03
		11. Contract or Grant No.
12. Sponsoring Agency Name and Address National Aeronautics and Space Administration Washington, DC 20546		13. Type of Report and Period Covered Technical Memorandum
		14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

A computer code, XSECT, has been developed to generate fuselage cross sections from a given area distribution and wing definition. The cross sections are generated to match the wing definition while conforming to the area requirement. An iterative procedure is used to generate each cross section. Fuselage area balancing may be included in this procedure if desired.

The code is intended as an aid for engineers who must first design a wing under certain aerodynamic constraints and then design a fuselage for the wing such that the constraints remain satisfied. This report contains the information necessary for accessing and executing the code, which is written in FORTRAN to execute on the Cyber 170 series computers (NOS operating system) and produces graphical output for a Tektronix 4014 CRT. The LRC graphics software is used in combination with the interface between this software and the PLOT 10 software.

17. Key Words (Suggested by Author(s)) wave-drag supersonic aerodynamics supersonic area rule	18. Distribution Statement

19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 64	22. Price A04