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# FAA TECHNICAL CENTER LETTER REPORT

SOFTWARE DOCUMENTATION:  
PARAMETER CALCULATIONS  
FOR  
ILS GLIDE SLOPE  
ANTENNA SYSTEMS

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## ABSTRACT

This report documents the FORTRAN program ANTHTS1. The program will accept input values for the ILS glide slope null reference, sideband reference, or capture effect antenna systems. The program then uses these values to calculate other unknown factors about the system. The author of this report is Bruce L. Perry. For further information about this report contact Edmund Zyzys, FAA Technical Center, Atlantic City Airport, NJ 08405, (609) 641-8200, ext. 3816.

### Key Words

Glide Slope  
Antenna Heights  
Antenna Offset  
A-Ratio

### Project No.

071-313-840

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## PURPOSE

The purpose of this program is to aid project personnel involved in math modeling studies of glide slope sites, by condensing several operations into one easily accessible program.

## BACKGROUND

Project engineers have identified some areas in the ILS glide slope math modeling process, which with modification, will increase the efficiency of the modeling process:

1. In order to run a glide slope math model, it is necessary to compute the antenna heights of the system under consideration. These values are then used as inputs to the modeling process. To determine these antenna heights, the operator must estimate the average slope of the terrain in front of the glide slope antenna mast. This value is algebraically subtracted from the flat earth glide angle to yield an operator corrected glide angle (OCGA). Since the glide slope math model provides a more accurate representation of the terrain, there is normally a discrepancy between the modeled glide angle (MGA) and the desired glide angle (DGA). To correct this error, the antenna heights must be recalculated using the difference between MGA and DGA as a correction factor. The model is then rerun using the new antenna heights.

The difficulty occurs after the first modeling attempt when the new antenna heights are being computed. The OCGA used to compute the original antenna heights cannot be conveniently saved in the input or output files of the math modeling program without modification of the program. To avoid this the operator records this value in a logbook. This has proven to be cumbersome and the idea of a short program to calculate this value was conceived.

2. The operator must occasionally determine a new value for the ratio of the separate sideband amplitude to the carrier sideband signal amplitude (A-Ratio) based on the old value of the A-ratio and the desired glide path width. For convenience, this calculation is included in ANTHTS1.

## DISCUSSION

ANTHTS1 is an interactive program written in FORTRAN and usable on the Honeywell 66/60 computer. The following portion of the discussion refers to the flowchart in Appendix A. The program first clears the screen and initializes variables RAD and DEG to values of 0.017453 and 57.2958, respectively (page A-1). These two variables are used throughout the program to convert angular values from degrees to radians and vice-versa. The variables SEL and SYS, declared as character variables at the beginning of the program, are used to guide program control to the proper point in the program based on user responses to various prompts from the program. After start-up, the program presents the user with a menu from which the user selects one option: antenna heights calculation (A-2), glide slope angle calculation (A-3) or A-Ratio calculation (A-4). If the antenna heights calculation is selected, the program will request a value for glide slope angle (all angular values should be in degrees; linear values in feet). The program will

then request horizontal and vertical components of the terrain in front of the antenna mast. If the terrain is considered to be flat earth, the user should enter zero for each component. For terrain that slopes downward from the mast the user should enter a negative value for the vertical component. After the user enters these values, the program will compute the OCGA and then request the user to identify the antenna system. If the sideband reference system is selected, the operator must input a value for the ratio of the upper antenna height to the lower antenna height. At this point, sufficient data has been entered to allow the program to calculate the antenna heights for the antenna system. The program will provide the user with the option to determine the antenna offset(s). If this is desired the user will be asked to enter a value for the shortest horizontal distance between the mast and the runway centerline (A-5). The program computes the offset value(s) and outputs the antenna heights along with the antenna offset(s). Should the offset option not be selected, the program will output just antenna heights. In either case program control will return to the beginning of the program when the user hits the carriage return key. The other major options follow a similar procedure. The functions which ANTHTS1 can perform, along with their respective inputs, are listed below:

Function: Calculate antenna heights for any one system.

Inputs: Glide path angle  
Horizontal component of terrain in front of mast  
Vertical component of terrain in front of mast  
Antenna heights ratio for sideband reference system

Function: Calculate antenna offset(s) for any one system.

Inputs: Antenna heights  
Minimum horizontal distance between the mast and  
the runway centerline

Function: Calculate glide path angle for any one system.

Inputs: Upper antenna heights for null reference or sideband  
reference systems  
Middle antenna heights for capture effect system  
Antenna heights ratio for sideband reference system

Function: Calculate new A-Ratio.

Inputs: Old A-Ratio  
Path width

Appendix B includes several sample runs of ANTHTS1 for verification purposes. Pages B-1 and B-2 both show calculations of antenna heights for a three-degree null reference antenna system. The run on page B-1 is calculated using level terrain and page B-2 shows the same computation with terrain rising from the base of the mast at almost exactly a one-degree slope. This yields an OCGA of two degrees. DOT/FAA Order No. 6750.6B, Chapter 2, Par. 10, Page 15, Table 2 confirms the values calculated in these two runs to be correct. Pages B-3 and B-4 indicate the calculated antenna heights and offsets for a three-degree capture effect and a

three-degree sideband reference antenna system. Pages B-5 through B-7 verify the accuracy of the glide slope angle calculations when using different antenna heights ratios for the sideband reference system. Page B-8 checks the reliability of the antenna heights recalculation function described in the background section of this report. The resultant values for all of these runs can be confirmed using the previously mentioned source.

Appendix C is a listing of the program.

## REFERENCES

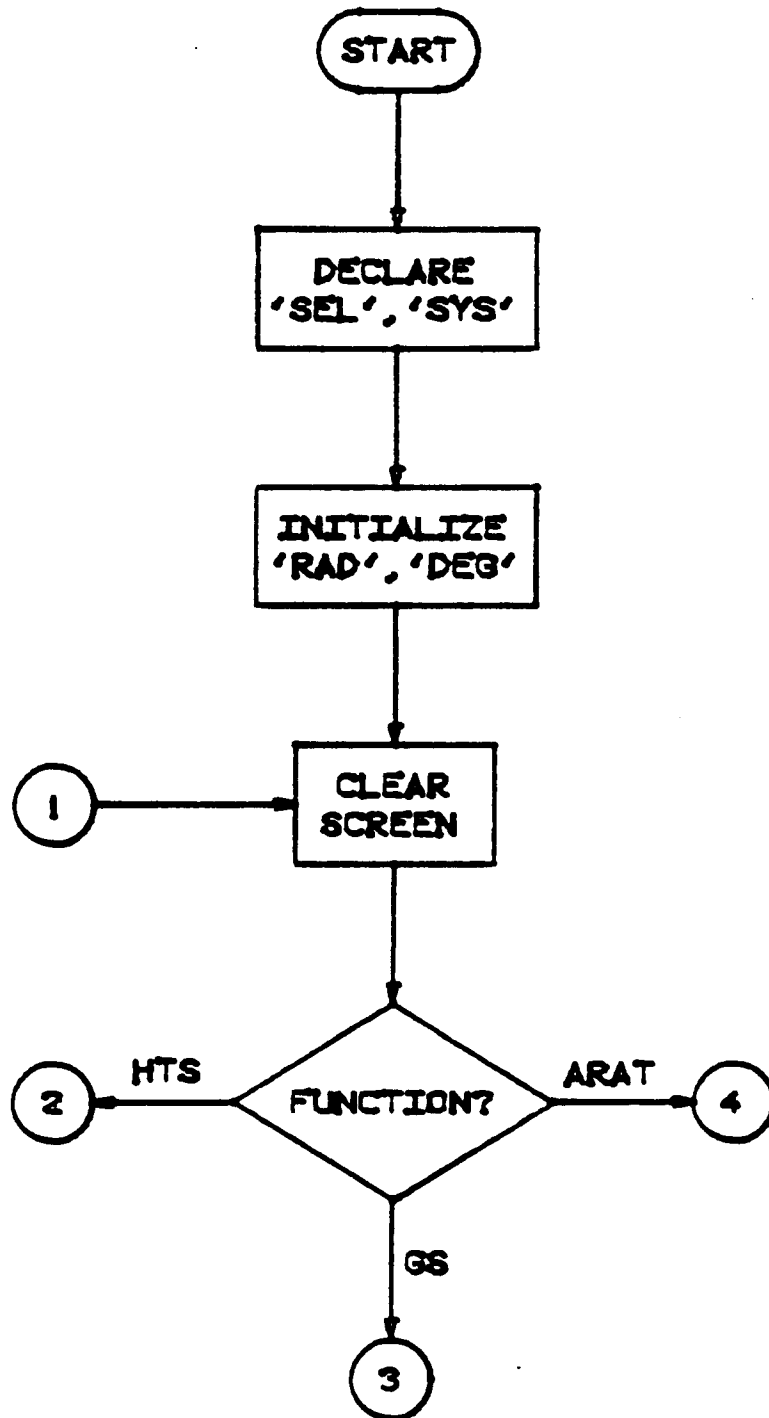
Installation Instructions For Category I and Category II ILS Glide Slopes, DOT/FAA, Order No. 6750.6B, 1979.

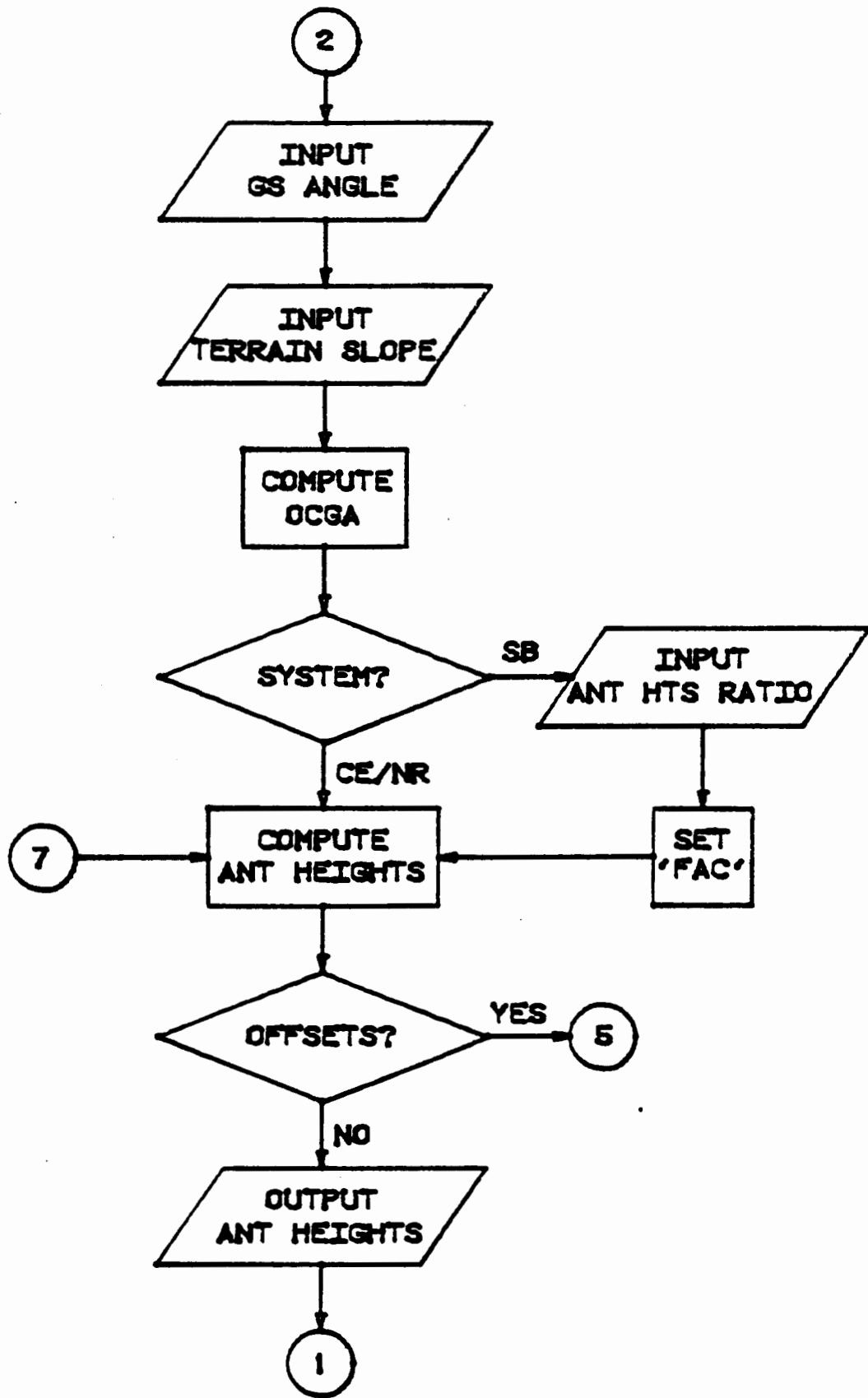
Instrument Landing System Glide Slope, FAA Training Division, Manual No. FV-301, 1964.

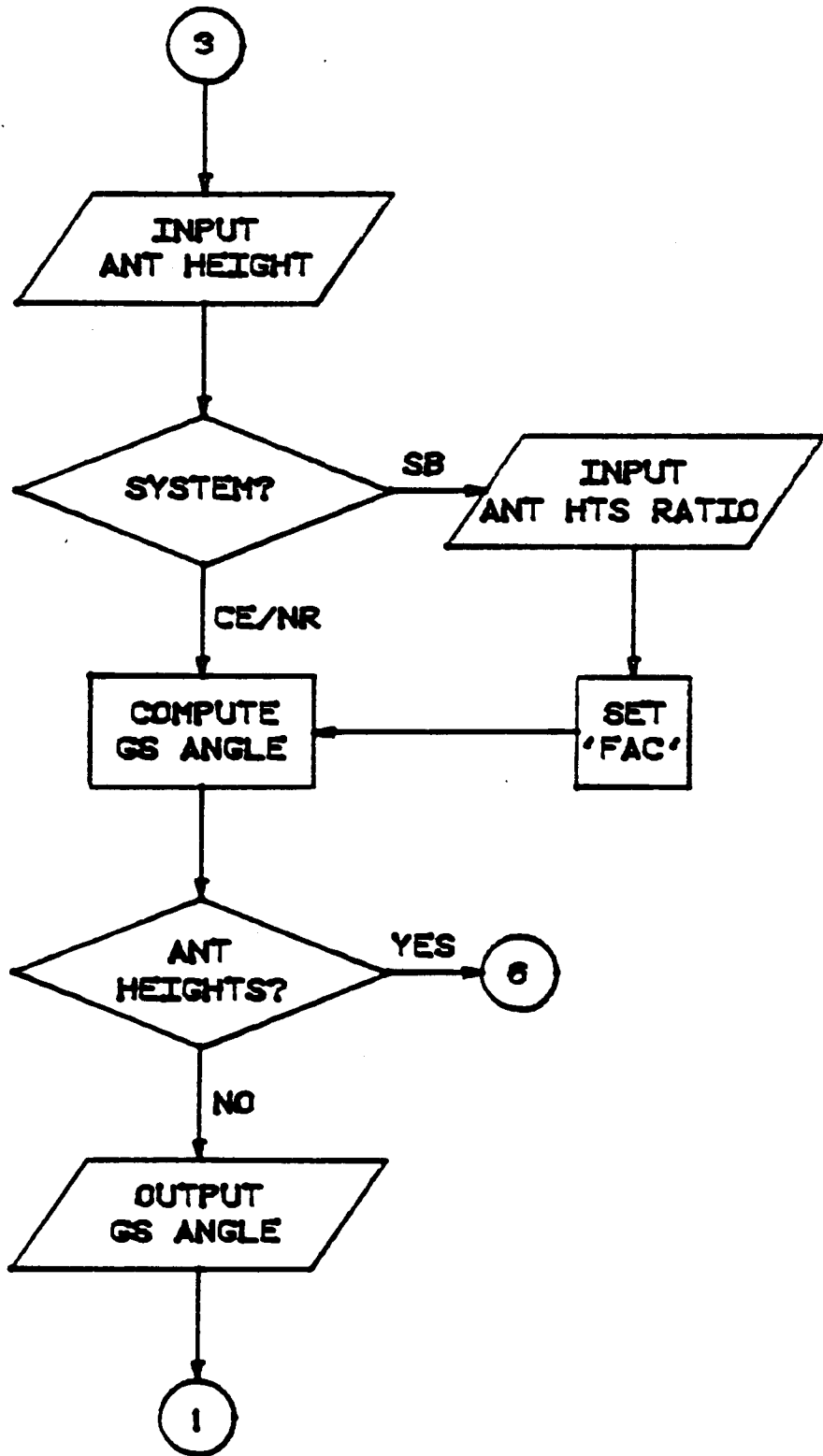
Offset1, FORTRAN Program to compute Antenna Heights and Offsets, Project No. 071-313-840, by John Walls, April 1982.

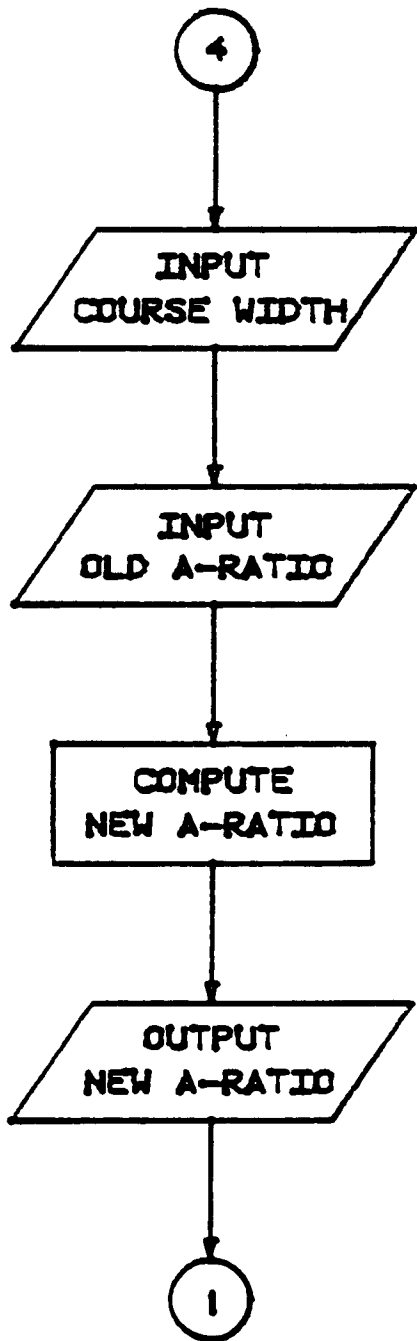
Makeouinpt, BASIC Program to Compute Antenna Heights and Offsets, Project No 071-313-840, by Jesse Jones, July 1981.

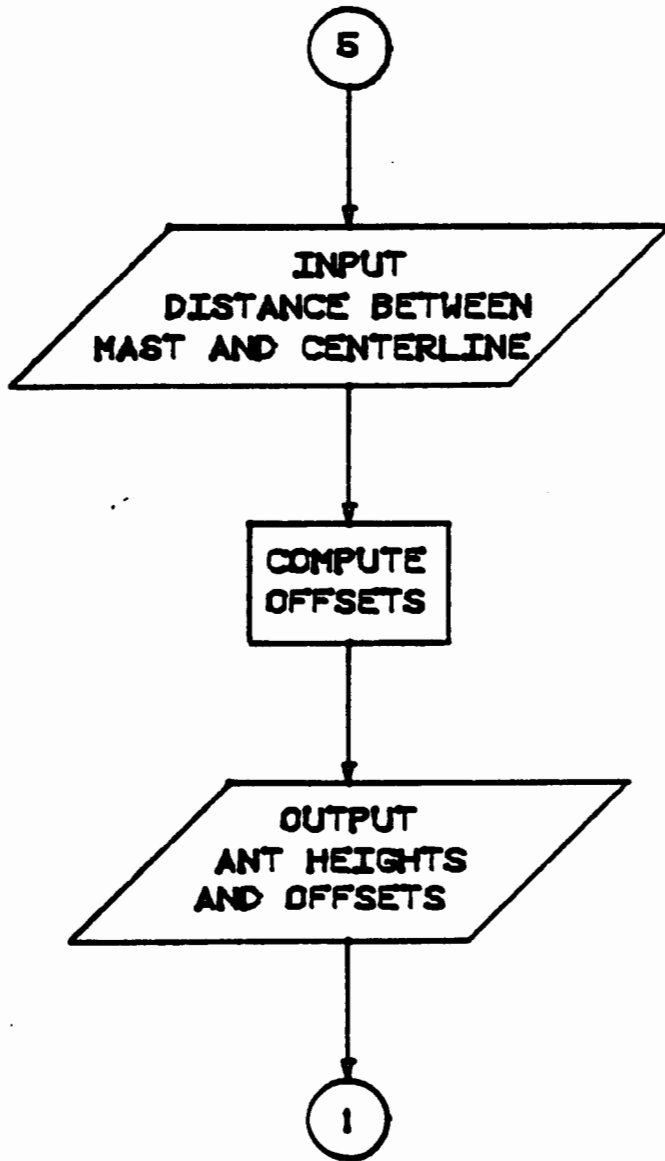
APPENDIX A  
"ANTHTSI" FLOWCHART

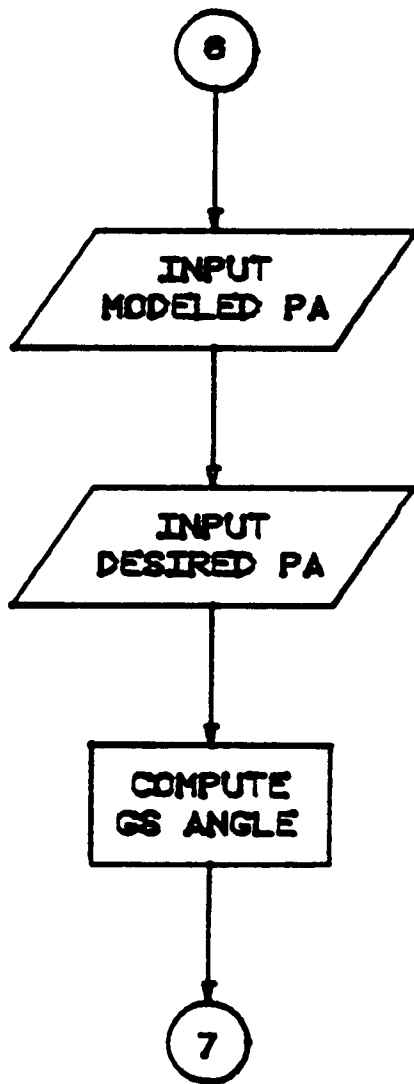












ENTER ONE OF THE FOLLOWING:  
'H' - TO CALCULATE HEIGHT OF ANTENNAS  
'G' - TO CALCULATE GLIDESLOPE ANGLE  
'A' - TO CALCULATE NEW ARATIO

=H  
ENTER THE GLIDESLOPE ANGLE (DEGREES)

=S  
ENTER HORIZ(X) AND VERT(Z) COMPONENTS OF AVG SLOPE OF TERRAIN IN FRONT OF MAST (FEET)

=0.0  
ENTER ONE OF THE FOLLOWING:  
'CE' - FOR CAPTURE EFFECT SYSTEM  
'NR' - FOR NULL REF SYSTEM  
'SB' - FOR SIDEBAND REF SYSTEM

=NR  
DO YOU WANT ANTENNA OFFSETS? ('Y' OR 'N')

=N  
SIDEBAND ANT HEIGHT, 20.27      CARRIER ANT HEIGHT, 14.13  
PRESS 'RETURN' TO CONTINUE

ENTER ONE OF THE FOLLOWING:

- 'H' - TO CALCULATE HEIGHT OF ANTENNAS
- 'G' - TO CALCULATE GLIDESLOPE ANGLE
- 'A' - TO CALCULATE NEW ARATIO

=H

ENTER THE GLIDESLOPE ANGLE (DEGREES)

=3

ENTER HORIZ(X) AND VERT(Z) COMPONENTS OF AVG SLOPE OF TERRAIN IN FRONT OF MAST (FEET)

=1000,17.5

ENTER ONE OF THE FOLLOWING:

- 'CE' - FOR CAPTURE EFFECT SYSTEM
- 'NR' - FOR NULL REF SYSTEM
- 'SB' - FOR SIDEBAND REF SYSTEM

=NR

DO YOU WANT ANTENNA OFFSETS? ('Y' OR 'N')

=N

SIDEBAND ANT HEIGHT: 42.44      CARRIER ANT HEIGHT: 21.22  
PRESS 'RETURN' TO CONTINUE

=

ENTER ONE OF THE FOLLOWING.

'H' - TO CALCULATE HEIGHT OF ANTENNAS

'G' - TO CALCULATE GLIDESLOPE ANGLE

'A' - TO CALCULATE NEW ARATIO

=H

ENTER THE GLIDESLOPE ANGLE(DEGREES)

=3

ENTER HORIZ(X) AND VERT(Z) COMPONENTS OF AVG SLOPE OF TERRAIN IN FRONT OF MAST(FEET)

=0.0

ENTER ONE OF THE FOLLOWING.

'CE' - FOR CAPTURE EFFECT SYSTEM

'NR' - FOR NULL REF SYSTEM

'SB' - FOR SIDEBAND REF SYSTEM

=SB

ENTER THE HEIGHT RATIO(SIDEBAND/CARRIER)

=3

DO YOU WANT ANTENNA OFFSETS?'Y' OR 'N')

=Y

ENTER THE HORIZONTAL DISTANCE(FEET) BETWEEN THE ANTENNA MAST  
AND THE RUNWAY CENTERLINE(INCLUDE SIGN)

=400

SIDEBAND ANT HEIGHT: 21.26      CARRIER ANT HEIGHT: 7.00

SIDEBAND ANTENNA OFFSET: 300.400

PRESS 'RETURN' TO CONTINUE

ENTER ONE OF THE FOLLOWING:

'H' - TO CALCULATE HEIGHT OF ANTENNAS  
'G' - TO CALCULATE GLIDESLOPE ANGLE  
'A' - TO CALCULATE NEW ARATIO

=H

ENTER THE GLIDESLOPE ANGLE(DEGREES)

=3

ENTER HORIZ(X) AND VERT(Z) COMPONENTS OF AVG SLOPE OF TERRAIN IN FRONT OF MAST(FEET)

=0.0

ENTER ONE OF THE FOLLOWING:

'CE' - FOR CAPTURE EFFECT SYSTEM  
'NR' - FOR NULL REF SYSTEM  
'SB' - FOR SIDEBAND REF SYSTEM

=CE

DO YOU WANT ANTENNA OFFSETS?('Y' OR 'N')

=Y

ENTER THE HORIZONTAL DISTANCE(FEET) BETWEEN THE ANTENNA MAST  
AND THE RUNWAY CENTERLINE(INCLUDE SIGN)

=-400

UPP ANT HEIGHT: 42.48      MID ANT HEIGHT: 20.27      LOW ANT HEIGHT: 14.13  
UPPER ANTENNA OFFSET: -300.752      LOWER ANTENNA OFFSET: -400.740  
PRESS 'RETURN' TO CONTINUE

ENTER ONE OF THE FOLLOWING:  
'H' - TO CALCULATE HEIGHT OF ANTENNAS  
'G' - TO CALCULATE GLIDESLOPE ANGLE  
'A' - TO CALCULATE NEW ARATIO

=G  
ENTER ONE OF THE FOLLOWING:  
'SB' - FOR SIDEBAND REF SYSTEM  
'GO' - IF NOT SIDEBAND REFERENCE SYSTEM

=SB  
ENTER HEIGHT(FEET) OF UPPER ANTENNA

=20.1  
ENTER THE HEIGHT RATIO(SIDEBAND/CARRIER)

=2.5  
DO YOU WANT RECALCULATED ANTENNA HEIGHTS BASED ON THE DIFFERENCE BETWEEN  
ACTUAL PATH ANGLE AND DESIRED PATH ANGLE?('Y' OR 'N')

=N  
GLIDESLOPE ANGLE: 3.01  
PRESS 'RETURN' TO CONTINUE

ENTER ONE OF THE FOLLOWING:

- 'H' - TO CALCULATE HEIGHT OF ANTENNAS
- 'G' - TO CALCULATE GLIDESLOPE ANGLE
- 'A' - TO CALCULATE NEW ARATIO

=G

ENTER ONE OF THE FOLLOWING:

- 'SB' - FOR SIDEBAND REF SYSTEM
- 'GO' - IF NOT SIDEBAND REFERENCE SYSTEM

=SB

ENTER HEIGHT(FEET) OF UPPER ANTENNA

=21.1

ENTER THE HEIGHT RATIO(SIDEBAND/CARRIER)

=3

DO YOU WANT RECALCULATED ANTENNA HEIGHTS BASED ON THE DIFFERENCE BETWEEN  
ACTUAL PATH ANGLE AND DESIRED PATH ANGLE?('Y' OR 'N')

=N

GLIDESLOPE ANGLE: 3.82  
PRESS 'RETURN' TO CONTINUE

=

ENTER ONE OF THE FOLLOWING.

'H' - TO CALCULATE HEIGHT OF ANTENNAS

'G' - TO CALCULATE GLIDESLOPE ANGLE

'A' - TO CALCULATE NEW ARATIO

=G

ENTER ONE OF THE FOLLOWING.

'SB' - FOR SIDEBAND REF SYSTEM

'CO' - IF NOT SIDEBAND REFERENCE SYSTEM

=SB

ENTER HEIGHT( FEET) OF UPPER ANTENNA

=22.5

ENTER THE HEIGHT RATIO(SIDEBAND/CARRIER)

=4

DO YOU WANT RECALCULATED ANTENNA HEIGHTS BASED ON THE DIFFERENCE BETWEEN  
ACTUAL PATH ANGLE AND DESIRED PATH ANGLE?('Y' OR 'N')

=N

GLIDESLOPE ANGLE: 3.02

PRESS 'RETURN' TO CONTINUE

=

ENTER ONE OF THE FOLLOWING:

- 'H' - TO CALCULATE HEIGHT OF ANTENNAS
- 'G' - TO CALCULATE GLIDESLOPE ANGLE
- 'A' - TO CALCULATE NEW ARATIO

=G

ENTER ONE OF THE FOLLOWING:

- 'SB' - FOR SIDEBAND REF SYSTEM
- 'CO' - IF NOT SIDEBAND REFERENCE SYSTEM

=GO

ENTER ONE OF THE FOLLOWING:

- 1) HEIGHT (FEET) OF UPPER ANTENNA FOR NULL REFERENCE SYSTEM
- 2) HEIGHT (FEET) OF MIDDLE ANTENNA FOR CAPTURE EFFECT SYSTEM

=28.26

DO YOU WANT RECALCULATED ANTENNA HEIGHTS BASED ON THE DIFFERENCE BETWEEN ACTUAL PATH ANGLE AND DESIRED PATH ANGLE? ('Y' OR 'N')

=Y

ENTER ACTUAL (A) AND DESIRED (B) PATH ANGLES ((A,B) DEGREES)

=2.8.3

ENTER ONE OF THE FOLLOWING:

- 'CE' - FOR CAPTURE EFFECT SYSTEM
- 'NR' - FOR NULL REF SYSTEM

=NR

DO YOU WANT ANTENNA OFFSETS? ('Y' OR 'N')

=N

SIDEBAND ANT HEIGHT, 26.68      CARRIER ANT HEIGHT, 13.25  
PRESS 'RETURN' TO CONTINUE

```

10      CHARACTER *2SEL,SYS
20      DATA RAD,DEC/.017453,57.2958/
30*
40      1 PRINT ,""
50      DO 2 I=1,200000
60      2 CONTINUE
70*****
80*
90*      PROGRAM: ANTHTS1
100*     AUTHOR: BRUCE L. PERRY
110*     DATE: 19 NOVEMBER 1982
120*
130*****
140*
150*     SELECT HEIGHT, GLIDE SLOPE OR A-RATIO CALCULATIONS
160*
170      10 WRITE(6,15)
180      WRITE(6,20)
190      WRITE(6,25)
200      WRITE(6,85)
210      READ ,SEL
220      IF(SEL.EQ.'H')GO TO 1000
230      IF(SEL.EQ.'G')GO TO 2000
240      IF(SEL.EQ.'A')GO TO 3000
250      GO TO 10
260*

```

```

270*          COMPUTE OPERATOR CORRECTED GLIDE SLOPE ANGLE
280*
290  1000      WRITE(6,45)
300          READ ,GS
310          WRITE(6,90)
320          READ ,X,Z
330          IF(X.EQ.0)GO TO 1001
340          GS=GS-(ATAN(Z/X)*DEG)
350*
360*          SELECT ANTENNA SYSTEM
370*
380  1001      WRITE(6,15)
390          WRITE(6,30)
400          WRITE(6,35)
410          WRITE(6,40)
420          READ ,SYS
430          IF(SYS.EQ.'CE')GO TO 1100
440          IF(SYS.EQ.'NR')GO TO 1200
450          IF(SYS.EQ.'SB')GO TO 1300
460          GO TO 1001
470*

```

```

480*          CALCULATE CAPTURE EFFECT SYSTEM ANTENNA HEIGHTS
490*          OPTION: CALCULATE ANTENNA OFFSETS
500*
510  1100      HT1=1.4793/SIN(GS*RADI)
520          HT2=HT1/2.
530          HT3=HT1+HT2
540  1101      WRITE(6,50)
550          READ ,SEL
560          IF(SEL.EQ.'N')GO TO 4000
570          IF(SEL.NE.'Y')GO TO 1101
580          WRITE(6,55)
590          WRITE(6,56)
600          READ ,DIS
610          OFFST1=DIS-(((HT3)**2-(HT1)**2)/(DIS*2.))
620          OFFST2=DIS+(((HT1)**2-(HT2)**2)/(DIS*2.))
630          GO TO 4010
640*

```

```

650*      CALCULATE NULL REFERENCE SYSTEM ANTENNA HEIGHTS
660*      OPTION; CALCULATE ANTENNA OFFSET
670*
680 1200   HT1=1.4793/SIN(GS*RAD)
690       HT2=HT1/2.
700 1201   WRITE(6,50)
710       READ ,SEL
720       IF(SEL.EQ.'N')GO TO 4100
730       IF(SEL.NE.'Y')GO TO 1201
740       WRITE(6,55)
750       WRITE(6,56)
760       READ ,DIS
770       OFFST1=DIS-(((HT1)**2-(HT2)**2)/(DIS*2.))
780       GO TO 4110
790*

```

```
800*      CALCULATE SIDEBAND REFERENCE SYSTEM ANTENNA HEIGHTS
810*      OPTION: CALCULATE ANTENNA OFFSET
820*
830 1300   WRITE(6,60)
840      READ ,RAT
850      IF(RAT.EQ.2.5)FAC=1.4
860      IF(RAT.EQ.3.)FAC=1.33
870      IF(RAT.EQ.4.)FAC=1.25
880 1301   HT1=1.4793/SIN(GS*FAC*RAD)
890      HT2=HT1/RAT
900 1302   WRITE(6,50)
910      READ ,SEL
920      IF(SEL.EQ.'N')GO TO 4100
930      IF(SEL.NE.'Y')GO TO 1302
940      WRITE(6,55)
950      WRITE(6,56)
960      READ ,DIS
970      OFFST1=DIS-((HT1)**2-(HT2)**2)/(DIS*2.)
980      GO TO 4110
990*
```

```
1000*          SELECT ANTENNA SYSTEM
1010*
1020  2000     WRITE(6,15)
1030          WRITE(6,40)
1040          WRITE(6,65)
1050          READ ,SYS
1060          IF(SYS.EQ.'SB')GO TO 2100
1070          IF(SYS.EQ.'GO')GO TO 2200
1080          GO TO 2000
1090*
```

```

1100*      CALCULATE GLIDE SLOPE ANGLE FOR SIDEBAND REFERENCE SYSTE
1110*      OPTION: RECALCULATE ANTENNA HEIGHTS
1120*
1130 2100   WRITE(6,70)
1140       READ ,HT
1150       WRITE(6,60)
1160       READ ,RAT
1170       IF(RAT.EQ.2.5)FAC=1.4
1180       IF(RAT.EQ.3.)FAC=1.33
1190       IF(RAT.EQ.4.)FAC=1.25
1200       GS=ARSIN(1.4793/HT)/FAC*DEG
1210 2101   WRITE(6,95)
1220       WRITE(6,96)
1230       READ ,SEL
1240       IF(SEL.EQ.'N')GO TO 4200
1250       IF(SEL.NE.'Y')GO TO 2101
1260       WRITE(6,99)
1270       READ ,APA,DPA
1280       GS=GS+(DPA-APA)
1290       GO TO 1301
1300*

```

```

1310*          CALCULATE GLIDE SLOPE ANGLE FOR NULL REF/CAP EFF SYSTEM
1320*          OPTION: RECALCULATE ANTENNA HEIGHTS
1330*
1340 2200      WRITE(6,15)
1350          WRITE(6,75)
1360          WRITE(6,80)
1370          READ ,HT
1380          GS=ARSIN(1.4793/HT)*DEC
1390 2201      WRITE(6,95)
1400          WRITE(6,96)
1410          READ ,SEL
1420          IF(SEL.EQ.'N')GO TO 4200
1430          IF(SEL.NE.'Y')GO TO 2201
1440          WRITE(6,99)
1450          READ ,APA,DPA
1460          GS=GS+(DPA-APA)
1470 2202      WRITE(6,15)
1480          WRITE(6,30)
1490          WRITE(6,35)
1500          READ ,SEL
1510          IF(SEL.EQ.'CE')GO TO 1100
1520          IF(SEL.EQ.'NR')GO TO 1200
1530          GO TO 2202
1540*

```

```

1550*          CALCULATE NEW A-RATIO
1560*
1570  3000      WRITE(6,140)
1580          READ ,A,B
1590          ARAT=A/.7*B
1600          GO TO 4300
1610*
1620*          OUTPUT
1630*
1640  4000      WRITE(6,100)HT3,HT1,HT2
1650          GO TO 999
1660  4010      WRITE(6,100)HT3,HT1,HT2
1670          WRITE(6,105)OFFST1,OFFST2
1680          GO TO 999
1690  4100      WRITE(6,110)HT1,HT2
1700          GO TO 999
1710  4110      WRITE(6,110)HT1,HT2
1720          WRITE(6,115)OFFST1
1730          GO TO 999
1740  4200      WRITE(6,120)GS
1750          GO TO 999
1760  4300      WRITE(6,150)ARAT
1770          GO TO 999
1780*
1790*
1800  999      WRITE(6,160)
1810          READ ,SEL
1820          IF(SEL.EQ.' ')GO TO 1
1830          GO TO 999
1840*

```

```

1850 15 FORMAT(1H)," ENTER ONE OF THE FOLLOWING:")
1860 20 FORMAT(1H ,T5," 'H' - TO CALCULATE HEIGHT OF ANTENNAS")
1870 25 FORMAT(1H ,T5," 'G' - TO CALCULATE GLIDESLOPE ANGLE")
1880 30 FORMAT(1H ,T5," 'CE' - FOR CAPTURE EFFECT SYSTEM")
1890 35 FORMAT(1H ,T5," 'NR' - FOR NULL REF SYSTEM")
1900 40 FORMAT(1H ,T5," 'SB' - FOR SIDEBAND REF SYSTEM")
1910 45 FORMAT(1H)," ENTER THE GLIDESLOPE ANGLE(DEGREES)")
1920 50 FORMAT(1H)," DO YOU WANT ANTENNA OFFSETS?('Y' OR 'N')")
1930 55 FORMAT(1H ," ENTER THE HORIZONTAL DISTANCE(FEET) BETWEEN THE ANTENNA
AST")
1940 56 FORMAT(1H ," AND THE RUNWAY CENTERLINE(INCLUDE SIGN)")
1950 60 FORMAT(1H ," ENTER THE HEIGHT RATIO(SIDEBAND/CARRIER)")
1960 65 FORMAT(1H ,T5," 'GO' - IF NOT SIDEBAND REFERENCE SYSTEM")
1970 70 FORMAT(1H ," ENTER HEIGHT(FEET) OF UPPER ANTENNA")
1980 75 FORMAT(1H ,T5,"1) HEIGHT(FEET) OF UPPER ANTENNA FOR NULL REFERENCE S
TEM")
1990 80 FORMAT(1H ,T5,"2) HEIGHT(FEET) OF MIDDLE ANTENNA FOR CAPTURE EFFECT
STEM")

```

```

2000      85 FORMAT(1H ,T5,"'A' - TO CALCULATE NEW ARATIO")
2010      90 FORMAT(1H ," ENTER HORIZ(X) AND VERT(Z) COMPONENTS OF AVG SLOPE OF T
RAIN IN FRONT OF MAST(FEET)")
2020      95 FORMAT(1H ," DO YOU WANT RECALCULATED ANTENNA HEIGHTS BASED ON THE D
REFERENCE BETWEEN")
2030      96 FORMAT(1H ," ACTUAL PATH ANGLE AND DESIRED PATH ANGLE?('Y' OR 'N')")
2040      99 FORMAT(1H ," ENTER ACTUAL(A) AND DESIRED(B) PATH ANGLES((A,B)DEGREES
)
2050     100 FORMAT(1H ," UPP ANT HEIGHT: ",F7.2,5X,"MID ANT HEIGHT: ",F7.2,5X,"LOW
ANT HEIGHT: ",F7.2)
2060     105 FORMAT(1H ," UPPER ANTENNA OFFSET: ",F8.3,5X,"LOWER ANTENNA OFFSET: ",
.3)
2070     110 FORMAT(1H ," SIDEBAND ANT HEIGHT: ",F7.2,5X,"CARRIER ANT HEIGHT: ",F7.
2)
2080     115 FORMAT(1H ," SIDEBAND ANTENNA OFFSET: ",F8.3)
2090     120 FORMAT(1H ," GLIDESLOPE ANGLE: ",F7.2)
2100     140 FORMAT(1H ," ENTER COURSE WIDTH(A) AND OLD ARATIO(B) - (A,B)")
2110     150 FORMAT(1H ," NEW ARATIO: ",F6.3)
2120     160 FORMAT(1H ," PRESS 'RETURN' TO CONTINUE")
2130      END

```