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THESIS

COMPUTER PROGRAMS FOR HELICOPTER DATA DISPLAY
AND CONCEPTUAL DESIGN

by

Gary M. Bishop

December 1983

Thesis Advisor:

Donald M. Layton

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Computer Programs for Helicopter Data Display
and Conceptual Design

by

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Submitted in partial fulfillment of the
requirements for the degree of

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ABSTRACT

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I. INTRODUCTION

A. BACKGRUND

The helicopter industry, as in most industries, incorporates many of the attributes of its previous designs into its new products. New aircraft are generally built upon the successes of previous designs with minor changes due to technological advances. These technological advances usually relate to new materials and new methods of control but hardly ever result in drastic changes to the aerodynamic surfaces. These proven designs of the integral parts which have specific aerodynamic characteristics are well documented and extremely useful in the design process. It is essential for the designer to have this corporate knowledge of design trends for the design process as well as for the validation of his design. This knowledge of design trends is necessary for both the designer in industry and the student in a learning environment.

Outside of specific helicopter companies, little has been done to analyze the interrelationships that exist between design parameters. These interrelationships provide a bases for the simplification of assumptions and validation of design results. This knowledge needs to be available to

the design student just as it is to the design engineer so that the information can be used for an analysis or verification during the design process. Therefore, it is important that this information be readily available and that the student have quick, easy and well defined access to this information.

The retrieval and analysis of historical data is but one part of the design process. The critical part is the actual process whereby a conceptual design is accomplished through many iterations. This process is long and involved but provides the design student with a basic understanding of the design process. For a more indepth study of the design process it is necessary for the student to vary as many of the design parameters as possible in order to see the interrelationships that exist. This process also allows the student to become intimately familiar with the problems and needs of the designer.

To date, no known programs for the IBM 3033 have been prepared that will take the design student through the entire process from historical analyses to conceptual design completion.

B. GOALS

The objective of this study was to develop an interactive capability for the design student using the IBM 3033 computer. The program, if used at the Naval Postgraduate School, should be capable of providing graphical representations of the critical data necessary for a proper analysis in the data analysis phase. During the conceptual design phase the program should allow for design student/computer interaction so that the design student can readily see the effects of varying critical parameters. To maximize the assets available at the Naval Postgraduate School, the Tektronix 618 dual screen system and the DISSPLA [Ref. 1] software system should be incorporated in the structuring of the computer programs.

The programs should be designed primarily for the use of Aeronautical Engineering students at the Naval Postgraduate School enrolled in the Helicopter Performance, Helicopter Design, and Advanced Helicopter Design courses.

II. APPROACH TO THE PROBLEM

A. INTRODUCTION

The basic approach was to write two computer programs utilizing the DISSPLA software system for use on the IBM 3033 using FORTRAN IV. The programs are completely interactive, prompting the user for all necessary information and then graphically depicting the information in the form of tables on the IBM 3278 screen or as a graph on either the Tektronix 618 screen or by use of the VERSATEC plotter. If the Tektronix machine is used, the displayed graph can be copied directly using electrostatic copiers attached to each machine.

B. ANALYSIS OF HELICOPTER DESIGN DATA

The first program consists of a historical data display system that takes thirty critical design parameters and allows the user to select the parameters for analysis. The user can then specify the page format as well as the number of graphs per page of the finished graph. Subroutines within the program are as follows:

1. Block data
2. Data point identification
3. Graphical display formatting

C. CONCEPTUAL HELICOPTER DESIGN

The second program is written to correspond procedurally WITH THE Helicopter Design Manual [Ref. 2] used in the AE 4306 Helicopter Design course at the Naval Postgraduate School. The formulae necessary for the computation of each section is provided in lieu of subroutine use. This allows for quick and easy updating of the program as it becomes necessary. Also, if the student desires, it can be seen how the data that is received is computed. This program is completely interactive and requires only that the student have the information listed on the design specification sheet and the accompanying charts and references necessary for the required decisions during the design process. All tables and graphs are generated and displayed either on the IBM 3278 screen or the Tektronix 618 screen. Output for the tabular data is provided on a separate file and the single graph needed for design decisions can be obtained using the electrostatic printers.

Detailed knowledge of the IBM 3033 computer is not necessary. A familiarity of helicopter aerodynamics and performance is, however, necessary for proper utilization of the program in order to obtain meaningful design information.

III. SOLUTIONS TO THE PROBLEMS

A. DATA DISPLAY PROGRAM

Table I lists the thirty critical design parameters used most often in any analysis of an aircrafts performance as found in the Helicopter Performance Manual [Ref. 3].

TABLE I

Design Parameters

Main rotor radius
Tail rotor radius
Number of main rotor blades
Number of tail rotor blades
Height of the main rotor system
Speed of the main rotor
Speed of the tail rotor
Chord of the main rotor
Chord of the tail rotor
Span of the main rotor
Span of the tail rotor
Twist of the main rotor blade
Twist of the tail rotor blade
Profile drag of the main rotor blade
Profile drag of the tail rotor blade
Disc loading of the main rotor system
Width of the fuselage
Length of the fuselage
Frontal equivalent flat plate area
Vertical equivalent flat plate area
Maximum forward velocity
Maximum range
Rate of climb
Hover ceiling (IGE)
Hover ceiling (CGE)
Length of the tail
Operating weight
Load weight
Fuel weight
Maximum gross weight

The above parameters have been deemed those most critical to the design process. The airfoil data has been extrapolated from NACA data and the specific helicopter

performance parameters have been extrapolated from the various manuals for the specific helicopters. Tables III through X, Appendix C, list the specific data utilized for the study.

Table II lists the helicopters used for the analysis portion of the graphing.

TABLE II
Representative Helicopters

<u>Military Designator</u>	<u>Weight Classification</u>	<u>Branch of Service</u>
AH-64	Medium	USA
OH-6A	Light	USA
SH-3H	Medium	USN
S-76	Medium	USN
UH-60A	Medium	USA/USN
CH-54B	Heavy	USA
CH-53D	Heavy	USN
CH-53E	Heavy	USN

All the helicopters selected for study were single main rotor helicopters that are still in the active inventories of the agencies listed. The selections were made with deference to aircraft of the U.S. Army and U.S. Navy and then to a representative sampling of the three major weight classifications.

The data from Tables III through X can now be graphed in the following combinations using the Data Display program:

1. Simple X-Y plot

- a. Horizontal page format (11 X 8.5 inches)
 - b. Vertical page format (8.5 X 11 inches)
2. Two parameters versus a third
 - a. Horizontal page format (11 X 8.5 inches)
 - (1) Two axes on the abscissa scale
 - (2) Two axes on the ordinate scale
 - b. Vertical page format (8.5 X 11 inches)
 - (1) Two axes on the abscissa scale
 - (2) Two axes on the ordinate scale
 3. Two X-Y plots on the same page with a horizontal page format
 4. Three parameters versus one common parameter with a vertical page format
 5. Four separate X-Y plots on the same page with a horizontal page format

Figures 3.1. through 3.9., Appendix C, illustrate the capability of the program. The program was devised so as to allow the greatest flexibility for the analyst as to the graphical presentation.

B. CONCEPTUAL DESIGN PROGRAM

The design process is in accordance with the procedural steps as outlined in the Helicopter Design Manual. The

program is devised so as to allow the design student the ability to do a complete conceptual design at one sitting if he is properly prepared. The program lists all critical tables and information necessary for doing an analysis of the design and also provides the necessary information to prepare a written report. If the Tektronix dual screen combination is used, the student has a graphical representation of the total power curve at altitude presented to him which must be used to extrapolate critical design performance parameters. Figure 3.10. is a sample of the graphical representation provided. Sample output is provided in Appendix B to illustrate the capabilities of the program and the possible usefulness to the design student.

IV. RESULTS AND CONCLUSIONS

A. DATA DISPLAY PROGRAM

This program provided good results in use for the analyses of the design parameters considered, particularly in the correlation between commonly used 'rules of thumb' and graphical analyses of the same parameters.

The capability of the program could be enhanced in several ways. First, additional single main rotor helicopters could be added to enable a more complete analysis to be accomplished. Second, the use of different scales, such as the logarithmic scale, for the graphical analysis could prove to be more suitable for some of the parameters. Third, additional parameters that other companies have compiled in their technical manuals could be added for analysis.

B. CONCEPTUAL DESIGN PROGRAM

This program provided information consistent with existing aircraft. The interactive characteristic of the program allows the student to actively participate in the design process and, most importantly, the program allows the student to vary parameters and see the effects of changing a

single parameter on the entire design process. If the student was prepared and had all the appropriate references, this process need only take an hour to complete one iteration of the entire process. This allows for multiple iterations, optimization, and parameter variation.

One problem with the program is that it is only as good as the assumptions that have been made for the model to simplify the formulae used as given in Reference 3. A crude approximation to existing aircraft can be made with the understanding that the aircraft designed during this process is merely a conceptual design and the beginning step in the process for the final product. This model has been developed so that changes made to the course can be incorporated easily and that any corrections can be made quickly. This program also can be run on any FORTRAN capable computer using the coding listed in Appendix B.

APPENDIX A

A. USERS GUIDE TO THE DATA DISPLAY PROGRAM

The program has been written with the user in mind. It is completely interactive once the program has been loaded into the DISSPLA mode so that the user need only read the instructions presented on the screen carefully.

Use the following procedure to invoke the Data Display program once the Fortran program resides on the users disk.

1. Logon as normal at either a regular IBM 3278 terminal or at a Tektronix 618 dual screen terminal
2. Obtain the use of temporary storage space by entering the following:

```
DEFINE STORAGE 1M (enter)
```

3. When the PSW '00020000 00000000' appears on the screen type in:

```
I CMS (enter)
```

4. If the program has not been previously compiled on your disk type in:

```
PORTGI HELODATA (enter)
```

5. When the program has been compiled you are ready to enter into DISSPLA by typing in:

```
DISSPLA HELODATA (enter)
```

6. Follow the instructions given on the screen. If you desire a hard copy of the graphs do the following:

```
IBM terminal--Exit the program and  
enter DISSPOP and then  
follow the instructions
```

TEK terminal-- Press the hard copy button
on the large monitor

B. PROGRAM NOMENCLATURE

<u>MNEMONIC</u>	<u>DEFINITION</u>
ANS	General variable for reading keyboard answers
B	Number of main rotor blades
BTR	Number of tail rotor blades
C	Chord of a main rotor blade in feet
CDO	Profile drag of a main rotor blade section
CDOTR	Profile drag of a tail rotor blade section
CTR	Chord of a tail rotor blade in feet
DL	Disc loading of the main rotor system
FH	Frontal effective flat plate area in square feet
FV	Vertical effective flat plate area in square feet
FWT	Fuel weight in pounds
HOVIGE	Hover ceiling (in ground effect) in feet
HOVOGE	Hover ceiling (out of ground effect) in feet
HT	Height of the main rotor system above the ground in feet
I	Do loop variable
IPAK	Array for packing legend information
KINDS	Array for packing legend information
LGH	Length of the fuselage in feet
LT	Length of the tail in feet

LWT Load weight in pounds
 MGW Maximum gross weight in pounds
 OPTION Term used in Switch subroutine for page formatting
 OWT Operating weight in pounds
 PANS References page format selection
 R Main rotor radius in feet
 RC Maximum rate of climb in feet per minute
 RNG Maximum range in nautical miles
 RPM Speed of the main rotor system in RPM
 RPMTR Speed of the tail rotor system in RPM
 RS Span of a main rotor blade in feet
 RSTR Span of a tail rotor blade in feet
 RTR Tail rotor radius in feet
 TEMP1 Dummy parameter returned from subroutine
 TEMP2 Dummy parameter returned from subroutine
 TEMP3 Dummy parameter returned from subroutine
 TITALT Program trip used in multiple axes plotting
 TWOAX References which axis has two axes plotted
 TWST Twist of a main rotor blade in degrees
 TWSTR Twist of a tail rotor blade in degrees
 VM Maximum velocity in knots
 WDT Width of the fuselage in feet
 X Array returned from Switch subroutine containing
 abscissas for plotting

XANS Answer referenced to X axis selection
XANS1 Answer referenced to multiple X axes selection
XANS2 Answer referenced to multiple X axes selection
XMAX Maximum value of abscissa desired for plotting
XORIG Minimum value of abscissa desired for plotting
XPOS Array of values referencing subplot locations of abscissas
XSTP Increment size between minimum and maximum of the abscissa axis
XTWO Array returned from Switch subroutine containing abscissas for plotting
X2ANS Array for X axis answers for two graph option
X4ANS Array for X axis answers for four graph option
Y Array returned from Switch subroutine containing ordinates for plotting
YANS Answer referenced to Y axis selection
YANS1 Answer referenced to multiple Y axes selection
YANS2 Answer referenced to multiple Y axes selection
YMAX Maximum value of abscissa desired for plotting
YORIG Minimum value of ordinate desired for plotting
YPOS Array of values referencing subplot locations of ordinates
YSTP Increment size between minimum and maximum of the abscissa axis
YTWO Array returned from Switch subroutine containing ordinates for plotting
Y2ANS Array for Y axis answers for two graph option
Y3ANS Array for Y axis answers for three graph option

Y4ANS Array for Y axis answers for four graph option
Z Array in subroutine switch for parameters

C. PROGRAM LISTING

```

REAL R(8), RSTR(8), B(8), STR(8), HT(8), RPM(8), RPMTR(8), C(8), CTR(8)
REAL WCT(8), LGH(8), FH(8), FV(8), TMS TTR(8), TMS TTR(8), CDO(8), CDO(8), DL(8)
REAL HOVGE(8), YSTP, YMAX, XORIG, XSTP, XMAX, XANS, YANS, XANS1, XANS2, XANS, Y
1 ANS2, YANS2, TITALT, TMOAX, ANS, PANS, XTWO
2 ANS1, Y1, X1, Y2, ANS(2), X(8), Y(8)
3 INTEGER XPOS(1), XINDS(200), IPAK(200)
DATA XPOS/1, 5, 13, 15, 6, 11, 11, 6, 5, 1, 1, 6, 5, 1, 1, 6, 5/
COMMON /C1/ R, RTR, B, STR, HT, RPM, RPMTR, C, CTR, RS, RSTR, TMS T, TMS TTR, CDO
1, CDO(1), LGH, CT, LGH, FH, FV, VM, RNG, RC, HOVGE, LI, OMT, LNT, FWT, MGW
C** THIS SECTION DETERMINES WHICH TYPE OF TEXTRONIX EQUIPMENT THAT YOU
C** ARE USING AND MAKES THE APPROPRIATE CALLS TO BRING THE SYSTEM ON
C** LINE
C** *****
CALL FRTCMS ('CLRS CRN 6')
WRITE (6, 37)
WRITE (6, 38)
IF (ANS(5), NE. 1.) GO TO 360
CALL FRTCMS ('CLRS CRN 6')
WRITE (6, 39)
READ (5, 39) ANS
CALL FRTCMS ('CLRS CRN 6')
IF (ANS(NE. 1.) GO TO 10
CALL TEEK618
GO TO 30
IF (ANS(NE. 2.) GO TO 20
CALL TEEKALL (4662, 30, 31, 1, 0)
GO TO 30
IF (ANS(NE. 3.) GO TO 340
CALL INCCMPRS
CALL SWITCLR ('BLACK')
CALL SWITCLR (1)
CALL HEIGHT
CALL SETICN
PACKS THE INFORMATION INTO AN ARRAY SO THAT A STORY
C** THIS PORTION CANTO EACH GRAPH WITH THE MEANING OF THE NUMBERS THAT
C** CAN BE PRIVATE FOR EACH PLOT
C** LABELS GIVE
C** CALL LINES ('1. AH-64 5. UH-60A$, KINDS, 1)

```

```

CALL LINES (12, OH-6A, 6, CH-54B$, KINCS, 2)
CALL LINES (13, SH-3H, 7, CH-53D$, KINCS, 3)
CALL LINES (14, HEIGHT, 8, CH-54E$, KINCS, 4)
CALL MARKER (15)
CALL SHFCHR (19, 0.002, 1)
CALL SHFSCR (19, SCREEN)
C** THIS SECTION ALLOWS THE USER TO SELECT IF THEY WANT 1 GRAPH, 2
C** GRAPHS OR FULLY SIDE BY SIDE 3 GRAPHS VERTICALLY WITH THE SAME
C** X AXIS OR FULL GRAPHS ON THE SAME PAGE.
C** WRITE (6, 40)
READ (5, 4) ANS
CALL FRM (ANS, 1, 0) GO TO 280
IF (ANS.EQ.1) GO TO 280
C** THIS SECTION PRESENTS THE 30 DIFFERENT PARAMETERS THAT CAN BE USED IN
C** COMPARISON AND ALLOWS THE USER TO SELECT UP TO 3 FOR COMPARISON
C** TOTAL=C.O
WRITE (6, 41)
WRITE (6, 42)
READ (5, 4) ANS
CALL FRM (ANS, 1, 0) GO TO 280
IF (ANS.EQ.1) GO TO 280
C** ONLY 2 PARAMETERS ARE SELECTED, A CHOICE OF PAGE FORMAT IS GIVEN
C** AND A CHOICE OF WHICH PARAMETER IS TO BE ON WHICH AXIS IS GIVEN
C** SUBROUTINE ARE CALLED WHICH CHANGE THE PARAMETER SELECTED VALUES INTO
C** VALUES TO BE PLOTTED ALONG WITH THEIR RESPECTIVE PLOTTING INFORMATION
C** IF (ANS.EQ.2) GO TO 60
WRITE (6, 43)
READ (5, 4) ANS
CALL FRM (ANS, 1, 0) GO TO 40
IF (ANS.EQ.1) GO TO 340
WRITE (6, 44)
READ (5, 4) ANS
CALL FRM (ANS, 1, 0) GO TO 340
IF (ANS.EQ.1) GO TO 340
CALL PAGEA2D (19, 8.5)
CALL HEIGHT (19, 16)
CALL MESSAGE (HELI COPTER DESIGN$, -100, 0., 6.5)
CALL MESSAGE (HEIGHT)
CALL MESSAGE (AE 4306/4900$, 100, 1.2, 6.25)
CALL MESSAGE (1)
CALL MESSAGE (KINCS, 7.25, 6.25)

```



```

CALL LINES ('SECONDARY AXES$', IPAK, 2)
CALL LSETCL ('BLACK')
CALL RESET ('HEIGHT')
IF (ANS, NE, 3.) GO TO 340
WRITE (6, 430)
READ (5, 440) FANS
CALL FRICMS ('CLRSCRN 6')
WRITE (6, 450)
READ (5, 460) TMOAX
CALL FRICMS ('CLRSCRN 6')
IF (PANS, NE, 1.) GO TO 70
IF (TWOAX, NE, 1.) GO TO 110
GO TO 90
IF (PANS, NE, 2.) GO TO 340
IF (TWOAX, NE, 1.) GO TO 80
GO TO 130
IF (TWOAX, NE, 2.) GO TO 340
GO TO 150
CONTINUE (2, 56C)
WRITE (5, 470) ANS
IF (ANS, NE, 1.) GO TO 340
CALL FRICMS ('CLRSCRN 6')
WRITE (6, 480)
WRITE (6, 490) XANS1, XANS2, YANS
READ (5, 500)
CALL FRICMS ('CLRSCRN 6')
CALL PHYSOR (11, 8.5)
CALL AREIGHT (9, 15)
CALL AREIGHT (3)
CALL HEISAG ('HEIGHT')
CALL RESET ('AE 4306/4900$', 100, 1.2, 5.25)
CALL MESSAG (KANS, 4, 7.25, 5.25)
CALL LSWITCH (XANS1, 1, X, XORIG, XSTP, XMAX)
CALL LSWITCH (YANS, 2, Y, YORIG, YSTP, YMAX)
DO 100 I=1, I
YTHT(I)=Y(I)
CONTINUE
TI=1.0
TOTAL=170
GO TO INUE
CONTINUE (6, 57C)
WRITE (5, 480) ANS
READ (ANS, NE, 1.) GO TO 340
CALL FRICMS ('CLRSCRN 6')
WRITE (6, 410)

```

70

80

90

100

110

```

WRITE (6,47C)
READ (5,4) XANS, YANS1, YANS2
CALL FRGMS (1,8.5)
CALL PAGESOR (2,5.1,0)
CALL AREAZD (7,5.6)
CALL HESEGT (3)
CALL HESESSAG (HEIGHT)
CALL HESESSAG (AE 4306/4900$, 100,1.2,6.25)
CALL LSTORY (KINDS 4,5.75,6.25)
CALL SWITCH (XANS1,1,X,XORIG,XSTP,XMAX)
DO 120 I=1,6
XTWO(I)=X(I)
CONTINUE=0
GO TO 170
CONTINUE=70
WRITE (6,4) ANS
READ (5,NE 1) GO TO 340
IF (ANS.FRTCHMS (6,410))
CALL FRGMS (6,46C)
WRITE (6,4) XANS1, XANS2, YANS
READ (5,4) XANS1, XANS2, YANS
CALL FRGMS (5,11)
CALL PAGESOR (5,AUTO)
CALL HWYSOR (1,5,2,1)
CALL AREAZD (6,5,7.5)
CALL HESEGT (6,3)
CALL HESESSAG (HEIGHT)
CALL HESESSAG (AE 4306/4900$, 100,1.2,7.75)
CALL LSTORY (KINDS 4,4.75,7.75)
CALL SWITCH (XANS1,1,X,XORIG,XSTP,XMAX)
DO 140 I=1,6
XTWO(I)=Y(I)
CONTINUE=30
GO TO 170
CONTINUE=170
WRITE (6,4) ANS
READ (5,NE 1) GO TO 340
CALL FRGMS (6,4)

```

120

130

140

150

```

160
WRITE (6,41C)
READ (5,47C)
CALL FRAMES (8.5,11.0)
CALL HPYRSOR (2.25,1.0)
CALL AREAZD (5.3)
CALL HEISAG (HEIGHT)
CALL HESET (AE 4306/4900$,100,1.2,8.25)
CALL HESSAG (KANS,14.4,8.25)
CALL HSTCRH (XANS,1.0,X,XORIG,XSTP,XMAX)
CALL LSWITCH (YANSI,2.0,Y,YORIG,YSTP,YMAX)
DO 160 I=1,E
XTWO(I)=X(I)E
CONTINUE=4.0
TOTAL=170
CONTINUE
170
C**NORMAL DISPLA CALLS TO ESTABLISH THE STYLE OF WRITING, PUTTING A
C BORDER AROUND THE SUBPLOT AREA, MAKING A GENERIC HEADING, SUPPRESSING
C PRINTED VALUES AT THE ENDS OF THE AXES OF THE GRAPH, CALLING THE CURVE
C THAT PLOTS THEIR INCREMENT AND THEN CALLING A ROUTINE THAT LABELS THE
C MARKERS BY THE TYPE OF AIRCRAFT
C**
CALL SETCLR ('RED')
CALL FRAME ('NCENDS')
CALL XAXEND ('NOENDS')
CALL YAXEND ('NOENDS')
CALL GRAF ('XORIG,XSTP,XMAX,YORIG,YSTP,YMAX')
CALL RESET ('XTICKS')
CALL RESET ('YTIKCS')
CALL CURVE (X,Y,8,-1)
CALL LABEL (X,Y)
CALL RESET ('HEIGHT')
C**SECONDARY AXIS IS DRAWN WITH APPROPRIATE TITLE AND VALUES AND THEN A
C PLOT OF THE NEW POINTS IS MADE AND THEIR POINTS LABELLED
C**
180 CONTINUE
IF (TOTAL.NE.0.0) GO TO 190
GO TO 350
IF (TOTAL.NE.1.0) GO TO 200
CALL SWITCH (XANS2,3.0,XTWO,TEMP1,TEMP2,TEMP3)
190

```

```

200 GO TO 230
    IF (ITALT.NE.2.0) GO TO 210
    CALL SWITCH (VANS2,4.,YTWO,TEMP1,TEMP2,TEMP3)
    GO TO 230
210 IF (ITALT.NE.3.0) GO TO 220
    CALL SWITCH (XANS2,5.,XTWO,TEMP1,TEMP2,TEMP3)
    GO TO 230
220 CONTINUE
    CALL SWITCH (VANS2,6.,YTWO,TEMP1,TEMP2,TEMP3)
    GO TO 230
230 CONTINUE
    CALL SWITCH (GREEN)
    CALL MARKER (16)
    CALL CURVE (XTWO,YTWO,8,-1)
    CALL LABEL (HEIGHT)
    IF (ITALT.NE.1.) GO TO 240
    CALL LEGEND (IPAK,2,0,2,4.5)
    GO TO 270
240 IF (ITALT.NE.2.) GO TO 250
    CALL LEGEND (IPAK,2,0,2,5.5)
    GO TO 270
250 IF (ITALT.NE.3.) GO TO 260
    CALL LEGEND (IPAK,2,0,2,7.)
    GO TO 270
260 IF (ITALT.NE.4.) GO TO 340
    CALL LEGEND (IPAK,2,0,2,7.5)
    GO TO 270
270 CONTINUE
    CALL RESET ('MARKER')
    GO TO 350
C*****
C THIS SECTION ALLOWS THE USER TO SELECT 2 SEPARATE GRAPHS ON THE
C SAME PAGE ON A HORIZONTAL PAGE FORMAT.
C*****
280 IF (ANS.NE.2.) GO TO 340
    WRITE (6,48C)
    READ (5,*) ANS
    CALL FRIGMS (CLRS CRN 6)
    IF (ANS.NE.2.0) GO TO 300
    WRITE (6,60C)
    READ (5,*) ANS
    IF (ANS.NE.1.) GO TO 340
    CALL FRIGMS (CLRS CRN 6)
    WRITE (6,41C)
    WRITE (6,49C)
    READ (5,*) X2ANS(1),Y2ANS(1),X2ANS(2),Y2ANS(2)

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C

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CALL FRTCMS (' CLRSCRN 6')
CALL PAGEA2D (1,8,5)
CALL HEIGHT (9,6)
CALL MESSAGE (' HELICOPTER DESIGN$, -100,0.25,6.5)
CALL MESSAGE (' HEIGHT')
CALL MESSAGE (' AE 4306/4900$, 100,1.45,6.25)
CALL MESSAGE (' KINDS,4,7.5,6.25)
CALL LENGTH (0)
DO 290 SETDGR 1,2 (' RED',)
CALL SETSOR (' XPOS(1), YPOS(1))
CALL PHRAMET (3.85,6.)
CALL HEIGHT (14)
CALL SWITCH (X2ANS(1),1,X,XORIG,XSTP,XMAX)
CALL SWITCH (Y2ANS(1),2,Y,YORIG,YSTP,YMAX)
CALL XAXEND (' NCENDS,')
CALL YAXREF (' XORIG,XSTP,XMAX,YORIG,YSTP,YMAX)
CALL GRESET (' XTICKS,')
CALL REFVE (' YTICKS,')
CALL LABEL (' X,Y,8,-1)
CALL LENGTH (0)
CONTINUE
CALL NETCLR (' BLACK')
GO TO 350
290 *****
C** THIS SECTION ALLOWS THE USER TO PUT 3 GRAPHS WITH A COMMON X AXIS *****
C** ON ONE VERTICAL CAL *****
C** *****
300 *****
IF (ANS.NE.3.0) GO TO 320
WRITE (6,61) ANS
READ (5,*) ANS
IF (ANS.NE.1) GO TO 340
CALL NETCLR (' CLRSCRN 6')
WRITE (6,41) ANS
WRITE (6,50) ANS,Y3ANS(1),Y3ANS(2),Y3ANS(3)
READ (5,*) ANS,XANS (' AUTO,')
CALL HWRGT (5,11.)
CALL PAGEA2D (7,7.)
CALL HEIGHT (3)
CALL MESSAGE (' HELICOPTER DESIGN$, -100,0.,8.)
CALL MESSAGE (' AE 4306/4900$, 100,1.2,7.75)

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CALL STCRY (KINDS,4,5.25,7.75)
CALL LENDGR (0)
CALL SETCLR (GREEN)
CALL CALLPHYSOR (XPOS(3),YPOS(3))
CALL CALLAREAZD (7.,2.5)
CALL CALLAREAF (XANS,1.,X,XORIG,XSTP,XMAX)
CALL CALLSWITCH (10)
CALL CALLSWITCH (Y3ANS(1),2.,Y,YORIG,YSTP,YMAX)
CALL CALLSWAXEND (NENDS)
CALL CALLSWAXEND (NENDS)
CALL CALLYGRAF (XORIG,XSTP,XMAX,YORIG,YSTP,YMAX)
CALL CALLCURVE (X,Y,8,-1)
CALL CALLRESET (HEIGHT)
CALL CALLREABEL (X)
CALL CALLLENDGR (0)
DO 310 I=1,2
CALL CALLPHYSOR (XPOS(I+3),YPOS(I+3))
CALL CALLAREAZD (7.,2.5)
CALL CALLAREAF (XANS,7.,X,XORIG,XSTP,XMAX)
CALL CALLSWITCH (10)
CALL CALLSWITCH (Y3ANS(I+1),2.,Y,YORIG,YSTP,YMAX)
CALL CALLSWAXEND (NENDS)
CALL CALLSWAXEND (NENDS)
CALL CALLXNCNUM (XORIG,XSTP,XMAX,YORIG,YSTP,YMAX)
CALL CALLGRAFIT (XTICKS)
CALL CALLRESET (YTIKCS)
CALL CALLCURVE (X,Y,8,-1)
CALL CALLREABEL (X,Y)
CALL CALLRENDGR (0)
CALL CONTINUECLR ('BLACK')
GO TO 350
310 *****
C** THIS SECTION ALLOWS THE USER TO PUT 4 GRAPHS ON A HORIZONTAL PAGE, *****
C** BASICALLY DIVIDE THE PAGE IN QUARTERS, WITH WHATEVER AXES WANTED. *****
C** *****
320 *****
IF (ANS.NE.4.0) GO TO 340
WRITE (6,62) ANS
IF (ANS.NE.1.) GO TO 340
CALL CLEARSCREEN (6,51)
WRITE (6,51)

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READ (5,*) X4ANS(1),Y4ANS(1),X4ANS(2),Y4ANS(2),X4ANS(3),Y4ANS(3),X
14ANS(4),Y4ANS(4)
CALL FRM5 (5,*) ANS
CALL PAGE2D (11,8,5)
CALL AREAZD (19,5)
CALL HEIGHT (3)
CALL HESSET (HELI COPTER DESIGN$, -100, -.25, 5.5)
CALL HESSET (HEIGHT)
CALL HESSTAG (AE 4306/4900$, 100, .95, 5.25)
CALL HESTORY (KINDS 4, 7.5, 5.25)
CALL ENDGR (0)
DO 330 I=1,4
CALL HYSOR (XPOS(I+5),YPOS(I+5))
CALL HYSCLR (RED)
CALL AREAZD (4,2,5)
CALL AREAZD (10)
CALL HEIGHT (X4ANS(1),1, X, XOR IG, XSTP, XMAX)
CALL SWITCH (Y4ANS(1),2, Y, YOR IG, YSTP, YMAX)
CALL XAXEND (NOENDS)
CALL YAXAF (XOR IG, XSTP, XMAX, YOR IG, YSTP, YMAX)
CALL RESET (XTICKS)
CALL CURVE (Y, Y, 8, -1)
CALL LABEL (X, Y)
CALL RENLGR (HEIGHT)
CONTINUE
CALL SETCLR (BLACK)
GO TO 350
C***** THIS SECTION ALLOWS THE USER TO REMAIN WITHIN THE PROGRAM IF HE
C MAKES A MISTAKE IN ENTERING DATA.
C*****
340 CONTINUE
WRITE (6,52C)
READ (5,*) ANS
CALL FRM5 (5,*) ANS (CLRS CRN 6)
IF (ANS.1.) GO TO 360
GO TO 30
CONTINUE
CALL ENDPL (0)
C***** THIS SECTION IS USED TO ALLOW THE USER TO MAKE ADDITIONAL GRAPHS
C WITHOUT LEAVING THE PROGRAM AND HAVING TO REINITIATE DISS PLA
C*****
WRITE (6,53C)

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READ (5*) ANS
CALL FRICMS (CLRS CRN 60)
IF (ANS NE 1) GO TO 360
CALL RESET (ALL)
GO TO 30
CONTINUE
CALL DCNEPL
STOP
*****
370 ***** THIS IS AN INTERACTIVE PROGRAM FOR YOU TO BE ABLE TO, 2
10H GRAPHICALLY DISPLAY, /, 36H THE VARIOUS DESIGN PARAMETERS THAT 3
29H YOU HAVE BEEN EXPOSED TO IN HELICOPTER, /, 15H DESIGN. PLEASE 53H
3 ENTER A NUMBER AS A RESPONSE TO THE QUESTIONS ASKED. /, /, /, 9X, 53H*
4 ***** PLEASE FOLLOW THE INSTRUCTIONS *****
*****
380 ***** (///, 18X, 38H ENTER A NUMBER IF YOU DESIRE TO CONTINUE, /, 18X
1, 39H
390 ***** (///, 18X, 38H PLEASE ENTER THE TYPE OF MACHINE THAT YOU AR
1E, 10H USING NOW, /, /, /, 10X, 57H
2 ***** (///, 18X, 38H)
3 ***** (///, 18X, 38H)
4 ***** (///, 18X, 38H)
*****
400 ***** (///, 18X, 38H)
1E, 11H SAME PAGE: /, /, /, 5X, 60H
2 ***** (///, 18X, 38H)
3 ***** (///, 18X, 38H)
4 ***** (///, 18X, 38H)
*****
410 ***** (///, 18X, 38H)
1 ***** (///, 18X, 38H)
2 ***** (///, 18X, 38H)
3 ***** (///, 18X, 38H)
4 ***** (///, 18X, 38H)
*****
420 ***** (///, 18X, 38H)
1 ***** (///, 18X, 38H)
2 ***** (///, 18X, 38H)
3 ***** (///, 18X, 38H)
4 ***** (///, 18X, 38H)
*****
430 ***** (///, 18X, 38H)
1 ***** (///, 18X, 38H)
2 ***** (///, 18X, 38H)
3 ***** (///, 18X, 38H)
4 ***** (///, 18X, 38H)
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440 FORMAT (53H ENTER THE X AXIS PARAMETER AND Y AXIS PARAMETER FROM 1
14H THE ABOVE LIST,/,29H (ENTER THEM RESPECTIVELY AND,22H SEPARATED
28Y A SPACE))
450 FORMAT (///15X,33H WHICH AXIS WILL HAVE TWO SCALES?/,15X,33H
1
2
3
4X,1HI,12X,1HI,15X,1HI,18X,1HI,15
515X,1HI,12X,1HI,15X,1HI,18X,1HI,15
6/,15X,20HI
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DATA WGT/3.56,4.57,7.08,7.75,7.08,8.83,8.83/
DATA LGH/34.15,30.31,23.0,55.2,43.4,50.1,70.2,367.2,99.0/
DATA FV/45.8,11.6,30.8,30.5,15.5,30.8,99.4,90.1,20.1,20.1/
DATA VNG/249C,14200,7100,4200,26.5,31.6,0,106.7,5.1,52.3,4.23632,33226./
DATA RC/249C,14200,7100,4200,26.5,31.6,0,106.7,5.1,52.3,4.23632,33226./
DATA HOVIGE/14200,7100,4200,26.5,31.6,0,106.7,5.1,52.3,4.23632,33226./
DATA HOVIGE/14200,7100,4200,26.5,31.6,0,106.7,5.1,52.3,4.23632,33226./
DATA LWT/2021,1155,995,400,2550,2100,1000,20250,4200,73500./
DATA LWT/2021,1155,995,400,2550,2100,1000,20250,4200,73500./
DATA FWT/1624,400,5641,1883,2345,8580,15483,4338,14030,14186,14030,24791./
DATA MGW/14660,2550,2100,1000,20250,4200,73500./

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C** THIS SUBROUTINE TAKES THE X AND Y VALUES FROM THE PARAMETER SELECTION **
C SUBROUTINE (S) AND LABELS THE MARKER POINTS AS TO THE APPROPRIATE **
C AIRCRAFT **
C**

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SUBROUTINE LABEL (X,Y)
REAL X(8),Y(8)
CALL MSHFTS (1,1,0,100,X(1),Y(1))
CALL MSHFTS (1,1,0,100,X(2),Y(2))
CALL MSHFTS (0,3,1,100,X(3),Y(3))
CALL MSHFTS (0,4,1,100,X(4),Y(4))
CALL MSHFTS (1,5,1,100,X(5),Y(5))
CALL MSHFTS (0,6,1,100,X(6),Y(6))
CALL MSHFTS (0,7,1,100,X(7),Y(7))
CALL MSHFTS (1,8,1,100,X(8),Y(8))
RETURN
END

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C** SUBROUTINE USED TO SELECT THE PARAMETER DESIRED FOR THE PRIMARY X **
C AXIS AND A PLOT CAN BE MADE **
C SO THAT **
C**
SUBROUTINE SWITCH (Z,OPTION,X,XORIG,XSTP,XMAX)
REAL R(8),RTR(8),B(8),BTR(8),HT(8),RPH(8),RPMTR(8),C(8),CTR(8)

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REAL RST(8), RSTR(8), TWST(8), TWSTTR(8), CDO(8), CDOTR(8), DL(8)
REAL WDOVGE(8), LGH(8), FH(8), FV(8), VM(8), RNG(8), RC(8), HOVIGE(8)
REAL HOVGE(8), LT(8), OWT(8), LWT(8), FWT(8), MGN(8), X(8)
INTEGER XORIG, XSTP, XMAX, Z, OPTION
COMMON /C1/ R, RTR, B, BTR, HT, RPM, RPMTR, C, CTR, RS, RSTR, TWST, TWSTTR, CDO
1, CDOT, CL, W, CT, LGH, FH, FV, VM, RNG, RC, HOVIGE, HOVGE, LT, OWT, LWT, FWT, MGN
CALL XAXEND ( : NOENDS : )
CALL YAXANG ( 0. )
IF ( Z. NE. 1. ) GO TO 90
DO 10 I=1,8
X(I)=R(I)
CONTINUE
XORIG=15.
XMAX=45.
ICN=NE.1.) GO TO 20
IF (OPTICKS(5)
CALL XNAME ('MAIN ROTOR RADIUS (FT)$', 100)
GO TO 2710
IF (OPTICKS(5) GO TO 30
CALL YNAME ('MAIN ROTOR RADIUS (FT)$', 100)
GO TO 2710
IF (OPTICKS(5) GO TO 40
CALL XREVTK
CALL XGRAXS (XORIG, XSTP, XMAX, 9., 'MAIN ROTOR RADIUS (FT)$.
100, 0., -.75)
('XTICKS:;)
CALL RESET
GO TO 2710
IF (OPTICKS(5) GO TO 50
CALL YREVTK
CALL YGRAXS (XORIG, XSTP, XMAX, 6., 'MAIN ROTOR RADIUS (FT)$.
100, 0., -.75)
('YICKS:;)
CALL RESET
GO TO 2710
IF (OPTICKS(5) GO TO 60
CALL XREVTK
CALL XGRAXS (XORIG, XSTP, XMAX, 6.5, 'MAIN ROTOR RADIUS (FT)$.
100, 0., -.75)
('XTICKS:;)
CALL RESET
GO TO 2710
IF (OPTICKS(5) GO TO 70
CALL YREVTK
CALL YGRAXS (XORIG, XSTP, XMAX, 6.5, 'MAIN ROTOR RADIUS (FT)$.
100, 0., -.75)
('YICKS:;)

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1 CALL YREVTK (XORIG,XSTP,XMAX,8.,'MAIN ROTOR RADIUS (FT)',$
CALL YGRAXS (100,-1,15,0.)
CALL RESET (YTTICKS)
GO TO 2710
IF (OPTION,NE,7.) GO TO 80
CALL XTICKS (5)
CALL XNAME ('',1)
GO TO 2710
CONTINUE
GO TO 2700
IF (Z,NE,2.) GO TO 180
DO 100 I=1,E
X(I)=RTR(I)
CONTINUE
XORIG=0.
XSTP=2.
XMAX=12.
IF (OPTION,NE,1.) GO TO 110
CALL XTICKS (5)
CALL XNAME ('TAIL ROTOR RADIUS (FT)',$,100)
GO TO 2710
IF (OPTION,NE,2.) GO TO 120
CALL YNAME ('TAIL ROTOR RADIUS (FT)',$,100)
GO TO 2710
IF (OPTION,NE,3.) GO TO 130
CALL XTICKS (2)
CALL XREVTK
CALL XGRAXS (XORIG,XSTP,XMAX,9.,'TAIL ROTOR RADIUS (FT)',$,
100,0.,-.75)
1 GO TO 2710
IF (OPTION,NE,4.) GO TO 140
CALL YTTICKS (2)
CALL YREVTK
CALL YGRAXS (XORIG,XSTP,XMAX,6.,'TAIL RCTOR RADIUS (FT)',$,
100,-1,0.)
1 GO TO 2710
IF (OPTION,NE,5.) GO TO 150
CALL XTICKS (2)
CALL XREVTK
CALL XGRAXS (XORIG,XSTP,XMAX,6.5,'TAIL ROTOR RADIUS (FT)',$,
100,0.,-.75)
1 GO TO 2710
IF (OPTION,NE,6.) GO TO 160
CALL YTTICKS (2)
CALL YREVTK
CALL YGRAXS (XORIG,XSTP,XMAX,8.,'TAIL ROTOR RADIUS (FT)',$,

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100,-1.15,0.)
160 1 GO TO 2710
    IF (OPTION,NE.7.) GO TC 170
    CALL XTICKS(2)
    CALL XNAME(,1)
    GO TO 2710
170 CONTINUE
    GO TO 2700
180 IF (Z,NE.3.) GO TO 270
    DO I=1,E
    X(I)=8(I)
    CONTINUE
    XORIG=0.
    XSTP=1.
    XMAX=9.
    IF (OPTION,NE.1.) GO TO 200
    CALL XINTAX(,NUMBER MAIN ROTOR BLADES$,100)
    GO TO 2710
200 IF (OPTION,NE.2.) GO TC 210
    CALL YINTAX(,NUMBER MAIN ROTOR BLADES$,100)
    GO TO 2710
210 IF (OPTION,NE.3.) GO TO 220
    CALL XREVTK(XORIG,XSTP,XMAX,9.,NUMBER MAIN ROTOR BLADES$,100,0.,-.75)
    CALL XGRAXS
1 CALL XINTAX
    GO TO 2710
220 IF (OPTION,NE.4.) GO TC 230
    CALL YREVTK(XORIG,XSTP,XMAX,6.,NUMBER MAIN ROTOR BLADES$,100,-1.,0.)
    CALL YGRAXS
1 CALL YINTAX
    GO TO 2710
230 IF (OPTION,NE.5.) GO TC 240
    CALL XREVTK(XORIG,XSTP,XMAX,6.5,NUMBER MAIN ROTOR BLADES$,100,0.,-.75)
    CALL XGRAXS
1 CALL XINTAX
    GO TO 2710
240 IF (OPTION,NE.6.) GO TO 250
    CALL YREVTK(XORIG,XSTP,XMAX,8.,NUMBER MAIN ROTOR BLADES$,100,-1.15,0.)
    CALL YGRAXS
1 CALL YINTAX
    GO TO 2710
250 IF (OPTION,NE.7.) GO TO 260

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260 CALL XNAME (' ',1)
GO TO 2710
CONTINUE
270 GO TO 2700
IF (Z.NE.4.) GO TO 360
DO 280 I=1,8
X(I)=BTR(I)
CONTINUE
XORIG=0.
XSTP=1.
XMAX=6.
IF (OPTION.NE.1.) GO TO 290
CALL XNAME ('NUMBER TAIL ROTOR BLADES$',100)
CALL XINTAX
GO TO 2710
290 IF (OPTION.NE.2.) GO TO 300
CALL YNAME ('NUMBER TAIL ROTOR BLADES$',100)
CALL YINTAX
GO TO 2710
300 IF (OPTION.NE.3.) GO TO 310
CALL XREVTK (XORIG,XSTP,XMAX,9,'NUMBER TAIL ROTOR BLADES$',100,0.,-.75)
CALL XGRAXS
1 CALL XINTAX
GO TO 2710
310 IF (OPTION.NE.4.) GO TO 320
CALL YREVTK (XORIG,XSTP,XMAX,6,'NUMBER TAIL ROTOR BLADES$',100,-1.,0.)
CALL YGRAXS
1 CALL YINTAX
GO TO 2710
320 IF (OPTION.NE.5.) GO TO 330
CALL XREVTK (XORIG,XSTP,XMAX,6.5,'NUMBER TAIL ROTOR BLADES$',100,0.,-.75)
CALL XGRAXS
1 CALL XINTAX
GO TO 2710
330 IF (OPTION.NE.6.) GO TO 340
CALL YREVTK (XORIG,XSTP,XMAX,8,'NUMBER TAIL ROTOR BLADES$',100,-1.15,0.)
CALL YGRAXS
1 CALL YINTAX
GO TO 2710
340 IF (OPTION.NE.7.) GO TO 350
CALL XNAME (' ',1)
GO TO 2710
CONTINUE
350 GO TO 2700

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360 IF (Z,NE,5.) GO TO 450
370 DO 370 I=1,8
X(I)=HT(I)
CONTINUE
XORIG=0.
XSTP=5.
XMAX=20.
IF (OPTION,NE,1.) GO TO 380
CALL XTICKS (5)
CALL XNAME ('HEIGHT OF ROTOR SYSTEM (FT)',100)
GO TO 2710
380 IF (OPTION,NE,2.) GO TO 390
CALL YTICKS (5)
CALL YNAME ('HEIGHT OF ROTOR SYSTEM (FT)',100)
GO TO 2710
390 IF (OPTION,NE,3.) GO TO 400
CALL XTICKS (5)
CALL XREVTK
CALL XGRAXS (XORIG,XSTP,XMAX,9,'SYSTEM (FT)',100,0.,-.75)
1 GO TO 2710
400 IF (OPTION,NE,4.) GO TO 410
CALL YTICKS (5)
CALL YREVTK
CALL YGRAXS (XORIG,XSTP,XMAX,6,'SYSTEM (FT)',100,-1.,0.)
1 GO TO 2710
410 IF (OPTION,NE,5.) GO TO 420
CALL XTICKS (5)
CALL XREVTK
CALL XGRAXS (XORIG,XSTP,XMAX,6,5,'SYSTEM (FT)',100,0.,-.75)
1 GO TO 2710
420 IF (OPTION,NE,6.) GO TO 430
CALL YTICKS (5)
CALL YREVTK
CALL YGRAXS (XORIG,XSTP,XMAX,8,'SYSTEM (FT)',100,-1.15,0.)
1 GO TO 2710
430 IF (OPTION,NE,7.) GO TO 440
CALL XTICKS (5)
CALL XNAME ('',1)
GO TO 2710
440 CONTINUE
GO TO 2700
450 IF (Z,NE,6.) GO TO 540
DO 460 I=1,8
X(I)=RPM(I)

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460 CONTINUE
XORIG=0.
XSTP=50.
XMAX=600.
CALL XINTAX
IF (OPTICN, NE, 1.) GO TO 470
CALL XNAME (, MAIN ROTOR SPEED (RPM)$, 100)
CALL XINTAX
GO TO 2710
IF (OPTICN, NE, 2.) GO TO 480
CALL YNAME (, MAIN ROTOR SPEED (RPM)$, 100)
CALL YINTAX
GO TO 2710
IF (OPTICN, NE, 3.) GO TO 490
CALL XREVTK
CALL XGRAXS
1 CALL XINTAX
GO TO 2710
IF (OPTICN, NE, 4.) GO TC 500
CALL YREVTK
CALL YGRAXS
1 CALL YINTAX
GO TO 2710
IF (OPTICN, NE, 5.) GO TO 510
CALL XREVTK
CALL XGRAXS
1 CALL XINTAX
GO TO 2710
IF (OPTICN, NE, 6.) GO TC 520
CALL YREVTK
CALL YGRAXS
1 CALL YINTAX
GO TO 2710
IF (OPTICN, NE, 7.) GO TO 530
CALL XNAME (, , 1)
GO TO 2710

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620 CALL XTICKS (5)
    CALL XNAME ('',1)
    GO TO 2710
CONTINUE
630 GO TO 2700
    IF (Z.NE.8.) GO TO 720
DO 640 I=1,E
X(I)=C(I)
CONTINUE
XORIG=0.0
XSTP=0.5
XMAX=3.0
IF (OPTION.NE.1.) GO TO 650
CALL XTICKS (5)
CALL XNAME ('MAIN ROTOR BLADE CHORD(FT)',100)
GO TO 2710
650 IF (OPTION.NE.2.) GO TC 660
    CALL YTIKES (5)
    CALL YNAME ('MAIN ROTOR BLADE CHORD(FT)',100)
    GO TO 2710
660 IF (OPTION.NE.3.) GO TO 67C
    CALL XREVTK (5)
    CALL XGRAXS (XORIG,XSTP,XMAX,9.,CHORD(FT)$,100,0.,-.75)
1 GO TO 2710
    IF (OPTION.NE.4.) GO TO 680
    CALL YTIKES (5)
    CALL YREVTK (XORIG,XSTP,XMAX,6.,CHORD(FT)$,100,-1.,0.)
1 GO TO 2710
    IF (OPTION.NE.5.) GO TC 690
    CALL XREVTK (5)
    CALL XGRAXS (XORIG,XSTP,XMAX,6.5,CHORD(FT)$,100,0.,-.75)
1 GO TO 2710
    IF (OPTION.NE.6.) GO TC 700
    CALL YTIKES (5)
    CALL YREVTK (XORIG,XSTP,XMAX,8.,CHORD(FT)$,100,-1.15,0.)
1 GO TO 2710
    IF (OPTION.NE.7.) GO TO 710
    CALL XTIKES (5)
    CALL XNAME ('',1)
    GO TO 2710

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710 CONTINUE
720 GO TO 2700
IF (Z.NE.9.) GO TO 810
DO 730 I=1,5
X(I)=CTR(I)
CONTINUE
XORIG=0.3
XSTP=0.1
XMAX=1.5
IF (OPTION.NE.1.) GO TO 740
CALL XTICKS (5)
CALL XNAME ('TAIL ROTOR BLADE CHORD(FT)',100)
GO TO 2710
740 IF (OPTION.NE.2.) GO TO 750
CALL YTICKS (5)
CALL YNAME ('TAIL ROTOR BLADE CHORD(FT)',100)
GO TO 2710
750 IF (OPTION.NE.3.) GO TO 760
CALL XTICKS (5)
CALL XREVTK
CALL XGRAXS
1
GO TO 2710
760 IF (OPTION.NE.4.) GO TO 770
CALL YTICKS (5)
CALL YREVTK
CALL YGRAXS
1
GO TO 2710
770 IF (OPTION.NE.5.) GO TO 780
CALL XTICKS (5)
CALL XREVTK
CALL XGRAXS
1
GO TO 2710
780 IF (OPTION.NE.6.) GO TO 790
CALL YTICKS (5)
CALL YREVTK
CALL YGRAXS
1
GO TO 2710
790 IF (OPTION.NE.7.) GO TO 800
CALL XTICKS (5)
CALL XNAME ('',1)
GO TO 2710
800 CONTINUE
GO TO 2700
810 IF (Z.NE.10.) GO TO 900

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```

820 DO 820 I=1,E
      X(I)=RS(I)
      CONTINUE
      XORIG=10.
      XSTP=5.
      XMAX=40.
      IF (OPTION,NE,1.) GO TO 830
      CALL XTICKS (5)
      CALL XNAME ('MAIN ROTOR BLADE SPAN(FT)',100)
      GO TO 2710
830 IF (OPTION,NE,2.) GO TC 840
      CALL YTICKS (5)
      CALL YNAME ('MAIN ROTOR BLADE SPAN(FT)',100)
      GO TO 2710
840 IF (OPTION,NE,3.) GO TO 850
      CALL XTICKS (5)
      CALL XREVTK
      CALL XGRAXS (XORIG,XSIP,XMAX,9.*SPAN(FT),100,0.,-.75)
      GO TO 2710
      IF (OPTION,NE,4.) GO TO 860
      CALL YTICKS (5)
      CALL YREVTK
      CALL YGRAXS (XORIG,XSIP,XMAX,6.*SPAN(FT),100,-1.,0.)
850 IF (OPTION,NE,5.) GO TC 870
      CALL XTICKS (5)
      CALL XREVTK
      CALL XGRAXS (XORIG,XSIP,XMAX,6.*SPAN(FT),100,0.,-.75)
860 IF (OPTION,NE,6.) GO TC 880
      CALL YTICKS (5)
      CALL YREVTK
      CALL YGRAXS (XORIG,XSIP,XMAX,8.*SPAN(FT),100,-1.,0.)
870 IF (OPTION,NE,7.) GO TO 890
      CALL XTICKS (5)
      CALL XNAME ('',1)
      GO TO 2710
880 IF (OPTION,NE,8.) GO TO 990
      CALL XTICKS (5)
      CALL XNAME ('',1)
      GO TO 2710
890 CONTINUE
900 GO TO 2700
910 IF (Z,NE,1.) GO TO 990
      DO 910 I=1,E
      X(I)=RS(I)
      CONTINUE

```

```

XORIG=0.
XSTP=1.
XMAX=1.
IF (OPTION, NE, 1.) GO TO 920
CALL XTICKS (5)
CALL XNAME ('TAIL ROTOR BLADE SPAN(FT)', 100)
GO TO 2710
IF (OPTION, NE, 2.) GO TO 930
CALL YTICKS (5)
CALL YNAME ('TAIL ROTOR BLADE SPAN(FT)', 100)
GO TO 2710
IF (OPTION, NE, 3.) GO TO 940
CALL XTICKS (5)
CALL XREVTK
CALL XGRAXS (XORIG, XSTP, XMAX, 9, SPAN(FT), 100, 0., -.75)
1 GO TO 2710
IF (OPTION, NE, 4.) GO TO 950
CALL YTICKS (5)
CALL YREVTK
CALL YGRAXS (XORIG, XSTP, XMAX, 6, SPAN(FT), 100, -1., 0.)
1 GO TO 2710
IF (OPTION, NE, 5.) GO TO 960
CALL XTICKS (5)
CALL XREVTK
CALL XGRAXS (XORIG, XSTP, XMAX, 6.5, SPAN(FT), 100, 0., -.75)
1 GO TO 2710
IF (OPTION, NE, 6.) GO TO 970
CALL YTICKS (5)
CALL YREVTK
CALL YGRAXS (XORIG, XSTP, XMAX, 8, SPAN(FT), 100, -1.15, 0.)
1 GO TO 2710
IF (OPTION, NE, 7.) GO TO 980
CALL XTICKS (5)
CALL XNAME ('', 1)
GO TO 2710
CONTINUE
GO TO 2700
IF (Z, NE, 12.) GO TO 1080
DO 1000 I=1, 8
X(I)=TWST(I)
CONTINUE
XORIG=-5.
XSTP=-5.
XMAX=-20.
920
930
940
950
960
970
980
990
1000

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```

1010 IF (OPTION,NE,1.) GO TO 1010
      CALL XTICKS (5)
      CALL XNAME ('MAIN ROTOR BLADE TWIST(DEG)',100)
      GO TO 2710
      IF (OPTION,NE,2.) GO TC 1020
      CALL YTICKS (5)
      CALL YNAME ('MAIN ROTOR BLADE TWIST(DEG)',100)
      GO TO 2710
      IF (OPTION,NE,3.) GO TO 1030
      CALL XTICKS (5)
      CALL XREVTK
      CALL XGRAXS
      1 GO TO 2710
      IF (OPTION,NE,4.) GO TC 1040
      CALL YTICKS (5)
      CALL YREVTK
      CALL YGRAXS
      1 GO TO 2710
      IF (OPTION,NE,5.) GO TG 1050
      CALL XTICKS (5)
      CALL XREVTK
      CALL XGRAXS
      1 GO TO 2710
      IF (OPTION,NE,6.) GO TO 1060
      CALL YTICKS (5)
      CALL YREVTK
      CALL YGRAXS
      1 GO TO 2710
      IF (OPTION,NE,7.) GO TO 1070
      CALL XNAME ('',1)
      GO TO 2710
      CONTINUE
      GO TO 2700
      IF (2,NE,13.) GO TO 1170
      DO 1090 I=1,8
      XI(I)=TWSTTR(I)
      CONTINUE
      XORIG=5.
      XSTIP=-5.
      XMAX=-20.
      IF (OPTION,NE,1.) GO TO 1100
      CALL XTICKS (5)
      CALL XNAME ('TAIL ROTOR BLADE TWIST(DEG)',100)

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1100      GO TO 2710
          IF (OPTION,NE,2.) GO TO 1110
          CALL YTICKS (5)
          CALL YNAME ('TAIL ROTOR BLADE TWIST(DEG)$',100)
          GO TO 2710
1110      IF (OPTION,NE,3.) GO TO 1120
          CALL XTICKS (5)
          CALL XREVTK
          CALL XGRAXS (XORIG,XSTP,XMAX,9.,TWIST(DEG)$,100,0.,-.75)
          1 GO TO 2710
          IF (OPTION,NE,4.) GO TO 1130
          CALL YTICKS (5)
          CALL YREVTK
          CALL YGRAXS (XORIG,XSTP,XMAX,6.,TWIST(DEG)$,100,-1.,0.)
          1 GO TO 2710
          IF (OPTION,NE,5.) GO TO 1140
          CALL XTICKS (5)
          CALL XREVTK
          CALL XGRAXS (XORIG,XSTP,XMAX,6.5,TWIST(DEG)$,100,0.,-.75)
          1 GO TO 2710
          IF (OPTION,NE,6.) GO TO 1150
          CALL YTICKS (5)
          CALL YREVTK
          CALL YGRAXS (XORIG,XSTP,XMAX,8.,TWIST(DEG)$,100,-1.15,0.)
          1 GO TO 2710
          IF (OPTION,NE,7.) GO TO 1160
          CALL XTICKS (5)
          CALL XNAME ('',1)
          GO TO 2710
          CGNTINUE
1160      GO TO 2700
1170      IF (Z,NE,14.) GO TO 1260
          DO 1180 I=1,8
          X(I)=CCCC(I)
          CGNTINUE 007
          XSTP=.001
          XMAX=.011
          IF (OPTION,NE,1.) GO TO 1190
          CALL XTICKS (5)
          CALL XNAME ('PROFILE DRAG MAIN ROTOR$',100)
          GO TO 2710
          IF (OPTION,NE,2.) GO TO 1200
          CALL

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1200 CALL YNAME ('PROFILE DRAG MAIN ROTCR$',100)
      GO TO 2710
      IF (OPTION$.NE.3.) GO TC 1210
      CALL XTICKS$ (5)
      CALL XREVTK
      CALL XGRAXS (XORIG,XSTP,XMAX,9.,
1      'PROFILE DRAG MAIN ROTOR$',100,0.,-.75)
1210 GO TO 2710
      IF (OPTION$.NE.4.) GO TO 1220
      CALL YTICKS$ (5)
      CALL YREVTK
      CALL YGRAXS (XORIG,XSTP,XMAX,6.,
1      'PROFILE DRAG MAIN ROTOR$',100,-1.,0.)
1220 GO TO 2710
      IF (OPTION$.NE.5.) GO TO 1230
      CALL XTICKS$ (5)
      CALL XREVTK
      CALL XGRAXS (XORIG,XSTP,XMAX,6.5,
1      'PROFILE DRAG MAIN ROTOR$',100,0.,-.75)
1230 GO TO 2710
      IF (OPTION$.NE.6.) GO TO 1240
      CALL YTICKS$ (5)
      CALL YREVTK
      CALL YGRAXS (XORIG,XSTP,XMAX,8.,
1      'PROFILE DRAG MAIN ROTCR$',100,-1.15,0.)
1240 GO TO 2710
      IF (OPTION$.NE.7.) GO TC 1250
      CALL XTICKS$ (5)
      CALL XNAME ('',1)
      GO TO 2710
      CONTINUE
1250 GO TO 2700
1260 IF (Z.NE.15.) GO TO 1350
      DO 1270 I=1,8
      X(I)=CCCTR(I)
      CONTINUE
      XORIG=.007
      XSTP=.002
      XMAX=.017
1270 IF (OPTION$.NE.1.) GO TO 1280
      CALL XTICKS$ (2)
      CALL YNAME ('PROFILE DRAG TAIL ROTOR$',100)
      GO TO 2710
1280 IF (OPTION$.NE.2.) GO TO 1290
      CALL YTICKS$ (2)
      CALL YNAME ('PROFILE DRAG TAIL ROTOR$',100)
      GO TO 2710
1290 IF (OPTION$.NE.3.) GO TO 1300

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CALL XTICKS (2)
CALL XREVTK
CALL XGRAXS
1 GO TO 2710
1300 IF (OPTION,NE.4.) GO TC 1310
CALL YTTICKS (2)
CALL YREVTK
CALL YGRAXS
1 GO TO 2710
1310 IF (OPTION,NE.5.) GO TO 1320
CALL XTICKS (2)
CALL XREVTK
CALL XGRAXS
1 GO TO 2710
1320 IF (OPTION,NE.6.) GO TO 1330
CALL YTTICKS (2)
CALL YREVTK
CALL YGRAXS
1 GO TO 2710
1330 IF (OPTION,NE.7.) GO TO 1340
CALL XTICKS (2)
CALL XNAME ('',1)
GO TO 2710
1340 CONTINUE
GO TO 2700
1350 IF (Z,NE.16.) GO TO 1440
DO (I)=DL(1)
X(I)=DL(I)
CONTINUE
XORIG=4.
XSIP=1.
XMAX=16.
IF (OPTION,NE.1.) GO TO 1370
CALL XTICKS (2)
CALL XNAME ('DISC LOADING$',100)
GO TO 2710
1370 IF (OPTION,NE.2.) GO TO 1380
CALL YTTICKS (2)
CALL YNAME ('DISC LOADING$',100)
GO TO 2710
1380 IF (OPTION,NE.3.) GO TO 1390
CALL XTICKS (2)
CALL XREVTK
CALL XGRAXS (XORIG,XSTP,XMAX,9.,

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1390      'DISC LOADING$,100,0.,-.75)
        GO TO 2710
        IF (OPTICN,NE,4.) GO TO 1400
        CALL YTTICKS (2)
        CALL YREVTK (XORIG,XSTP,XMAX,6,
        CALL YGRAXS 'DISC LOADING$,100,-1.,0.)

1400      GO TO 2710
        IF (OPTICN,NE,5.) GO TO 1410
        CALL XTTICKS (2)
        CALL XREVTK (XORIG,XSTP,XMAX,6.5,
        CALL XGRAXS 'DISC LOADING$,100,0.,-.75)

1410      GO TO 2710
        IF (OPTICN,NE,6.) GO TO 1420
        CALL YTTICKS (2)
        CALL YREVTK (XORIG,XSTP,XMAX,8,
        CALL YGRAXS 'DISC LOADING$,100,-1.15,0.)

1420      GO TO 2710
        IF (OPTICN,NE,7.) GO TO 1430
        CALL XTTICKS (2)
        CALL XNAME ('',1)
        GO TO 2710
        CONTINUE
        GO TO 2700
1430      GO TO 2700
1440      IF (Z,NE,17.) GO TO 1530
        DO 1450 I=1,8
        X(I)=WDT(I)
        CONTINUE
        XORIG=2.
        XSTP=1.0
        XMAX=1.0
        IF (OPTICN,NE,1.) GO TO 1460
        CALL XTTICKS (2)
        CALL XNAME ('FUSELAGE WIDTH (FT)$',100)
        GO TO 2710
1460      IF (OPTICN,NE,2.) GO TO 1470
        CALL YTTICKS (2)
        CALL YNAME ('FUSELAGE WIDTH (FT)$',100)
        GO TO 2710
1470      IF (OPTICN,NE,3.) GO TO 1480
        CALL XTTICKS (2)
        CALL XREVTK (XORIG,XSTP,XMAX,9,
        CALL XGRAXS 'FUSELAGE WIDTH (FT)$',100,0.,-.75)

1480      GO TO 2710
        IF (OPTICN,NE,4.) GO TO 1490

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CALL YTICKS (2)
CALL YREVTK
CALL YGRAXS (XORIG,XSTP,XMAX,6,(FT)$,100,-1,0,0.)
1 GO TO 2710
IF (OPTION,NE,5.) GO TO 1500
CALL XTICKS (2)
CALL XREVTK
CALL XGRAXS (XORIG,XSTP,XMAX,6,(FT)$,100,0,,-.75)
1 GO TO 2710
IF (OPTION,NE,6.) GO TO 1510
CALL YTICKS (2)
CALL YREVTK
CALL YGRAXS (XORIG,XSTP,XMAX,8,(FT)$,100,-1.15,0.)
1 GO TO 2710
IF (OPTION,NE,7.) GO TO 1520
CALL XTICKS (2)
CALL XNAME ('',1)
GO TO 2710
CONTINUE
GO TO 2700
IF (Z,NE,18.) GO TO 1620
DO (I)=1,8
X(I)=LGH(I)
CONTINUE
XORIG=20.
XSTP=20.
XMAX=120.
IF (OPTION,NE,1.) GO TO 1550
CALL XTICKS (2)
CALL XNAME ('FUSELAGE LENGTH (FT)$',100)
GO TO 2710
IF (OPTION,NE,2.) GO TO 1560
CALL YTICKS (2)
CALL YNAME ('FUSELAGE LENGTH (FT)$',100)
GO TO 2710
IF (OPTION,NE,3.) GO TO 1570
CALL XREVTK
CALL XGRAXS (XORIG,XSTP,XMAX,9,(FT)$,100,0,,-.75)
1 GO TO 2710
IF (OPTION,NE,4.) GO TO 1580
CALL YTICKS (2)
CALL YREVTK
CALL YGRAXS (XORIG,XSTP,XMAX,6.,

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1580      1 GO TO 2710
          IF (OPTION,NE,5.) GO TO 1590
          CALL XTICKS (2)
          CALL XREVTK
          CALL XGRAXS
          * FUSELAGE LENGTH (FT) $,100,-1.,0.)
1590      1 GO TO 2710
          IF (OPTION,NE,6.) GO TO 1600
          CALL XTICKS (2)
          CALL YREVTK
          CALL YGRAXS
          (XORIG,XSTP,XMAX,6,5)
          * FUSELAGE LENGTH (FT) $,100,0.,-.75)
1600      1 GO TO 2710
          IF (OPTION,NE,7.) GO TO 1610
          CALL XTICKS (2)
          CALL XNAME (.,.,1)
          GO TO 2710
          CONTINUE
1610      GO TO 2710
1620      IF (Z,NE,19.) GO TO 1710
          DO 1630 I=1,8
          X(I)=FH(I)
          CONTINUE
          XORIG=0.
          XSTP=10.
          XMAX=70.
          IF (OPTION,NE,1.) GO TO 1640
          CALL XTICKS (2)
          CALL XNAME ('FRONT FLAT PLATE AREA(SF) $,100)
          GO TO 2710
1640      IF (OPTION,NE,2.) GO TO 1650
          CALL XTICKS (2)
          CALL YNAME ('FRONT FLAT PLATE AREA(SF) $,100)
          GO TO 2710
1650      IF (OPTION,NE,3.) GO TO 1660
          CALL XTICKS (2)
          CALL XREVTK
          CALL XGRAXS
          (XORIG,XSTP,XMAX,9)
          *FRONT FLAT PLATE AREA(SF) $,100,0.,-.75)
1660      GO TO 2710
          IF (OPTION,NE,4.) GO TO 1670
          CALL YTICKS (2)
          CALL YREVTK
          CALL YGRAXS
          (XORIG,XSTP,XMAX,6)
          *FRONT FLAT PLATE AREA(SF) $,100,-1.,0.)
1670      GO TO 2710
          IF (OPTION,NE,5.) GO TO 1680

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CALL XTICKS (2)
CALL XREVTK (XORIG,XSTP,XMAX,6.5
:FRONT,FLAT,PLATE AREA(SF)$,100,0.0,-.75)
CALL XGRAXS
1 GO TO 2710
IF (OPTION,NE,6.) GO TO 1690
CALL YTTICKS (2)
CALL YREVTK
CALL YGRAXS
1 GO TO 2710
IF (OPTION,NE,7.) GO TO 1700
CALL XTICKS (2)
CALL XNAME (,1)
GO TO 2710
CONTINUE
GO TO 2700
IF (Z,NE,20.) GO TO 1800
DO 1720 I=1,8
X(I)=FV(I)
CONTINUE
XORIG=0.
XSTP=300.
XMAX=150.
IF (OPTION,NE,1.) GO TO 1730
CALL YTTICKS (3)
CALL YNAME (1,VERT. FLAT PLATE AREA(SF)$,100)
GO TO 2710
IF (OPTION,NE,2.) GO TO 1740
CALL YTTICKS (3)
CALL YNAME (1,VERT. FLAT PLATE AREA(SF)$,100)
GO TO 2710
IF (OPTION,NE,3.) GO TO 1750
CALL XREVTK
CALL XGRAXS (XORIG,XSTP,XMAX,9.
:VERT. FLAT,PLATE AREA(SF)$,100,0.0,-.75)
1 GO TO 2710
IF (OPTION,NE,4.) GO TO 1760
CALL YREVTK
CALL YGRAXS
1 GO TO 2710
IF (OPTION,NE,5.) GO TO 1770
CALL XREVTK
CALL XGRAXS (XORIG,XSTP,XMAX,6.5,

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1      ' VERT. FLAT PLATE AREA(SF) $ , 100, 0. , -.75 )
1770  GO TO 2710
      IF (OPTICN, NE, 6.) GO TO 1780
      CALL YTICKS (3)
      CALL YREVTK
      CALL YGRAXS (XORIG, XSTP, XMAX, 8.,
1780  ' VERT. FLAT PLATE AREA(SF) $ , 100, -1.15, 0. )
      GO TO 2710
      IF (OPTICN, NE, 7.) GO TO 1790
      CALL XTICKS (3)
      CALL XNAME (1., 1)
      GO TO 2710
      CONTINUE
      GO TO 2700
      IF (Z, NE, 21.) GO TO 1890
1800  DO 1810 I=1, 8
      X(I)=VM(I)
      CONTINUE
      XORIG=100.
      XSTP=100.
      XMAX=180.
      IF (OPTICN, NE, 1.) GO TO 1820
      CALL XTICKS (2)
      CALL XNAME ('MAXIMUM VELOCITY (KNT) $ , 100)
      CALL XINTAX
      GO TO 2710
1820  IF (OPTICN, NE, 2.) GO TO 1830
      CALL YTICKS (2)
      CALL YNAME ('MAXIMUM VELOCITY (KNT) $ , 100)
      CALL YINTAX
      GO TO 2710
1830  IF (OPTICN, NE, 3.) GO TO 1840
      CALL XTICKS (2)
      CALL XREVTK
      CALL XGRAXS (XORIG, XSTP, XMAX, 9.,
1840  ' MAXIMUM VELOCITY (KNT) $ , 100, 0. , -.75 )
      CALL XINTAX
      GO TO 2710
      IF (OPTICN, NE, 4.) GO TO 1850
      CALL YTICKS (2)
      CALL YREVTK
      CALL YGRAXS (XORIG, XSTP, XMAX, 6.,
1850  ' MAXIMUM VELOCITY (KNT) $ , 100, -1., 0. )
      CALL YINTAX
      GO TO 2710
      IF (OPTICN, NE, 5.) GO TO 1860
      CALL XTICKS (2)
      CALL XREVTK

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1 CALL XGRAXS (XORIG,XSTP,XMAX,6.5,
:MAXIMUM VELOCITY (KNT)$,100,0.,-.75)
1860 CALL XINTAX
GO TO 2710
IF (OPTION,NE,6.) GO TO 1870
CALL OPTTICKS (2)
CALL YREVTK
CALL YGRAXS
1 CALL YINTAX
GO TO 2710
IF (OPTION,NE,7.) GO TO 1880
1870 CALL XTICKS (2)
CALL XNAME ('',1)
GO TO 2710
CONTINUE
GO TO 450
1880 IF (Z,NE,22.) GO TO 1980
1890 DO 1900 I=1,8
X(I)=RNG(I)
CONTINUE
XORIG=150.
XSTP=550.
XMAX=550.
IF (OPTION,NE,1.) GO TO 1910
1900 CALL XTICKS (2)
CALL XNAME ('MAXIMUM RANGES (NM)$,100)
CALL XINTAX
GO TO 2710
1910 IF (OPTION,NE,2.) GO TO 1920
CALL YTICKS (2)
CALL YNAME ('MAXIMUM RANGES (NM)$,100)
CALL YINTAX
GO TO 2710
1920 IF (OPTION,NE,3.) GO TO 1930
CALL XTICKS (2)
CALL XREVTK
CALL XGRAXS (XORIG,XSTP,XMAX,9.0,
:MAXIMUM RANGE (NM))
1 CALL XINTAX
GO TO 2710
1930 IF (OPTION,NE,4.) GO TO 1940
CALL YTICKS (2)
CALL YREVTK
CALL YGRAXS (XORIG,XSTP,XMAX,6.0,
:MAXIMUM RANGE (NM))
1 CALL YINTAX
GO TO 2710

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1940 IF (OPTION, NE, 5.) GO TO 1950
      CALL XTICKS (2)
      CALL XREVTK (XORIG, XSTP, XMAX, 6.5)
      CALL XGRAXS (XORIG, XSTP, XMAX, 6.5)
1     CALL XINTAX
      GO TO 2710
1950 IF (OPTION, NE, 6.) GO TO 1960
      CALL YTICKS (2)
      CALL YREVTK (XORIG, XSTP, XMAX, 8.)
      CALL YGRAXS (XORIG, XSTP, XMAX, 8.)
1     CALL YINTAX
      GO TO 2710
1960 IF (OPTION, NE, 7.) GO TO 1970
      CALL XTICKS (2)
      CALL XNAME (, , 1)
      GO TO 2710
1970 CONTINUE
      GO TO 2700
1980 IF (Z, NE, 23.) GO TO 2070
      DO (I)=RCL(1)
1990 CONTINUE
      XORIG=500.
      XSTP=3000.
      XMAX=3000.
      IF (OPTION, NE, 1.) GO TO 2000
      CALL XTICKS (2)
      CALL XNAME (RATE OF CLIMB (FT/MIN)$, 100)
      CALL XINTAX
      GO TO 2710
2000 IF (OPTION, NE, 2.) GO TO 2010
      CALL YTICKS (2)
      CALL YNAME (RATE OF CLIMB (FT/MIN)$, 100)
      CALL YINTAX
      GO TO 2710
2010 IF (OPTION, NE, 3.) GO TO 2020
      CALL XTICKS (2)
      CALL XREVTK (XORIG, XSTP, XMAX, 9)
      CALL XGRAXS (XORIG, XSTP, XMAX, 9)
      CALL XINTAX
      GO TO 2710
2020 IF (OPTION, NE, 4.) GO TO 2030
      CALL YTICKS (2)
      CALL YREVTK (XORIG, XSTP, XMAX, 6.)
      CALL YGRAXS (XORIG, XSTP, XMAX, 6.)

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1 CALL Y IN TAX
  GO TO 2710
  IF (OPTIGN, NE.5.) GO TO 2040
  CALL XTICKS (2)
  CALL XREVTK
  CALL XGRAXS
  'RATE OF CLIMB (FT/MIN)$, 100, -1., 0.)

1 CALL X IN TAX
  GO TO 2710
  IF (OPTIGN, NE.6.) GO TO 2050
  CALL YTICKS (2)
  CALL YREVTK
  CALL YGRAXS
  (XORIG, XSTP, XMAX, 6.5,
  'RATE OF CLIMB (FT/MIN)$, 100, 0., -.75)

1 CALL Y IN TAX
  GO TO 2710
  IF (OPTIGN, NE.7.) GO TO 2060
  CALL XTICKS (2)
  CALL XNAME (1, 1)
  GO TO 2710
  CONTINUE
  GO TO 2700
  IF (Z, NE.24.) GO TO 2160
  DO (Z, 2080 I=1, 8
  X(I)=HCVIGE(I)
  CONTIG=3000.
  XSTP=3000.
  XMAX=15000.
  IF (OPTIGN, NE.1.) GO TO 2090
  CALL XTICKS (3)
  CALL XNAME ('HOVER CEILING (FT) IGE$', 100)
  CALL X IN TAX
  GO TO 2710
  IF (OPTIGN, NE.2.) GO TO 2100
  CALL YTICKS (3)
  CALL YNAME ('HOVER CEILING (FT) IGE$', 100)
  CALL Y IN TAX
  GO TO 2710
  IF (OPTIGN, NE.3.) GO TO 2110
  CALL XTICKS (3)
  CALL XREVTK
  CALL XGRAXS
  (XORIG, XSTP, XMAX, 9,
  'HOVER CEILING (FT) IGE$', 100, 0., -.75)

1 CALL X IN TAX
  GO TO 2710
  IF (OPTIGN, NE.4.) GO TO 2120

```



```

2200 CALL X INTAX
      GO TO 2710
      IF (OPTION, NE, 4.) GO TO 2210
      CALL Y TICKS (3)
      CALL Y REVTK
      CALL Y GRAXS
      1 CALL Y INTAX
        GO TO 2710
        IF (OPTION, NE, 5.) GO TO 2220
        CALL X TICKS (3)
        CALL X REVTK
        CALL X GRAXS
      1 CALL X INTAX
        GO TO 2710
        IF (OPTION, NE, 6.) GO TO 2230
        CALL Y TICKS (3)
        CALL Y REVTK
        CALL Y GRAXS
      1 CALL Y INTAX
        GO TO 2710
        IF (OPTION, NE, 7.) GO TO 2240
        CALL X NAME (, , 1)
        GO TO 2710
        CONTINUE
        IF (Z, NE, 26.) GO TO 2340
        DO 2260 I=1,8
        X(I)=LT(I)
        CONTINUE
        XORIG=10.
        XSTP=10.
        XMAX=60.
        IF (OPTION, CN, 1.) GO TO 2270
        CALL X TICKS (5)
        CALL X NAME (, LENGTH OF TAIL (FT)$, 100)
        GO TO 2710
        IF (OPTION, NE, 2.) GO TO 2280
        CALL Y TICKS (5)
        CALL Y NAME (, LENGTH OF TAIL (FT)$, 100)
        GO TO 2710
        IF (OPTION, NE, 3.) GO TO 2290
        CALL X REVTK
        CALL X GRAXS (XORIG, XSTP, XMAX, 9.,
2210
2220
2230
2240
2250
2260
2270
2280

```

```

1 GO TO 2710
IF (OPTION, NE, 4.) GO TO 2300
2290 CALL YTICKS (5)
CALL YREVTK
CALL YGRAXS (XORIG, XSTP, XMAX, 6.,
'LENGTH OF TAIL (FT)', 100, 0., -.75)

1 GO TO 2710
IF (OPTION, NE, 5.) GO TO 2310
2300 CALL XTICKS (5)
CALL XREVTK
CALL XGRAXS (XORIG, XSTP, XMAX, 6.5,
'LENGTH OF TAIL (FT)', 100, 0., -.75)

1 GO TO 2710
IF (OPTION, NE, 6.) GO TO 2320
2310 CALL YTICKS (5)
CALL YREVTK
CALL YGRAXS (XORIG, XSTP, XMAX, 8.,
'LENGTH OF TAIL (FT)', 100, -1.15, 0.)

1 GO TO 2710
IF (OPTION, NE, 7.) GO TO 2330
2320 CALL XTICKS (5)
CALL XNAME (1, 1)
GO TO 2710
CONTINUE
2330 GO TO 2700
2340 IF (Z, NE, 27.) GO TO 2430
DO 2350 I=1, 8
X(I)=0
CONTINUE
2350 XORIG=0
XSTP=5000
XMAX=4000
IF (OPTION, NE, 1.) GO TO 2360
CALL XTICKS (2)
CALL XNAME ('OPERATING WEIGHT (LB)', 100)
CALL XINTAX
GO TO 2710
2360 IF (OPTION, NE, 2.) GO TO 2370
CALL YTICKS (2)
CALL YNAME ('OPERATING WEIGHT (LB)', 100)
CALL YINTAX
GO TO 2710
2370 IF (OPTION, NE, 3.) GO TO 2380
CALL XTICKS (2)
CALL XREVTK
CALL XGRAXS (XORIG, XSTP, XMAX, 9.,
'OPERATING WEIGHT (LB)', 100, 0., -.75)
1

```

```

2380      CALL XINTAX
        GO TO 2710
        IF (OPTION, NE, 4.) GO TO 2390
        CALL YTTICKS (2)
        CALL YREVTK
        CALL YGRAXS
1         CALL YINTAX
        GO TO 2710
        IF (OPTION, NE, 5.) GO TO 2400
        CALL XTTICKS (2)
        CALL XREVTK
        CALL XGRAXS
1         CALL XINTAX
        GO TO 2710
        IF (OPTION, NE, 6.) GO TO 2410
        CALL YTTICKS (2)
        CALL YREVTK
        CALL YGRAXS
1         CALL YINTAX
        GO TO 2710
        IF (OPTION, NE, 7.) GO TO 2420
        CALL XTTICKS (2)
        CALL XNAME ('', 1)
        GO TO 2710
        CONTINUE
        GO TO 2700
        IF (Z, NE, 28.) GO TO 2520
        DO 2440 I=1,8
        X(I)=LHT(I)
        CONTINUE
        XORIG=0.
        XSTP=50000.
        XMAX=30000.
        IF (OPTION, NE, 1.) GO TO 2450
        CALL XTTICKS (2)
        CALL XNAME ('LOAD WEIGHT (LB)$', 100)
        CALL XINTAX
        GO TO 2710
        IF (OPTION, NE, 2.) GO TO 2460
        CALL YTTICKS (2)
        CALL YNAME ('LOAD WEIGHT (LB)$', 100)
        CALL YINTAX
        GO TO 2710
        IF (OPTION, NE, 3.) GO TO 2470
        CALL XTTICKS (2)

```

```

CALL XREVTK (XORIG,XSTP,XMAX,9,$$,100,0.0,-.75)
CALL XGRAXS (LOAD WEIGHT (LB)$$,100,0.0,-.75)
1 CALL XINTAX
GO TO 2710
IF (OPTION,NE,4.0) GO TO 2480
CALL YTTICKS (2)
CALL YREVTK
CALL YGRAXS (XORIG,XSTP,XMAX,6,$$,100,-1.0,0.0)
1 CALL YINTAX
GO TO 2710
IF (OPTION,NE,5.0) GO TO 2490
CALL XTTICKS (2)
CALL XREVTK
CALL XGRAXS (XORIG,XSTP,XMAX,6,5,$$,100,0.0,-.75)
1 CALL XINTAX
GO TO 2710
IF (OPTION,NE,6.0) GO TO 2500
CALL YTTICKS (2)
CALL YREVTK
CALL YGRAXS (XORIG,XSTP,XMAX,8,$$,100,-1.15,0.0)
1 CALL YINTAX
GO TO 2710
IF (OPTION,NE,7.0) GO TO 2510
CALL XNAME ('',1)
GO TO 2710
CONTINUE
GO TO 2700
IF (Z,NE,29.0) GO TO 2610
DO 2530 I=1,8
X(I)=FWT(I)
CONTINUE
XORIG=C.0
XSTP=3000.0
XMAX=21000.0
NE,1.0) GO TO 2540
IF (OPTION,NE,3)
CALL XNAME ('FUEL WEIGHT (LB)$',100)
CALL XINTAX
GO TO 2710
IF (OPTION,NE,2.0) GO TO 2550
CALL YTTICKS (3)
CALL YNAME ('FUEL WEIGHT (LB)$',100)
CALL YINTAX

```

2470

2480

2490

2500

2510

2520

2530

2540

```

2550 GO TO 2710
      IF (OPTION, NE, 3.) GO TO 2560
      CALL XTICKS (3)
      CALL XREVTK
      CALL XGRAXS (XORIG, XSIP, XMAX, 9,
                  :FUEL WEIGHT (LB) $!, 100, 0., -.75)
1     CALL XINTAX
2560 GO TO 2710
      IF (OPTION, NE, 4.) GO TO 2570
      CALL YTICKS (3)
      CALL YREVTK
      CALL YGRAXS (XORIG, XSIP, XMAX, 6,
                  :FUEL WEIGHT (LB) $!, 100, -.1., 0.)
1     CALL YINTAX
2570 GO TO 2710
      IF (OPTION, NE, 5.) GO TO 2580
      CALL XTICKS (3)
      CALL XREVTK
      CALL XGRAXS (XORIG, XSIP, XMAX, 6.5,
                  :FUEL WEIGHT (LB) $!, 100, 0., -.75)
1     CALL XINTAX
2580 GO TO 2710
      IF (OPTION, NE, 6.) GO TO 2590
      CALL YTICKS (3)
      CALL YREVTK
      CALL YGRAXS (XORIG, XSIP, XMAX, 8,
                  :FUEL WEIGHT (LB) $!, 100, -.1.15, 0.)
1     CALL YINTAX
2590 GO TO 2710
      IF (OPTION, NE, 7.) GO TO 2600
      CALL XTICKS (3)
      CALL XNAME (., ., 1)
      CONTINUE
2600 GO TO 2700
2610 IF (Z, NE, 30.) GO TO 2700
      DO 2620 I=1, 8
      X(I)=MGW(I)
      CONTINUE
2620 XORIG=0.
      XSIP=30000.
      XMAX=90000.
      IF (OPTION, NE, 1.) GO TO 2630
      CALL XTICKS (3)
      CALL XNAME ('MAXIMUM GROSS WEIGHT (LB) $', 100)
      CALL XINTAX
      GO TO 2710
2630 IF (OPTION, NE, 2.) GO TO 2640

```

```

2640      Y T I C K S ( 3 )
          C A L L Y N A M E ( ' M A X I M U M G R O S S W E I G H T ( L B ) $ , 1 0 0 )
          C A L L Y I N T A X
          G O T O 2 7 1 0
          I F ( O P T I O N , N E , 3 . ) G O T O 2 6 5 0
          C A L L X T I C K S ( 3 )
          C A L L X R E V T K
          C A L L X G R A X S
          1
          C A L L X I N T A X
          G O T O 2 7 1 0
          I F ( O P T I O N , N E , 4 . ) G O T O 2 6 6 0
          C A L L Y T I C K S ( 3 )
          C A L L Y R E V T K
          C A L L Y G R A X S
          1
          C A L L Y I N T A X
          G O T O 2 7 1 0
          I F ( O P T I O N , N E , 5 . ) G O T O 2 6 7 0
          C A L L X T I C K S ( 3 )
          C A L L X R E V T K
          C A L L X G R A X S
          1
          C A L L X I N T A X
          G O T O 2 7 1 0
          I F ( O P T I O N , N E , 6 . ) G O T O 2 6 8 0
          C A L L Y T I C K S ( 3 )
          C A L L Y R E V T K
          C A L L Y G R A X S
          1
          C A L L Y I N T A X
          G O T O 2 7 1 0
          I F ( O P T I O N , N E , 7 . ) G O T O 2 6 9 0
          C A L L X T I C K S ( 3 )
          C A L L X N A M E ( ' , 1 )
          G O T O 2 7 1 0
          C O N T I N U E
          G O T O 2 7 0 0
          C O N T I N U E
          W R I T E ( 6 , 2 7 2 0 )
          C O N T I N U E
          C A L L R E S E T ( ' X R E V T K ' )
          C A L L R E S E T ( ' Y R E V T K ' )
          R E T U R N
          F O R M A T ( 5 4 H Y O U H A V E M A D E A M I S T A K E A N D E N T E R E D A N I N V A L I D N U M B E R )
          E N D
2650
2660
2670
2680
2690
2700
2710
2720

```

APPENDIX B

A. USERS GUIDE TO THE CONCEPTUAL DESIGN PROGRAM

The design program has been developed with the user in mind. The program is completely interactive in that it prompts the user for any inputs needed. The following steps should be taken to invoke the program and to get an output file useable for analysis.

1. Logon as normal on either the IBM 3278 or the Tektronix 618 dual screen system
2. Obtain temporary storage space by typing in:

 DEFINE STORAGE 1M (enter)
3. When PSW '00020000 00000 000' appears on the screen type in:

 I CMS (enter)
4. If the program has not been compiled on your disk yet type in the following:

 FORTGI DESIGN (enter)
5. After the program has been compiled you are ready to run the program by typing in:

 DISSPLA (enter)
6. You will be asked to enter library functions or to press enter. Press the enter key.
7. You will then be asked if you want additional temporary space for shading, etc.. Again, press the enter key.
8. Next you will be asked to enter any defined files that you want. Here you should enter the following:

FILEDEF 08 DISK DESIGN (file name)

9. After entering the above line the screen will flash and your FILEDEF should be listed on the bottom line of the existing FILEDEFS. If your filedef is listed press the enter key to start the program execution.
10. Follow the instructions given on the screen. You will need the Helicopter Design Manual and the appropriate handouts/references to complete the process.
11. If you are on the IBM 3278 terminal you will not get a graph, therefore, you must plot the total power data by hand and extrapolate the needed data
12. If you are using the TEK 618 dual screen system a graph will be drawn of the total power curve and its components at altitude which can immediately be used to extrapolate the necessary data to complete the entire design process.
13. Note that the output file of all the information that you have computed is in the file that you have defined. To get your data type in:

PRINT DESIGN (filename) (CC

B. PROGRAM NOMENCLATURE

MNEMONIC

DEFINITION

A	Sonic speed at standard sea level
AALT	Sonic speed at specification density altitude
AASLY	Average aircraft serviceable life in years
AFHPF	Average flight hours per flight
AFHPY	Average flight hours per year per airframe
ALPHA	Ordinate intercept of fuel flow-horsepower curve
ALT	Maximum rate of climb calculation altitude
ALTSC	Service ceiling altitude
AMAX	Steady flow stall angle of the airfoil

ANS	General variable for keyboard answer
AR	Aspect ratio of the main rotor system
AREAMR	Area of the main rotor disc
AREATR	Area of the tail rotor disc
ARTR	Aspect ratio of the tail rotor
ARVS	Vertical stabilizer aspect ratio
AVAIL	Availability of an engine
AVAILM	Availability (multiple engine)
A11	Term in definition of THETA2
A12	Term in definition of THETA2
A13	Term in definition of THETA2
A14	Term in definition of THETA2
A80	Vertical stabilizer angle of attack at 80 knots
A90	Angle of attack of the advancing blade (radians)
A160	Vertical stabilizer angle of attack at 160 knots
A90D	Angle of attack of the advancing blade (degrees)
A270	Angle of attack of retreating blade (radians)
A270D	Angle of attack of retreating blade (degrees)
B	Main rotor tip loss factor
BETA	Slope of the fuel flow horsepower curve
BH	Main rotor tip loss factor at a hover
BL	Blade loading of the main rotor system
BLADES	Number of main rotor blades

BLADTR Number of tail rotor blades
BS Term used in inboard stall analysis
BTA Tail rotor tip loss factor at altitude
BTR Tail rotor tip loss factor
BVS Span of the vertical stabilizer
CDO Coefficient of drag of a main rotor blade
CDOTR Coefficient of drag of a tail rotor blade
CHORD Chord of a main rotor blade
CHORDT Chord of a tail rotor blade
CL Coefficient of lift of a main rotor blade section
CLA Lift curve slope of a main rotor blade section
CLMAX Maximum coefficient of lift for a blade section
CL80 Section coefficient of lift at 80 knots
CL160 Section coefficient of lift at 160 knots
COLL Collective position (radians)
COLLD Collective position (degrees)
COMPAR Weight variance parameter
CONST Constant value in ICAO formulae
COUNT Counter variable
CPC Correction to power coefficient
CPS Correction to power coefficient due to stall
CREW Number of specified crew
CS Term used in stall analysis

CT	Main rotor coefficient of thrust
CTH	Main rotor coefficient of thrust at a hover
CTTA	Tail rotor coefficient of thrust at altitude
CTTR	Tail rotor coefficient of thrust at sea level
CYCD	Cyclic position (degrees)
CYCLIC	Cyclic position (radians)
C1	Cost of main rotor
C2A	Cost of tail rotor
C2B	Cost of tail rotor structure
C3	Cost of body
C4	Cost of landing gear
C5	Cost of nacelle
C6A	Cost of engine
C6B	Cost of drive system
C6C	Cost of fuel tanks
C7	Cost of flight controls
C8	Cost of auxiliary power
C9	Cost of instruments
C10	Cost of hydraulics
C11	Cost of electrical system
C12	Cost of avionics
C13	Cost of furnishings
C14	Cost of air and ice

C15	Cost of load and handling
D	Diameter of the rotor system
DA270	Blade angle of advancing blade (degrees)
DELTA	Fuel flow ratio
DERR	Error function
DL	Disc loading of the main rotor system
DLAMB	Term used in blade stall analysis
DP	Parasite drag
DREF	Acceptable error function
DW	Powerplant dry weight of an engine
DWG	Design gross weight
DWM	Powerplant dry weight (multiple engine)
D1	Stall analysis parameter
D2	Stall analysis parameter
EFPAPF	Effective flat plate area (horizontal)
EFPAPV	Effective flat plate area (vertical)
EIW	Engine installed weight
EIWM	Engine installed weight (multiple engine)
ENGSEL	Engine selected
ESHPR	Estimated shaft horsepower required to hover
EW	Estimated engine weight from weight estimations
EWNEW	New engine weight using powerplant data
EXCESS	Excess weight

E1	Stall analysis parameter
E2	Stall analysis parameter
E3	Stall analysis parameter
FL	Factor for landing gear weight approximation
FSLT	Length of the fuselage
FSLTS	Specification maximum length of the fuselage
FUEL	Amount of fuel in pounds
PW	Fuel weight in pounds
PWNEW	Change in original fuel weight for printout
GALIN	Internal fuel weight in gallons
GALOUT	External fuel weight in gallons
GAM	Stall analysis parameter
GWSPEC	Specification maximum gross weight
HL	Life of the aircraft
HOVIGE	Specification hover ceiling (in ground effect)
HP	Hover power of the main rotor system (out of ground effect)
ht	Rotor system height above the ground
I	Do loop parameter
IC	Initial cost of an engine
ICM	Initial costs (multiple engine)
IER	Library function error code
IF	Installation fraction
IHP	Array for plotting

IR	Inflation rate in 1977 dollars
K	Dc lcop parameter
KNOTS	Increment for forward speed
KNT	Increment for fcrward speed
KNTS	Knots increment for table
KS	Stall analysis parameter
LAMBDA	Stall analysis parameter
LAMB1	Stall analysis parameter
LAMFR	Used for reliability calculation
LCC	Life cycle cost of an engine
LCCM	Life cycle cost (multiple engine)
LERR	Acceptable error function
LG	Type of landing gear
LOAD	Loading used to find effective flat plate area
LREF	Acceptable error function
LTR	Length of the tail rotor
M	Figure of merit
MACH	Maximum allowable Mach number at sea level
MACHT	Main rotor system tip Mach number
MAINT	Maintainability of an engine
MAINTM	Maintainability (multiple engine)
MAXRC	Specification rate of climb
MAXV	Maxium forward velocity in feet per second

MCRIT Critical Mach number
MCRO Zero angle of attack critical Mach number
MD Drag divergence Mach number
MDT Mean down time of an engine
MTBF Mean time between engine failures
MTBMA Mean time between maintenance actions per engine
MTBR Mean time between repairs for an engine
MTBRM Mean time between repair (multiple engine)
MTIP Tip Mach number of the main rotor system
MTRR TIP MACH NUMBER OF THE TAIL ROTOR SYSTEM
MU Advance ratio of the main rotor system
MUTR Advance ratio of the tail rotor system
N Do loop parameter
NDEG Order of differential equation
NENG Number of engines
NEWUSE New useful load
NN Do loop parameter
NRPL Number of engine replacements (real or integer)
NRPLM Number of engine replacements (multiple engine)
NW Number of landing gear
NXRPL Number of engine replacements (integer)
NXRPLM Number of engine replacements (multiple engine)
OC Operating cost of an engine

OLD Previous gross weight used for comparison
 OMEGA Main rotor rotational velocity (radians)
 OMEGTR Tail rotor rotational velocity (radians)
 PA Specification pressure altitude
 PADJA Adjusted power at altitude
 PADJS Adjusted power at sea level
 PALT Rate of climb pressure
 PAVAIL Power available
 PC Power to climb
 PCMPA Array for compressible power at altitude
 PCMPs Array for compressible power at sea level
 PEOPLE Number of people
 PI Induced power of the main rotor system
 PIE Constant for value of pi
 PIHP Induced power of the main rotor system in HP
 PITLF Induced power (IGE) at a forward speed
 PITLFA Induced power at altitude at forward speed
 PITLFS Induced power at sea level at forward speed
 PITLGE Induced power in ground effect
 PITLGH Induced power at a hover
 PITLH Induced power at a hover
 PITLTF Induced power of the tail rotor in forward flight
 PITLTR Induced power for the tail rotor

PITRFA Induced power of the tail rotor at altitude
in forward flight

PITRFS Induced power of the tail rotor at sea level
in forward flight

PIVERT Induced power vertically

PIX Array used for plotting of total induced power at
sea level

PIY Array used for plotting total induced power at
altitude

PM Preventative maintenance cost of an engine

PMBS Blade stall power factor

PO Profile power of the main rotor system

POC Profile power to climb

POF Profile power at a forward speed

POFA Profile power at altitude at forward speed

POFS Profile power at sea level at forward speed

POH Profile power at a hover

POHP Profile power of the main rotor system in HP

POTA Profile power of tail rotor at altitude

POTR Profile power for the tail rotor

POTRF Profile power of the tail rotor in forward flight

POTRFA Profile power of the tail rotor at altitude
in forward flight

POTRFS Profile power of the tail rotor at sea level
in forward flight

POX Array used for plotting of total profile power at
sea level

POY Array used for plotting total profile power at
altitude

PP Parasite power
 PPC Parasite power to climb
 PPF Parasite power at a forward speed
 PPFA Parasite power at altitude at forward speed
 PPFS Parasite power at sea level at forward speed
 PPOGE In ground effect distance parameter
 PPOGEH Ground effect factor at a hover
 PPX Array used for plotting total parasite power at sea level
 PPY Array used for plotting total parasite power at altitude
 PRESS Specification pressure altitude
 PS Stall power
 PSHF Phantom shaft horsepower
 PT Total power of the main rotor system
 PTACH Total power for the aircraft to hover
 PTAH Total power of the aircraft to hover
 PTAVAL Total power available
 PTF Total power at a forward velocity
 PTFA Total power at altitude at forward speed
 PTFS Total power at sea level at forward speed
 PTH Total power at a hover
 PTHOVS Total power to hover
 PTHP Total power of the main rotor system in HP
 PTTAHP Total power of the aircraft to hover in HP

PTTRF Total power of the tail rotor in forward flight
 PTTRFA Total power of the tail rotor at altitude
 in forward flight
 PTTRFS Total power of the tail rotor at sea level
 in forward flight
 PTTRH Total power for the tail rotor at a hover
 PTTRHP Total power for the tail rotor at a hover in HP
 PTVERT Total power vertically
 PTX Array used for plotting total power at sea level
 PTY Array used for plotting total power at altitude
 Q Production run quantity
 R Rotor radius
 RBS Retreating blade stall velocity
 RC Recovery cost of an engine
 RCLIMB Rate of climb
 RCM Recovery cost (multiple engine)
 RDC Research and development cost of an engine
 RDCM Research and development costs (multiple engine)
 RELY Reliability of an engine
 RELYM Reliability (multiple engine)
 REVWE Revised empty weight
 REVWG Revised gross weight
 RHOALT Density at specification density altitude
 RHOMH Density at hover in ground effect ceiling
 RHOS Density at service ceiling

RHOSC	Service ceiling density
RHOSL	Sea level density
RNGMAX	Maximum range as per specification
RNGNMX	New maximum range
RSHPC	Required shaft horsepower for cruise
RSHPME	Required shaft horsepower for max endurance speed
RSHRME	Total required shaft horsepower for max endurance
RSHPRC	Total required shaft horsepower for cruise
RRSHP	Required shaft horsepower
RSHPM	Required shaft horsepower (military)
RSPEC	Specification maximum rotor radius
RT	Stall analysis parameter
RTR	Tail rotor radius
S	Main rotor planform area for weight estimation
SB	Body surface area for weight estimation
SC	Specification service ceiling
SFCC	Cruise specific fuel consumption
SFCM	Military specific fuel consumption
SFCN	Normal specific fuel consumption
SHPC	Cruise shaft horsepower
SHPM	Military shaft horsepower
SHPMH	Military shaft horsepower (multiple engine)
SHPN	Normal shaft horsepower

SIG	Pressure ratio
SIGMA	Solidity of the main rotor system
SIGTR	Solidity of the tail rotor system
SIM	Weight variance parameter
SPCLOD	Specification useful load
STEP	Variance parameter for iterations
STT	Total tail surface area for weight estimation
SV	Salvage value
SVM	Salvage value (multiple engine)
TALT	Rate of climb temperature
TEMP	Specification temperature
THETA	Temperature ratio
THETA0	Collective angle in radians
THETA2	Cyclic angle in radians
TOTALC	Total cost of an aircraft in a production run
TRIP1	Trips the program so that repetitive questions are repeated
TRIP2	Trips the program so that repetitive questions are repeated
TRIP3	Trips the program so that repetitive questions are repeated
TRIP4	Trips the program so that repetitive questions are repeated
TRIP5	Trips the program so that repetitive questions are repeated
TSHP	Total shaft horsepower
TTR	Thrust of the tail rotor

TTR80	Tail rotor thrust at 80 knots
TTR160	Tail rotor thrust at 160 knots
TWIST	Twist of main rotor blade
TYPE	Type of helicopter (light,medium,heavy)
TYPEN	Type of aircraft (light,medium,heavy)
T1	Term used in defining THETA0
T2	Term used in defining THETA0
T3	Term used in defining THETA0
T4	Term used in defining THETA0
USELOD	Useful load desired
VCR	Cruise velocity as per specification
VELMAX	Maximum forward velocity
VF	Forward velocity
VFWD	Forward velocity
VF80	Forward velocity at 80 knots in ft/sec
VF160	Forward velocity at 160 knots in ft/sce
VI	Induced velocity in a hover
VINEW	Induced velocity at hover
VIT	Vertical induced velocity at a hover
VITNEW	Induced vertical velocity at a hover
VITR	Induced velocity of the tail rotor
VITTR	Induced vertical velocity of the tail rotor
VL	stall parameter

VMAX	Specification maximum forward velocity
VMAXE	Maximum endurance velocity
VMAXF	Maximum forward velocity in knots
VMAXK	Initial forward velocity for stall analysis
VMAXR	Maximum range velocity
VOPT	Optimum velocity for aircraft in ft/sec
VOPTK	Optimum velocity for aircraft in knots
VS	Forward speed in ft/sec
VSK	Forward speed in knots
VTIP	Tip velocity of the main rotor system
VTIPTR	Tail rotor tip velocity
VTNEW	Solution to fourth order differential equation
VVERT	Vertical velocity
WE	Manufacturers empty weight
WFC	Cruise fuel flow rate
WFCR	Fuel flow rate for cruise flight
WFM	Military fuel flow rate
WFME	Fuel flow rate for max endurance velocity
WFN	Normal fuel flow rate
WG	Gross weight
WGNEW	New gross weight
WXO	Transmission and oil weight
WXOM	Transmission and oil weight (multiple engine)

W1	Rotor weight
W2A	Tail rotor weight
W2B	Tail rotor structure weight
W3	Body weight
W4	Landing gear weight
W5	Nacelle weight
W6A	Engine weight
W6B	Drive weight
W6C	Fuel tank weight
W7	Flight control weight
W8	Auxillary power weight
W9	Instrument weight
W10	Hydraulic weight
W11	Electrical weight
W12	Avionics weight
W13	Furnishings weight
W14	Air and ice weight
W15	Load and handling weight
X0	Radius used for stall analysis (inboard)
XRLG	Fixed or retractable landing gear
XS	Radius outboard analysis
YMC	Yearly maintenance cost of an engine
YMCN	Yearly maintenance costs (multiple engine)

YOC Yearly operating cost of an engine
YOCM Yearly operating costs (multiple engine)
ZCMPLX Array for library function
ZHI Zero horsepower intercept

C. PROGRAM LISTING

```

REAL TRIP1, TRIP2, TRIP3, TRIP4, SC,HOVIGE,RSPEC,FSLTS,MAXRC,SPCLOD,TR
1 REAL COUNT/O./,IR
REAL WG,GWSFEC
REAL WE
REAL A,MACH,VMAX,PIE,RHOSL
REAL DL,RA,REAMR
REAL OMEGA,CT
REAL VTIPI,MAXV,MU,BL,SIGMA
REAL VMAXF,AR
REAL CLL
REAL CLLA,CDC
REAL B,PI,PIHP,POHP,PTHP,HP
REAL FUEL,USELOD,STT,SBSS,W1,W2A,W2B,W3,W4,W5,W6A,W6B,W6C,W7,W8,W9
1 REAL W10,W11,W12,W13,W14,W15,REVWE,REVWG,TYPE
REAL MANS,CLD/O./
REAL STEP,FL,LG,XR,LG,NW
REAL H,C,P,PCGE,PITLGE,PTHOVS
REAL L,C,P,PF,PF,FK,NITS
REAL VF(55),AALG,PA,CONST
1 REAL ART,CHORDI,SIGTR
2 REAL AREATR,VTIPTR,CTIR,BTR,PITLTR,POTR,PTTRH,PTTRHP,CTTA,BTA,
REAL AREATR,PTTAHP
1 REAL FOTA,PTTAH,PTRFS(55),PITRFS(55),MTTR,POTRFA(55),P
1 REAL MU,TR,POTRFA(55),VITR,VITTR,PTTRF,PITLTF
1 REAL TTR160,TTR80,VS,BVS,CL80,CL160,VF80,VF160,CLARVS,A80,A160,ARV
1
REAL LAMBDA,KS,MCRIT,MTIP,LERR,MCR,OLAMB,CLMAX,VL,VMAX,PCMPA(55
1) PCMP(55),C1,C2,T1,T2,T3,T4,A11,A12,A13,A14,DP,DLAMB,LREF,E1,E2
3 DI,CY,CLIC,COLL,TWIST,GAM,AMAX,BS,RT,XS,XO,CS,CPS,KS,PS,A90A
37 O,A90MBS,CYC,COLL
4 REAL PTAH,PCX(55),PIX(55),PPX(55),PTX(55),POY(55),PIY(55),PPY(55),
1 PTY(55),KNOTS(55)
REAL PACJS,FADJA,RRSH
REAL RSHCS,CTH,BH,PITLH,PPOGEH,POH,PTH,RSHPM,PTACH,PITLGH
REAL AFHPY,AFHPF,ASLY,HL,PM(6),OC(6),YMC(6),YOC(6),MTBR(6),NRPL(6
1) NRPL(6),EIW(6),RC(6),IF(6),IC(6),SV(6),WXQ(6),SHPM(6),LAM
2 FR(6),MTBF(6),RELY(6),AVAIL(6),MTBMA(6),MDT(6),LCC(6),RDC(6),MAINT
3 (6),DWM(6),ICM(6),SHPMM(6),RDCM(6),MTBRM(6),YDCM(6),NRPLM(
46) NXRPLM(6),EIWM(6),SVMM(6),WXDM(6),RELYM(6),AVAILM(6),LCC
5 (6),MAINTM(6),SHPC(6),SHPN(6),ENGSEL

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TRIP2=0.
 TRIP3=0.
 TRIP4=0.
 WRITE (5,26) CRENH
 READ (5,26) S (°CLRSCRN 6°)
 CALLTE (6,27) SPCLOD
 READ (5,27) S (°CLRSCRN 6°)
 CALLTE (6,26) FDI IGE
 READ (5,26) F (°CLRSCRN 6°)
 CALLTE (6,26) SC
 READ (5,26) S (°CLRSCRN 6°)
 CALLTE (6,16) VMAXF
 READ (5,16) V (°CLRSCRN 6°)
 CALLTE (6,23) VCR
 READ (5,23) V (°CLRSCRN 6°)
 CALLTE (6,23) RINGMAX
 READ (5,23) R (°CLRSCRN 6°)
 CALLTE (6,27) PAXRC
 READ (5,27) P (°CLRSCRN 6°)
 CALLTE (6,15) GMSPEC
 READ (5,15) G (°CLRSCRN 6°)
 CALLTE (6,26) FSPEC
 READ (5,26) F (°CLRSCRN 6°)
 CALLTE (6,27) FSLTS
 READ (5,27) F (°CLRSCRN 6°)
 CALLTE (6,20) AFHPY
 READ (5,20) A (°CLRSCRN 6°)
 CALLTE (6,20) AFHPF
 READ (5,20) A (°CLRSCRN 6°)
 CALLTE (6,20) AASLY
 READ (5,20) A (°CLRSCRN 6°)
 CALLTE (6,26) FA
 READ (5,26) F (°CLRSCRN 6°)
 CALL

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WR ITE (6,26,50)
READ (5,1) TEMP
CALL F (5,1) CLRS CRN 6')
WR ITE (6,28,20)
READ (5,1) IR
CALL F (5,1) CLRS CRN 6')
C** 2. 1 MAKE A ROUGH ESTIMATE OF GROSS WEIGHT
C**
WR ITE (6,15,50)
READ (5,1) WG
CALL F (5,1) CLRS CRN 6')
WG=0.8
WR ITE (6,16,50)
CALL F (5,1) CLRS CRN 6')
C** 2. 2 MAKE A ROUGH ESTIMATE OF THE MANUFACTURER'S EMPTY
C**
WR ITE (6,15,80)
READ (5,1) WE
CALL F (5,1) CLRS CRN 6')
C** 2. 3 CALCULATE THE MAXIMUM TIP VELOCITY
C**
A=1116.85
MACH=0.65
VMAX=MACH*A
PIE=3.1415927
RHOSL=.0023769
C** 2. 4 DETERMINE THE ROTOR RADIUS
C**
WR ITE (6,16,10) WG
READ (5,1) DL
CALL F (5,1) CLRS CRN 6')
R=SQR((WG/(PIE*DL))
AR EAMR=PIE
C** 2. 5 DETERMINE A FIRST-CUT ROTATIONAL VELOCITY
C**
OMEGA=VMAX/F
C** 2. 6 MAKE A FIRST-CUT DETERMINATION OF THRUST
C**
COEFFICIENT
CONTINUE
VT=WG/(AREA*PR*RHOSL*VTIP**2)
40

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130 READ (5,*) TYPE
CALL FRMMS (,CLRSCRN 6,*)
CONTINUE
IF (TYPE,NE,1, ) GO TO 160
IF (TRIP2,EC,2, ) GO TO 140
WG=173.701*E*.378
CONTINUE
STT=264*EXF(.0135*HP)
SB=194.274*ALOG(WG)-1306.779
S=CHORD*(FLCAT(BLADES))**R
W1=408.562*ALOG(S)-1142.917
W2A=2.219*EXP(.0005*WG)
W2B=19.131*ALOG(STT)-32.414
W3=(COLN1*SB**1,917
IF (COLN1,NE,0, ) GO TO 150
W4=CO339*WG+200.912
CONTINUE
W5=34.0896*TP+221.338*FLOAT(NENG)
W6A=17.190*EXP(.0008*WG)
W6B=1384*(FLEL/6.5)**1.0717
W7=(1.28E-1C)*WG**3.469
W8=0.571*EXP(.0004*HP)
W9=24.051,0661*ALOG(SB)+367.947
W10=0.51,00451-122.282*ALOG(1,120.354*EXP(.003*HP))
W11=19.600*(EXP(.372*FLCAT(PEOPLE))+EXP(-.033*SB))
W12=-22.371*ALOG(SB)+143.396
W13=0.270
W14=0.270
W15=0.270
GO TO 160
IF (TYPE,NE,2, ) GO TO 240
IF (TRIP2,EC,2, ) GO TO 170
WG=16235.43*ALOG(WE)-130252.76
CONTINUE
STT=0.376*HF-8.106
S=63.6081*EXP(.000011*WG)
S=CHORD*(FLCAT(BLADES))**R
W1=11.00438*WG+12.470
W2A=2.411*STT-15.531
W2B=.282*SB**1.272
W3=(COUNT,NE,0, ) GO TO 190
IF (WG,GT,600, ) GO TO 180
W4=0.225*EXP(.000062*WG+8.020)
GO TO 190
W4=301.577*ALOG(WG)-2319.890
CONTINUE

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200 W5=.02*EXP(.000062*WG+8.02)
210 IF (NENG.NE.1.) GO TO 200
    W6 A=130.0+.451*HP
    GO TO 295.0+
    W6 A=(295.0+.188*HP)*FLOAT(NENG)
    W6 B=(741.460*ALOG(HP)-4542.0420)
    W6 C=(363.24*ALOG(FUEL/6.5)-1656.521)
    W7 =210.858*EXP(.000059*WG)
    IF (NENG.NE.1.) GO TO 220
    W8 =0.0
    GO TO 230
220 W8 =190.0975*ALOG(HP)-312.237
230 W9 =56.0362*WG+11.553
    W10 =.0362*WG+11.553
    W11 =481.735*ALOG(SB)-2794.53
    W12 =.135*HP+77.823
    W13 =.175*SB+22.*FLOAT(PEOPLE)-10.
    W14 =.122.468*ALOG(SB)-730.252
    W15 =84.54
    GO TO 270
240 CONTINUE
    IF (TRIF2.EC.2.) GO TO 250
    WG =4.975*WE**.887
250 CONTINUE
    ST =60.127*EXP(.000145*HP)
    SB =426.378*EXP(.000045*WG)
    S =CHORC*(FLCAT(ELADES))*R
    W1 =707.174*EXP(.00539*S)
    W2 A=324.550*ALOG(WG)-3021.510
    W2 B=-18.83*ST
    W3 =2.9818*SB-1321.921
    IF (COUNT.NE.0.) GO TO 260
    W4 =258.358*EXP(.000041*WG)
    CONTINUE
    W5 =.014*(.2041*WG)**1.136
    W6 A=(348.+.510*HP)*FLOAT(NENG)
    W6 B=(.4999*HF**.959)
    W6 C=(.454.615*(FUEL/6.5)**(-.0566))
    W7 =.0334*WG**1.224
    W8 =139.266*ALOG(HP)-387.598
    W10 =(6.63E-7)*WG**1.863
    W11 =9.780*SE**.539
    W12 =(1.6744.567*ALOG(HP)-108666.)***.536*1.90
    W13 =(1.159*SB+18.11)*FLOAT(PEOPLE)
    W14 =117.771*ALOG(SB)-710.594
    W15 =-172.+.111*SB+3.49*FLOAT(PEOPLE)
270 CONTINUE

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1+REVME=W1+W2A+W2B+W3+W4+W5+W6A+W6B+W6C+W7+W8+W9+W10+W11+W12+W13+W14
1+REVWNG=REVWE+FUEL+USELOD
WR ITE (6,1760) B,PIHP,POHP,PTHP,WE,FUEL,PEOPLE,USELOD,NENG,WG,SIGM
1A,RIHP (6,1770) W5,W6A,W6B,W7,W8,W9,W10,W11,W12,W13,W14,W15,REV
1WE IREVWNG (8,1760) B,PIHP,POHP,PTHP,WE,FUEL,PEOPLE,USELOD,NENG,WG,SIGM
1A,RIHP (8,1770) W5,W6A,W6B,W7,W8,W9,W10,W11,W12,W13,W14,W15,REV
1WE IREVWNG
C**3**VALIDATE DISC LOADING
C**3**WR ITE (6,1800) WG
C**3**READ (5,1800) ANS
C**3**CALL FRMNS (1, CLRSCRN 60)
C**3**IF (ANS.NE.1.) GO TO 280
C**3**WR ITE (6,1810)
C**3**CALL FRMNS (5,1810) CL
C**3**WG=REVWNG
C**3**WE=REI=1.
C**3**TR IPI2=20
C**3**GO CONTINUE
280C**3**ESTABLISH FIGURE OF MERIT AT APPROXIMATELY 0.75
C**3**M=(PI/PT)*100.
C**3**WR ITE (6,1750) M
C**3**WR ITE (6,1750) M
290C**3**CONTINUE
C**3**WR ITE (6,1750)
C**3**READ (5,1810) ANS
C**3**CALL FRMNS (1, CLRSCRN 60)
C**3**IF (ANS.NE.1.) GO TO 300
C**3**TR IPI1=1.
C**3**WG=REVWNG
C**3**WE=REI=2.0
C**3**OLD TO
C**3**GO TO 310
300C**3**IF (ANS.NE.1.) GO TO 310
C**3**WR ITE (6,2270) CHORD
C**3**READ (6,1810) CHORD

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CALL FRTCMS ('CLRSCRN 6')
WG=REVWNG
OLD=REVWNG
SIGMA=(FLOAT(BLADES)*CHORD)/(PIE*R)
TRIP1=1.
GO TO 7C
IF (ANS.NE.2.) GO TO 320
WRITE (6,1) CMEGA
CALL FRTCMS ('CLRSCRN 6')
TRIP1=1.
TRIP2=2.
WG=REVWNG
OLD=REVWNG
GO TO 4C
CONTINUE
C*****
C*****
C*****
3.5 REFFINE GROSS WEIGHT ESTIMATE *****
C*****
C*****
IF (COUNT.GE.2.) GO TO 360
IF (COUNT.GT.1.) GO TO 330
WRITE (6,2) LG
CALL FRTCMS ('CLRSCRN 6')
CONTINUE
IF (BLADES.GT.2) FL=4.
IF (BLADES.LT.3) FL=2.
IF (LG.NE.1.) GO TO 350
IF (COUNT.GT.1.) GO TO 340
WRITE (6,2) XRLG
CALL FRTCMS ('CLRSCRN 6')
WRITE (6,2) CO
READ (5,1) NW
CALL FRTCMS ('CLRSCRN 6')
CONTINUE
W4=REVWNG*(WG**.6662)*(NW**.536)*(XRLG**.1198)
WG=REVWNG
OLD=REVWNG
GO TO 12C
CONTINUE
W4=REVWNG*(WG**.8606)*(FL**.8046)

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WE=REVWEG
OLD=REVWEG
GO TO 120
***** ESTIMATE OF POWER REQUIRED TO HOVER *****
3. 6 MAKE THIRD ESTIMATE OF POWER REQUIRED TO HOVER *****
*****
3. 7 REPEAT THE GROSS WEIGHT ESTIMATE AND THE HOVER *****
POWER ITERATIONS *****
CONTINUE *****
STEP=1.(OLC/REVWEG) *****
IF (STEP.LT.0.1) GO TO 370 *****
WRITE (6,2740) *****
GO TO 250 *****
IF (STEP.GT.1) GO TO 380 *****
WRITE (6,2740) *****
CONTINUE *****
WG=REVWEG *****
IF (TRIF3.EC.3.) GO TO 390 *****
3. 8 DETERMINE THE POWER REQUIRED TO HOVER IGE, SSL *****
WRITE (6,1820) *****
CALL FRICMS ('CLRSCRN 6') *****
H=HT+10. *****
CONTINUE *****
D=2. *****
PPOGE=-.1276*(H/D)**4+.7080*(H/D)**3-1.4569*(H/D)**2+1.3432*(H/D)+
1.5147 *****
PITLGE=PPOGE*PI *****
PITHOVS=PITLGE+PO *****
3. 9 DETERMINE EQUIVALENT FLAT PLATE AREA (HORIZONTAL) *****
WRITE (6,1600) WG *****
READ (5,1830) *****
CALL FRICMS ('CLRSCRN 6') *****
FF=0 *****
KN=0 *****
WRITE (6,1840) *****
WRITE (8,1840) *****
3. 10 DETERMINE TOTAL POWER REQUIRED AND TIP MACH *****
NUMBER *****

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NN= AINT (MAXV/5. )+1
N= AINT (MAXV/5. )+11
DO 400 I=1,N
VF=KNTS*1.51*5280./3600.
PPF=5*RHOSSL*(VF**3)*EFPAFF
MU=VF/VTIP
POF=(1.+4.3*MU**2)*PO
POF=POF/550.
VI=SQRT(WG/(2.*RHOSSL*AREAMR))
VI T=VI *SQRT((- (VF**2/(2.*VI**2))**2)+1.)
1
PITL F=(1./8)*WG*VIT
PITL F=PITL F/550.
PTF=PTITL F+PCF+PPF
MACHT=(VF+VTIP)/A
PPFS(I)=PPF
PITLFS(I)=PTF
PTFS(I)=(6,18,50) KNTS,MACHT,PITL F,POF,PPF,PTF
WRITE (8,18,50) KNTS,MACHT,PITL F,POF,PPF,PTF
KNTS=KNTS+5.
CONTINUE
TEMP=TEMP+460.
THETA=TEMP/518.688
CONST=6.875-5E-6
PRESS=2116.22*(1.-CONST*PA)**5.2561
RHOALT=SS/223769*SIG*THETA
AALT=SQRT(1.4*32.174*53.3*TEMP)
WRITE (6,18,60)
WRITE (8,18,60)
KNTS=0.
DO 410 I=1,N
VF=KNTS*1.51*5280./3600.
PPF=5*RHOALT*(VF**3)*EFPAFF
MU=VF/VTIP
PO=1.25*SIGMA*CDOO*RHOALT*AREAMR*VTIP**3
POF=(1.+4.3*MU**2)*PO
POF=POF/550.
VI=SQRT(WG/(2.*RHOALT*AREAMR))
VI T=VI *SQRT((- (VF**2/(2.*VI**2))**2)+1.)
1
PITL F=(1./8)*WG*VIT
PITL F=PITL F/550.
PTF=PTITL F+PCF+PPF

```

400

100

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MACHT=(VF+VTIP)/AALT
PPFA(I)=PPF
POFA(I)=POF
PITLFA(I)=PITLF
PTFA(I)=(6,1850) KNTS,MACHI,PITLF,POF,PPF,PTF
WRITE (8,1850) KNTS,MACHI,PITLF,POF,PPF,PTF
KNITS=KNIS+5.
CONTINUE
4.1 MAKE PRELIMINARY SIZING OF TAIL ROTOR
RTR=1.3*SQR(WG/1000.)
WRITE (6,1880) RTR
WRIGTR (8,1880) RTR
OMEGTR=4.5*CMEGA
WRITE (6,1850) CMEGTR
CDOITR=1.38*CDO
WRITE (6,1900) CDOITR
WRITR (6,1900) CDOITR
IF ITR (6,1900) CDOITR GO TO 420
WRITE (6,1910) PLADTR
CALL FRUE (5,ICMS (%CLRSCRN 6))
CONTINUE
LITR=ITR+3.0 GO TO 430
IF ITR (6,1920)
READ FRUE (5,ICMS (%CLRSCRN 6))
CONTINUE
CHORDT=(FLOAT(BLADTR)*CHORDT)/(PIE*RTR)
SIGTR=1.2*DETERMINE TAIL ROTOR POWER REQUIRED AT FOWER
4.2 DETERMINE TAIL ROTOR POWER REQUIRED AT FOWER
AR EATR=PIEGALTR
TTIPTR=(CMEGTR*LTR)
VTIPTR=(AAREATR)*RHOSL*VTIPTR**2)
BTIPTR=TTIPTR/(AAREATR)*RHOSL*AREATR**2)
PITLTR=(1./BTIPTR)**(1.5/SQR(2.*RHOSL*AREATR))
PITRHP=PIILTR+POTR
PITRHP=PIILTR+POTR
CTTA=TTIPTR/(AAREATR)*RHOSL*AREATR**2)
BTA=1.-SQR(2.*CTTA)/FLOAT(BLADTR)

```

410
C**
C**

420

430

C**
C**
C**


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IF (TRIF3.EC.3.) GO TO 470
WRITE (6,2930)
READ (5,1*) MCRO
CALL FRICMS (.CLRSCRN 6*)
WRITE (6,2940)
READ (5,1*) CLMAX
CALL FRICMS (.CLRSCRN 6*)
CONTINUE
AMAX=CLMAX/CLAR, CHORD, BLADES, WG, VTIP, EFPAFF, NENG, H, RHOALT, AALT, TW
WRITE (8,2920) CLMAX, AMAX, CLA, CDO, MCRO
1 ISIT, CLMAX, AMR, RHOALT*(VTIP**2)
CT=WG/(AREA*1.55) PPOGE=1.0
IF (H/D.GT.1.55) PPOGE=1.0
B=1.0-(SCRT(2.*CT)/FLOAT(BLADES))
WRITE (8,2910) CT, AREAMR, SIGMA, B, PPOGE
VMAXX=SQR(WG/2./RHOALT/AREAMR)*(4./EFPAFF/AREAMR)**.333334
VELMAX=VMAXX/1.68894
DO 630 I=1,180) KNT
WRITE (E,2880) KNT
VF=KNT*1.151*5280./3600.
MU=VF/VTIP
VL=VF**2/(2.*VI**2)
C1=(B**2+.5*MU**2)
C2=(B**2-.5*MU**2)
T1=.5*C1
T2=(B**3)/3.+(MU**2*B*.5)
T3=(B**2/4.)*(B**2+MU**2)
T4=(MU/2.)*(B**2+MU**2/4.)
A11=((B**2*MU*.5-(MU**3/8.))*4.)/(B**2*C2)
A12=(8.*MU*B)/(3.*C2)
A13=(2.*MU**2)/C2
A14=(VF.GT.0.) GO TO 480
IF (VF.GT.0.) GO TO 480
ALPHA=0
WRITE (8,2900) ALPHA
LAMBDA1=-SQR(CT/2.)
IF (MU.LE.0.1) GO TO 510
IF (VF.EQ.0.) DP=0.
DP=PPFA(I)*550/VF
ALPHA=CP/WC
CONTINUE
LAMBDA=-CT/SQR(2*(LAMBDA1**2)+MU**2)+MU*TAN(ALPHA)
DLAMBDA=LAMBDA-LAMBDA1
LAMBDA1=LAMBDA
LREF=ABS(DLAMB)
IF (LREF.GE.LERR) GO TO 500

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470

480

490
500

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510 LAMBDA=LAMBDA*(SIGMA*CLA)
      EI=(2.*LAMBDA)
      E2=TI*(LAMBDA)
      E3=T3*(TWIST)
      D1=((2.*(AI1*(LAMBDA)-TI*(LAMBDA-TWIST)*T3
      D2=-((AI1*(LAMBDA)-TWIST*AI3)
      CYCLIC=(D1-T4*(D2*T2)-(D1*AI2))/((T2*AI4-T4*AI2)
      COLLD=(CYCLIC*57.29578)
      COLLD=CCLL*57.29578
      COLLD=CCLL*57.29578
      THETA2=(8,2820)
      WRITE(AA, X-COLL+CYCLIC
      GAM=AM*GAM+LAMBDA
      CS=MU*GAM+LAMBDA
      BS=-MU*GAM+LAMBDA
      RT=(BS*(8,2820)*TWIST*CS)
      WRITE(BS*(8,2820)*TWIST
      IF(RT)560,520
      XS=(-BS+SQRT(RT))/2.*TWIST)
      XO=(-XS-BS)/TWIST
      IF(XS)530,560
      IF(XS)560,540
      CPS=(SIGMA/24.*PIE))*((1.-MU)**2)*(1.-XS)*SQRT(1.-XS**2)
      IF((XS+XO)/2.*GE.1.0)KS=1.0
      IF((XS+XO)/2.*GT.1.0)GO TO 550
      KS=-((BS/2.*TWIST)+XS)/(1.-XS)
      CPS=KS*CPS
      GO TO 570
      CPS=0.0
      PS=CPS*RHODALT*AREAMR*(VTIP**3)/550.
      WRITE(BS,2840)KS,CPS
      A90=COLLD+CYCLIC+TWIST+LAMBDA/(1.+MU)
      A270=COLLD-CYCLIC+TWIST+LAMBDA/(1.+MU)
      A90D=A90*57.29278
      A270D=A270*57.29278
      WRITE(BS,2850)CYCD,COLL, A90D, A270D
      MTIP=(VF+VTIP)/AALT
      MCRIT=(MCR0-CLA*A90*.113
      IF(MTIP-1.)590,580,580
      WRITE(BS,2850)
      GO TO 610
      MD=MTIP-MCRIT-0.06
      IF(MD)610,600
      CPC=SIGMA*(C.012*MD+.1*(MD**3))
      GO TO 620
      CPC=0.0
610

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620 MD=0.0
      PC*RH*CAL T*AREAMR*(VTIP**3)/550.
      PCMPA(I)=PMES+PS
      WRITE(8,2870) MTIP,MCRTIT,MD,CPC,PITLFA(I),POFA(I),PPFA(I),PMBS,PS
1     1 PCMPA(I)
      TSHP=1.13*PCMPA(I)+10.0
      VOPT=SQR(WG/RHOAL T/AREAMR*SQR T(AREAMR/3./EFPAFF))
      VOPTK=VCPT/1.68894
      KNT=KNT+5.
      CONTINUE
630 K=MAXV +40
      WRITE(6,2430)
      WRITE(8,2430)
      DO 690 I=1,K
      VF=KNT*1.151*5280./3600.
      MU=VF/VTIP
      PP=(.5**2+.5*MU**2)
      C1=(8**2+.5*MU**2)
      C2=(8**2-.5*MU**2)
      T1=(5*C1)
      T2=(8**2*3)/3.+(MU**2*8*.5)
      T3=(8**2/4.)*(8**2+MU**2)
      T4=(MU/2.)*(8**2+MU**2/4.)
      A11=((8**2*MU*.5-(MU**3/8.))*4.)/(8**2*C2)
      A12=(8.**MU*8/13.*C2)
      A13=(2.**MU*8**2)/C2
      A14=(8**2+1.5*MU**2)/C2
      IF (VF.GT.0.) GO TO 640
      ALPHA=0.
      GO TO 650
640 ALPHA=- (FPP*550./VF/WG
650 LAMBDA1=-SQR(T/2.)
      IF (MU.LE.0.) GO TO 670
      LAMBDA=-CT/SQR T(2*(LAMBDA1**2)+MU**2)+MU*TAN(ALPHA)
      DLAMBDA=LAMBDA-LAMBDA1
      LAMBDA1=ABS(DLAMBDA)
      LAMBDA=ABS(DLAMBDA)
      IF (LAMBDA.LE.0.) GO TO 660
      IF (MU.LE.0.) LAMBDA=LAMBDA1
      E1=(2.*LAMBDA)
      E2=T1*LAMBDA
      E3=T3*LAMBDA
      D1=((2.*CT)/(SIGMA*CLAI)-T1*LAMBDA-TWIST*T3
      D2=- (A11*LAMBDA)-(TWIST*A13)
      CYCLIC=((D2*T2)-(D1*A12))/(T2*A14-T4*A12)
      COLLE=(D1-T4*CYCLIC)/T2
      THETA0=CCLL*57.29578

```

```

THETA2=CYCLIC*57.29578
A270=CCLL-CYCLIC+TWIST+LAMBDA/(1.+MU)
A270D=A270*57.29278
DA270=A270-AMAX
DREF=ABS(DA270)
IF (A2700.L1.12.) GO TO 680
IF (A2700.GT.13.) GO TO 680
VSK=VF/1.68894
WRITE (6,2440) VSK,A270D
WRITE (8,2440) VSK,A270D
CONTINUE
KNT=KNT+1.
CONTINUE
KNT=0.
CT=WG/(AREAMR*RHOSL*(VTIP**2))
IF (H/D.GT.1.55) PPOGE=1.0
B=1.0-(SQR(2.*CT)/FLOAT(BLADES))
VMAX=SQR(WG/2./RHOSL/AREAMR)*(4./(EFP AFF/AREAMR)**.333334
VMAXK=VMAX/1.68894
DO 850 I=1,N
VF=KNT*1.151*5280./3600.
MU=VF/VTIP
VL=VF**2/(2.*VI**2)
C1=(B**2+.5*MU**2)
C2=(B**2-.5*MU**2)
T1=.5*C1
T2=(B**2/3.+(MU**2*B*.5)
T3=(B**2/4.)*(B**2+MU**2)
T4=(MU/2.)*(B**2+MU**2/4.)
A11=((B**2*MU*.5-(MU**3/8.))*4.)/(B**2*C2)
A13=(2.*MU*B)/(3.*C2)
A14=(B**2+1.5*MU**2)/C2
IF (VF.GT.0.) GO TO 700
ALPHA=0.
LAMBDA1=-SQR(CT/2.)
IF (MU.LE.0.1) GO TO 730
IF (VF.EQ.0.) DP=0.
IF (VF.EQ.0.) GO TO 710
DP=PPFS(I)*550/VF
ALPHA=-DP/WG
CONTINUE
LAMBDA=-CT/SQR(2*(LAMBDA1**2)+MU**2)+MU*TAN(ALPHA)
DLAMBDA=LAMBDA-LAMBDA1
LAMBDA1=LAMBDA
LREF=ABS(DLAMB)
IF (LREF.GE.LERR) GO TO 720
LAMBDA=LAMBDA1

```

680
690

700

710
720

730

```

E1=(2.*CT1)/(SIGMA*CLA)
E2=I1*LAMBDA
E3=I3*TWIST/(SIGMA*CLA)-I1*LAMBDA-TWIST*T3
D1=((A11*LAMBDA)-(TWIST*A13))
D2CYCLIC=((D2*T2)-(D1*A12))/(T2*A14-T4*A12)
COLL=(C1-C2)/T2
THETA0=CCLL*57.29578
THETA2=CYCLIC*57.29578
GAM=AMAX-COLL+CYCLIC
CS=MU*GAM+LAMBDA
BS=-MU*TWIST-GAM*TWIST*CS
RT=(RT1-780+SQRT(RT))/2.*TWIST
XS=(-XS-BS+TWIST)/(2.*TWIST)
X0=-XS-1.1750780780
IF(XS)780,780,780,780
CPS=(SIGMA/24.*PIE)*((1.-MU)**2)*(1.-XS)*SQRT(1.-XS**2)
IF((XS+X0)/2..GE.1.0)KS=1.0
IF((XS+X0)/2..GT.1.0)GO TO 770
KS=-((BS/2.*TWIST)+XS)/(1.-XS)
CPS=KS*CPS
GO TO 790
CPS=0.0
PS=CPS*RHOSL*AREAMR*(VTIP**3)/550.
A90=COLL+CYCLIC+TWIST+LAMBDA/(1.+MU)
A270=COLL-CYCLIC+TWIST+LAMBDA/(1.+MU)
A90D=A90*57.29278
A270D=A270*57.29278
MTIP=(VF+VTIP)/AALT
MCRIT=(MCR0-CLA*A90*.113
IF(MTIP-1.)810,800,800
CONTINUE
GO TO 830
MD=MTIP-MCRIT-0.06
IF(MD)830,830,820
CPC=(SIGMA*(C.012*MD+.1*(MD**3)))
GO TO 840
CPC=0.0
MD=0.0
PMBSC=PC*RHCSL*AREAMR*(VTIP**3)/550.
PCMPS(I)=PMBSC+PS
TCHP=1.13*PCMPS(I)+10.0
VOPT=SQRT(WG/RHCSL/AREAMR*SQRT(AREAMR/3./EFPAFF))
VOPK=VOPT/1.68894
KNT=KNT+5.

```

```

740
750
760
770
780
790
800
810
820
830
840

```

```

850 CONTINUE
KNT=0 I=1 K
DU=900 I=151*5280./3600.
VF=KNT*1.1
MU=VF/V TIP
PP=(.5*RHOSL*EFPAF*(VF**3))/550.
C1=(B**2+.5*MU**2)
C2=(B**2-.5*MU**2)
T1=.5*C1
T2=(B**3)/3.+(MU**2*B*.5)
T3=(B**2/4.)*(B**2+MU**2)
T4=(MU/2.)*(B**2+MU**2/4.)
A11=((B**2*MU*.5-(MU**3/8.))*4.)/(B**2*C2)
A12=(8.*MU*B)/(3.*C2)
A13=(2.*MU**2)/C2
A14=(B**2+1.5*MU**2)/C2
IF (VF.GT.0.) GO TO 860
ALPHA=0.
GO TO 870
ALPHA=PP*.5/VF/WG
LAMBDA1=-SQRT(C/2.)
IF (MU.LE.0.1) GO TO 890
LAMBDA=-CT/SQRT(2*(LAMBDA1**2)+MU**2)+MU*TAN(ALPHA)
DLAMBDA=LAMBDA-LAMBDA1
LAMBDA1=LAMBDA
LREF=ABS(DLAMB)
IF (LREF.GE.0.1) LAMBDA=LAMBDA1
IF (MU.LE.0.1) SIGMA=CLA
EI=(2.*LAMBDA
E2=T1*TWIST
E3=T3*TWIST
D1=((2.*CT)/(SIGMA*CLA))-T1*LAMBDA-TWIST*T3
D2=-((A11*LAMBDA)-(TWIST*A13)
CYCLIC=((D2*T2)-(D1*A12))/(T2*A14-T4*A12)
COLL=(D1-T4*CYCLIC)/T2
THETA0=COLL*57.29578
THETA2=CYCLIC*57.29578
A270D=A270-AMAX
DA270=ABS(DA270)
DREF=ABT+1.
KNT=KNT+1.
CONTINUE
WRITE (6,29) FBS
READ (5,1) FBS
CALL FRICMS (,CLRCRN 6)
*****
C ***** 5.4 DETERMINE TOTAL POWER REQUIRED *****
C *****

```

```

C*****
PTAH=PTAH/550
WR IITE (6,1960) PTAH
WR IITS (8,1960) PTAH
KNOTS (1)=0.
WR IITE (6,1970)
WR IITE (8,1970)
DO I=1,N
POX(I)=POFS(I)+POTRFS(I)
PIY(I)=PITLFS(I)+PITRFS(I)
PPX(I)=PPFS(I)
PTX(I)=PCX(I)+PIX(I)+PCMPS(I)
WR IITE (6,1980) KNOTS(I),POX(I),PPX(I),PCMPS(I),PTX(I)
WR IITS (8,1980) KNOTS(I),PIX(I),POX(I),PPX(I),PCMPS(I),PTX(I)
KNOTS(I)+5.
CONTINUE
WR IITE (6,1990)
WR IITS (8,1990)
KNOTS(I)=0.
DO I=1,N
POY(I)=POFA(I)+POTRFA(I)
PIY(I)=PITLFA(I)+PITRFA(I)
PPY(I)=PPFA(I)
PTY(I)=PCY(I)+PIY(I)+PCMPA(I)
WR IITE (6,1980) KNOTS(I),POY(I),PPY(I),PCMPA(I),PTY(I)
WR IITS (8,1980) KNOTS(I),PIY(I),POY(I),PPY(I),PCMPA(I),PTY(I)
KNOTS(I)+5.
CONTINUE
*****
C*****
5.5 DETERMINE THE RSHP REQUIRED AT MAXIMUM VELOCITY
*****
PADJS=PTX(NN)+PCMPS(NN)
PADJA=PTY(NN)+PCMPA(NN)
IF SHP=PCACJJA
RR SHP=PADJA GO TO 930
GO TO 940
RR SHP=PADJS
CONTINUE (6,2000) RRSHP
WR IITE (8,2000) RRSHP
*****
C*****
5.6 DETERMINE RSHP FOR HOVER, CEILING, IGE
*****
RHS=.0023769*(1.-CONST*HOVIGE)**4.2561
CTH=WG/(AREAMR*RHS*VTIP**2)
BH=1.-SQRT(2.*CTH)/FLOAT(BLADESI)
PITLH=(1./BH)*((WG**1.5/SQRT(2.*RHS*AREAMR))

```

910

920

930

940

C

C

C

```

PPOGEH=-.1276*(H/D)**4+.708*(H/D)**3-1.4569*(H/D)**2+1.3432*(H/D)+
1.5147
PI TLGH=PPOGEH*PITLH
POH=.125*SIGMA*CDO*RHOS*AREAMR*VTIP**3
PTR=PTH/(OMEGA*LTR)
VTIPR=CMEGTR*PTR
BITR=1.-SQRT(AREA*RRHOS*VTIPR**2)/FLOAT(BLADTR)
PITLH=(1./PTR)*(TTR**1.5/SQRT(2.*RHOS*AREATR))
PTRH=.125*SIGTR*CDO*TR*RHOS*AREATR*(VTIPR**3)
PTACH=PTLH+PTRH
PTACH=PTACH/550.
*****
5.7 DETERMINE THE MAXIMUM RSHP REQUIRED
*****
IF (PTACH.GT.RRSHPI) GO TO 950
RSHPM=RRSHPI
GO TO 960
RSHPM=PTACH
CONTINUE
*****
5.8 DETERMINE THE TOTAL ESHP REQUIRED
*****
ESHPR=(.1*RSHPM*FLOAT(NENG-1))+1.03*RSHPM+10.
WRITE (8,2010) NENG,ESHPR
*****
6.1 SELECT TYPE AND NUMBER OF ENGINES
*****
6.2 INSTALLATION WEIGHT
*****
WRITE (6,2020) NENG
READ (5,*) ANS
CALL FRICMS (,CLRSCRN 6,1) GO TO 970
IF (ANS.NE.1.) GO TO 970
WRITE (6,*) NENG
CALL FRICMS (,CLRSCRN 6,1)
GO TO 960
CONTINUE
HL=(AASL025
PM(1)=.025
WRITE (8,2030)
WRITE (8,1=1,6
DO 1100

```

```

YMC(I) = AFHPY*PM(I)
YOC(I) = AFHPY*OC(I)
NRPL(I) = ((HL)/MTBR(I))-1.0)
NXRPL(I) = AINT((HL)/MTBR(I))-1.0)
IF (NRPL(I).NE.1.0) GO TO 980
IF (NRPL(I).NE.2.0) GO TO 990
IF (NRPL(I).NE.3.0) GO TO 1000
IF (NRPL(I).NE.4.0) GO TO 1010
IF (NRPL(I).NE.5.0) GO TO 1020
IF (NRPL(I).NE.6.0) GO TO 1030
IF (NRPL(I).NE.7.0) GO TO 1040
IF (NRPL(I).NE.8.0) GO TO 1050
IF (NRPL(I).NE.9.0) GO TO 1060
IF (NRPL(I).NE.10.0) GO TO 1070
IF (NRPL(I).NE.11.0) GO TO 1080
CONTINUE
NRPL(I) = NXRFL(I)+1.0)
CONTINUE
EIW(I) = CW(I) + IF(I)*DW(I)
RC(I) = 1.35*IC(I)
SV(I) = .8*IC(I)
WFO(I) = .35*SHPM(I)
LAMFR(I) = 1./MTBF(I)
RELY(I) = EXP((-LAMFR(I))*AFHPF)
AVAIL(I) = MTEMA(I)/(MTBMA(I)+MDT(I))
LCC(I) = (RDC(I)+IC(I)+HL*(YOC(I)+YMC(I))
1 MAINT(I) = (NRPL(I)*RC(I)-SV(I))*0.0001
CONTINUE
CONTINUE
WRITE (6,2100) (DW(I),I=1,6)
WRITE (6,2110) (LCC(I),I=1,6)
WRITE (6,2120) (LCC(I),I=1,6)
WRITE (6,2130) (MTBR(I),I=1,6)
WRITE (6,2140) (NRPL(I),I=1,6)

```

980
990
1000
1010
1020
1030
1040
1050
1060
1070
1080
1090
1100


```

YCCM(I)=0.
RCCM(I)=0.
SVALM(I)=0.
AVAILM(I)=0.
RELYM(I)=0.
MAINTM(I)=0.
SHRPLM(I)=0.
NXWOM(I)=0.
EIWOM(I)=0.
LCCM(I)=0.
LCONTINLE
TRIP3=3.20
1260
1270
CONTINUE
7.1 DETERMINE FUEL FLOW RATES
WRITE(6,2250)
WFC=SFCC(ENGSEL)
WFN=SF(6,2260)
WRITE(8,2250)
WRITE(8,2260)
7.2 DETERMINE FUEL FLOW PER HORSEPOWER
BE TA=(WFM-WFC)/(SHPM(ENGSEL)-
1 AL PHA=(BETA(SHPM(ENGSEL))-BETA*
1
7.3 COMPUTE THE INTERCEPT AT SPECIFICATION CONDITIONS
PRESS=516.68
TEMP=516.68
THETA=PRESS/2116.22*(1.-CONST*PA)
ZHI=ALPHA*(PRESS/2116.22)*SQRT(THETA)
WRITE(6,2280)
WRITE(8,2280)
7.4 DETERMINE THE ZERO VELOCITY HORSEPOWER INCREMENT
PSHP=(FLGAT(ENG)*ALPHA*DELTA*SQRT(THETA))/BETA
WRITE(6,2730)
READ(5,*)

```



```

1310 IF (ENGSEL,NE,2.) GO TO 1320
CALL GRAF (C.,10.,(MAXV+50.),(-1000.*FLCAT(NENG)),500.,
(1500.*FLOAT(NENG)))
1 GO TO 1360
IF (ENGSEL,NE,3.) GO TO 1330
CALL GRAF (C.,10.,(MAXV+50.),(-1500.*FLOAT(NENG)),500.,
(2500.*FLOAT(NENG)))
1 GO TO 1360
IF (ENGSEL,NE,4.) GO TO 1340
CALL GRAF (C.,10.,(MAXV+50.),(-1500.*FLCAT(NENG)),500.,
(2500.*FLOAT(NENG)))
1 GO TO 1360
IF (ENGSEL,NE,5.) GO TO 1350
CALL GRAF (C.,10.,(MAXV+50.),(-1500.*FLOAT(NENG)),500.,
(3500.*FLOAT(NENG)))
1 GO TO 1360
CONTINUE
CALL GRAF (C.,10.,(MAXV+50.),(-1500.*FLCAT(NENG)),
500.,(4500.*FLOAT(NENG)))
1360 CONTINUE
CALL PCLY3
CALL DCT
CALL LEGLIN (KNOTS,PIY,N,0)
CALL CURVE (.DOT,)
CALL RESET
CALL DASH
CALL LEGLIN (KNOTS,POY,N,0)
CALL CURVE (.DASH,)
CALL RESET
CALL CHACOT
CALL CURVE
CALL LEGLIN (KNOTS,PPY,N,0)
CALL RESET (.CHNDOT,)
CALL CHNDSH
CALL LEGLIN (KNOTS,PCMPA,N,0)
CALL CURVE (.CHND$H,)
CALL LEGLIN (KNOTS,PTY,N,0)
CALL CURVE (IHP,5,3,7,4,25)
CALL RLMESS (X--P$HP$,100,0.,-PSHP)
CALL RLMESS (X-MA X SHP$,100,0.,SHPMM(ENGSEL))
CALL RLMESS (X-CRUISE$,100,VCR,0.)
CALL BLESET (3,5,4,15,2,1,55,1.)
CALL RECT (THKCRV,)
CALL DCT
CALL GREID (2,1)
CALL RESET (.DOT,)

```

```

C** CALL ENDFL (0)
C** ** END OF DISSPLA SPECIFIC PORTION OF THE PROGRAM
C** ** WRITE (6,2310) PSHP
C** ** GO TO 1380
1370 CONTINUE
C** ** WRITE (6,2770)
1380 CONTINUE
C** ** 7.5 DETERMINE THE MAXIMUM RANGE VELOCITY
C** ** **
C** ** WRITE (6,2320) VMAXR
C** ** READ (5,1C)MS (,CLRS CRN 6)
C** ** WRITE (6,2760) VELMAX
C** ** READ (5,1C)MS (,CLRS CRN 6)
C** ** 7.6 DETERMINE THE MAXIMUM ENDURANCE VELOCITY
C** ** **
C** ** WRITE (6,2330) VMAXE
C** ** READ (5,1C)MS (,CLRS CRN 6)
C** ** WRITE (6,2340) RSHHPME
C** ** READ (5,1C)MS (,CLRS CRN 6)
C** ** RSHRME=FRSHP+RSHR
C** ** WRITE (6,2350)
C** ** READ (5,1C)MS (,CLRS CRN 6)
C** ** 7.7 DETERMINE THE POWER REQUIRED AND FUEL FLOW RATE AT
C** ** SPECIFIC CRUISE VELOCITY
C** ** **
C** ** WRITE (6,2350) FSHHPC
C** ** READ (5,1C)MS (,CLRS CRN 6)
C** ** RSHR=RSFPRC*BETA
C** ** CALL (TRIP) EC(4,1) GO TO 1390
1390 CONTINUE
C** ** 7.8 DETERMINE THE TOTAL FUEL REQUIREMENTS
C** ** **
C** ** FW=(.05*WFN)*2.+(WFCR*RNMAX/VCR)+.25*WFME
C** ** GALIN=FW/6.5
C** ** GALOUT=C
C** ** WRITE (6,2360) FW

```

```

C*****
C*****
C*****
WRITE (6,2360) FW
8.1 COMPUTE DESIGN GROSS AND EMPTY WEIGHT
DWG=HWGNW+FW-FUEL
WRITE (6,2350) DWG,REVMG
SIM=LIMIT-DWG/WG
IF (SIM.LT.1) GO TO 1400
WRITE (6,2420)
WE=DMWG-FW-USELOD
FUEL=FW
TRIP1=1.
TRIP2=3.
TRIP3=3.
TRIP4=4.
CONTINUE
EXCESS=VWG-DWG
IF (EXCESS.LE.0) GO TO 1430
WRITE (6,2400) EXCESS
READ (5)CMS (,CLRCRN 6)
CALL FNS (,FW,XCES)
IF (AN=FW+XCES) GO TO 1410
RNGNMW=(FWNEW-.05*WFN-.25*WFME-.05*WFN)*VCR/WFC
NEWSE=DMWG+EXCESS
DMG=DMWG+EXCESS
GO TO 1440
IF (AN=NEWSE) GO TO 1420
RNGNMW=SELCO+EXCESS
DMG=DMWG+EXCESS
CONTINUE (6,2410)
READ (5)EXCESS-FWNEW+USELOD
RNGNMW=(FWNEW-.05*WFN-.25*WFME-.05*WFN)*VCR/WFC
DMG=DMWG+EXCESS
GO TO 1440
RNGNMW=SELCO
NEWSE=LE
CONTINUE
FW=FWNEW
8.2 DETERMINE BEST RATE OF CLIMB
C*****
C*****

```

1400

1410

1420

1430

1440

1450

```
CONTINUE  
PAVAIL=(SHPMM(ENGSEL)-10.)/(0.1*FLOAT(NENG-1)+1.03)  
WRITE(6,2460)  
READ(5,*)VVERT  
RCLIMB=VVERT  
CALL FRTCMS(0,CLRSCRN,6,*)  
VVERT=VVERT/60  
VFWD=VMAXE*1.151*5280./3600.  
VINEW=SQRT(CWG/(2.*RHOSL*AREAMR))  
EFPAFF=2.*EFPAFF  
VITNEW(1)=1.*VVERT  
VITNEW(2)=2.*VVERT  
VITNEW(3)=VFWD**2+VVERT**2  
VITNEW(4)=0.  
VITNEW(5)=-VINEW**4  
NDEG=4  
CALL ZPCLR(VITNEW,NDEG,ZCMLPX,IER)  
VTNEW=ZCMLPX(3)  
PC=PC/DWG*VVERT  
MU=VFWD/VTIF  
MUTR=VFWD/VTIPTR  
PPC=(0.5*RHOSL*EPPA VF*VVERT**3)+(0.5*RHOSL*EFPAFF*VFWD**3)  
POC=PPC/550.  
POC=0.125*RHOSL*CDO*SIGMA*AREAMR*VTIP**3*(1.+4.3*HU**2)  
PIVERT=(1./8)*DWG*VTNEW  
PIVERT=PIVERT/550.  
PIVERT=PIVERT+PC+PPC  
POTRF=.125*SIGTR*CDCTR*RHOSL*AREATR*(VTIPTR**3)  
POTRF=(1.+4.3*MUTR**2)*POTR  
PPF=PCTRF/550.  
PPF=PPF/550.  
POF=.125*SIGMA*CDO*RHOSL*AREAMR*(VTIP**3)  
POF=(1.+4.3*MU**2)*PO  
VI=SQRT(DWG/(2.*RHOSL*AREAMR))  
VIT=VIT/SQRT((VFWD**2/(2.*VI**2))**2)+1.)  
1  
PITLF=(1./8)*DWG*VIT  
PITLF=PIITLF/550.  
PITLF=PIITLF+PPCF+PPF  
TTR=(PIITLF*550.)/(OMEGA*LTR))  
CTTR=(TTR/(AREAMR*(VTIPTR**2)*RHOSL))  
BTTR=1.-SQRT(2.*CTTR)/FLOAT(BLADTR)  
VITR=SQRT(TTR/(2.*RHOSL*AREATR))  
VITR=VITR/SQRT((-VFWD**2/(2.*VITR**2)))
```

```

1 +SQR T(( (VFWD**2/(2.*VITR**2)**2)+1.))
PIITLTF=(1./R)*TITR*VITR
PTITRF=PIITLTF+POTRF
PTAVAL=PTITRF+PTVERT
WRITE(6,2470) PAVAIL,PTAVAL,PIVERT
CALL FRICMS (,CLRSCRN 6,)
IF (ANS.EQ.1.) GO TO 1450
VWRITE (6,2480) RCLIMB
WRITE (8,2480) RCLIMB
WRITE (,3) COMPUTE MAXIMUM HOVER ALTITUDE, IGE
C*****
C*****
C*****
1460 CONTINUE
WRITE (6,2501)
READ (5,*) ALT
CALL FRICMS (,CLRSCRN 6,)
PALT=2116.22*(1.-CONST*ALT)**5.2561
DELTA=518.68*(1.-CONST*ALT)
THETA=IALC/ALC
CALL FRICMS (,CLRSCRN 6,)
RTHOMH=.0023769*(1.-CONST*ALT)**4.2561
BTH=1.-SQR T((RTHOMH**2)/FLOAT(BLADES))
PIITLH=(1./BTH)*(DWG**1.5/SQR T(2.*RTHOMH*AREAMR))
PPOGEH=-.1276*(H/D)**4+.708*(H/D)**3-1.4569*(H/D)**2+1.3432*(H/D)+
1.5147
1.5147
POH=.125*SIGMA*CDO*RHGMH*AREAMR*VTIP**3
PTH=PIITLH+PCH
TTR=PTH/(OMEGA*RTR)
VTIPTR=CMGTR*RTR
CITR=1.-SQR T((AREA*CTTR)*RTHOMH*VTIPTR**2)
BITR=1.-SQR T((AREA*CTTR)/FLOAT(BLADETR))
PIITLR=(1./BITR)*(TTR**1.5/SQR T(2.*RTHOMH*AREATR))
POTTR=.125*SIGTR*CDOTR*RTHOMH*AREATR**3
PTTRH=PIITLR+POTR
PTACH=PTACH/550
PTACHAIL=((SHFMM(ENGSEL)-10.)/(1.*FLOAT(NENG-1)+1.03))*DELTA/SQR T(TH
1.5147
WRITE (6,2450) PAVAIL,PTACH
READ (5,*) ANS
CALL FRICMS (,CLRSCRN 6,)
IF (ANS.EQ.1.) GO TO 1460
WRITE (6,2530) ALT

```

```

1470 WR ITE (8,2530) ALT
C** CONTINUE
C** 8.4 COMPUTE SERVICE CEILING
C** WR ITE (6,2510)
READ (5,2510) ALT SC
CALL FRICMS ('CLRS CRN 6')
P ALT = 2116.22*(1.-CONST*ALT SC)**5.2561
DELTA = 518.68*(1.-CONST*ALT SC)
THETA = .0023769*(1.-CONST*ALT SC)**4.2561
RHOSC = ((SHPN(ENGS EL)*FLOAT(NENG)-10.)/(.1*FLOAT(NENG-1)+1.03))*DE
PAVA IL = ((SQR(THETA)
1 LTA/SQR(100./60.
V VERT = 100./60.
V FWD = V MAXE*(1.151*5280./3600.
V I TNEW = SQR(DWG/(2.*RHOSC*AREAMR))
V I TNEW(1) = 1.*V VERT
V I TNEW(2) = 2.*V FWD**2+ V VERT**2
V I TNEW(3) = 0.
V I TNEW(4) = 0.
V I TNEW(5) = - V I TNEW**4
CALL Z PC CLR (V I TNEW,NDEG,ZC MPLX,IER)
V TNEW = ZC MPLX(3)
PC = DWG*V VERT
PC = PC/550.
PPC = (.5*RHOSC*EFPA VF*V VERT**3)+(.5*RHOSC*EFPAFF*V FWD**3)
PPC = PPC/550.
POC = .125*RHOSC*CDO *SIGMA*AREAMR*VTIP**3
PI VERT = (1./8)*DWG*V TNEW
PI VERT = PIVE FT/550.
PT VERT = FOC+FIVERT+ PC+PPC
MUTR = V FWD/V I PTR
PO TRF = .125*SIGTR*CD OTR*RHOSC*AK EATR*(V I PTR**3)
PO TRF = (1.+4.3*MUTR**2)*POTR
PPF = .5*RHOSC*(V FWD**3)*EFPAFF
PPF = PPF/550.
MU = V FWC/V I F
POF = .125*SIGMA*CDO*RHOSC*AREAMR*(V I P**3)
POF = (1.+4.3*MU**2)*PO
VI = SQR(DWG/(2.*RHOSC*AREAMR))
V I T = V I *SQR((- (V FWD**2/(2.*V I**2))+1.))
1 P I TLF = (1./8)*DWG*V I T

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PI TLF=FITLF/550.
PTTF=(PTTF*550.)/(OMEGA*LTR))
CTTR=(PTR/(AREA*TR*(VTI*PTR**2)*RHOSC)
BTTR=1.-SQRT(1-CTTR)/2.*RHOSC*(R*REATR))
VI TTR=SQRT(1-CTTR)/2.*RHOSC*(R*REATR))
1 VI TTR=VI TTR*SQRT(1-((VFWD**2)/(2.*VITR**2))**2)+1.)
PI TLF=(1./PI)*TTR*VITR
PTTF=PTTF/550.
PTTRF=PTTF+PTTRF
PTAVAL=PTTRF+PTVERT
WR ITE (6,2540) PAVAIL,PTAVAL
READ (5,*) ANS (,CLSCRN 6)
CALL FANS (6,2520) ALTSC
IF (ANS (6,2520) ALTSC
WR ITE (8,*)
WR ITE (8,*)
C*****9. 1 MAKE FINAL CHECK FOR SPECIFICATION COMPLIANCE*****
C*****
WR ITE (6,2550) CREW,PEOPLE,SPC LOD,NEMUSE,SC,ALTSC,HVIGE,ALT,VCR,V
1 MAXR,MAXV,VELMAX,VMAXE,VMAXR,RBS,RNGMX,MAX RC,RC,AL TSC,HVIGE,ALT,VCR,V
WR ITE (8,2550) CREW,PEOPLE,SPC LOD,NEMUSE,SC,ALTSC,HVIGE,ALT,VCR,V
1 MAXR,MAXV,VELMAX,VMAXE,VMAXR,RBS,RNGMX,MAX RC,RC,AL TSC,HVIGE,ALT,VCR,V
IF (ENGSSEL (6,2560)
WR ITE (8,2560)
WR ITE (8,2560)
GO TO NGSEL (NE.2) GO TO 1490
IF (EE (6,2570)
WR ITE (8,2570)
GO TO 1530
IF (ENGSSEL (NE.3) GO TO 1500
WR ITE (8,2580)
WR ITE (8,2580)
GO TO NGSEL (NE.4) GO TO 1510
IF (EE (6,2590)
WR ITE (8,2590)
GO TO NGSEL (NE.5) GO TO 1520
IF (ENGSSEL (NE.5) GO TO 1520
WR ITE (6,2600)
WR ITE (8,2600)
GO TO INLE
CONTINUE
WR ITE (8,2610)
WR ITE (8,2610)

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1590 FORMAT (55H ENTER THE GROSS WEIGHT THAT YOU WANT FOR THE FIRST 80%
1600 ESTIMATE), WEIGHT ESTIMATE =,F8.2,
1610 FORMAT (30H ENTER THE VALUE OF THE DISC LOADING FOR THE ESTIMATED,
OF, F9.2, 4H LBS),
1620 GROSS WEIGHT OF, F9.2, 4H LBS),
1) FORMAT (56H ENTER THE SPECIFICATION MAXIMUM FORWARD VELOCITY(KNOTS
1))
1630 (28H THE ADVANCE RATIO (MU) IS =,F6.4, /,
1640 (52H ENTER THE BLADE LOADING FOR THE GIVEN ADVANCE RATIO)
1650 (52H ENTER THE NUMBER OF MAIN ROTOR BLADES THAT YOU WANT)
1660 (30H)GROSS WEIGHT (LBS) SONIC SPEED =,F10.2, /, 30H EMPTY WEIGHT
=,F10.2, /, 30H SONIC SPEED (FPS)
1) MAXIMLM TIP VELOCITY (FPS) =,F10.2, /, 30H DISK LOADING
=,F10.2, /, 30H TIP VELOCITY (FPS)
2) VELOCITY ROTOR RADIUS (FT) =,F10.2, /, 30H
4) TATI CNAL VELOCITY (RPS) =,F10.2, /, 30H TIP VELOCITY (FPS)
=,F14.6, /, 30H ADVANC
5) RATIO (MU) =,F12.4, /, 30H BLADE LOADING
=,F15.7, /, 30H NUMBER OF MA
6) ROTOR BLADES =, 5X, 12, /, 30H CHORD MAIN ROTOR BLADE (FT) =,F14.6,
7) ROTOR BLADES =, 10X, 30H THE ASPECT RATIO IS =,F11.3, /, 10X, 30H
8) ROTOR BLADES =, 10X, 30H SPEED IS =,F11.3,
1670 THE ROTATIONAL SPEED OF LIFT WITH RESPECT TO ALPHA?
1680 (55H) WHAT IS THE COEFFICIENT OF LIFT WITH RESPECT TO ALPHA?
1690 (6H) (DEG))
1700 (43H) WHAT IS THE ZERO LIFT COEFFICIENT OF DRAG?
1710 (30H)GROSS WEIGHT (LBS) SONIC SPEED =,F10.2, /, 30H EMPTY WEIGHT
=,F10.2, /, 30H SONIC SPEED (FPS)
1) MAXIMLM TIP VELOCITY (FPS) =,F10.2, /, 30H DISK LOADING (LBS/
3SF) =,F10.2, /, 30H RADIUS (FT) =,F10.2, /, 30H
2) TATI CNAL VELOCITY (RPS) =,F10.2, /, 30H TIP VELOCITY (FPS)
=,F10.2, /, 30H TIP VELOCITY (FPS)
3) ROTOR BLADES =, 5X, 12, /, 30H CHORD MAIN ROTOR BLADE (FT) =,F11.3,
4) ROTOR BLADES =, 10X, 30H THE ASPECT RATIO IS =,F11.3, /, 10X, 30H
5) ROTOR BLADES =, 10X, 30H SPEED IS =,F11.3,
6) ROTOR BLADES =, 10X, 30H THE AMOUNT OF FUEL IN POUNDS)
7) ROTOR BLADES =, 10X, 30H USEFUL LOAD IN POUNDS THAT YOU WANT)
8) ROTOR BLADES =, 10X, 30H USEFUL LOAD IN POUNDS THAT YOU WANT)
9) ROTOR BLADES =, 10X, 30H USEFUL LOAD IN POUNDS THAT YOU WANT)
10) ROTOR BLADES =, 10X, 30H USEFUL LOAD IN POUNDS THAT YOU WANT)
11) ROTOR BLADES =, 10X, 30H USEFUL LOAD IN POUNDS THAT YOU WANT)
12) ROTOR BLADES =, 10X, 30H USEFUL LOAD IN POUNDS THAT YOU WANT)
13) ROTOR BLADES =, 10X, 30H USEFUL LOAD IN POUNDS THAT YOU WANT)
14) ROTOR BLADES =, 10X, 30H USEFUL LOAD IN POUNDS THAT YOU WANT)
15) ROTOR BLADES =, 10X, 30H USEFUL LOAD IN POUNDS THAT YOU WANT)
16) ROTOR BLADES =, 10X, 30H USEFUL LOAD IN POUNDS THAT YOU WANT)

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1770 7F16.7,/,30H ROTOR RADIUS (FT) =,F12.3,/,30H HOVER POWER
8 (HP) =,F10.1,/,30H ROTOR WEIGHT (LBS) =,F11.2,/,30H STRUCTURE (L
9/,30H TAIL: ROTCR (LBS) =,F11.2,/,30H ROTOR WEIGHT (LBS) =,F11.2,/,30H
$LANDING GEAR (LBS) =,F11.2,/,30H BODY (LBS) =,F11.2,/,30H
1 ENGINE (LBS) =,F11.2,/,30H DRIVE (LBS) =,F11.2,/,30H PROPULSION:
2/30H FUEL TANKS (LBS) =,F11.2,/,30H FLIGHT CONTROLS (L
3/30H INSTRUMENTS (LBS) =,F11.2,/,30H AUXILIARY POWER (LBS) =,F11.2,/,30H
4 INSTRUMENTS (LBS) =,F11.2,/,30H ELECTRICAL (LBS) =,F11.2,/,30H AVIONI
5 CS (LBS) =,F11.2,/,30H FURNISHINGS (LBS) =,F11.2,/,30H LOAD AND HAN
6 F11.2,/,30H AIR AND ICE (LBS) =,F11.2,/,30H REVISED EMPTY WEIGHT (LBS) =,F11.
7 DLING (LBS) =,F11.2,/,30H GROSS WEIGHT (LBS) =,F11.2,/,30H MERIT, IF NOT 70CM<80%,/10X,5
92,/,30H REVISED GROSS WEIGHT (LBS) =,F11.2,/,30H MERIT, WITH THE NEW DL,/,17X,20
10 FORMAT (//46H LOOK AT YOUR FIGURE OF MERIT (%)) =,F7.3)
11 THE CHANGE (//46H RECALCULATE THE FIGURE OF MERIT (%)) =,F7.3)
12 Y,/,17X,15H4. THE OLD GRCCS WEIGHT IS, F11.2,/,40H DO YOU WANT TO C
13 FORMAT (24H THE DISC LOADING?/,10X,7H1. YES,/,10X,6H2. NO)
14 FORMAT (56H ENTER A NEW DISK LOADING USING THE REVISED GROSS WEIGH
15 T)
1820 FORMAT (37H ENTER THE HEIGHT OF THE ROTCR SYSTEM)
1830 FORMAT (50H USE THE LATEST ESTIMATE OF GROSS WEIGHT AND ENTER,/,34
1840 1H THE EQUIVALENT FLAT PLATE LOADING)
1 2 ICE POWER PARASITE (SHP) @ SSL,/,55H AIRSPEED TIP INDUCED (SHP) PROF
3 PARASITE (SHP) TOTAL,7,58H (KNOTS) MACH (SHP) (SHP)
4 FORMAT (2X, F7.2,1X, F9.2,2X, F9.2,2X, F9.2,2X, F9.2)
1850 FORMAT (//43H1 MAIN ROTOR POWER PROFILE,/,49H
1860 AT SPECIFICATION ALTITUDE AND TEMPERATURE,/,55H
1 INDUCED PROFILE PARASITE (SHP) TOTAL,7,58H (KNOTS) MACH TIP
2 (SHP) (SHP) (SHP)
3 FORMAT (34H ENTER THE NEW CHORD THAT YOU WANT)
1870 FORMAT (//29H TAIL ROTOR RADIUS (FT) =, F8.3)
1880 FORMAT (5X, 24H TAIL ROTOR SPEED (RPS) =, F8.3)
1890 FORMAT (5X, 24H TAIL ROTOR CDD OF TAIL ROTOR BLADES,/,35H HELICOPT
1900 FORMAT (5X, 24H ENTER HELICOPTER NUMBER,/,36H FOR A MEDIUM HELICOPT
1910 FOR A LIGHT HELICOPTER,/,47 FOR A HEAVY HELICOPTER)
1 2 ER,/,35H
1920 FORMAT (43H ENTER ASPECT RATIO OF TAIL ROTOR (4.5-8.0))
1930 1H THE ASPECT RATIO OF TAIL ROTOR POWER PROFILE,/,27H POWER
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2  (KNOTS) /,47H AIRSPEED TIP INDUCED PROFILE TOTAL,/47H
3  (FORMAT (///29H1) (SHP) (SHP)) (SHP))
1  SPECIFICATION ALTITUDE AND TEMPERATURE /,48H A
2  POWER TOTAL,7,47H (KNOTS) /,47H AIRSPEED TIP INDUCED-----PROG
3  FILE (SHP) MACH (SHP) (SHP) (SHP) (SHP) (SHP) (SHP) (SHP)
4  )
1940
1950 (2X,F7,2,1X,F5,2,1X,F9,2,2X,F9,2,2X,F9,2,2X,F9,2)
1960 (///42H TOTAL POWER FOR THE AIRCRAFT TO HOVER IS=,F10,2)
1970 (///42H @ SSL,/8X,55H
1  PARASITE-----COMP-----INDUCED-----PROFILE (SHP)
2  (SHP) (SHP) (SHP) (SHP) (SHP) (SHP) (SHP) (SHP)
3  (2X,F7,2,1X,F9,2,2X,F9,2,2X,F9,2,2X,F9,2)
4  (FORMAT (///42H1) TOTAL,7,47H (SHP))
1980 AT SPECIFICATION ALTITUDE AND TEMPERATURE /,8X,55H
1990 (FORMAT (///42H1) TOTAL,7,47H (SHP))
2000 PROFILE (SHP) PARASITE (SHP) COMP (SHP) (SHP) (SHP)
2010 (36H THE REQUIRED SHAFT HORSEPOWER IS ,6H (SHP))
2020 (4H IS=,F10,2)
2030 (28H DO YOU WANT TO CHANGE THE NUMBER OF ENGINES SELECTED,/
2040 (15X,6H) YES,/15X,5H2,NO)
2050 (FORMAT (54H ENTER THE NUMBER OF ENGINES THAT YOU WANT)
19H AIRFRAME)
2060 (52H ENTER THE NUMBER OF AVERAGE FLIGHT HOURS PER YEAR PER,
2070 (46H ENTER THE AVERAGE AIRFRAME SERVICE LIFE YEARS)
2080 (51H1 ENGINE SELECTION CRITERIA,/2
14X,47H ----- 1 ENGINE -----, /,24X,46H
2  A (FORMAT (///51H) B C D F)
1,24X,15H -----,12,26H ENGINE(S) -----, /,24X,46H
2  )
2090
2100 POWERPLANT WEIGHT (LB): ,6F8,1)
2110 LIFE-CYCLE COST($10M): ,6F8,2)
2120 ENGINE LIFE(HRS): ,6F8,1)
2130 NUMBER OF REPLACEMENTS: ,6F8,1)
2140 R AND D COSTS($K): ,6F8,1)
2150 INITIAL COST($K): ,6F8,1)
2160 YEAR MAINT COST($K): ,6F8,2)
2170 YEAR OPERATE COST($K): ,6F8,2)
2180 REPLACEMENT COST($K): ,6F8,2)
2190 SALVAGE VALUE($K): ,6F8,2)
2200 AVAILABILITY(ENG): ,6F8,4)

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2210 RELIABILITY(ENG): ,6F8.4)
2220 INABILITY(ENG): ,6F8.3)
2230 MAINTAINANCE(SHP-MIL): ,6F8.1)
2240 SELECT: (1.A)---(2.8)---(4.D)---(5.E)---(6.F))
2250 FUEL FLOW RATES-----
2260 MILITARY POWER NORMAL POWER =,F8.2)
2270 FLO.27X FLO.27X FLO.27X FLO.27X FLO.27X
2280 CURRENT CHORD IS =,F10.3,/,30H PRESSURE (PS
2290 ALPHA AT SSL =,F10.3,/,30H DELTA AT SPEC ALTI
2300 TEMPERATURE (R) =,F10.3,/,30H ZERO HORSEPOWER INTERCEPT,/,30H AT SPEC AL
2310 THETA AT SPEC ALTI =,F10.3)
2320 ZERO HORSEPOWER INCREMENT AT ALTI TIDE =,F10.3)
2330 OLD GROSS WEIGHT =,F10.2,/,19H NEW GROSS WEIGHT =,F1
2340 THE PHANTOM HORSEPOWER IS =,F10.2)
2350 ENTER THE MAX RANGE VELOCITY FROM GRAPHS)
2360 ENTER THE MAX ENDURANCE VELOCITY FROM THE GRAPHS)
2370 ENTER THE MAX REQUIRED HORSEPOWER AT CRUISE VELOCITY)
2380 ENTER THE MAX RANGE VELOCITY IN KNOTS)
2390 THE DESIGN WEIGHT IS =,F10.2,/,32H THE ESTIMA
2400 GROSS WEIGHT IS =,F10.2)
2410 ADVANTAGEOUS EXCESS WEIGHT IS =,F10.1,/,41H WHICH PARAME
2420 FUEL LOAD,/,10X,18H1. FUEL CAPABILITY,/,10X,14H
2430 YOU WANT TO INCREASE? /,10X,18H1. FUEL CAPABILITY,/,10X,14H
2440 LOAD,/,10X,18H1. FUEL CAPABILITY,/,10X,14H
2450 FEET PER SECOND)
2460 THE ESTIMATED GROSS WEIGHT AND THEREFORE,
2470 MUST BE OVER THE VELOCITY THAT HAS THE STALL ANGLE LESS,/,31H
2480 THAN OR EQUAL TO 12.5 DEGREES ,/,21H VELOCITY ANGLE,/,21H
2490 (KNOTS)
2500 (X, F9.2, 7X, F6.1)
2510 THE REQUIRED SHAFT HORSEPOWER IS =,F10.2)
2520 THE REQUIRED RATE OF CLIMB, ENTER A GUES
2530 COMPUTATIONAL RATE OF CLIMB (FEET/MINUTE)
2540 FOR THE POWER AVAILABLE IS =,F10.2,/,37H THE T
2550 THE AIRCRAFT IS =,F10.2,/,37H THE PROFILE POWER IS
2560 =,F10.2,/,53H
2570 THE TOTAL POWER SHOULD EQUAL THE POWER AVAILAB
2580 IF NOT, ENTER A 1, ELSE, ENTER A 2)
2590 THE BEST RATE OF CLIMB IS, F10.2, 16H FEET PER MINUT
2600 THE AIRCRAFT IS =,F10.2,/,53H =,F10.2,/,37H THE T

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2500 2 THE POWER AVAILABLE, 7, 35H IF NOT, 49H THE TOTAL POWER SHOULD EQUAL
FORMAT (//, 53H COMPUTATION OF THE MAX HOVER ALT (IGEL), ENTER A 2)
2510 1S //, 25H FOR THE ALTITUDE IN FEET)
FORMAT (//, 51H COMPUTATION IN FEET)
2520 1 //, 25H AT THE ALTITUDE IN FEET)
FORMAT (//, 24H THE SERVICE CEILING ALTITUDE IS =, F10.2)
2530 1 //, 25H AT THE HOVER CEILING ALTITUDE IS =, F10.2)
2540 1 //, 25H AT THE HOVER CEILING ALTITUDE IS =, F10.2)
FORMAT (37H CF THE AIRCRAFT IS =, F10.2)
2550 2 THE POWER AVAILABLE, 7, 35H IF NOT, 49H THE TOTAL POWER SHOULD EQUAL
FORMAT (43H)
1306 //, 27X, 13HF INAL SUMMARY //, 28X, 11HPERFORMANCE, //, 40X, 30HSPECIFI
2CA TION DESIGN, //, 41H INTERNAL LOAD (LBS)
3 //, 18X, 12, //, 41H INTERC. LOAD (LBS)
4 //, 10X, F10.1 //, 41H SERVICE CEILING (FT)
5 //, 10X, F10.1 //, 41H HOVER CEILING (FT)
6 //, 10X, F10.1 //, 41H VELOCITY (KTS) CRUISE
7 //, 10X, F10.1 //, 41H MAXIMUM RANGE
8 //, 10X, F10.1 //, 41H MAX ENDURANCE
9 //, 10X, F10.1 //, 41H RETREATING BLADE STALL
$ //, 10X, F10.1 //, 41H MAXIMUM RANGE (NMI)
$ //, 10X, F10.1 //, 41H MAXIMUM RATE OF CLIMB
$ //, 10X, F10.1 //, 41H ENGINE NUMBER
2560 1 //, 10X, F10.1 //, 41H MILITARY - MAX GROSS
FORMAT (10X, 31HTYPE)
2570 1 //, 10X, F10.1 //, 41H MILITARY - MAX GROSS
FORMAT (10X, 31HTYPE)
2580 1 //, 10X, F10.1 //, 41H MILITARY - MAX GROSS
FORMAT (10X, 31HTYPE)
2590 1 //, 10X, F10.1 //, 41H MILITARY - MAX GROSS
FORMAT (10X, 31HTYPE)
2600 1 //, 10X, F10.1 //, 41H MILITARY - MAX GROSS
FORMAT (10X, 31HTYPE)
2610 1 //, 10X, F10.1 //, 41H MILITARY - MAX GROSS
FORMAT (10X, 31HTYPE)
2620 1 //, 10X, F10.1 //, 41H MILITARY - MAX GROSS
FORMAT (10X, 31HTYPE)
2630 1 //, 10X, F10.1 //, 41H MILITARY - MAX GROSS
FORMAT (10X, 31HTYPE)

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3.....:20X,F10.2,/,41H FUSELAGE LENGTH (FT),AREA (FT),FORMA
4.....:F10.2,10X,F10.2,/,41H EQUIVALENT FLAT PLAGE AREA (FT),FORMA
5RD :20X,F10.2,/,41H
610.2)
2640 FORMAT (50H ENTER THE SPECIFICATION PRESSURE ALTITUDE IN FEET)
2650 FORMAT (43H ENTER THE SPECIFICATION TEMPERATURE IN (F))
2660 FORMAT (53H FROM THE SPECIFICATIONS SHEET, WHAT IS THE NUMBER OF,6
1H CREW?)
2670 FORMAT (51H FROM THE SPECIFICATIONS SHEET, WHAT IS THE SERVICE,9H
1CEILING?)
2680 FORMAT (55H FROM THE SPECIFICATIONS SHEET, WHAT IS THE HOVER (IGE)
19H CEILING?)
2690 FORMAT (51H FROM THE SPECIFICATIONS SHEET, WHAT IS THE MAXIMUM,14H
1FROTOR RADIUS?)
2700 FORMAT (51H FROM THE SPECIFICATIONS SHEET, WHAT IS THE MAXIMUM,17H
1FUSELAGE LENGTH?)
2710 FORMAT (47H ENTER TYPE OF HELICOPTER FOR WEIGHT ESTIMATION,/,15X,8
1HLIGHT,/,15X,9H2.MEDIUM,/,15X,8H3.HEAVY)
2720 FORMAT (52H ENTER THE MAXIMUM RATE OF CLIMB FROM SPECIFICATIONS)
2730 FORMAT (40H WHICH TYPE HELICOPTER ARE YOU DESIGNING,/,10X,7HLIGH
1T,/,10X,8H2.MEDIUM,/,10X,7H3.HEAVY)
2740 FORMAT (49H YOU HAVE NOT CONVERGED TO WITH 10% OF THE WEIGHT,/,29H
1THEREFORE YOU MUST REITERATE)
2750 FORMAT (36H ENTER THE SPECIFICATION USEFUL LOAD)
2760 FORMAT (44H ENTER THE MAXIMUM POSSIBLE FORWARD VELOCITY)
2770 FORMAT (36H ENTER IS THE TOTAL POWER VS. FORWARD,16H VELOCITY TABLE
1,/,16H NOW GRAPH A FEW,39H POINTS AND EXTRAPOLATE THE NEEDED DATA
2)
2780 FORMAT (35H ENTER TYPE OF LANDING GEAR DESIRED,/,10X,10H1. WHEEL
1S,/,10X,9H2. SKIDS)
2790 FORMAT (32H WHAT TYPE OF GEAR DO YOU DESIRE,/,10X,9H1. FIXED,/,1
10X,15H2. RETRACTABLE)
2800 FORMAT (33H ENTER THE NUMBER OF LANDING GEAR)
2810 FORMAT (55H ICOST ANALYSIS PER VEHICLE (IN DOLLARS FOR 100 A/C RUN)
1,/,5X,3CH RCTOR =,F11.2,/,5X,30H
2) =,F11.2,/,5X,30H NACELLE =,F11.2,/,5X,30H LANDING =
3) =,F11.2,/,5X,30H PROPULSION: ENGINE =,F11.2,/,5X,30H
4) =,F11.2,/,5X,30H DRIVE =,F11.2,/,5X,30H FUEL TANKS
5) =,F11.2,/,5X,30H FLIGHT CONTROLS =,F11.2,/,5X,30H AU
6) =,F11.2,/,5X,30H INSTRUMENTS =,F11.2,/,5X,30H
7) =,F11.2,/,5X,30H HYDRAULICS =,F11.2,/,5X,30H
8) =,F11.2,/,5X,30H AVIONICS =,F11.2,/,5X,30H
9) =,F11.2,/,5X,30H FURNISHINGS =,F11.2,/,5X,30H
10) =,F11.2,/,5X,30H TOTAL COST PER VEHICLE =,F11.2,/,5X,30H
11) =,F11.2,/,5X,30H INFLATION RATE DOLLARS =,F11.2)

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2830          DYNAMIC PARAMETERS, /, 38H      ALL.....
1. F10.6 /, 38H      A12..... F10.6 /, 38H      A
2. F14..... F10.6 /, 38H      T1..... F10.6 /, 38H      F
3. F10.6 /, 38H      T2..... F10.6 /, 38H      T4.
4. F10.6 /, 38H      T3..... F10.6 /, 38H      INFLW RATIO (LAMBDA
5. F10.6 /, 38H      F10.6 /, 38H
6. F10.6 /, 38H
7. F10.6 /, 38H
2840          BOARD STALL CORRECTION FACTOR..... F16.7 //, 5X, 3
17. STALL COEFFICIENT OF ATTACK CALCULATIONS //, 5X, 35H LONGITUDINAL
18. CYCLIC ANGLE (DEG)..... F10.6 /, 5X, 35H LONGITUDINAL COLLECTIVE ANGLE (
25. HALPH (90) (DEG)..... F10.6 /, 5X, 3
35. HALPH (270) (DEG)..... F10.6 /, 5X, 35HRT.....
2860          STALL CORRECTION FACTOR..... F16.7 //, 5X, 3
1. F10.6 /, 38H      A12..... F10.6 /, 38H      A
2. F14..... F10.6 /, 38H      T1..... F10.6 /, 38H      F
3. F10.6 /, 38H      T2..... F10.6 /, 38H      T4.
4. F10.6 /, 38H      T3..... F10.6 /, 38H      INFLW RATIO (LAMBDA
5. F10.6 /, 38H      F10.6 /, 38H
6. F10.6 /, 38H
7. F10.6 /, 38H
2870          BOARD STALL CORRECTION FACTOR..... F16.7 //, 5X, 3
17. STALL COEFFICIENT OF ATTACK CALCULATIONS //, 5X, 35H LONGITUDINAL
18. CYCLIC ANGLE (DEG)..... F10.6 /, 5X, 35H LONGITUDINAL COLLECTIVE ANGLE (
25. HALPH (90) (DEG)..... F10.6 /, 5X, 3
35. HALPH (270) (DEG)..... F10.6 /, 5X, 35HRT.....
2880          STALL CORRECTION FACTOR..... F16.7 //, 5X, 3
1. F10.6 /, 38H      A12..... F10.6 /, 38H      A
2. F14..... F10.6 /, 38H      T1..... F10.6 /, 38H      F
3. F10.6 /, 38H      T2..... F10.6 /, 38H      T4.
4. F10.6 /, 38H      T3..... F10.6 /, 38H      INFLW RATIO (LAMBDA
5. F10.6 /, 38H      F10.6 /, 38H
6. F10.6 /, 38H
7. F10.6 /, 38H
2890          BOARD STALL CORRECTION FACTOR..... F16.7 //, 5X, 3
17. STALL COEFFICIENT OF ATTACK CALCULATIONS //, 5X, 35H LONGITUDINAL
18. CYCLIC ANGLE (DEG)..... F10.6 /, 5X, 35H LONGITUDINAL COLLECTIVE ANGLE (
25. HALPH (90) (DEG)..... F10.6 /, 5X, 3
35. HALPH (270) (DEG)..... F10.6 /, 5X, 35HRT.....
2900          STALL CORRECTION FACTOR..... F16.7 //, 5X, 3
1. F10.6 /, 38H      A12..... F10.6 /, 38H      A
2. F14..... F10.6 /, 38H      T1..... F10.6 /, 38H      F
3. F10.6 /, 38H      T2..... F10.6 /, 38H      T4.
4. F10.6 /, 38H      T3..... F10.6 /, 38H      INFLW RATIO (LAMBDA
5. F10.6 /, 38H      F10.6 /, 38H
6. F10.6 /, 38H
7. F10.6 /, 38H
2910          BOARD STALL CORRECTION FACTOR..... F16.7 //, 5X, 3
17. STALL COEFFICIENT OF ATTACK CALCULATIONS //, 5X, 35H LONGITUDINAL
18. CYCLIC ANGLE (DEG)..... F10.6 /, 5X, 35H LONGITUDINAL COLLECTIVE ANGLE (
25. HALPH (90) (DEG)..... F10.6 /, 5X, 3
35. HALPH (270) (DEG)..... F10.6 /, 5X, 35HRT.....
2920          STALL CORRECTION FACTOR..... F16.7 //, 5X, 3
1. F10.6 /, 38H      A12..... F10.6 /, 38H      A
2. F14..... F10.6 /, 38H      T1..... F10.6 /, 38H      F
3. F10.6 /, 38H      T2..... F10.6 /, 38H      T4.
4. F10.6 /, 38H      T3..... F10.6 /, 38H      INFLW RATIO (LAMBDA
5. F10.6 /, 38H      F10.6 /, 38H
6. F10.6 /, 38H
7. F10.6 /, 38H
2930          BOARD STALL CORRECTION FACTOR..... F16.7 //, 5X, 3
17. STALL COEFFICIENT OF ATTACK CALCULATIONS //, 5X, 35H LONGITUDINAL
18. CYCLIC ANGLE (DEG)..... F10.6 /, 5X, 35H LONGITUDINAL COLLECTIVE ANGLE (
25. HALPH (90) (DEG)..... F10.6 /, 5X, 3
35. HALPH (270) (DEG)..... F10.6 /, 5X, 35HRT.....

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D. SAMPLE OUTPUT

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GROSS WEIGHT (LBS)          14400.00
EMPTY WEIGHT (LBS)          4320.00
SONIC SPEED (FPS)          1116.89
MAXIMUM TIP VELOCITY (FPS) 1725.98
DISK LOAD RADIUS (FT)      25.41
ROTATIONAL VELOCITY (RPS)  28.57
TIP VELOCITY (FPS)         725.98
COEFFICIENT OF THRUST      0.005668
ADVANCE RATIO (MU)         0.3721
BLADE LOAD                  0.0960
SOLIDITY OF MAIN ROTOR BLADES 4
NUMBER OF MAIN ROTOR BLADES 1.178138
CHORD MAIN ROTOR BLADE (FT) 21.567
THE ASPECT RATIO IS =      28.572
THE ROTATIONAL SPEED IS =

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GROSS WEIGHT (LBS)          14400.00
EMPTY WEIGHT (LBS)          4320.00
SONIC SPEED (FPS)          1116.89
MAXIMUM TIP VELOCITY (FPS) 1725.98
DISK LOAD RADIUS (FT)      25.41
ROTATIONAL VELOCITY (RPS)  27.00
TIP VELOCITY (FPS)         686.03
COEFFICIENT OF THRUST      0.006347
ADVANCE RATIO (MU)         0.3937
BLADE LOAD                  0.0920
SOLIDITY OF MAIN ROTOR BLADES 4
NUMBER OF MAIN ROTOR BLADES 1.377
CHORD MAIN ROTOR BLADE (FT) 18.46
ASPECT RATIO OF MAIN ROTOR 0.5520
COEFF OF LIFT (AVG)        6.3025
COEFF OF DRAG @ 0 LIFT     0.0100

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TIP LOSS FACED)	(HP)	0.9721020
POWER (PROFILE)	(HP)	1310.3
POWER (TOTAL)	(HP)	353.6
EMPTY WEIGHT	(LBS)	1663.9
FUEL WEIGHT OF PCPL		8867.39
NUMBER OF ENGINES		4000.00
USEFUL LOAD	(LBS)	14
NUMBER OF ENGINES		4500.00
ESTIMATED GROSS WEIGHT	(LBS)	2
SOLIDITY DIUS	(FT)	17367.39
ROTOR POWER	(HP)	26.0762025
HOVER WEIGHT	(LBS)	1663.9
ROTOR WEIGHT	(LBS)	1725.18
TAIL: ROTOR STRUCTURE	(LBS)	111.77
BODY (LBS)		1323.89
LANDING GEAR	(LBS)	624.21
NACELLE	(LBS)	178.53
PROPULSION: ENGINE	(LBS)	1215.64
DRIVE	(LBS)	1957.32
FUEL TANKS	(LBS)	676.49
FLIGHT CONTROLS	(LBS)	587.49
AUXILIARY POWER	(LBS)	190.00
INSTRUMENTS	(LBS)	103.83
HYDRAULICS	(LBS)	74.42
ELECTRICAL	(LBS)	407.26
AVIONICS	(LBS)	309.15
FURNISHINGS	(LBS)	4
AIR AND ICE	(LBS)	832.72
LOAD AND HANDLING	(LBS)	84.50
REVISED EMPTY WEIGHT	(LBS)	9174.45
REVISED GROSS WEIGHT	(LBS)	17674.45

FIGURE OF MERIT (%) = 78.747

MAIN ROTOR POWER PROFILE

AIR SPEED (KNOTS)	TIP MACH	INDUCED (SHP)	POWER PROFILE (SHP)	PARASITE (SHP)	TOTAL (SHP)
0	0	13	3	0	16
5	0	32	5	0	37
10	0	127	8	0	135
15	0	111	16	1	128
20	0	103	26	4	133
25	0	103	33	8	144
30	0	103	41	13	157
35	0	103	49	19	172
40	0	103	57	27	183
45	0	103	66	38	202
50	0	103	76	50	229
55	0	103	87	63	270
60	0	103	99	84	317
65	0	103	111	108	369
70	0	103	127	135	422
75	0	103	144	167	481
80	0	103	162	202	544
85	0	103	181	241	612
90	0	103	202	285	687
95	0	103	225	334	768
100	0	103	250	388	848
105	0	103	277	448	925
110	0	103	305	515	1000
115	0	103	334	588	1080
120	0	103	364	667	1160
125	0	103	395	752	1240
130	0	103	427	843	1320
135	0	103	460	940	1400
140	0	103	495	1043	1480
145	0	103	531	1152	1560
150	0	103	568	1267	1640
155	0	103	607	1388	1720
160	0	103	647	1515	1800
165	0	103	688	1648	1880
170	0	103	730	1787	1960
175	0	103	773	1932	2040
180	0	103	817	2083	2120
185	0	103	862	2240	2200
190	0	103	907	2403	2280
195	0	103	953	2572	2360
200	0	103	1000	2747	2440
205	0	103	1047	2928	2520
210	0	103	1095	3115	2600
215	0	103	1143	3308	2680
220	0	103	1192	3507	2760
225	0	103	1241	3712	2840
230	0	103	1291	3923	2920
235	0	103	1341	4140	3000
240	0	103	1392	4363	3080
245	0	103	1443	4592	3160
250	0	103	1494	4827	3240
255	0	103	1545	5068	3320
260	0	103	1596	5315	3400
265	0	103	1647	5568	3480
270	0	103	1698	5827	3560
275	0	103	1749	6092	3640
280	0	103	1800	6363	3720
285	0	103	1851	6640	3800
290	0	103	1902	6923	3880
295	0	103	1953	7212	3960
300	0	103	2004	7507	4040
305	0	103	2055	7808	4120
310	0	103	2106	8115	4200
315	0	103	2157	8428	4280
320	0	103	2208	8747	4360
325	0	103	2259	9072	4440
330	0	103	2310	9403	4520
335	0	103	2361	9740	4600
340	0	103	2412	10083	4680
345	0	103	2463	10432	4760
350	0	103	2514	10787	4840
355	0	103	2565	11148	4920
360	0	103	2616	11515	5000
365	0	103	2667	11888	5080
370	0	103	2718	12267	5160
375	0	103	2769	12652	5240
380	0	103	2820	13043	5320
385	0	103	2871	13440	5400
390	0	103	2922	13843	5480
395	0	103	2973	14252	5560
400	0	103	3024	14667	5640
405	0	103	3075	15088	5720
410	0	103	3126	15515	5800
415	0	103	3177	15948	5880
420	0	103	3228	16387	5960
425	0	103	3279	16832	6040
430	0	103	3330	17283	6120
435	0	103	3381	17740	6200
440	0	103	3432	18203	6280
445	0	103	3483	18672	6360
450	0	103	3534	19147	6440
455	0	103	3585	19628	6520
460	0	103	3636	20115	6600
465	0	103	3687	20608	6680
470	0	103	3738	21107	6760
475	0	103	3789	21612	6840
480	0	103	3840	22123	6920
485	0	103	3891	22640	7000
490	0	103	3942	23163	7080
495	0	103	3993	23692	7160
500	0	103	4044	24227	7240
505	0	103	4095	24768	7320
510	0	103	4146	25315	7400
515	0	103	4197	25868	7480
520	0	103	4248	26427	7560
525	0	103	4299	26992	7640
530	0	103	4350	27563	7720
535	0	103	4401	28140	7800
540	0	103	4452	28723	7880
545	0	103	4503	29312	7960
550	0	103	4554	29907	8040
555	0	103	4605	30508	8120
560	0	103	4656	31115	8200
565	0	103	4707	31728	8280
570	0	103	4758	32347	8360
575	0	103	4809	32972	8440
580	0	103	4860	33603	8520
585	0	103	4911	34240	8600
590	0	103	4962	34883	8680
595	0	103	5013	35532	8760
600	0	103	5064	36187	8840
605	0	103	5115	36848	8920
610	0	103	5166	37515	9000
615	0	103	5217	38188	9080
620	0	103	5268	38867	9160
625	0	103	5319	39552	9240
630	0	103	5370	40243	9320
635	0	103	5421	40940	9400
640	0	103	5472	41643	9480
645	0	103	5523	42352	9560
650	0	103	5574	43067	9640
655	0	103	5625	43788	9720
660	0	103	5676	44515	9800
665	0	103	5727	45248	9880
670	0	103	5778	45987	9960
675	0	103	5829	46732	10040
680	0	103	5880	47483	10120
685	0	103	5931	48240	10200
690	0	103	5982	49003	10280
695	0	103	6033	49772	10360
700	0	103	6084	50547	10440
705	0	103	6135	51328	10520
710	0	103	6186	52115	10600
715	0	103	6237	52908	10680
720	0	103	6288	53707	10760
725	0	103	6339	54512	10840
730	0	103	6390	55323	10920
735	0	103	6441	56140	11000
740	0	103	6492	56963	11080
745	0	103	6543	57792	11160
750	0	103	6594	58627	11240
755	0	103	6645	59468	11320
760	0	103	6696	60315	11400
765	0	103	6747	61168	11480
770	0	103	6798	62027	11560
775	0	103	6849	62892	11640
780	0	103	6900	63763	11720
785	0	103	6951	64640	11800
790	0	103	7002	65523	11880
795	0	103	7053	66412	11960
800	0	103	7104	67307	12040
805	0	103	7155	68208	12120
810	0	103	7206	69115	12200
815	0	103	7257	70028	12280
820	0	103	7308	70947	12360
825	0	103	7359	71872	12440
830	0	103	7410	72803	12520
835	0	103	7461	73740	12600
840	0	103	7512	74683	12680
845	0	103	7563	75632	12760
850	0	103	7614	76587	12840
855	0	103	7665	77548	12920
860	0	103	7716	78515	13000
865	0	103	7767	79488	13080
870	0	103	7818	80467	13160
875	0	103	7869	81452	13240
880	0	103	7920	82443	13320
885	0	103	7971	83440	13400
890	0	103	8022	84443	13480
895	0	103	8073	85452	13560
900	0	103	8124	86467	13640
905	0	103	8175	87488	13720
910	0	103	8226	88515	13800
915	0	103	8277	89548	13880
920	0	103	8328	90587	13960
925	0	103	8379	91632	14040
930	0	103	8430	92683	14120
935	0	103	8481	93740	14200
940	0	103	8532	94803	14280
945	0	103	8583	95872	14360
950	0	103	8634	96947	14440
955	0	103	8685	98028	14520
960	0	103	8736	99115	14600
965	0	103	8787	100208	14680
970	0	103	8838	101307	14760
975	0	103	8889	102412	14840
980	0	103	8940	103523	14920
985	0	103	8991	104640	15000
990	0	103	9042	105763	15080
995	0	103	9093	106892	15160
1000	0	103	9144	108027	15240

AIR SPEED (KNOTS)	AT SPECIFIC TIP MACH	INDUCED (SHP)	MAIN ROTOR ALTITUDE (SHP)	POWER PROFILE (SHP)	PROFILE AND TEMPERATURE (SHP)	PARASITE (SHP)	TOTAL (SHP)
0	0	1387	4	326	0	0	1715
5	0	1374	3	327	0	0	1701
15	0	1269	3	328	0	0	1662
25	0	1186	3	329	0	0	1599
30	0	1094	3	331	4	0	1427
35	0	900	3	336	7	0	1335
40	0	815	3	338	12	0	1248
45	0	745	3	342	18	0	1172
50	0	675	3	345	25	0	1107
55	0	618	3	349	35	0	1056
60	0	554	3	354	46	0	1015
65	0	492	3	358	60	0	985
70	0	437	3	364	77	0	964
75	0	382	3	369	96	0	952
80	0	327	3	375	118	0	948
85	0	271	3	381	144	0	951
90	0	214	3	388	172	0	978
95	0	157	3	395	205	0	1001
100	0	100	4	402	241	0	1031
105	0	50	4	410	281	0	1066
110	0	0	4	418	325	0	1108
115	0	0	4	427	374	0	1157
120	0	0	4	436	428	0	1211
125	0	0	4	445	486	0	1273
130	0	0	4	455	549	0	1340
135	0	0	4	465	618	0	1415
140	0	0	4	476	692	0	1496
145	0	0	4	487	772	0	1584
150	0	0	4	499	858	0	1679
155	0	0	5	502	950	0	1781
160	0	0	5	513	1053	0	1891
165	0	0	5	523	1126	0	2008
170	0	0	5	536	1204	0	2133
175	0	0	5	549	1288	0	2266
180	0	0	5	563	1377	0	2407
185	0	0	5	573	1472	0	2557
190	0	0	6	580	1573	0	2715

TAIL ROTOR SPEED (RPS) = 5.451
 TAIL ROTOR CDO = 122.201
 TAIL ROTOR CDO = 0.0138000

TAIL ROTOR POWER PROFILE

AIR SPEED (KNOTS)	TIP MACH	INDUCED (SHP)	SSL POWER	PROFILE (SHP)	TOTAL (SHP)
0	0.00	0	0	0	0
5	0.60	95.87	4	43.67	139.54
10	0.61	88.34	7	43.79	132.13
15	0.62	79.64	7	43.94	123.61
20	0.63	68.94	4	44.15	113.09
25	0.64	57.45	6	44.75	101.31
30	0.65	46.26	5	45.14	91.40
35	0.66	37.29	1	45.60	82.50
40	0.67	29.31	7	46.18	75.48
45	0.68	22.77	9	47.31	70.97
50	0.69	17.54	13	48.01	66.62
55	0.70	13.40	17	48.76	63.14
60	0.71	10.55	20	49.57	62.30
65	0.72	8.09	23	50.45	61.04
70	0.73	6.05	29	51.38	62.43
75	0.74	4.52	39	52.33	63.11
80	0.75	3.45	55	53.45	64.02
85	0.76	2.76	70	54.72	65.16
90	0.77	2.35	90	55.96	66.51
95	0.78	2.15	110	58.26	68.06
100	0.79	1.86	123	59.61	69.73
105	0.80	1.67	139	61.03	71.86
110	0.81	1.54	150	62.50	73.20
115	0.82	1.45	167	64.04	76.74
120	0.83	1.38	173	65.30	81.51
125	0.84	1.32	180	67.08	84.75
130	0.85	1.26	224	69.08	87.25
135	0.86	1.22	246	72.63	95.08
140	0.87	1.19	265	74.49	99.46
145	0.88	1.16	296	76.51	103.16
150	0.88	1.13	332	78.05	108.22
155	0.88	1.10	359	82.73	113.65
160	0.88	1.07	393	84.93	118.48
165	0.88	1.04	434	87.19	124.48
170	0.88	1.01	483	87.19	130.75

AIR SPEED (KNOTS)	AT SPECIFICATION	TIP MACH	INDUCED (SHP)	ROTOR ALTITUDE (SHP)	POWER PROFILE (SHP)	TEMPERATURE PROFILE (SHP)	TOTAL (SHP)
0	0	0	1	142	40	140	140
5	0	0	1	140	40	135	140
10	0	0	1	86	40	126	135
15	0	0	1	75	40	115	126
20	0	0	1	63	40	104	115
25	0	0	1	51	41	93	104
30	0	0	1	43	41	83	93
35	0	0	1	37	42	75	83
40	0	0	1	32	43	69	75
45	0	0	1	29	43	65	69
50	0	0	1	27	44	62	65
55	0	0	1	26	45	61	62
60	0	0	1	25	45	59	61
65	0	0	1	24	46	59	59
70	0	0	1	23	47	59	59
75	0	0	1	22	48	59	59
80	0	0	1	21	49	60	60
85	0	0	1	21	50	61	61
90	0	0	1	21	52	63	63
95	0	0	1	21	55	65	65
100	0	0	1	21	58	67	67
105	0	0	1	21	61	69	69
110	0	0	1	21	64	71	71
115	0	0	1	21	67	73	73
120	0	0	1	21	70	76	76
125	0	0	1	21	73	78	78
130	0	0	1	21	76	81	81
135	0	0	1	21	79	85	85
140	0	0	1	21	81	88	88
145	0	0	1	21	83	92	92
150	0	0	1	21	85	96	96
155	0	0	1	21	87	100	100
160	0	0	1	21	89	105	105
165	0	0	1	21	91	110	110
170	0	0	1	21	93	115	115
175	0	0	1	21	95	121	121
180	0	0	1	21	97	128	128
185	0	0	1	21	99	136	136
190	0	0	1	21	101	145	145
195	0	0	1	21	103	155	155
200	0	0	1	21	105	166	166
205	0	0	1	21	107	178	178
210	0	0	1	21	109	191	191
215	0	0	1	21	111	205	205
220	0	0	1	21	113	220	220
225	0	0	1	21	115	236	236
230	0	0	1	21	117	253	253
235	0	0	1	21	119	271	271
240	0	0	1	21	121	290	290
245	0	0	1	21	123	310	310
250	0	0	1	21	125	331	331
255	0	0	1	21	127	353	353
260	0	0	1	21	129	376	376
265	0	0	1	21	131	400	400
270	0	0	1	21	133	425	425
275	0	0	1	21	135	451	451
280	0	0	1	21	137	478	478
285	0	0	1	21	139	506	506
290	0	0	1	21	141	535	535
295	0	0	1	21	143	565	565
300	0	0	1	21	145	596	596
305	0	0	1	21	147	628	628
310	0	0	1	21	149	661	661
315	0	0	1	21	151	695	695
320	0	0	1	21	153	730	730
325	0	0	1	21	155	766	766
330	0	0	1	21	157	803	803
335	0	0	1	21	159	841	841
340	0	0	1	21	161	880	880
345	0	0	1	21	163	920	920
350	0	0	1	21	165	961	961
355	0	0	1	21	167	1003	1003
360	0	0	1	21	169	1046	1046
365	0	0	1	21	171	1090	1090
370	0	0	1	21	173	1135	1135
375	0	0	1	21	175	1181	1181
380	0	0	1	21	177	1228	1228
385	0	0	1	21	179	1276	1276
390	0	0	1	21	181	1325	1325
395	0	0	1	21	183	1375	1375
400	0	0	1	21	185	1426	1426
405	0	0	1	21	187	1478	1478
410	0	0	1	21	189	1531	1531
415	0	0	1	21	191	1585	1585
420	0	0	1	21	193	1640	1640
425	0	0	1	21	195	1696	1696
430	0	0	1	21	197	1753	1753
435	0	0	1	21	199	1811	1811
440	0	0	1	21	201	1870	1870
445	0	0	1	21	203	1930	1930
450	0	0	1	21	205	1991	1991
455	0	0	1	21	207	2053	2053
460	0	0	1	21	209	2116	2116
465	0	0	1	21	211	2180	2180
470	0	0	1	21	213	2245	2245
475	0	0	1	21	215	2311	2311
480	0	0	1	21	217	2378	2378
485	0	0	1	21	219	2446	2446
490	0	0	1	21	221	2515	2515
495	0	0	1	21	223	2585	2585
500	0	0	1	21	225	2656	2656
505	0	0	1	21	227	2728	2728
510	0	0	1	21	229	2801	2801
515	0	0	1	21	231	2875	2875
520	0	0	1	21	233	2950	2950
525	0	0	1	21	235	3026	3026
530	0	0	1	21	237	3103	3103
535	0	0	1	21	239	3181	3181
540	0	0	1	21	241	3260	3260
545	0	0	1	21	243	3340	3340
550	0	0	1	21	245	3421	3421
555	0	0	1	21	247	3503	3503
560	0	0	1	21	249	3586	3586
565	0	0	1	21	251	3670	3670
570	0	0	1	21	253	3755	3755
575	0	0	1	21	255	3841	3841
580	0	0	1	21	257	3928	3928
585	0	0	1	21	259	4016	4016
590	0	0	1	21	261	4105	4105
595	0	0	1	21	263	4195	4195
600	0	0	1	21	265	4286	4286
605	0	0	1	21	267	4378	4378
610	0	0	1	21	269	4471	4471
615	0	0	1	21	271	4565	4565
620	0	0	1	21	273	4660	4660
625	0	0	1	21	275	4756	4756
630	0	0	1	21	277	4853	4853
635	0	0	1	21	279	4951	4951
640	0	0	1	21	281	5050	5050
645	0	0	1	21	283	5150	5150
650	0	0	1	21	285	5251	5251
655	0	0	1	21	287	5353	5353
660	0	0	1	21	289	5456	5456
665	0	0	1	21	291	5560	5560
670	0	0	1	21	293	5665	5665
675	0	0	1	21	295	5771	5771
680	0	0	1	21	297	5878	5878
685	0	0	1	21	299	5986	5986
690	0	0	1	21	301	6095	6095
695	0	0	1	21	303	6205	6205
700	0	0	1	21	305	6316	6316
705	0	0	1	21	307	6428	6428
710	0	0	1	21	309	6541	6541
715	0	0	1	21	311	6655	6655
720	0	0	1	21	313	6770	6770
725	0	0	1	21	315	6886	6886
730	0	0	1	21	317	7003	7003
735	0	0	1	21	319	7121	7121
740	0	0	1	21	321	7240	7240
745	0	0	1	21	323	7360	7360
750	0	0	1	21	325	7481	7481
755	0	0	1	21	327	7603	7603
760	0	0	1	21	329	7726	7726
765	0	0	1	21	331	7850	7850
770	0	0	1	21	333	7975	7975
775	0	0	1	21	335	8101	8101
780	0	0	1	21	337	8228	8228
785	0	0	1	21	339	8356	8356
790	0	0	1	21	341	8485	8485
795	0	0	1	21	343	8615	8615
800	0	0	1	21	345	8746	8746
805	0	0	1	21	347	8878	8878
810	0	0	1	21	349	9011	9011
815	0	0	1	21	351	9145	9145
820	0	0	1	21	353	9280	9280
825	0	0	1	21	355	9416	9416
830	0	0	1	21	357	9553	9553
835	0	0	1	21	359	9691	9691
840	0	0	1	21	361	9830	9830
845	0	0	1	21	363	9970	9970
850	0	0	1	21	365	10111	10111
855	0	0	1	21	367	10253	10253
860	0	0	1	21	369	10396	10396
865	0	0	1	21	371	10540	10540
870	0	0	1	21	373	10685	10685
875	0	0	1	21	375	10831	10831
880	0	0	1	21	377	10978	10978
885	0	0	1	21	379	11126	11126
890	0	0	1	21	381	11275	11275
895	0	0	1	21	383	11425	11425
900	0	0	1	21	385	11576	11576
905	0	0	1	21	387	11728	11728
910	0	0	1	21	389	11881	11881
915	0	0	1	21	391	12035	12035
920	0	0	1	21	393	12190	12190
925	0	0	1	21	395	12346	12346
930	0	0	1	21	397	12503	12503
935	0	0	1	21	399	12661	12661
940	0	0	1	21	401	12820	12820
945	0	0	1	21	403	12980	12980
950	0	0	1	21	405	13141	13141
955	0	0	1	21	407	13303	13303
960	0	0	1	21	409	13466	13466
965	0	0	1	21	411	13630	13630
970	0						

VERTICAL STABILIZER DATA

160 KNOTS
0.46359
3.268

80 KNOTS
0.83326
22.263

SECTION COEFFICIENT OF LIFT
ANGLE OF ATTACK TO UNLOAD TAIL ROTOR

RADIUS OF MAIN ROTOR CHORD..... 26.733826
 NUMBER OF MAIN ROTOR BLADES..... 1.600000
 AIRCRAFT TIP VELOCITY..... 0.000000
 ROTOR TIP VELOCITY..... 17585.0703
 HORIZONTAL FLAT PLATE AREA..... 725.978027
 NUMBER OF ENGINES IN HELICOPTER.. 29.308441
 .. 0.000000

MAIN ROTOR HEIGHT ABOVE GROUND... 23.000000
 AIR DENSITY (RHO)..... 0.002197
 SONIC VELOCITY..... 1154.32056
 BLADE GEOMETRIC TWIST..... -0.174533

MAXIMUM 2-D LIFT COEFFICIENT..... 1.250000
 2-D STATIC STALL ANGLE (AMAX)..... 0.1983330
 LIFT CURVE SLOPE (/RAD)..... 6.302530
 ZERO-LIFT DRAG COEFFICIENT..... 0.010000
 CRITICAL MACH NO (FOR CL = 0)..... 0.720000
 COEFFICIENT OF THRUST..... 0.006765
 DISC AREA..... 2245.28784
 SOLIDITY..... 0.076202
 TIP-LOSS FACTOR..... 0.970920
 GROUND EFFECT RATIO..... 0.874897

 FORWARD VELOCITY IN KNOTS = 0.0

 DISK PLANE ANGLE OF ATTACK = 0.0

DYNAMIC PARAMETERS

A11..... 0.0
 A12..... 0.0
 A13..... 0.0
 A14..... 1.000000
 T1..... 0.471343
 T2..... 0.305091
 T3..... 0.222164
 T4..... 0.0
 INFLOW RATIO (LAMBDA)..... -0.058160

STALL PCWER CALCULATIONS

RT..... -0.028292
 INBOARD STALL CORRECTION FACTOR..... 0.0
 STALL PCWER COEFFICIENT..... 0.0

ANGLE OF ATTACK CALCULATIONS

LONGITUDINAL CYCLIC ANGLE(DEG)..... 0.0
 LONGITUDINAL COLLECTIVE ANGLE(DEG)..... 17.720932
 ALPHA(90) (DEG)..... 4.388375
 ALPHA(270) (DEG)..... 4.388375

HIGH SPEED MACH EFFECTS

ADVANCING BLADE TIP MACH NUMBER... 0.628922
 CRITICAL MACH NUMBER..... 0.665450
 DRAG DIVERGENCE MACH NUMBER..... 0.0
 COMPRESSIBILITY POWER COEFF..... 0.0

MAIN FOTOR POWER REQUIRED

INDUCED POWER = 1388.74
 PROFILE POWER = 326.81
 PARASITE POWER = 0.0
 COMPRESSIBILITY POWER = 0.0
 STALL POWER = 0.0

HIGH SPEED EFFECTS = 0.0

 FORWARD VELOCITY IN KNOTS = 140.00

DYNAMIC PARAMETERS

A11..... 0.711244
 A12..... 0.947375
 A13..... 0.689869
 A14..... 1.238236
 T1..... 0.497838
 T2..... 0.356539
 T3..... 0.247140
 T4..... 0.157756
 INFLOW RATIO (LAMBDA)..... -0.053642

STALL PCWER CALCULATIONS

RT..... 0.002215
 INBOARD STALL CORRECTION FACTOR..... 0.5647528
 STALL PCWER COEFFICIENT..... 0.0000402

ANGLE OF ATTACK CALCULATIONS

LONGITUDINAL CYCLIC ANGLE(DEG)..... -7.126393
 LONGITUDINAL COLLECTIVE ANGLE(DEG)..... 18.903610
 ALPHA(90) (DEG)..... -0.541373
 ALPHA(270) (DEG)..... 13.710670

HIGH SPEED MACH EFFECTS

ADVANCING BLADE TIP MACH NUMBER..... 0.833665
 CRITICAL MACH NUMBER..... 0.726730
 DRAG DIVERGENCE MACH NUMBER..... 0.046935
 COMPRESSIBILITY POWER COEFF..... 0.000044

MAIN ROTOR POWER REQUIRED

INDUCED POWER = 247.98
 PROFILE POWER = 475.75
 PARASITE POWER = 772.58
 COMPRESSIBILITY POWER = 149.96
 STALL PCWER = 137.91

HIGH SPEED EFFECTS = 287.86

NOTE THE VELOCITY THAT HAS THE STALL ANGLE LESS THAN OR EQUAL TO 12.5 DEGREES

VELOCITY (KNOTS)	ANGLE (DEG)
126.94	12.1
127.94	12.2
128.94	12.3
129.94	12.4
130.94	12.6
131.94	12.7
132.94	12.8
133.94	12.9

TOTAL POWER FOR THE AIRCRAFT TO HOVER IS = 1829.48

TOTAL ROTOR POWER PROFILE

AIR SPEED (KNOTS)	INDUCED (SHP)	PROFILE (SHP)	PARASITE (SHP)	COMP (SHP)	TOTAL (SHP)
0	0	397	0	0	1828
5	59	397	0	0	1765
10	52	399	0	0	1599
15	48	401	1	0	1496
20	26	403	2	0	1300
30	57	405	4	0	1221
35	84	408	8	0	1156
40	83	412	13	0	1107
45	50	416	19	0	1067
50	51	420	28	0	1040
55	51	425	38	0	1023
60	54	431	55	0	1016
65	54	437	83	0	1016
70	56	443	108	0	1024
75	67	450	155	0	1091
80	75	457	221	0	1281
85	75	463	264	0	1411
90	81	473	340	0	1501
95	88	482	425	0	1601
100	90	491	505	0	1708
105	90	501	555	0	1822
110	90	511	625	0	1942
115	90	523	699	0	2172
120	90	544	743	0	2356
130	90	556	828	0	2723
140	90	569	936	0	3057
150	90	595	1028	0	3287
160	90	623	1157	0	3418
170	90	653	1227	0	3612
180	90	669	1279	0	3612
190	90	686	1304	0	3612
200	90	702	1319	0	3612
210	90	719	1320	0	3612
220	90	737	1320	0	3612
230	90	753	1320	0	3612
240	90	771	1320	0	3612
250	90	789	1320	0	3612
260	90	806	1320	0	3612
270	90	823	1320	0	3612
280	90	837	1320	0	3612
290	90	851	1320	0	3612
300	90	865	1320	0	3612
310	90	879	1320	0	3612
320	90	893	1320	0	3612
330	90	907	1320	0	3612
340	90	921	1320	0	3612
350	90	935	1320	0	3612
360	90	949	1320	0	3612
370	90	963	1320	0	3612
380	90	977	1320	0	3612
390	90	991	1320	0	3612
400	90	1005	1320	0	3612
410	90	1019	1320	0	3612
420	90	1033	1320	0	3612
430	90	1047	1320	0	3612
440	90	1061	1320	0	3612
450	90	1075	1320	0	3612
460	90	1089	1320	0	3612
470	90	1103	1320	0	3612
480	90	1117	1320	0	3612
490	90	1131	1320	0	3612
500	90	1145	1320	0	3612
510	90	1159	1320	0	3612
520	90	1173	1320	0	3612
530	90	1187	1320	0	3612
540	90	1201	1320	0	3612
550	90	1215	1320	0	3612
560	90	1229	1320	0	3612
570	90	1243	1320	0	3612
580	90	1257	1320	0	3612
590	90	1271	1320	0	3612
600	90	1285	1320	0	3612
610	90	1299	1320	0	3612
620	90	1313	1320	0	3612
630	90	1327	1320	0	3612
640	90	1341	1320	0	3612
650	90	1355	1320	0	3612
660	90	1369	1320	0	3612
670	90	1383	1320	0	3612
680	90	1397	1320	0	3612
690	90	1411	1320	0	3612
700	90	1425	1320	0	3612
710	90	1439	1320	0	3612
720	90	1453	1320	0	3612
730	90	1467	1320	0	3612
740	90	1481	1320	0	3612
750	90	1495	1320	0	3612
760	90	1509	1320	0	3612
770	90	1523	1320	0	3612
780	90	1537	1320	0	3612
790	90	1551	1320	0	3612
800	90	1565	1320	0	3612
810	90	1579	1320	0	3612
820	90	1593	1320	0	3612
830	90	1607	1320	0	3612
840	90	1621	1320	0	3612
850	90	1635	1320	0	3612
860	90	1649	1320	0	3612
870	90	1663	1320	0	3612
880	90	1677	1320	0	3612
890	90	1691	1320	0	3612
900	90	1705	1320	0	3612
910	90	1719	1320	0	3612
920	90	1733	1320	0	3612
930	90	1747	1320	0	3612
940	90	1761	1320	0	3612
950	90	1775	1320	0	3612
960	90	1789	1320	0	3612
970	90	1803	1320	0	3612
980	90	1817	1320	0	3612
990	90	1831	1320	0	3612
1000	90	1845	1320	0	3612

AIR SPEED (KNOTS)	AT SPECIFICATION	TOTAL ROTOR ALTITUDE POWER PROFILE AND TEMPERATURE	INDUCED (SHP)	PROFILE (SHP)	PARASITE (SHP)	COMP (SHP)	TOTAL (SHP)
0	1451	367	0	0	0	0	1858
5	1429	368	0	0	0	0	1797
10	1356	369	0	0	0	0	1726
15	1256	370	0	0	0	0	1634
20	1155	372	0	0	0	0	1532
25	1046	375	0	0	0	0	1428
30	948	377	0	0	0	0	1332
35	848	381	0	0	0	0	1277
40	797	384	0	0	0	0	1211
45	767	388	0	0	0	0	1178
50	697	393	0	0	0	0	1107
55	638	398	0	0	0	0	1046
60	587	403	0	0	0	0	1024
65	543	409	0	0	0	0	1012
70	502	416	0	0	0	0	1007
75	472	422	0	0	0	0	1010
80	448	437	0	0	0	0	1021
85	418	445	0	0	0	0	1038
90	395	454	0	0	0	0	1062
95	357	463	0	0	0	0	1094
100	341	472	0	0	0	0	1148
105	326	482	0	0	0	0	1210
110	311	492	0	0	0	0	1278
115	291	503	0	0	0	0	1353
120	281	514	0	0	0	0	1435
125	267	525	0	0	0	0	1525
130	247	537	0	0	0	0	1621
135	226	550	0	0	0	0	1863
140	205	563	0	0	0	0	2046
145	184	576	0	0	0	0	2235
150	164	590	0	0	0	0	2482
155	145	604	0	0	0	0	2753
160	126	618	0	0	0	0	3055
165	107	634	0	0	0	0	3394
170	90	649	0	0	0	0	3753
175	75	665	0	0	0	0	4146
180	60	681	0	0	0	0	4573
185	46	697	0	0	0	0	5039
190	32	713	0	0	0	0	5547
		729	0	0	0	0	6099
		745	0	0	0	0	6686
		761	0	0	0	0	7311
		777	0	0	0	0	7975
		793	0	0	0	0	8679
		809	0	0	0	0	9425
		825	0	0	0	0	10215
		841	0	0	0	0	11051
		857	0	0	0	0	11945
		873	0	0	0	0	12899
		889	0	0	0	0	13925
		905	0	0	0	0	15025
		921	0	0	0	0	16201
		937	0	0	0	0	17455
		953	0	0	0	0	18791
		969	0	0	0	0	20211
		985	0	0	0	0	21719
		1001	0	0	0	0	23319
		1017	0	0	0	0	25015
		1033	0	0	0	0	26811
		1049	0	0	0	0	28711
		1065	0	0	0	0	30711
		1081	0	0	0	0	32811
		1097	0	0	0	0	35011
		1113	0	0	0	0	37311
		1129	0	0	0	0	39711
		1145	0	0	0	0	42211
		1161	0	0	0	0	44811
		1177	0	0	0	0	47511
		1193	0	0	0	0	50311
		1209	0	0	0	0	53211
		1225	0	0	0	0	56211
		1241	0	0	0	0	59311
		1257	0	0	0	0	62511
		1273	0	0	0	0	65811
		1289	0	0	0	0	69211
		1305	0	0	0	0	72711
		1321	0	0	0	0	76311
		1337	0	0	0	0	80011
		1353	0	0	0	0	83811
		1369	0	0	0	0	87711
		1385	0	0	0	0	91711
		1401	0	0	0	0	95811
		1417	0	0	0	0	100011
		1433	0	0	0	0	104311
		1449	0	0	0	0	108711
		1465	0	0	0	0	113211
		1481	0	0	0	0	117811
		1497	0	0	0	0	122511
		1513	0	0	0	0	127311
		1529	0	0	0	0	132211
		1545	0	0	0	0	137211
		1561	0	0	0	0	142311
		1577	0	0	0	0	147511
		1593	0	0	0	0	152811
		1609	0	0	0	0	158211
		1625	0	0	0	0	163711
		1641	0	0	0	0	169311
		1657	0	0	0	0	175011
		1673	0	0	0	0	180811
		1689	0	0	0	0	186611
		1705	0	0	0	0	192511
		1721	0	0	0	0	198511
		1737	0	0	0	0	204611
		1753	0	0	0	0	210811
		1769	0	0	0	0	217111
		1785	0	0	0	0	223511
		1801	0	0	0	0	230011
		1817	0	0	0	0	236611
		1833	0	0	0	0	243311
		1849	0	0	0	0	250111
		1865	0	0	0	0	257011
		1881	0	0	0	0	264011
		1897	0	0	0	0	271111
		1913	0	0	0	0	278311
		1929	0	0	0	0	285611
		1945	0	0	0	0	293011
		1961	0	0	0	0	300511
		1977	0	0	0	0	308111
		1993	0	0	0	0	315811
		2009	0	0	0	0	323611
		2025	0	0	0	0	331411
		2041	0	0	0	0	339411

THE REQUIRED SHAFT HORSEPOWER IS = 3013.56

FOR 2 ENGINE(S), THE REQUIRED SHAFT HORSEPOWER IS= 3415.32

	ENGINE SELECTION CRITERIA					
	A	B	C	D	E	F
POWERPLANT WEIGHT(LB):	158.0	288.0	423.0	709.0	580.0	750.0
LIFE-CYCLE COST(\$10M):	3.00	5.97	10.95	14.50	18.13	25.39
ENGINE LIFE(HRS):	600.0	750.0	800.0	800.0	1000.0	750.0
NUMBER OF REPLACEMENTS:	4.0	3.0	3.0	3.0	2.0	3.0
REPLACEMENT COST(\$K):	0.0	0.0	0.0	0.0	0.0	0.0
INITIAL MAINT COST(\$K):	93.0	100.0	580.0	360.0	640.0	700.0
YEAR OPERATE COST(\$K):	7.50	15.00	30.00	37.50	48.00	66.00
REPLACEMENT COST(\$K):	2.40	14.80	6.00	10.50	12.00	18.00
SALVAGE VALUE(\$K):	125.55	135.00	783.00	486.00	864.00	945.00
AVAILABILITY(ENG):	74.40	80.00	464.00	288.00	512.00	560.00
RELIABILITY(ENG):	0.8333	0.8333	0.8000	0.6977	0.6667	0.5738
AVAILABILITY(ENG):	0.9892	0.9905	0.9903	0.9930	0.9929	0.9938
MAINTAINABILITY(SHP-MIL):	0.350	0.300	0.250	0.650	1.000	1.300
PERFORMANCE	420.0	708.0	1561.0	1800.0	2500.0	3400.0

ENGINE SELECTION CRITERIA

	ENGINE SELECTION CRITERIA					
	A	B	C	D	E	F
POWERPLANT WEIGHT(LB):	316.0	576.0	846.0	1418.0	1160.0	1500.0
LIFE-CYCLE COST(\$10M):	6.00	11.93	21.91	28.99	36.27	50.77
ENGINE LIFE(HRS):	600.0	750.0	800.0	800.0	1000.0	750.0
NUMBER OF REPLACEMENTS:	8.0	6.0	5.0	5.0	4.0	6.0
REPLACEMENT COST(\$K):	0.0	0.0	0.0	0.0	0.0	0.0
INITIAL MAINT COST(\$K):	186.0	200.0	1160.0	720.0	1280.0	1400.0
YEAR OPERATE COST(\$K):	15.00	30.00	60.00	75.00	96.00	132.00
REPLACEMENT COST(\$K):	4.80	9.60	12.00	21.00	24.00	36.00
SALVAGE VALUE(\$K):	251.10	270.00	1566.00	576.00	1728.00	1890.00
AVAILABILITY(ENG):	148.80	160.00	928.00	576.00	1024.00	1120.00
RELIABILITY(ENG):	0.8333	0.8333	0.8000	0.6977	0.6667	0.5738
AVAILABILITY(ENG):	0.9892	0.9905	0.9903	0.9930	0.9929	0.9938
MAINTAINABILITY(SHP-MIL):	0.350	0.300	0.250	0.650	1.000	1.300
PERFORMANCE	840.0	1416.0	3122.0	3600.0	5000.0	6800.0

THE REQUIRED SHAFT HORSEPOWER IS = 3415.32

OLD GROSS WEIGHT = 17585.07
 NEW GROSS WEIGHT = 18409.23

----- FUEL FLOW RATES -----
 MILITARY POWER 2142.00 NORMAL POWER 1854.36 CRUISE POWER 1517.66

TEMPERATURE (R) = 504.423
 PRESSURE (PSF) = 1827.697
 ALPHA AT SPEC ALTITUDE = 624.344
 DELTA AT SPEC ALTITUDE = 0.972
 ZEROC HORSEPOWER INTERCEPT = 0.864
 AT SPEC ALTITUDE = 531.755

THE ZERO HORSEPOWER INCREMENT AT ALTITUDE = 2221.240

THE FUEL WEIGHT IS = 3959.12LBS
 THE DESIGN GROSS WEIGHT IS = 18368.34
 THE ESTIMATED GROSS WEIGHT IS = 17585.07

THE BEST RATE OF CLIMB IS 3800.00 FEET PER MINUTE

THE HOVER CEILING ALTITUDE IS = 12000.00

THE SERVICE CEILING ALTITUDE IS = 21000.00

HELICOPTER DESIGN
AE4306
FINAL SUMMARY

PERFORMANCE

CREW.....	DESIGN	14
INTERNAL LOAD (LBS).....	4500.0	
INTERICE CEILING (FT).....	21000.0	
HOVER IGE (FT).....	12000.0	
VELOCITY (KTS).....	170.0	
MAXIMUM RANGE.....	196.0	
MAX ENDURANCE.....	170.0	
MAX RANGE.....	170.0	
RETRATING BLADE STALL.....	130.0	
MAXIMUM RANGE OF CLIMB (FT/MIN).....	250.0	
ENGINE - TYPE.....	3800.0	2
SHP (SSL) MILITARY.....	3600.0	D

SPECIFICATION

3750.0
17500.0
135.0
160.0
250.0
2500.0

GEOMETRY

WEIGHT (LBS) - MAX GROSS.....	18368.3
EMPTY.....	9095.5
FUEL CAPACITY (GAL) - INTERNAL.....	609.1
EXTERNAL.....	0.0
MAIN ROTOR - CHORD (FT).....	1.60
RADIUS (FT).....	26.73
NUMBER OF BLADES.....	4
DRAW COEFFICIENT.....	0.0100
ROTATIONAL VELOCITY.....	27.16
SOLIDITY.....	0.076202
TAIL ROTOR - CHORD (FT).....	0.91
RADIUS (FT).....	5.45
NUMBER OF BLADES.....	4
DRAW COEFFICIENT.....	0.0138
ROTATIONAL VELOCITY.....	122.20
SOLIDITY.....	0.212207
VERTICAL TAIL AREA (FT).....	55.43
FUSELAGE LENGTH (FT).....	50.10
EQUIVALENT FLAT PLAGE AREA (FT).....	29.31
FORWARD VERTICAL.....	58.62
18000.0	
29.00	
56.00	

COST ANALYSIS PER VEHICLE (IN DOLLARS FOR 100 A/C RUN)

ROTOR	207647.31
TAIL:	11561.87
STRUCTURE	20104.41
BODY	182568.06
LANDING GEAR	119506.94
NACELLE	34988.90
PROPULSION:	1281599.00
ENGINE	121739.87
DRIVE	160159.44
FUEL TANKS	109443.50
FLIGHT CCNTFOLS	54357.60
AUXILLARY PCWER	15419.93
INSTRUMENTS	8067.89
HYDRAULICAL	68819.69
ELECTRICAL	52901.66
AVIONICS	35208.07
FURNISHINGS	21086.03
AIR AND ICE	20675.80
LOAD AND HANDLING	
TOTAL CCST PER VEHICLE	= 2525889.00

APPENDIX C

TABLE III

AH-64 Data

<u>Parameter</u>	<u>Value</u>	
Main rotor radius	24.0	feet
Tail rotor radius	4.6	feet
Number of main rotor blades	4	
Number of tail rotor blades	4	
Height of the main rotor system	12.6	feet
Speed of the main rotor	30.3	rads/sec
Speed of the tail rotor	147.0	rads/sec
Chord of the main rotor	1.75	feet
Chord of the tail rotor	0.83	feet
Span of the main rotor	18.8	feet
Span of the tail rotor	3.1	feet
Twist of the main rotor blade	-9.0	degrees
Twist of the tail rotor blade	-8.8	degrees
Profile drag of the main rotor blade	0.009	
Profile drag of the tail rotor blade	0.009	
Disc loading of the main rotor system	8.1	
Width of the fuselage	3.96	feet
Length of the fuselage	49.1	feet
Frontal equivalent flat plate area	34.7	sq ft
Vertical equivalent flat plate area	45.8	sq ft
Maximum forward velocity	154	knots
Maximum range	246	nmi
Rate of climb	2490	ft/min
Hover ceiling (IGE)	14,200	feet
Hover ceiling (OGE)	11,000	feet
Length of the tail	29.7	feet
Operating weight	11,010	pounds
Load weight	2,020	pounds
Fuel weight	1,620	pounds
Maximum gross weight	14,650	pounds

TABLE IV

OH-6A Data

<u>Parameter</u>	<u>Value</u>	
Main rotor radius	16.3	feet
Tail rotor radius	4.3	feet
Number of main rotor blades	4	
Number of tail rotor blades	2	
Height of the main rotor system	7.0	feet
Speed of the main rotor	49.2	rads/sec
Speed of the tail rotor	315.0	rads/sec
Chord of the main rotor	0.57	feet
Chord of the tail rotor	0.40	feet
Span of the main rotor	11.5	feet
Span of the tail rotor	1.4	feet
Twist of the main rotor blade	-9.0	degrees
Twist of the tail rotor blade	-8.0	degrees
Profile drag of the main rotor blade	0.009	
Profile drag of the tail rotor blade	0.009	
Disc loading of the main rotor system	8.1	
Width of the fuselage	4.57	feet
Length of the fuselage	23.0	feet
Frontal equivalent flat plate area	5.0	sq ft
Vertical equivalent flat plate area	10.8	sq ft
Maximum forward velocity	116	knots
Maximum range	330	nmi
Rate of climb	500	ft/min
Hover ceiling (IGE)	7,100	feet
Hover ceiling (OGE)	4,200	feet
Length of the tail	15.2	feet
Operating weight	1,160	pounds
Load weight	960	pounds
Fuel weight	400	pounds
Maximum gross weight	2,520	pounds

TABLE V

SH-3H Data

<u>Parameter</u>	<u>Value</u>	
Main rotor radius	31.0	feet
Tail rotor radius	5.3	feet
Number of main rotor blades	5	
Number of tail rotor blades	5	
Height of the main rotor system	14.3	feet
Speed of the main rotor	21.3	rads/sec
Speed of the tail rotor	130.0	rads/sec
Chord of the main rotor	1.52	feet
Chord of the tail rotor	0.61	feet
Span of the main rotor	29.3	feet
Span of the tail rotor	4.0	feet
Twist of the main rotor blade	-8.0	degrees
Twist of the tail rotor blade	0.0	degrees
Profile drag of the main rotor blade	0.0095	
Profile drag of the tail rotor blade	0.0105	
Disc loading of the main rotor system	6.96	
Width of the fuselage	7.08	feet
Length of the fuselage	31.3	feet
Frontal equivalent flat plate area	31.3	sq ft
Vertical equivalent flat plate area	36.0	sq ft
Maximum forward velocity	120	knots
Maximum range	505	nmi
Rate of climb	500	ft/min
Hover ceiling (IGE)	3,700	feet
Hover ceiling (OGE)	4,000	feet
Length of the tail	36.6	feet
Operating weight	13,600	pounds
Load weight	1,760	pounds
Fuel weight	5,640	pounds
Maximum gross weight	21,000	pounds

TABLE VI

S-76 Data

<u>Parameter</u>	<u>Value</u>	
Main rotor radius	22.0	feet
Tail rotor radius	4.0	feet
Number of main rotor blades	4	
Number of tail rotor blades	4	
Height of the main rotor system	10.0	feet
Speed of the main rotor	30.7	rads/sec
Speed of the tail rotor	168.0	rads/sec
Chord of the main rotor	1.29	feet
Chord of the tail rotor	0.54	feet
Span of the main rotor	17.0	feet
Span of the tail rotor	3.3	feet
Twist of the main rotor blade	-10.0	degrees
Twist of the tail rotor blade	-8.0	degrees
Profile drag of the main rotor blade	0.009	
Profile drag of the tail rotor blade	0.015	
Disc loading of the main rotor system	8.1	
Width of the fuselage	7.00	feet
Length of the fuselage	43.4	feet
Frontal equivalent flat plate area	11.6	sq ft
Vertical equivalent flat plate area	30.0	sq ft
Maximum forward velocity	155	knots
Maximum range	404	nmi
Rate of climb	425	ft/min
Hover ceiling (IGE)	6,200	feet
Hover ceiling (OGE)	2,800	feet
Length of the tail	26.5	feet
Operating weight	5,600	pounds
Load weight	2,520	pounds
Fuel weight	1,880	pounds
Maximum gross weight	10,000	pounds

TABLE VII
UH-60A Data

<u>Parameter</u>	<u>Value</u>	
Main rotor radius	26.8	feet
Tail rotor radius	4.0	feet
Number of main rotor blades	4	
Number of tail rotor blades	4	
Height of the main rotor system	11.2	feet
Speed of the main rotor	27.2	rads/sec
Speed of the tail rotor	125.0	rads/sec
Chord of the main rotor	1.75	feet
Chord of the tail rotor	0.81	feet
Span of the main rotor	29.3	feet
Span of the tail rotor	4.25	feet
Twist of the main rotor blade	-18.0	degrees
Twist of the tail rotor blade	-18.0	degrees
Profile drag of the main rotor blade	0.008	
Profile drag of the tail rotor blade	0.008	
Disc loading of the main rotor system	8.95	
Width of the fuselage	7.75	feet
Length of the fuselage	50.1	feet
Frontal equivalent flat plate area	25.7	sq ft
Vertical equivalent flat plate area	30.8	sq ft
Maximum forward velocity	156	knots
Maximum range	275	nmi
Rate of climb	200	ft/min
Hover ceiling (IGE)	7,800	feet
Hover ceiling (OGE)	3,900	feet
Length of the tail	31.5	feet
Operating weight	10,680	pounds
Load weight	7,270	pounds
Fuel weight	2,350	pounds
Maximum gross weight	20,250	pounds

TABLE VIII

CH-54B Data

<u>Parameter</u>	<u>Value</u>	
Main rotor radius	36.0	feet
Tail rotor radius	8.0	feet
Number of main rotor blades	6	
Number of tail rotor blades	4	
Height of the main rotor system	17.6	feet
Speed of the main rotor	19.4	rads/sec
Speed of the tail rotor	66.0	rads/sec
Chord of the main rotor	1.97	feet
Chord of the tail rotor	1.28	feet
Span of the main rotor	29.8	feet
Span of the tail rotor	6.45	feet
Twist of the main rotor blade	-8.0	degrees
Twist of the tail rotor blade	-8.0	degrees
Profile drag of the main rotor blade	0.0095	
Profile drag of the tail rotor blade	0.0105	
Disc loading of the main rotor system	10.3	
Width of the fuselage	7.08	feet
Length of the fuselage	70.2	feet
Frontal equivalent flat plate area	65.0	sq ft
Vertical equivalent flat plate area	99.4	sq ft
Maximum forward velocity	110	knots
Maximum range	200	nmi
Rate of climb	189	ft/min
Hover ceiling (IGE)	6,400	feet
Hover ceiling (OGE)	2,400	feet
Length of the tail	44.5	feet
Operating weight	19,230	pounds
Load weight	14,190	pounds
Fuel weight	8,580	pounds
Maximum gross weight	42,000	pounds

TABLE IX
CH-53D Data

<u>Parameter</u>	<u>Value</u>	
Main rotor radius	36.1	feet
Tail rotor radius	8.0	feet
Number of main rotor blades	6	
Number of tail rotor blades	4	
Height of the main rotor system	15.8	feet
Speed of the main rotor	19.4	rads/sec
Speed of the tail rotor	83.0	rads/sec
Chord of the main rotor	2.17	feet
Chord of the tail rotor	1.28	feet
Span of the main rotor	28.9	feet
Span of the tail rotor	6.45	feet
Twist of the main rotor blade	-6.0	degrees
Twist of the tail rotor blade	-8.0	degrees
Profile drag of the main rotor blade	0.0095	
Profile drag of the tail rotor blade	0.0095	
Disc loading of the main rotor system	10.3	
Width of the fuselage	8.83	feet
Length of the fuselage	67.2	feet
Frontal equivalent flat plate area	47.3	sq ft
Vertical equivalent flat plate area	90.0	sq ft
Maximum forward velocity	164	knots
Maximum range	242	nmi
Rate of climb	625	ft/min
Hover ceiling (IGE)	14,000	feet
Hover ceiling (OGE)	8,000	feet
Length of the tail	44.5	feet
Operating weight	23,630	pounds
Load weight	14,030	pounds
Fuel weight	4,340	pounds
Maximum gross weight	42,000	pounds

TABLE X
CH-53E Data

<u>Parameter</u>	<u>Value</u>	
Main rotor radius	38.5	feet
Tail rotor radius	10.0	feet
Number of main rotor blades	7	
Number of tail rotor blades	4	
Height of the main rotor system	16.0	feet
Speed of the main rotor	18.7	rads/sec
Speed of the tail rotor	73.0	rads/sec
Chord of the main rotor	2.44	feet
Chord of the tail rotor	1.28	feet
Span of the main rotor	28.6	feet
Span of the tail rotor	8.53	feet
Twist of the main rotor blade	-13.6	degrees
Twist of the tail rotor blade	-8.0	degrees
Profile drag of the main rotor blade	0.009	
Profile drag of the tail rotor blade	0.0095	
Disc loading of the main rotor system	15.0	
Width of the fuselage	8.83	feet
Length of the fuselage	99.0	feet
Frontal equivalent flat plate area	120.0	sq ft
Vertical equivalent flat plate area	63.6	sq ft
Maximum forward velocity	146	knots
Maximum range	400	nmi
Rate of climb	325	ft/min
Hover ceiling (IGE)	6,000	feet
Hover ceiling (OGE)	1,400	feet
Length of the tail	48.0	feet
Operating weight	24,790	pounds
Load weight	15,480	pounds
Fuel weight	25,480	pounds
Maximum gross weight	73,500	pounds

HELICOPTER DESIGN

AE 4308/4900

- 1. AH-64
- 2. CH-53A
- 3. OH-6A
- 4. S-70
- 5. UH-60A
- 6. CH-53B
- 7. CH-53D
- 8. CH-54E

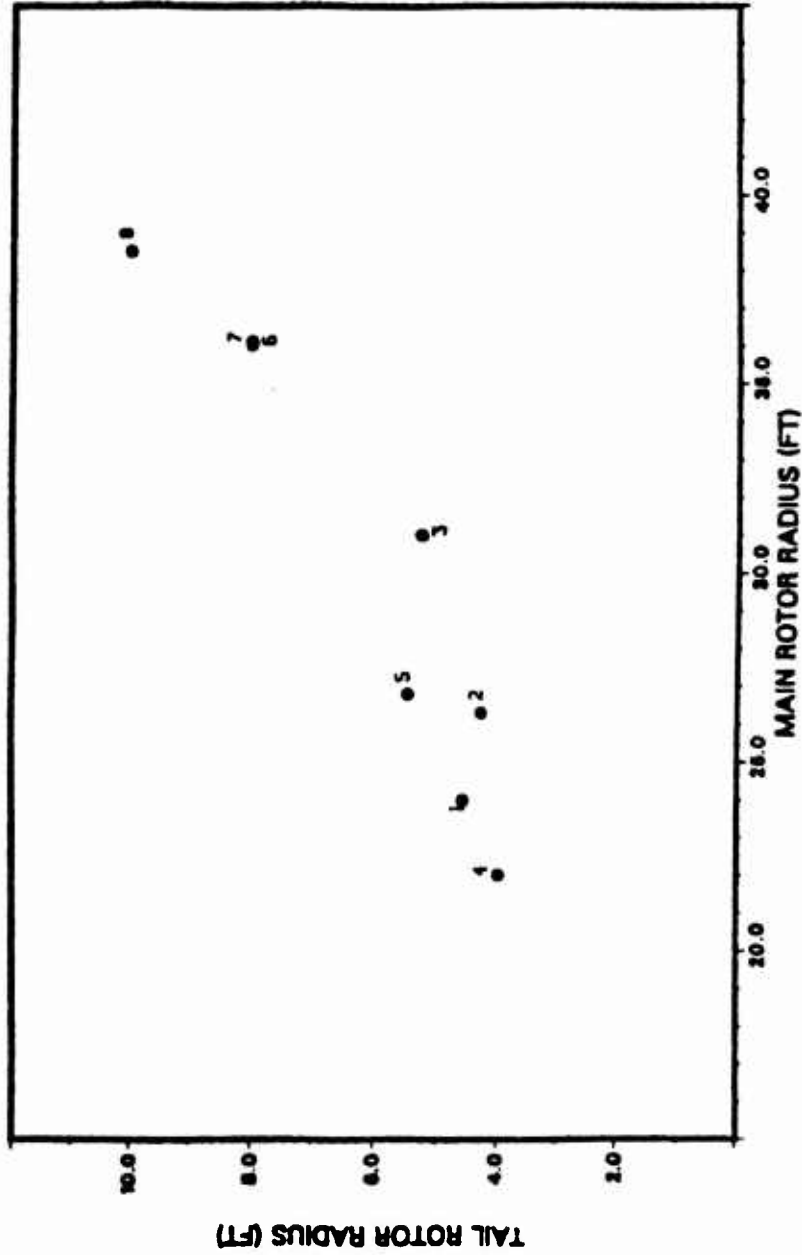


Figure 3.1. X-Y Plot (horizontal page format)

HELICOPTER DESIGN

AE 4308/4800

- | | |
|----------|-----------|
| 1. AH-64 | 8. UH-60A |
| 2. OH-6A | 9. CH-54E |
| 3. SH-60 | 7. CH-53D |
| 4. S-78 | 6. CH-54E |

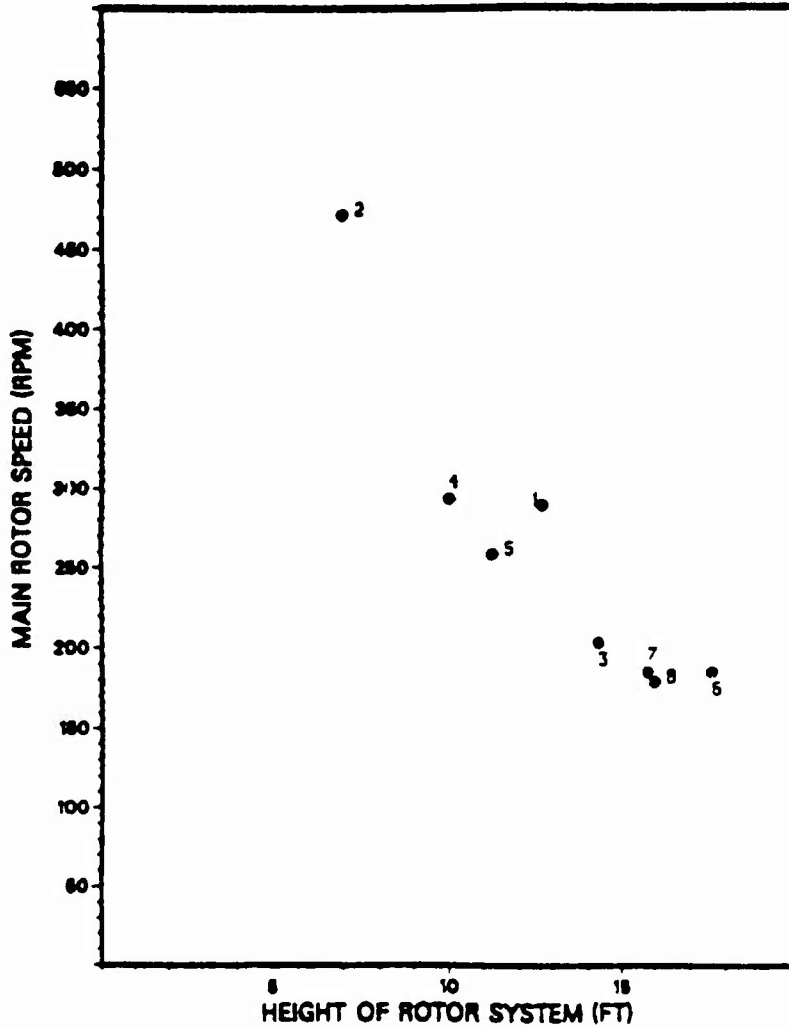


Figure 3.2. X-Y Plot (vertical page format)

HELICOPTER DESIGN

AE 4308/4900

- 1. AH-64
- 2. CH-64
- 3. SH-3H
- 4. S-70
- 5. UH-60A
- 6. CH-540
- 7. CH-530
- 8. CH-54E

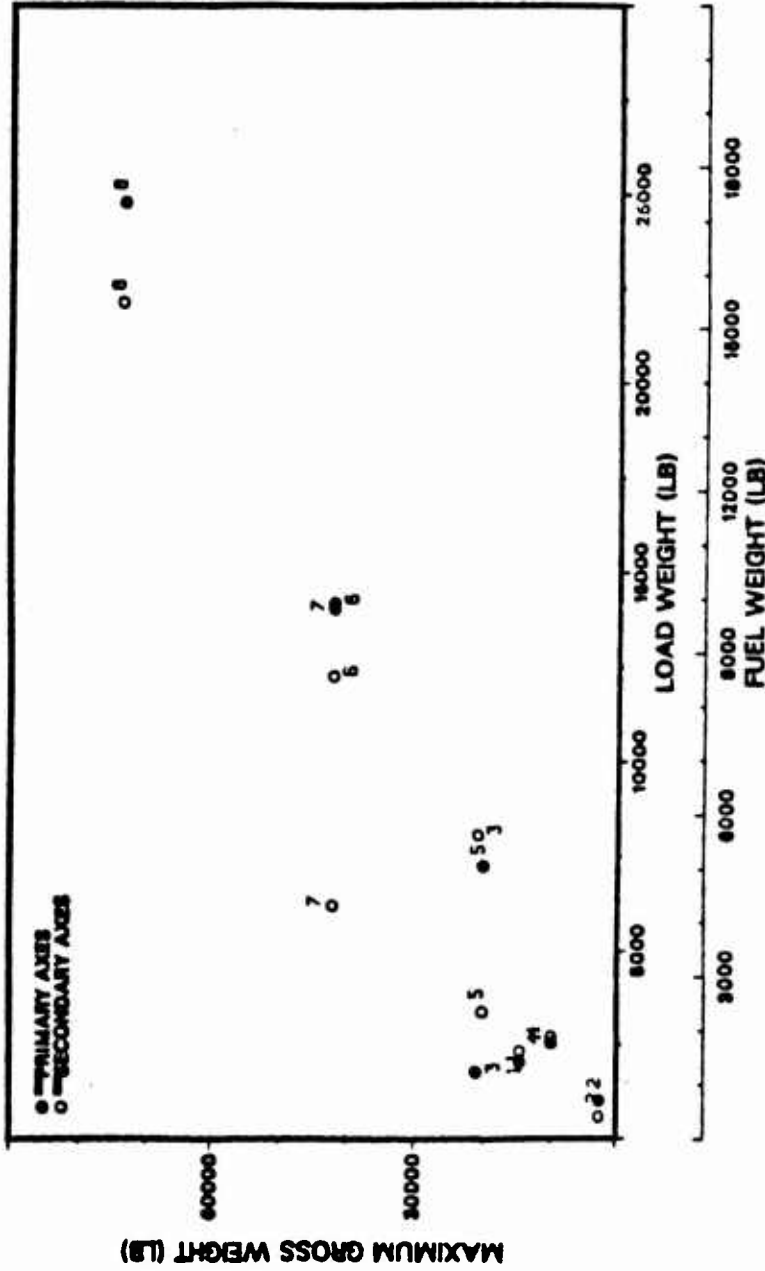


Figure 3.3. Multiple X Axes Plot (horizontal page format)

HELICOPTER DESIGN

AE 4308/4800

- | | |
|----------|-----------|
| 1. AH-64 | 6. UH-60A |
| 2. OH-6A | 8. CH-54B |
| 3. SH-60 | 7. CH-53D |
| 4. S-70 | 9. CH-54E |

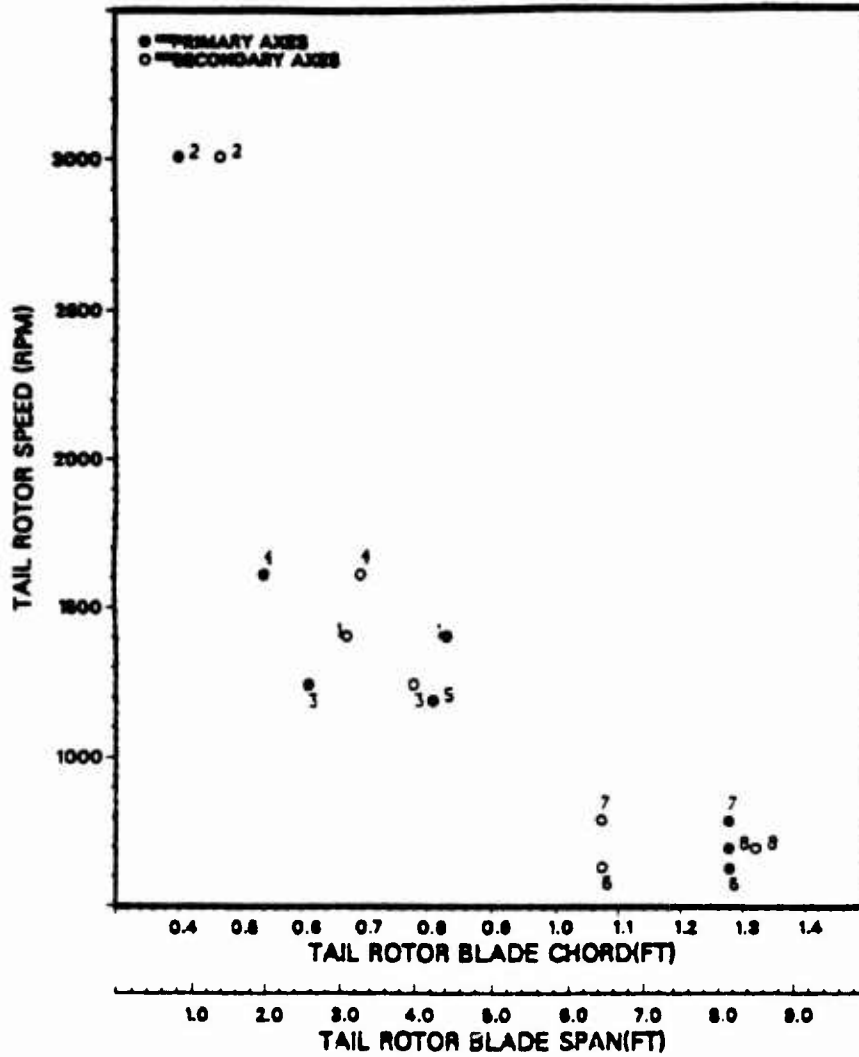


Figure 3.4. Multiple X Axes Plot (vertical page format)

HELICOPTER DESIGN

AE 4306/4900

- 1. AH-64
- 2. CH-53A
- 3. SH-53H
- 4. S-76
- 5. UH-60A
- 6. CH-53B
- 7. CH-53D
- 8. CH-54E

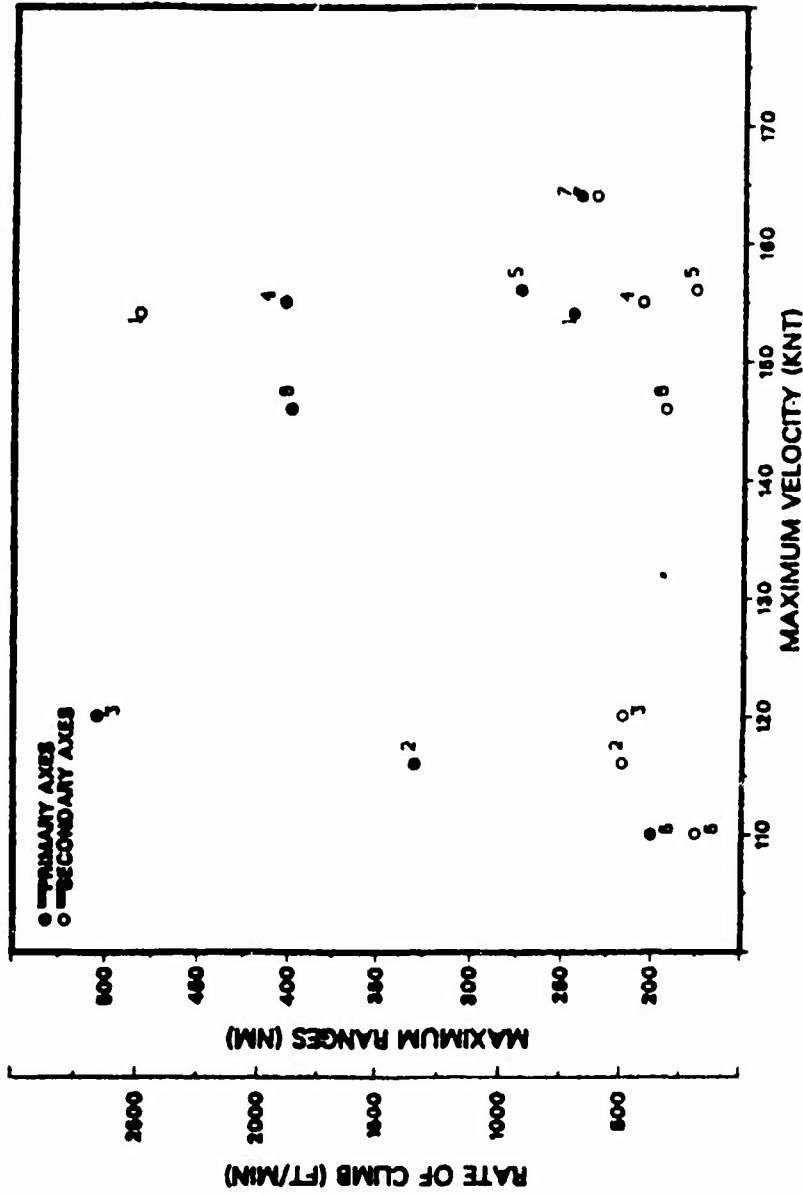


Figure 3.5. Multiple Y Axes Plot (horizontal page format)

HELICOPTER DESIGN

AE 4308/4800

- | | |
|-----------|-----------|
| 1. AH-64 | 5. UH-60A |
| 2. CH-53A | 6. CH-54B |
| 3. BH-3H | 7. CH-53D |
| 4. S-70 | 8. CH-54E |

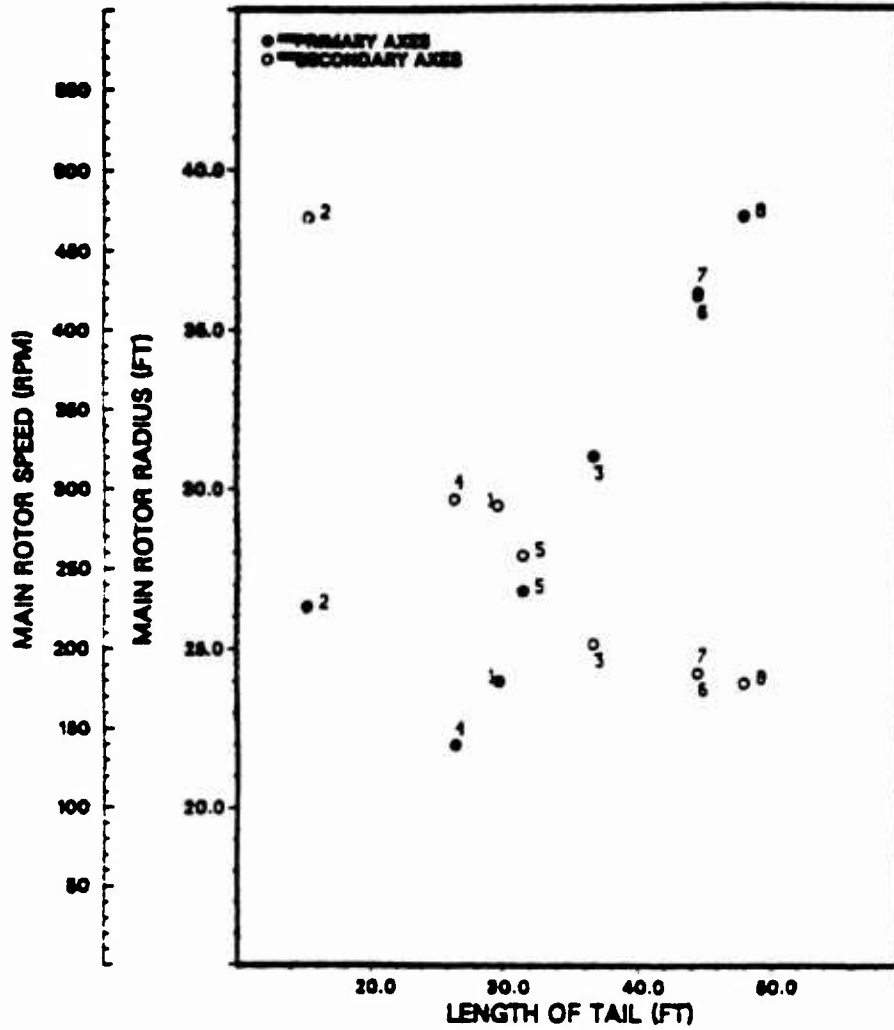


Figure 3.6. Multiple Y Axes Plot (vertical page format)

HELICOPTER DESIGN

AE 4308/4900

- 1. AH-64
- 2. OH-6A
- 3. OH-3H
- 4. S-78
- 5. UN-60A
- 6. CH-54E
- 7. CH-53D
- 8. CH-54E

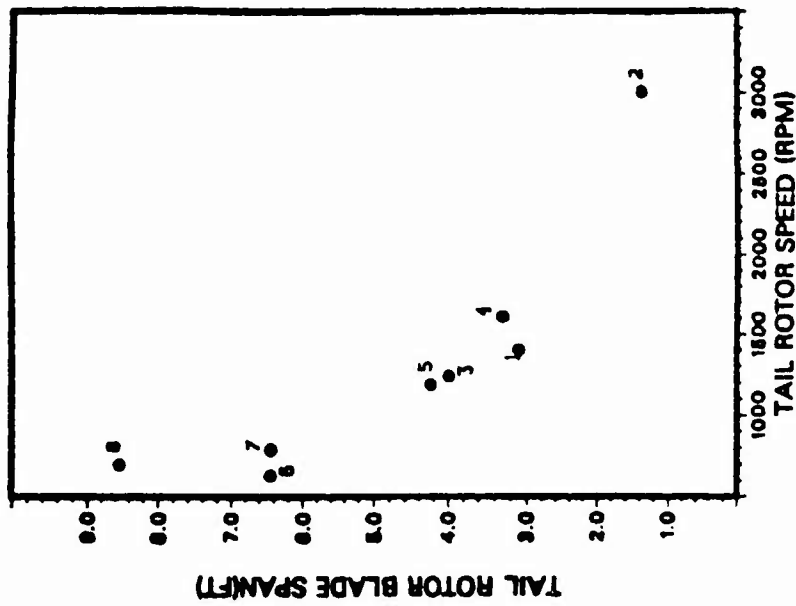
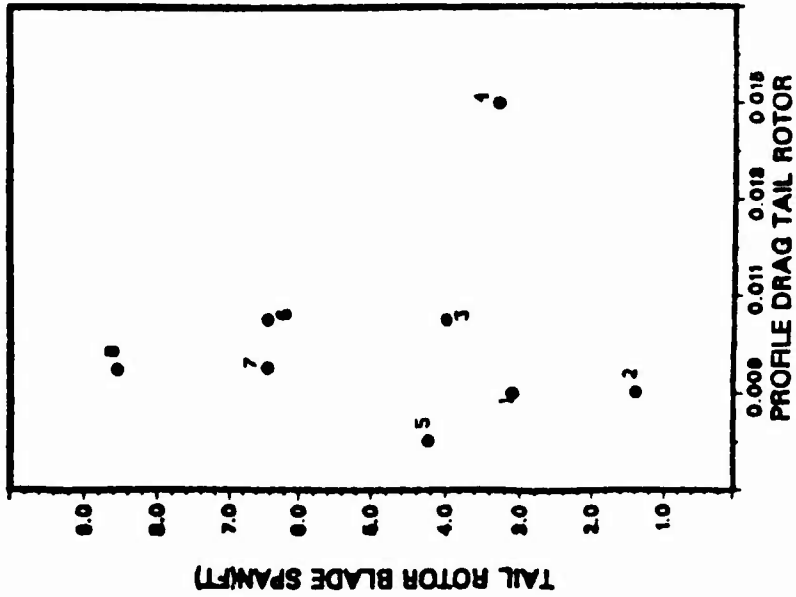


Figure 3.7. Two Plot Option

HELICOPTER DESIGN

AE 4308/4800

- | | |
|----------|-----------|
| 1. AH-64 | 8. UH-60A |
| 2. OH-6A | 9. CH-53E |
| 3. SH-53 | 7. CH-53D |
| 4. S-70 | 6. CH-54E |

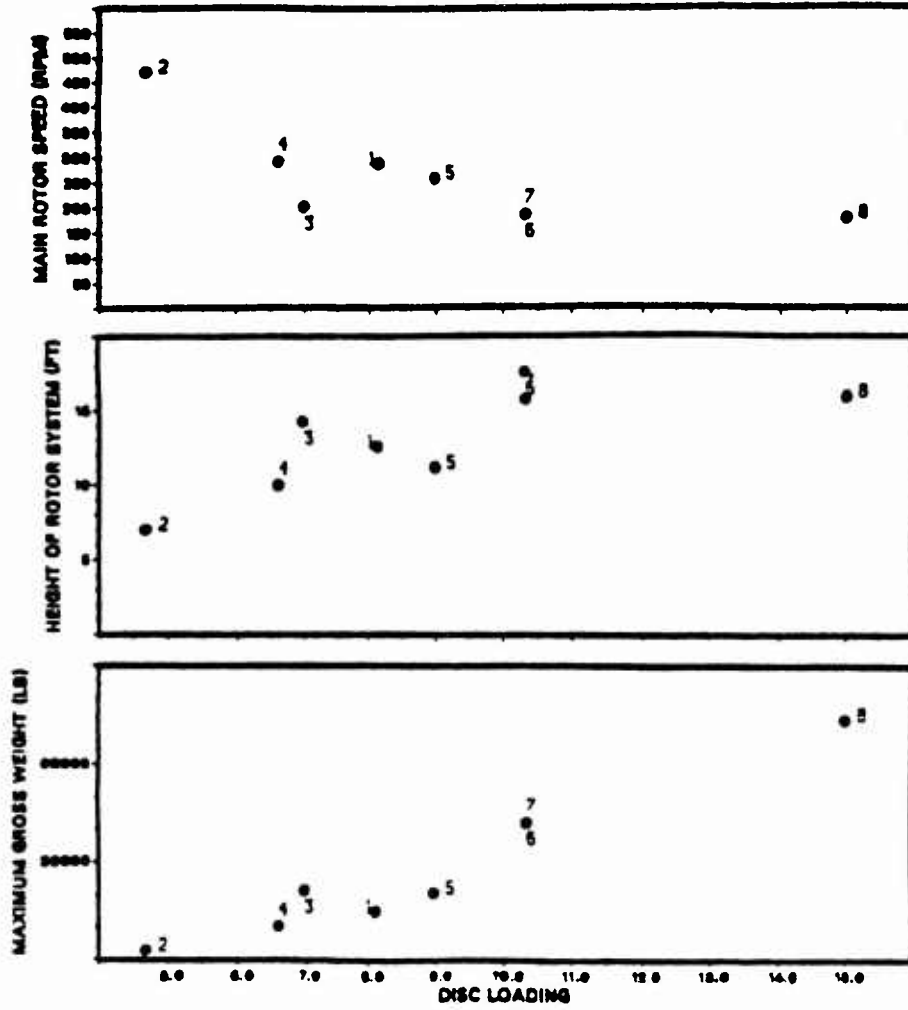


Figure 3.8. Three Plot Option

HELICOPTER DESIGN

AE 4308/4900

- 1. AH-64
- 2. CH-53A
- 3. SH-53A
- 4. B-76
- 5. UH-60A
- 6. CH-54B
- 7. CH-53D
- 8. CH-54E

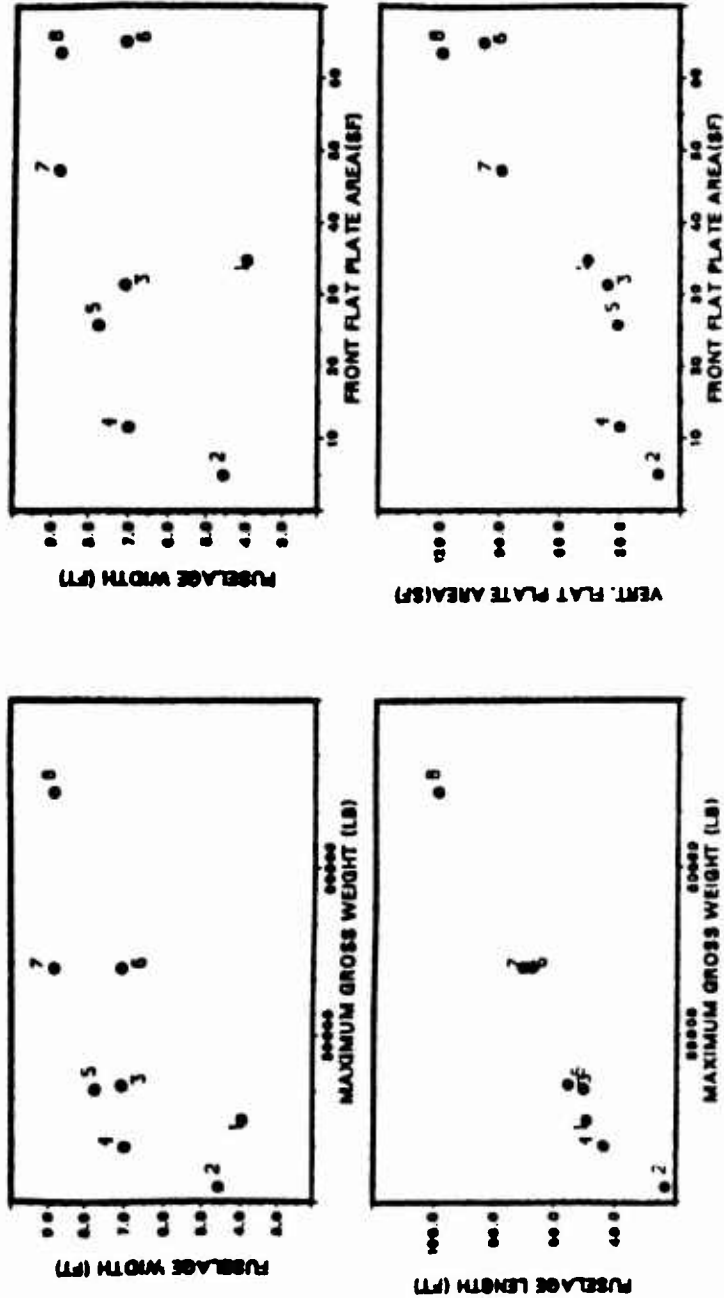


Figure 3.9. Four Plot Option

POWER VS. VELOCITY AT ALTITUDE

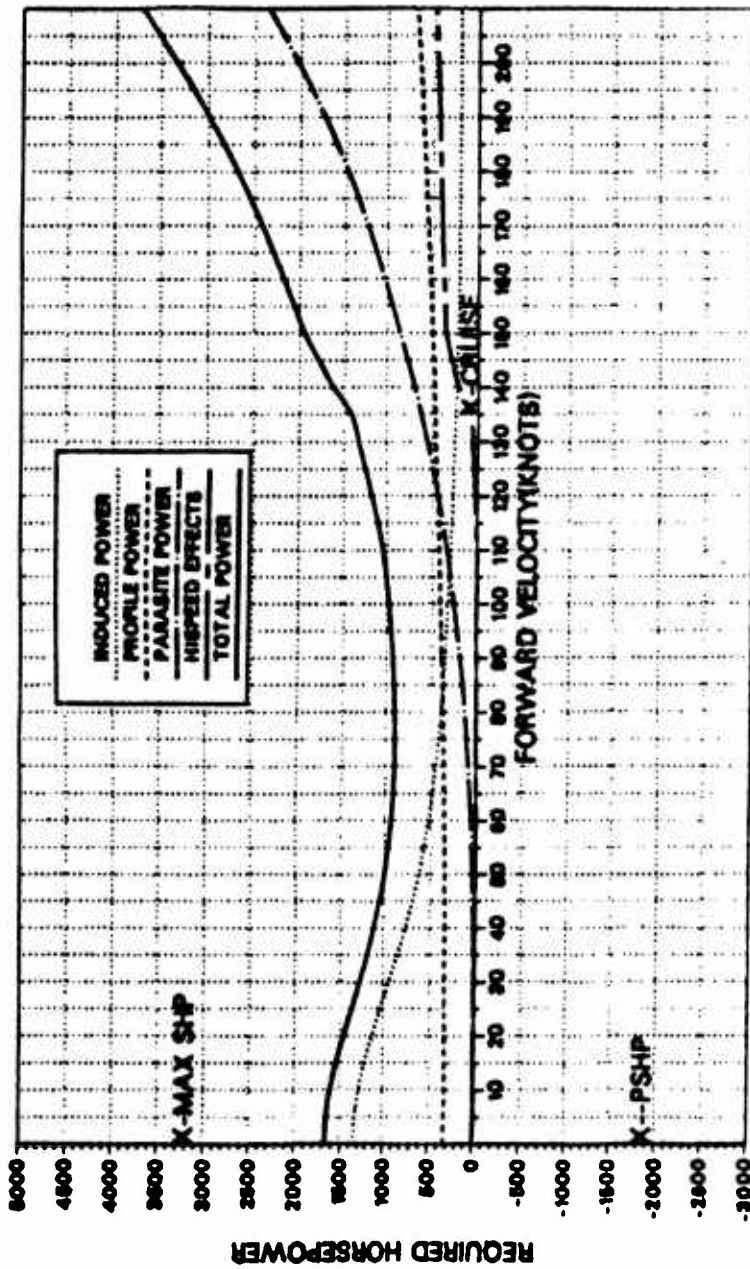


Figure 3.10. Sample Total Power Curve

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