KINETIC ENERGY DMAP FOR MODE IDENTIFICATION

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ABSTRACT

The ability to solve large dynamic finite element problems of high modal density has increased the difficulty of modal identification. As an aid in overcoming this difficulty, the concept of kinetic energy of modes is utilized. With this aid, structural as well as local modes can be quickly isolated. This paper presents the DMAP alter package and examples of how this method was applied to the NASTRAN dynamic analysis of the Hughes Advanced Attack Helicopter.

INTRODUCTION

NASTRAN provides the user with pre-coded programs that can be executed without having to learn the NASTRAN programming language. However, NASTRAN has a unique capability that allows the user to get inside the fixed programs and alter them. This is called altering with a "Direct Matrix Abstraction Program" or DMAP. Few users take advantage of this powerful capability.

With the aid of some recent features in NASTRAN, namely, fast eigenvalue extraction routines, substructuring, and component mode synthesis, the scope of obtaining modal data has changed. We no longer have to use reduction techniques where the model was reduced to a small size with a loss of accuracy and fidelity. Also, we can now divide the model into substructures, obtain the modes, and synthesize them to represent the whole structure economically. However, the ability to solve these larger problems has also increased the task of modal identification. Plotting routines that are available allow us to thoroughly assess the modes; however, they are both costly and time-consuming. The authors believe that the kinetic energy modal identification concept presented in this paper, when coupled with a good plotting routine, represent a viable method for quickly isolating and identifying structural modes.

APPROACH

The concept of kinetic energy based upon modal data was first introduced in a practical application by Mr. R. J. Ruggiero of Rockwell International Space Division, and has received little exposure throughout the industry.

The modal kinetic energy expression is quite simple and is based on certain fundamental orthogonality principles and equations shown in Figure 1. Equations (1) and (2) are based on the use of orthonormal modes. With a special matrix multiply called, element by element, the resultant [KE] matrix in Equation (3) is formed, which is a variation of Equation (1). In this matrix, the rows represent each degree-of-freedom (DOF) of the model, and the columns represent each mode that was calculated. The summation of any one column will be equal to 1.00 or, in other words, the value in any column is the percent of its contribution to the total energy of that mode.

Through the use of DMAP, the procedure necessary to perform the kinetic energy calculation has been added to MSC/NASTRAN as shown in Figure 2. The following is an explanation of the DMAP alter statements.

EXPLANATION OF DMAP PROGRAM[2]

The DMAP is divided into three basic sections. The first section prints the frequency summary table which relates the mode number and frequency. The kinetic energy matrix of Equation (3) is computed and each column is summed to verify it equals unity.

The second section prints the node, direction and value of the maximum kinetic energy contributor for each mode.

In the third section, the kinetic energy matrix is filtered such that only the largest contributors are displayed.

In the First Section:

"OFP" Prints the frequency summary table (LAMA).

"MPYAD" Multiplies the mass matrix times the modal matrix to form "MPHI".

$$[MGG]\,[\phi] = [MPHI]$$

"ADD" Performs the element by element multiply with the modal matrix and "MPHI" to produce "KES", the kinetic energy matrix of Equation (3).

$$[\phi] \overset{E}{\underset{E}{*}} [MGG] [\phi] = [KES]$$

"DIAGONAL" Creates a "G" size column vector "GSIZE" of 1.0's.

"MPYAD" Performs the following matrix multiply

$$[GSIZE]^T [KES] = [CHK]$$

"MATPRN" Prints the resulting row vector "CHK" which contains the sum of each column of "KES", and should be unity.

<u>In the Second Section:</u>

"MATMOD" Forms a column vector "ENERGY", the maximum values from each column of "KES".

"PARAML" Sets the parameter "SIZE" equal to the number of rows of "ENERGY" based on its matrix trailer.

"MATGEN" Creates an identity matrix "IDENT" based on "SIZE" or the number of modes that were calculated.

"MATMOD" Creates a column "COL" of 1.0's from "IDENT".

"TRNSP" Forms a row vector "ROW" of 1.0's from "COL".

"MPYAD" Performs the following matrix multiply

$$[ENERGY] [ROW] = [FULL]$$

where "ENERGY" is duplicated such that its elements are contained on the diagonals of "FULL".

"DIAGONAL" Extracts the diagonal from "FULL" into "SCALE".

"NORM" Normalizes "KES" into "KNORM", where the largest value of each column is equal to 1.0.

"MATMOD" Filters "KNORM" into "FILTI" such that only the maximum values remain.

"MPYAD" Performs the following matrix multiply

$$[FILTI]\ [SCALE] = [MAX]$$

where the matrix "MAX" contains only the maximum value of each column found in "KES".

"MATGPR" Prints from the "G" size definition, the node, direction, and kinetic energy contribution of each column of "MAX".

In the Third Section:

"MATMOD" Filters "KNORM" into "FILT" such that only the maximum values, and values equal to or greater than 1 percent of it remain.

"MPYAD" Performs the following matrix multiply

$$[FILT]\ [SCALE] = [KENG]$$

where "KENG" contains the non-filtered terms scaled back to their original values in "KES".

"MATGPR" Prints from the "G" size definition, the node, direction, and kinetic energy contribution of each column of "KENG".

The procedure can be simply illustrated in the example problem in Figure 3. Let's assume we had 3 degrees-of-freedom and were evaluating modes 1, 2, and 3 in Equation (4). We first construct a diagonal matrix, containing the maximum of each column as shown in Equation (5). Next we normalize each column of Equation (4); i.e., the maximum value is 1.0 as shown. In Equation (7), a filter operation removes any value less than the prescribed value, which in this case is 1 percent. And finally, the filtered matrix is multiplied by the diagonal matrix, Equation (7) times Equation (5), resulting in a matrix which contains data of only the largest energy contributions for that mode.

APPLICATION TO AAH ANALYSIS

The structure used for this paper was the dynamic model of the Hughes Advanced Attack Helicopter (AAH) and is shown in Figure 4. The static model (Figure 5) was developed by the Structures Group and a compatible mass matrix was formed from a FORTRAN lumping program using data supplied by the Mass Properties Group. The model contained 1632 grids, 4357 elements and 9992 DOF.

In order to gain some insight into the quality of the model, i.e., evaluate the first few structural modes and detect any obvious modeling errors, modes and frequencies were calculated from 0 to 10 Hz using Generalized Dynamic Reduction. Table 1 is a frequency summary table of the results. Prior to our use of kinetic energy, modal identification was determined from plots. Considerable time and expense were used in indentifying these modes. For plotting, we use the MCAUTO[1] FASTDRAW/3 interactive graphics post processing program which allows us to plot the mode-shapes in deflected form, or as vectors. Although it is felt that this program is one of the best available, it is time-consuming and expensive to use.

After applying the DMAP alter program, a scan is made of the maximum values matrix shown in Figure 6. These values provide quick-look data for the distribution output. Low values indicate a large distribution of energy and high values local energy. Next a visual scan of the kinetic energy distribution matrix quickly indicated which modes were candidates for major structural modes, and pointed out the local modes which could be assessed as true local modes or potential modeling errors. This information greatly enhanced the analyst's efficienty at the plotter.

The output of the distribution is shown in Figure 7. Columns 1 through 6, represent the 6 rigid body modes of the free-free structure and the quantity of the numbers indicates a distribution of energy over many points, which shows the entire structure is moving. As stated, one outstanding feature of this aid is the ability to quickly select candidates for structural modes. One can see at a glance that modes 15, 21, 24, 30, 40, 42 and possibly 33, 34, 36 and 37 are candidates for structural modes. Another important kinetic energy feature is the ability to give specific information (node and direction) for assessing the non-structural modes which we call "local modes". These modes can be further described as "true" local modes, where the substructure actually vibrates at a low frequency, or as modeling errors, where the structure has not been constrained or properly represented. Examples of this can be seen in Figure 7, where mode 7 indicates over 99 percent of the energy is contained at one point (5702) on the frame at Station 57. Also, this point is a rotation about the Y-axis and could not be seen while plotting. Modes 8 through 10, columns 8 through 10, respectively, also suggest local modeling errors where 86, 80, and 99 percent of the energy are contained at one point. Columns 19 and 22, with a few numbers, turned out to be corresponding local engine modes on each side of the fuselage.

Table 2 shows a summary table of the fundamental structural modes that were identified using the kinetic energy data. Figures 8 to 16 show the corresponding plots of these modes.

Mode 15, the first torsional mode, is shown in Figure 8 in a segmented view looking aft. Figure 9 shows mode 17 which is the first symmetric wing bending mode. This mode is being driven by the inboard pylons which are out of phase. For this case, the inboard pylons carry stores whereas the outboard pylons are unloaded. Local engine modes 19 and 22 are shown in Figures 10 and 11. Figure 12 shows mode 23 which is the first antisymmetric wing bending mode. Note that the inboard pylons are in phase this time. Next, Figure 13 shows mode 24, the first vertical bending mode. Figure 14 shows mode 36, the first wing/pylon antisymmetric torsional mode where the pylons are out of phase. Figure 15 shows mode 37, the first wing/pylon symmetric torsional mode with the pylons in phase. And finally Figure 16 shows mode 42, the first lateral bending mode.

CONCLUSIONS

The solution of large eigenvalue problems has enabled us to gain more detailed information about a structure than ever before. But the task of modal identification has also grown.

With the use of the kinetic energy method, candidates for structural as well as local modes can be easily identified, resulting in a tremendous saving of time.

The cost for performing the kinetic energy calculation is minimal when compared with the cost of plotting each mode. Anyone who has ever been involved with the task of identifying a set of modes without the aid of a good plotting routine or other aids can fully appreciate a method such as this.

And finally, it would certainly be nice to have a "KE" module in MSC/NASTRAN of the following form:

```
KE    GPL,EQEXIN,USET,LAMA,UGV,MGG//C,N,NTERMS/C,N,FILTER $
```

which would give the user the option of ranking the kinetic energy and selecting the number of terms per mode or to filter on the percentage. A typical "NTERMS" printed output would be as shown in Figure 17.

ACKNOWLEDGEMENT

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REFERENCES

1. MCAUTO FASTDRAW/3 Interactive Post-Processing Manual, McDonnell Douglas Automation Company.

2. NASTRAN Users and Programmers Manuals, MacNeal-Schwendler Corporation.

ORTHOGONALITY PRINCIPLE

(1) $\underset{42 \times 10000}{[\phi]^T} \; \underset{10000^2}{[M]} \; \underset{10000 \times 42}{[\phi]} = \underset{42 \times 42}{\lceil I \rfloor}$ GENERALIZED MASS

(2) $\underset{42 \times 10000}{[\phi]^T} \; \underset{10000^2}{[K]} \; \underset{10000 \times 42}{[\phi]} = \underset{42 \times 42}{\lceil \omega^2 \rfloor}$ GENERALIZED STIFFNESS

WHERE:

$[M]$ = MASS MATRIX (10000 DOF)
$[K]$ = STIFFNESS MATRIX (10000 DOF)
$[\phi]$ = ORTHONORMAL MODES (42 MODES)
$\lceil I \rfloor$ = IDENTIFY MATRIX (42 ORDER)
$\lceil \omega^2 \rfloor$ = EIGENVALUES (42 ORDER)

MODAL KINETIC ENERGY

(3) $\underset{10000 \times 42}{[\phi]^{E}_{*E}} \; \underset{10000^2}{[M]} \; \underset{10000 \times 42}{[\phi]} = \text{DOF} \overset{\text{MODES}}{\underset{10000 \times 42}{[KE]}}$

KINETIC ENERGY, [KE], IS DEFINED AS THE CONTRIBUTION OF EACH DEGREE-OF-FREEDOM (DOF) TO A GENERALIZED MASS OF UNITY.

820019-7

Figure 1. Kinetic Energy Calculation

```
NASTRAN FILES=(OPTP)
ID  AAH,AV06 MODEL
TIME  15
SOL 3
DIAG   8
CHKPNT NO
$READ DICT
ALTER 417
$
$       COMMENT-- THE FOLLOWING DMAP PERFORMS THE KINETIC
$                 ENERGY CALCULATION ON CHECKPOINTED DATA
$                 FROM A SOLUTION 3 RUN.
$
OFP         LAMA// $
MPYAD       MGG,UGV,/MPHI/ $
ADD         UGV,MPHI/KES///1 $
DIAGONAL    MGG/GSIZE/COLUMN/0.0 $
MPYAD       GSIZE,KES,/CHK/1/ $
MATPRN      CHK//$
$
MATMOD      KES,,,,,/ENERGY,/7 $
PARAML      ENERGY//TRAILER/2/V,N,SIZE $
MATGEN      ,/IDENT/1/V,N,SIZE $
MATMOD      IDENT,,,,,/COL,/7 $
TRNSP       COL/ROW  $
MPYAD       ENERGY,ROW,/FULL $
DIAGONAL    FULL/SCALE/SQUARE/1.0 $
NORM        KES/KNORM $
MATMOD      KNORM,,,,,/FILT1,/2////C,Y,FILTER=0.9999 $
MPYAD       FILT1,SCALE,/MAX $
MATGPR      GPL,USET,SIL,MAX//H/G//0.00001 $
$
MATMOD      KNORM,,,,,/FILT,/2////C,Y,FILTER=0.01 $
MPYAD       FILT,SCALE,/KENG/ $
MATGPR      GPL,USET,SIL,KENG//H/G//0.00001 $
EXIT $
$
```

Figure 2. Kinetic Energy DMAP

EXAMPLE:

$$(4)\quad [KE] = DOF \quad \begin{array}{c} \\ 1 \\ 2 \\ 3 \end{array} \begin{array}{c} \text{MODE} \\ \begin{array}{ccc} 1 & 2 & 3 \end{array} \\ \begin{bmatrix} .496 & .005 & .667 \\ .500 & .005 & .330 \\ .004 & .990 & .003 \end{bmatrix} \end{array}$$

CONSTRUCT A DIAGONAL MATRIX FROM THE MAXIMUM VALUE OF EACH COLUMN

$$(5)\quad \begin{bmatrix} .500 & & \\ & .990 & \\ & & .667 \end{bmatrix}$$

NORMALIZE (4) TO LARGEST COLUMN VALUE

$$(6)\quad \begin{array}{c} \begin{array}{ccc} X2 & X1.01 & X1.5 \end{array} \\ \begin{bmatrix} .992 & .005 & 1.000 \\ 1.000 & .005 & .495 \\ .008 & 1.000 & .005 \end{bmatrix} \end{array}$$

FILTER OUT ANY VALUE IN (6) LESS THAN 1% OF LARGEST VALUE

$$(7)\quad \begin{bmatrix} .992 & 0 & 1.000 \\ 1.000 & 0 & .495 \\ 0 & 1.000 & 0 \end{bmatrix}$$

MULTIPLY (7) X (5) AND PRINT MAJOR ENERGY DISTRIBUTION

$$(8)\quad \begin{bmatrix} .992 & 0 & 1.000 \\ 1.000 & 0 & .495 \\ 0 & 1.000 & 0 \end{bmatrix} \begin{bmatrix} .500 & & \\ & .990 & \\ & & .667 \end{bmatrix} = \begin{bmatrix} .496 & 0 & .667 \\ .500 & 0 & .330 \\ 0 & .990 & .0 \end{bmatrix}$$

Figure 3. Filtered Kinetic Energy

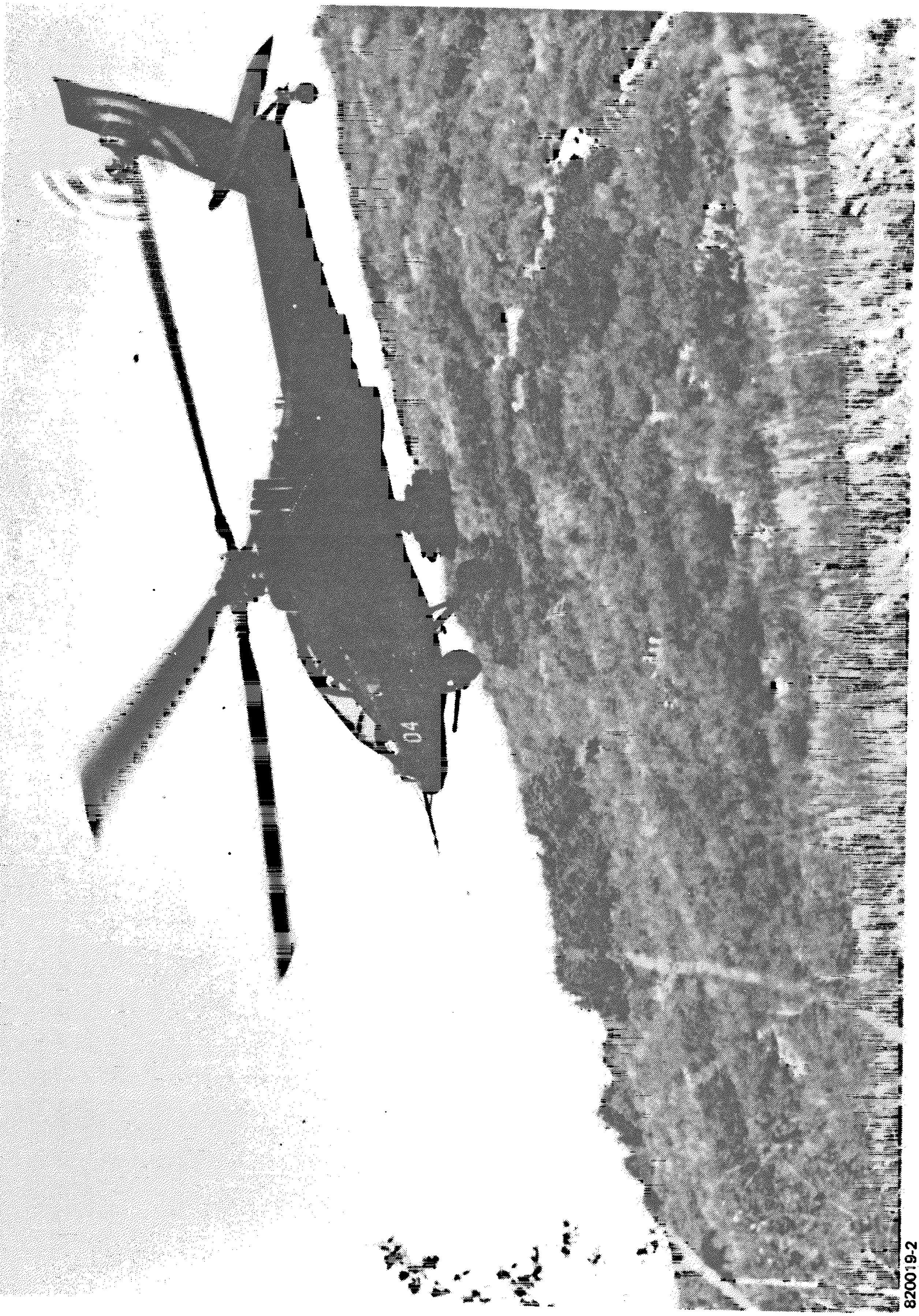
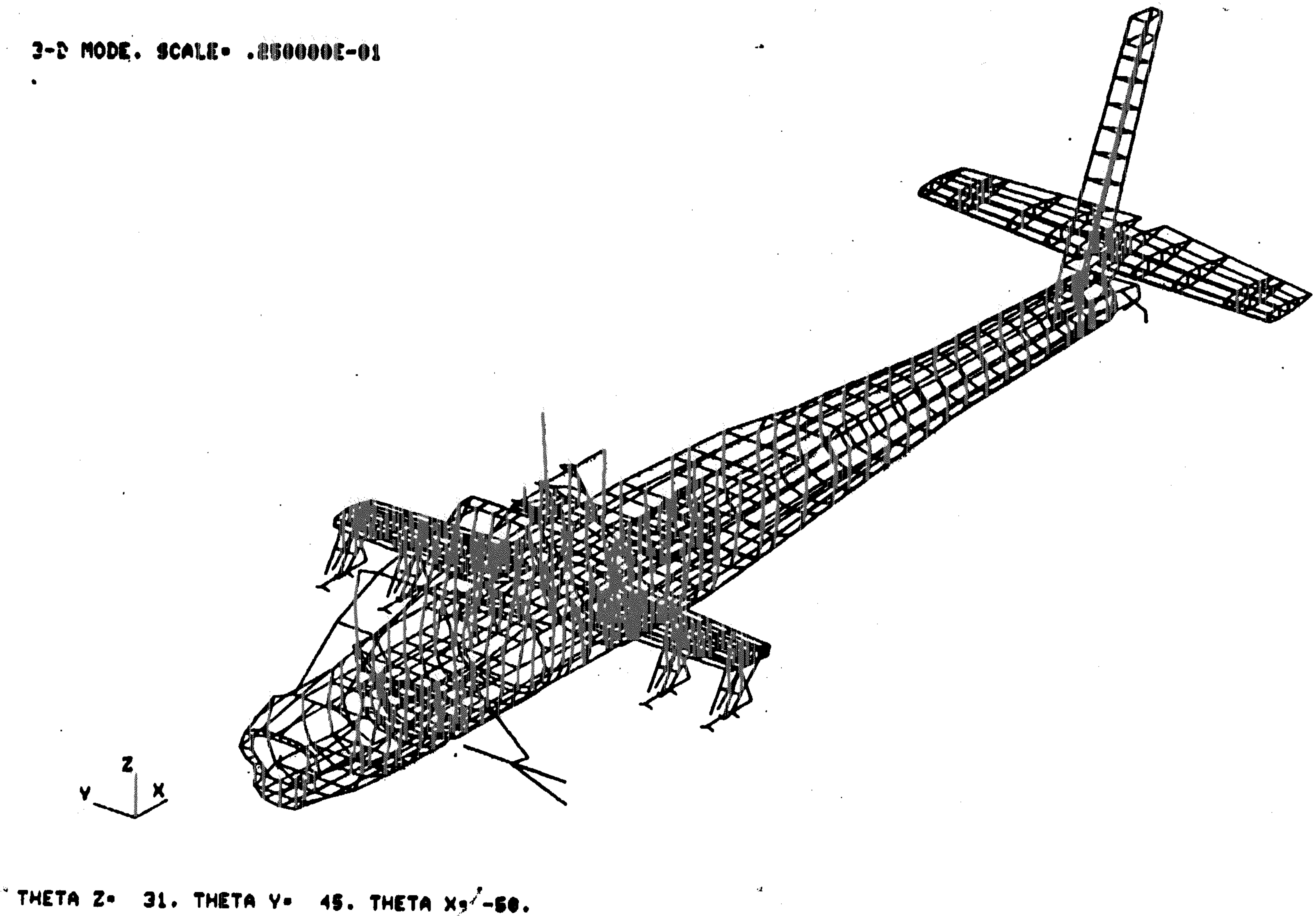


Figure 4. AH-64A APACHE



820019-9

Figure 5. AAH NASTRAN Static Model

TABLE I. FREQUENCY SUMMARY TABLE

MODE NO.	EXTRACTION ORDER	EIGENVALUE	REAL EIGENVALUES RADIANS	CYCLES	GENERALIZED MASS	GENERALIZED STIFFNESS
1	77	2.431023E-07	4.930541E-04	7.847199E-05	1.000000E+00	2.431023E-07
2	75	-1.960437E-06	1.400156E-03	2.228418E-04	1.000000E+00	-1.960437E-06
3	76	2.095112E-06	1.447450E-03	2.303688E-04	1.000000E+00	2.095112E-06
4	74	-1.687273E-05	4.107643E-03	6.537516E-04	1.000000E+00	-1.687273E-05
5	72	-1.076778E-04	1.037679E-02	1.651518E-03	1.000000E+00	-1.076778E-04
6	73	-1.138557E-04	1.067032E-02	1.698234E-03	1.000000E+00	-1.138557E-04
7	53	1.346377E+02	1.160335E+01	1.846731E+00	1.000000E+00	1.346377E+02
8	54	2.015526E+02	1.419692E+01	2.259510E+00	1.000000E+00	2.015526E+02
9	55	2.516970E+02	1.586496E+01	2.524987E+00	1.000000E+00	2.516970E+02
10	56	3.070885E+02	1.752394E+01	2.789022E+00	1.000000E+00	3.070885E+02
11	57	3.394329E+02	1.842370E+01	2.932224E+00	1.000000E+00	3.394329E+02
12	58	3.671485E+02	1.916112E+01	3.049587E+00	1.000000E+00	3.671485E+02
13	70	4.154079E+02	2.038156E+01	3.243826E+00	1.000000E+00	4.154079E+02
14	71	4.154104E+02	2.038162E+01	3.243836E+00	1.000000E+00	4.154104E+02
15	59	6.390647E+02	2.527973E+01	4.023394E+00	1.000000E+00	6.390647E+02
16	60	7.648244E+02	2.765546E+01	4.401503E+00	1.000000E+00	7.648244E+02
17	69	8.738818E+02	2.956149E+01	4.704858E+00	1.000000E+00	8.738818E+02
18	68	8.769654E+02	2.961360E+01	4.713151E+00	1.000000E+00	8.769654E+02
19	67	8.995766E+02	2.999294E+01	4.773525E+00	1.000000E+00	8.995766E+02
20	64	1.029641E+03	3.208802E+01	5.106967E+00	1.000000E+00	1.029641E+03
21	65	1.049183E+03	3.239110E+01	5.155204E+00	1.000000E+00	1.049183E+03
22	66	1.070174E+03	3.271352E+01	5.206518E+00	1.000000E+00	1.070174E+03
23	63	1.147452E+03	3.387406E+01	5.391224E+00	1.000000E+00	1.147452E+03
24	62	1.184217E+03	3.441246E+01	5.476913E+00	1.000000E+00	1.184217E+03
25	61	1.214503E+03	3.484972E+01	5.546506E+00	1.000000E+00	1.214503E+03
26	52	1.488441E+03	3.858032E+01	6.140249E+00	1.000000E+00	1.488441E+03
27	51	1.496168E+03	3.868033E+01	6.156165E+00	1.000000E+00	1.496168E+03
28	50	1.609405E+03	4.011740E+01	6.384882E+00	1.000000E+00	1.609405E+03
29	49	1.814096E+03	4.259220E+01	6.778760E+00	1.000000E+00	1.814096E+03
30	48	1.836499E+03	4.285439E+01	6.820489E+00	1.000000E+00	1.836499E+03
31	45	1.951738E+03	4.417848E+01	7.031223E+00	1.000000E+00	1.951738E+03
32	46	1.971549E+03	4.440213E+01	7.066819E+00	1.000000E+00	1.971549E+03
33	47	2.021086E+03	4.495649E+01	7.155048E+00	1.000000E+00	2.021086E+03
34	44	2.086216E+03	4.567512E+01	7.269420E+00	1.000000E+00	2.086216E+03
35	43	2.170956E+03	4.659352E+01	7.415589E+00	1.000000E+00	2.170956E+03
36	42	2.272373E+03	4.766941E+01	7.586822E+00	1.000000E+00	2.272373E+03
37	41	2.455529E+03	4.955329E+01	7.886652E+00	1.000000E+00	2.455529E+03
38	40	2.541348E+03	5.041178E+01	8.023284E+00	1.000000E+00	2.541348E+03
39	39	2.811670E+03	5.302519E+01	8.439221E+00	1.000000E+00	2.811670E+03
40	38	3.038846E+03	5.512573E+01	8.773533E+00	1.000000E+00	3.038846E+03
41	37	3.121986E+03	5.587473E+01	8.892740E+00	1.000000E+00	3.121986E+03
42	36	3.362283E+03	5.798520E+01	9.228631E+00	1.000000E+00	3.362283E+03
43	35	3.495320E+03	5.912123E+01	9.409437E+00	0.0	0.0
44	34	3.652026E+03	6.043200E+01	9.618051E+00	0.0	0.0
45	33	3.790056E+03	6.156343E+01	9.798124E+00	0.0	0.0
46	32	3.854032E+03	6.208085E+01	9.880474E+00	0.0	0.0
47	31	4.068478E+03	6.378462E+01	1.015164E+01	0.0	0.0
48	30	4.503702E+03	6.710963E+01	1.068083E+01	0.0	0.0
49	29	4.751757E+03	6.893299E+01	1.097103E+01	0.0	0.0
50	28	4.883765E+03	6.988394E+01	1.112237E+01	0.0	0.0

820019-11

COLUMN	MAX POINT	MAX VALUE
COLUMN 1	15499 T3	8.71617E-02
COLUMN 2	54 T2	2.96322E-01
COLUMN 3	15499 T2	1.06678E-01
COLUMN 4	25899 T1	8.81439E-02
COLUMN 5	55050 T3	7.20495E-02
COLUMN 6	55050 T2	6.13206E-02
COLUMN 7	5702 R2	9.99695E-01
COLUMN 8	11508 R3	8.64511E-01
COLUMN 9	20290 R3	8.06633E-01
COLUMN 10	5722 R3	9.94715E-01
COLUMN 11	25056 R3	8.76771E-01
COLUMN 12	25057 R3	7.53718E-01
COLUMN 13	920312 R1	5.00543E-01
COLUMN 14	20312 R1	5.00541E-01
COLUMN 15	55050 T2	2.64140E-01
COLUMN 16	5706 R3	9.38434E-01
COLUMN 17	206002 T2	3.80058E-01
COLUMN 18	11530 R3	6.59806E-01
COLUMN 19	25059 R3	2.61231E-01
COLUMN 20	10066 R2	4.50058E-01
COLUMN 21	24739 T2	9.95029E-02
COLUMN 22	25058 R3	3.02887E-01
COLUMN 23	206003 T2	3.34428E-01
COLUMN 24	11502 R2	2.84136E-01
COLUMN 25	11502 R2	6.97710E-01
COLUMN 26	8004 R3	9.27269E-01
COLUMN 27	5704 R2	8.54240E-01
COLUMN 28	11506 R3	4.12615E-01
COLUMN 29	15411 R2	8.80323E-01
COLUMN 30	21250 T3	7.47015E-02
COLUMN 31	15426 R3	6.47670E-01
COLUMN 32	10514 R1	4.73399E-01
COLUMN 33	5724 R2	3.79753E-01
COLUMN 34	5724 R2	4.69310E-01
COLUMN 35	11508 R2	5.05423E-01
COLUMN 36	206003 T1	2.48072E-01
COLUMN 37	206003 T1	2.72013E-01
COLUMN 38	15406 R3	9.68083E-01
COLUMN 39	5702 R3	6.51562E-01
COLUMN 40	55050 T1	1.13271E-01
COLUMN 41	15411 T1	5.14339E-01
COLUMN 42	8401 R1	1.57290E-01

820019-12

Figure 6. AAH Kinetic Energy Calculation Maximum Values

KENG

POINT	VALUE	POINT	VALUE	POINT	VALUE	POINT	VALUE	POINT	VALUE
COLUMN 1									
63 T3	2.76269E-03	64 T3	5.94899E-03	2499 T2	3.21137E-03	2499 T3	4.72124E-02	5702 T3	[illegible]
5709 T3	5.75386E-03	8008 T3	2.78557E-03	8016 T3	3.93477E-03	8025 T3	6.86693E-03	8401 T3	3.43151E-03
8403 T3	4.39621E-03	9003 T3	5.72388E-03	9135 T3	4.71108E-03	10011 T3	1.34341E-02	10012 T2	3.58007E-03
10012 T3	1.44654E-02	10013 T3	9.92290E-03	10031 T3	3.56982E-03	10032 T3	4.72617E-03	10501 T3	5.95880E-03
10502 T3	2.80335E-03	10509 T3	3.39370E-03	10510 T3	2.79314E-03	10514 T3	5.55845E-03	11501 T3	5.65311E-03
11502 T3	6.12755E-03	11542 T3	2.70013E-03	12021 T3	3.55221E-03	12022 T3	7.91149E-03	12024 T3	5.50690E-03
13508 T3	2.79975E-03	13524 T3	4.94933E-03	14303 T3	3.32905E-03	15411 T3	4.25336E-03	15499 T1	3.33803E-03
15499 T2	8.69527E-03	15499 T3	8.71617E-02	17600 T3	3.49677E-03	17659 T3	3.05465E-03	10020 T2	2.75576E-03
10020 T3	3.05618E-02	10066 T3	5.29581E-03	20005 T3	4.01098E-03	21303 T3	3.08638E-03	21305 T3	4.09373E-03
21330 T3	2.62880E-03	25899 T1	3.42250E-03	25899 T2	6.41711E-03	25899 T3	5.25006E-02	17 T3	4.19859E-03
51 T3	8.29105E-03	54 T2	6.91062E-03	54 T3	6.07100E-02	59 T3	4.64854E-03	60 T3	1.57774E-02
62 T3	5.06596E-03	500 T3	4.18246E-03	900060 T3	1.19133E-02	21251 T3	8.11384E-03	24739 T3	4.71197E-03
924003 T3	3.60659E-02	924002 T3	1.09269E-02	206002 T2	5.41167E-03	206002 T3	4.50343E-02	206006 T3	6.02974E-03
926002 T3	2.40698E-02	206003 T2	5.41167E-03	206003 T3	7.08706E-03	926003 T3	3.76372E-03	26933 T3	3.49267E-03
COLUMN 2									
11502 T2	8.90477E-03	51 T2	2.66763E-02	54 T2	2.96322E-01	59 T2	1.79057E-02	60 T2	1.30803E-02
62 T2	1.26697E-02	900060 T2	1.38108E-02	924003 T2	2.70416E-02	924003 T3	1.19698E-02	924002 T2	2.80120E-02
924002 T3	2.69075E-02	206002 T3	3.17167E-02	926002 T3	1.70334E-02	206003 T3	5.18223E-02	926003 T3	2.78011E-02
55050 T2	2.27728E-02	955050 T2	1.20545E-02						
COLUMN 3									
2499 T2	5.05115E-02	2499 T3	5.18601E-03	5702 T2	8.34464E-03	5709 T2	7.57154E-03	8008 T2	4.67684E-03
8016 T2	4.37877E-03	8025 T2	8.57303E-03	9003 T2	5.63898E-03	9135 T2	4.16021E-03	10011 T2	1.29381E-02
10012 T2	2.81192E-02	10013 T2	6.35066E-03	10031 T2	6.62039E-03	10032 T2	4.66075E-03	10501 T2	6.09769E-03
10502 T2	3.40055E-03	10510 T2	4.56434E-03	10514 T2	7.64492E-03	11501 T2	5.79990E-03	12021 T2	9.68958E-03
12022 T2	9.68958E-03	12023 T2	9.03804E-03	12024 T2	9.05651E-03	13508 T2	4.52506E-03	13524 T2	4.58434E-03
15499 T2	1.06678E-01	15499 T3	8.71601E-03	17600 T2	3.65521E-03	10020 T2	3.52151E-02	25899 T2	6.78116E-02
25899 T3	4.24207E-03	54 T3	5.62651E-03	60 T2	8.22771E-03	900060 T2	4.89758E-03	924003 T2	8.12048E-03
924002 T2	8.02045E-03	924002 T3	1.21516E-02	206002 T2	4.17078E-02	206006 T2	3.49830E-03	926002 T2	1.91256E-02
206003 T2	4.17078E-02	206003 T3	2.07662E-02	206007 T2	3.49830E-03	926003 T2	1.91256E-02	926003 T3	1.11173E-02
55050 T2	6.51754E-03	955050 T2	3.49817E-03						
COLUMN 4									
63 T1	3.08744E-03	64 T1	6.68108E-03	2499 T1	2.61679E-02	5702 T1	6.51529E-03	5709 T1	3.52387E-03
8025 T1	4.26911E-03	8401 T1	2.66411E-03	8403 T1	2.74379E-03	9003 T1	3.02935E-03	9135 T1	2.98001E-03
10011 T1	9.48527E-03	10012 T1	1.04414E-02	10013 T1	9.45175E-03	10031 T1	3.51781E-03	10501 T1	4.47900E-03
10502 T1	2.79239E-03	10514 T1	3.81765E-03	11501 T1	4.44351E-03	11502 T1	4.78418E-03	12021 T1	4.77298E-03
12022 T1	4.81808E-03	12023 T1	3.39661E-03	12024 T1	3.44284E-03	13508 T1	3.23231E-03	13524 T1	3.29639E-03
14303 T1	2.68833E-03	15411 T1	4.29171E-03	15499 T1	8.24755E-02	17600 T1	3.69819E-03	10020 T1	3.73068E-02
10028 T1	3.62750E-03	10066 T1	1.03508E-02	20003 T1	3.53092E-03	20005 T1	4.12870E-03	21303 T1	4.86926E-03
21305 T1	4.55372E-03	25899 T1	8.81439E-02	32001 T1	4.43544E-03	17 T1	4.87800E-03	51 T1	1.01932E-02
54 T1	7.43345E-02	59 T1	5.70566E-03	60 T1	2.01768E-02	62 T1	6.21940E-03	500 T1	5.17063E-03
900060 T1	1.47471E-02	21251 T1	6.51848E-03	24739 T1	5.39431E-03	924003 T1	3.31184E-02	21250 T1	6.34891E-03
24738 T1	5.08690E-03	924002 T1	3.36113E-02	206002 T1	2.51163E-02	206006 T1	3.46724E-03	926002 T1	1.35170E-02
206003 T1	2.46680E-02	206007 T1	3.40559E-03	926003 T1	1.32761E-02	55017 T1	2.66521E-03	55033 T1	2.65076E-03
55050 T1	1.13653E-02	955050 T1	5.79709E-03	26933 T1	4.49874E-03	52500 T1	4.05842E-03		
COLUMN 5									

820019-13

Figure 7. AAH Kinetic Energy Distribution (Sheet 1 of 5)

KENO

POINT	VALUE	POINT	VALUE	POINT	VALUE	POINT	VALUE	POINT	VALUE
2499 T2	1.93841E-02	2499 T3	2.34382E-02	5702 T2	3.81900E-03	5702 T3	3.98936E-03	5709 T3	2.17800E-03
10011 T2	2.58128E-03	10011 T3	2.97872E-03	10012 T3	2.74261E-03	10028 T2	2.20593E-03	10066 T3	2.94058E-03
25899 T2	2.56309E-02	25899 T3	2.51655E-02	32001 T2	3.35531E-03	32001 T3	4.13284E-03	42326 T2	2.69706E-03
42326 T3	3.18159E-03	42328 T3	2.31786E-03	45001 T2	3.25837E-03	45001 T3	3.82421E-03	50306 T2	5.81858E-03
50306 T3	6.29920E-03	50318 T2	5.75781E-03	50318 T3	6.67297E-03	54750 T2	4.96737E-03	54750 T3	5.72445E-03
54757 T3	2.29036E-03	54758 T3	2.34199E-03	54759 T2	9.62177E-03	54759 T3	1.04398E-02	54760 T2	6.37447E-03
54760 T3	6.75313E-03	954759 T2	5.41377E-03	954759 T3	5.80569E-03	54 T1	1.86127E-02	24739 T3	3.78484E-03
924003 T1	5.02616E-03	924003 T2	2.88719E-03	924003 T3	9.20195E-03	924002 T2	3.21406E-03	924002 T3	3.34856E-03
206002 T3	2.26046E-03	206003 T1	1.19142E-02	926003 T1	5.26015E-03	55017 T2	1.25904E-02	55017 T3	1.63807E-02
55018 T2	3.30073E-03	55018 T3	4.19851E-03	55019 T2	2.92217E-03	55019 T3	3.72390E-03	55020 T2	2.92217E-03
55020 T3	3.66735E-03	55023 T2	4.07622E-03	55023 T3	5.33195E-03	55024 T2	5.43496E-03	55024 T3	7.00547E-03
55027 T3	2.59391E-03	55033 T2	1.21568E-02	55033 T3	1.75249E-02	55050 T1	3.45111E-03	55050 T2	4.94647E-02
55050 T3	7.20495E-02	955050 T2	2.54609E-02	955050 T3	3.63148E-02	56098 T3	2.20315E-03	56099 T2	2.34647E-03
56099 T3	3.00918E-03	56111 T2	2.34646E-03	56111 T3	2.49130E-03	26933 T3	2.18962E-03	51601 T2	3.87777E-03
51601 T3	4.49681E-03	52500 T2	1.87768E-02	52500 T3	2.21055E-02	956150 T2	3.06102E-03	956150 T3	3.60322E-03

COLUMN 6

POINT	VALUE	POINT	VALUE	POINT	VALUE	POINT	VALUE	POINT	VALUE
2499 T2	2.12551E-02	2499 T3	1.84868E-02	5702 T2	4.26944E-03	5702 T3	3.09864E-03	10011 T2	2.65136E-03
10011 T3	2.31524E-03	10012 T3	2.11607E-03	10020 T2	2.98655E-03	10028 T2	3.15188E-03	10028 T3	2.05347E-03
10066 T2	2.84006E-03	10066 T3	2.84785E-03	25899 T2	3.87862E-02	25899 T3	2.01476E-02	32001 T2	4.56866E-03
32001 T3	3.28231E-03	36020 T2	1.88936E-03	42326 T2	3.57847E-03	42326 T3	2.17827E-03	42328 T2	2.52777E-03
45001 T2	4.26006E-03	45001 T3	3.02299E-03	50306 T2	7.60474E-03	50306 T3	5.41889E-03	50318 T2	7.52532E-03
50318 T3	4.83524E-03	54738 T2	2.13009E-03	54745 T2	2.33539E-03	54750 T2	6.44106E-03	54750 T3	4.36508E-03
54757 T2	2.73596E-03	54757 T3	1.85901E-03	54758 T2	2.73597E-03	54759 T2	1.25587E-02	54759 T3	8.24467E-03
54760 T2	8.34567E-03	54760 T3	5.32927E-03	954759 T2	7.07264E-03	954759 T3	4.58161E-03	54 T1	1.49210E-02
24739 T2	2.50747E-03	924003 T2	4.29294E-03	24738 T2	2.39022E-03	24738 T3	3.30093E-03	924002 T1	5.63509E-03
924002 T2	4.73919E-03	924002 T3	9.84934E-03	206002 T1	1.21976E-02	206002 T2	2.60095E-03	926002 T1	5.52268E-03
206003 T2	2.60095E-03	206003 T3	3.26606E-03	55017 T2	1.59414E-02	55017 T3	1.25801E-02	55018 T2	4.17924E-03
55018 T3	3.41301E-03	55019 T2	3.70809E-03	55019 T3	2.87936E-03	55020 T2	3.70809E-03	55020 T3	2.94710E-03
55023 T2	5.14346E-03	55023 T3	4.12461E-03	55024 T2	6.85794E-03	55024 T3	5.62381E-03	55027 T2	2.42426E-03
55027 T3	2.00746E-03	55033 T2	1.50394E-02	55033 T3	1.34969E-02	55050 T2	6.13206E-02	55050 T3	5.34846E-02
55050 R1	-1.94320E-03	55400 T2	2.11699E-03	55500 T2	1.91614E-03	955050 T2	3.15361E-02	955050 T3	2.86649E-02
56098 T2	2.18444E-03	56099 T2	3.01987E-03	56099 T3	1.86653E-03	56110 T2	2.18443E-03	56111 T2	3.01986E-03
56111 T3	2.48726E-03	51601 T2	5.02765E-03	51601 T3	3.55105E-03	52500 T2	2.42489E-02	52500 T3	1.74544E-02
956150 T2	3.94110E-03	956150 T3	2.84425E-03						

COLUMN 7

POINT	VALUE
5702 R2	9.99695E-01

COLUMN 8

POINT	VALUE	POINT	VALUE
11506 R3	1.23727E-01	11508 R3	8.64511E-01

COLUMN 9

POINT	VALUE	POINT	VALUE
20290 R1	1.93360E-01	20290 R3	8.06633E-01

COLUMN 10

POINT	VALUE
5722 R3	9.94715E-01

COLUMN 11

POINT	VALUE	POINT	VALUE	POINT	VALUE	POINT	VALUE
25056 R3	8.76771E-01	25058 R3	4.40327E-02	25060 R2	3.21996E-02	25060 R3	3.98798E-02

820019-14

Figure 7. AAH Kinetic Energy Distribution (Sheet 2 of 5)

KENG

	POINT	VALUE	POINT	VALUE	POINT	VALUE	POINT	VALUE	POINT	VALUE
COLUMN 12	25057 R3	7.53718E-01	25059 R3	8.74358E-02	25061 R2	6.17170E-02	25061 R3	8.46551E-02		
COLUMN 13	20312 R1	4.99157E-01	920312 R1	5.00543E-01						
COLUMN 14	20312 R1	5.00541E-01	920312 R1	4.99155E-01						
COLUMN 15	2499 T2	4.60279E-02	25899 T2	3.17655E-02	54 T2	2.06149E-02	924003 T2	1.14183E-02	924002 T2	1.22308E-02
	206002 T1	1.13226E-02	55017 T2	1.17114E-02	55033 T2	6.75684E-02	55037 T2	8.42982E-03	55050 T2	2.64140E-01
	55050 R1	3.59546E-02	55800 T2	1.19294E-02	955050 T2	1.40696E-01				
COLUMN 16	5706 R3	9.38434E-01	8004 R3	5.35664E-02						
COLUMN 17	11530 R3	1.48056E-02	206002 T2	3.80058E-01	926002 T2	8.30367E-02	206003 T2	3.72910E-01	926003 T2	8.13959E-02
COLUMN 18	11528 R3	2.73484E-01	11530 R3	6.59806E-01						
COLUMN 19	25055 R2	1.11254E-02	25055 R3	1.08969E-02	25057 R3	2.46057E-01	25059 R3	2.61231E-01	25061 R2	2.04696E-01
	25061 R3	2.55404E-01								
COLUMN 20	10066 T1	4.09938E-01	10066 T3	4.53376E-02	10066 R2	4.50058E-01				
COLUMN 21	2499 T3	1.29945E-02	10066 T1	3.03377E-02	10066 R2	3.63998E-02	25899 T3	6.08071E-03	54 T1	4.96831E-03
	21251 T1	1.25582E-02	21251 T2	3.49777E-02	21251 T3	2.92913E-02	24739 T1	1.05307E-02	24739 T2	9.95029E-02
	24739 T3	9.13539E-03	24739 R3	6.45685E-03	924003 T1	5.32517E-02	924003 T3	2.37640E-02	924003 R1	4.92500E-03
	924003 R2	1.79029E-02	924003 R3	6.63161E-02	21250 T1	9.97592E-03	21250 T2	3.11596E-02	21250 T3	2.32652E-02
	24738 T1	8.10289E-03	24738 T2	7.92658E-02	24738 T3	6.31354E-03	24738 R3	4.24722E-03	924002 T1	4.51756E-02
	924002 T3	1.69903E-02	924002 R1	4.14013E-03	924002 R2	1.32756E-02	924002 R3	5.36597E-02	206003 T1	5.38449E-03
	206003 T2	3.54075E-03	55033 T1	7.57727E-03	55033 T3	4.68942E-03	55050 T1	3.20667E-02	55050 T3	1.44612E-02
	55050 R3	4.41120E-03	955050 T1	1.49634E-02	955050 T3	7.87124E-03				
COLUMN 22	25054 R2	1.94151E-02	25054 R3	1.27620E-02	25056 R3	1.22457E-01	25058 R3	3.02887E-01	25060 R2	2.49232E-01
	25060 R3	2.77181E-01								
COLUMN 23	2499 T2	1.21418E-02	15499 T2	1.87796E-02	25899 T2	1.27734E-02	54 T2	1.03155E-02	206002 T2	3.04142E-01
	926002 T2	5.49278E-02	206003 T2	3.34428E-01	926003 T2	6.05302E-02				
COLUMN 24										

820019-15

Figure 7. AAH Kinetic Energy Distribution (Sheet 3 of 5)

KENG

	POINT	VALUE	POINT	VALUE	POINT	VALUE	POINT	VALUE	POINT	VALUE
	2499 T3	3.24271E-02	11502 R2	2.84136E-01	25899 T3	1.97604E-02	54 T1	3.22088E-02	21251 T2	8.57199E-[illegible]
	24739 T2	2.35160E-02	24739 T3	1.25058E-02	924003 R3	1.58746E-02	24738 T2	2.85640E-02	24738 T3	9.63665E-[illegible]
	924002 T1	1.00295E-02	924002 R3	1.68543E-02	206002 T2	3.49193E-02	206003 T2	1.09141E-02	55033 T1	1.42036E-02
	55033 T3	8.95062E-03	55050 T1	5.98864E-02	55050 T3	2.63234E-02	55050 R3	8.96657E-03	955050 T1	2.77762E-02
	955050 T3	1.47386E-02								
COLUMN 25										
	11502 R2	6.97710E-01	55050 T1	3.03248E-02						
COLUMN 26										
	5706 R3	5.14081E-02	8004 R3	9.27269E-01						
COLUMN 27										
	5704 R2	8.54240E-01	5704 R3	1.20411E-01						
COLUMN 28										
	11506 T1	7.89054E-02	11506 R3	4.12615E-01	11508 R2	3.46769E-01	11508 R3	9.22003E-02		
COLUMN 29										
	15411 T1	6.33836E-02	15411 R2	8.80323E-01						
COLUMN 30										
	5702 R3	3.27956E-03	8401 T2	4.81278E-03	8403 T2	4.94293E-03	11502 T2	9.04786E-03	11506 R3	3.47996E-03
	15426 R3	4.32619E-03	54 T2	2.60798E-03	21251 T1	1.01203E-02	21251 T2	3.57515E-02	21251 T3	7.25103E-02
	24739 T1	8.47273E-03	24739 T2	4.45382E-02	24739 T3	3.34213E-02	24739 R2	4.04455E-03	24739 R3	4.01800E-03
	924003 T1	4.32423E-02	924003 T2	8.40736E-03	924003 T3	4.56560E-02	924003 R1	1.26669E-02	924003 R2	5.18802E-02
	924003 R3	4.12675E-02	21250 T1	1.35944E-02	21250 T2	4.44416E-02	21250 T3	7.47015E-02	24738 T1	1.10223E-02
	24738 T2	6.60713E-02	24738 T3	3.47563E-02	24738 R2	3.91164E-03	24738 R3	4.36780E-03	924002 T1	6.06134E-02
	924002 T2	2.64537E-03	924002 T3	3.59397E-02	924002 R1	1.40263E-02	924002 R2	5.28702E-02	924002 R3	5.51831E-02
	206002 T1	3.36502E-03	206003 T1	4.97813E-03						
COLUMN 31										
	10514 T3	5.62735E-02	10514 R1	1.05005E-01	11502 T2	2.46830E-02	15426 R3	6.47670E-01		
COLUMN 32										
	10514 T2	5.67340E-02	10514 T3	2.66709E-01	10514 R1	4.73399E-01	15426 R3	1.85392E-01		
COLUMN 33										
	5702 R3	7.88540E-02	5724 R2	3.79753E-01	5724 R3	5.76398E-02	8401 T2	4.30596E-02	8401 R1	1.32721E-02
	8403 T2	4.42265E-02	11502 T2	7.96959E-02	11506 T2	1.71705E-02	11506 R3	1.61222E-02	11530 T2	1.40120E-02
	14303 T2	1.46734E-02	15426 R3	1.18933E-01						
COLUMN 34										
	5702 R3	4.33146E-02	5724 R2	4.69310E-01	5724 R3	6.63319E-02	8401 T2	4.38522E-02	8401 R1	1.70259E-02
	8403 T2	4.50101E-02	8403 R1	1.86944E-02	11502 T2	7.51643E-02	11506 T2	1.59085E-02	11506 R3	2.62111E-02
	15426 R3	3.14113E-02								
COLUMN 35										
	11506 T1	2.97039E-02	11506 R2	2.58954E-02	11506 R3	3.75533E-01	11508 R2	5.05423E-01	11508 R3	3.30464E-02
COLUMN 36										

820019-16

Figure 7. AAH Kinetic Energy Distribution (Sheet 4 of 5)

KENG

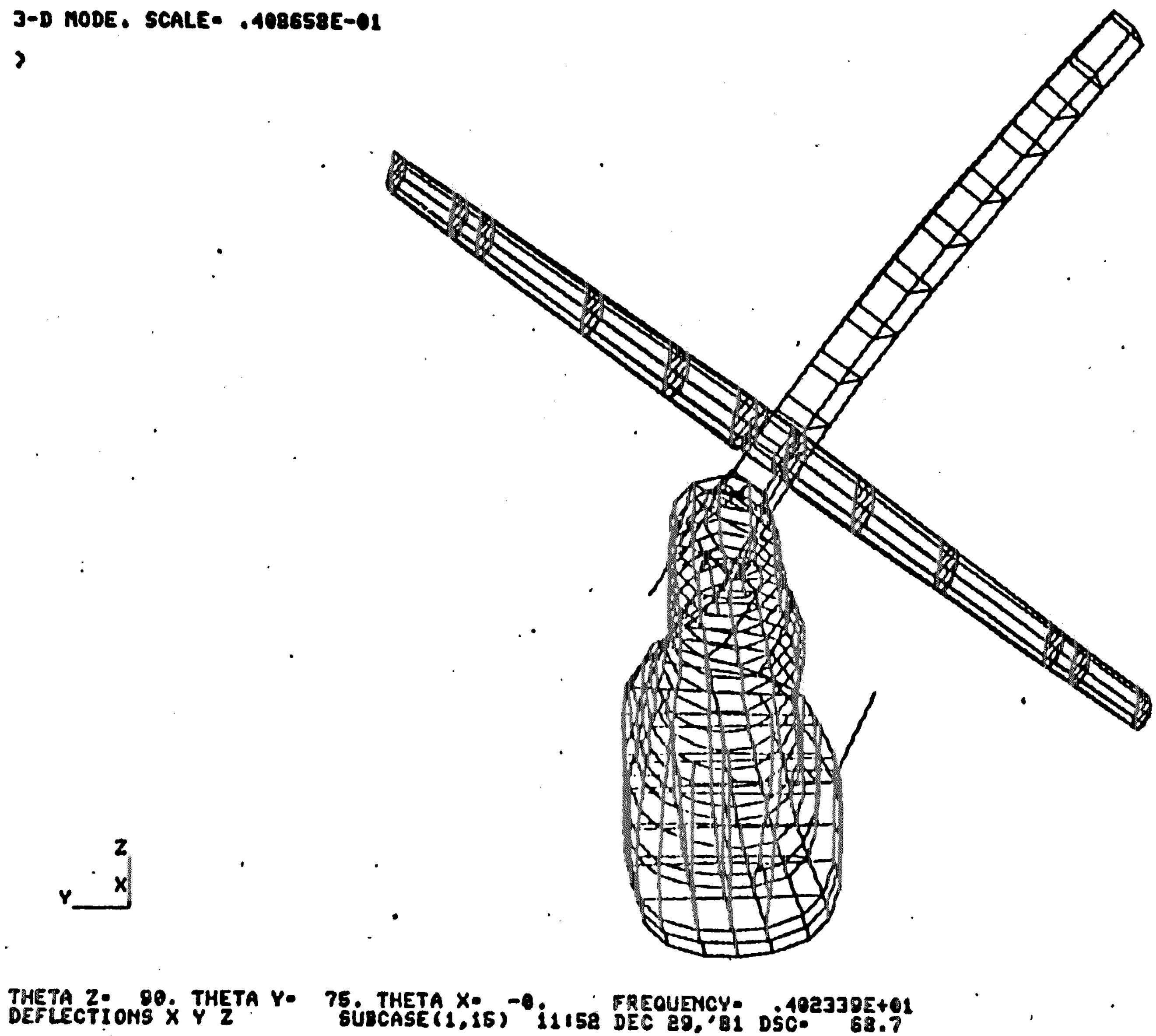
	POINT	VALUE	POINT	VALUE	POINT	VALUE	POINT	VALUE	POINT	VALUE
	54759 T2	2. 42773E-02	54760 T2	2. 27400E-02	954759 T2	1 72417E-02	54 T2	8. 47587E-03	206002 T1	2. 44327E-01
	206002 T3	1. 78622E-02	926002 T1	8 10523E-02	926002 T3	7. 92833E-03	206003 T1	2. 48072E-01	206003 T3	2. 27599E-02
	926003 T1	8. 20052E-02	926003 T3	1. 03078E-02	55050 T2	8. 29901E-03	55050 R1	9. 96167E-03	52500 T2	9. 10476E-03
COLUMN	37									
	15406 R3	1. 56597E-02	54 T1	8 49456E-03	206002 T1	2. 70281E-01	206002 T3	4. 01186E-02	926002 T1	8. 52661E-02
	926002 T3	1. 86477E-02	206003 T1	2 72013E-01	206003 T3	3. 92505E-02	926003 T1	8. 54078E-02	926003 T3	1 81841E-02
COLUMN	38									
	15406 R3	9. 68083E-01								
COLUMN	39									
	5702 R3	6. 51562E-01	8401 R1	4. 62273E-02	8401 R3	3. 06440E-02	8403 R1	2. 51271E-02		
COLUMN	40									
	2499 T2	3. 08293E-02	2499 T3	2. 34211E-02	5702 T3	4. 41277E-03	5702 R3	3. 62184E-02	8401 T2	5. 42597E-03
	8401 T3	5. 17552E-03	8401 R1	2. 38437E-02	8401 R3	9. 68334E-03	8403 T2	5. 56333E-03	8403 R1	1. 66337E-02
	8403 R3	6. 40244E-03	11502 T2	5. 49692E-03	15411 T1	3. 76307E-02	15411 R2	4. 68370E-03	25899 T2	1 00620E-02
	50306 T3	3. 87347E-03	54759 T2	6. 89916E-03	54760 T2	6. 79386E-03	954759 T2	5. 12511E-03	21251 T3	1. 47031E-02
	24739 T3	3. 48113E-03	924003 T1	6. 58040E-03	924003 T2	9. 68956E-03	924003 T3	1. 40170E-02	924003 R2	8. 12453E-03
	21250 T3	9. 72356E-03	924002 T1	4. 66677E-03	924002 T3	1. 93663E-02	206002 T1	1. 62558E-02	206002 T3	6. 21689E-03
	926002 T1	4 38381E-03	206003 T1	1. 11257E-02	206003 T3	4. 03478E-03	926003 T1	3. 52844E-03	55017 T1	4. 61039E-03
	55017 T3	3. 61184E-03	55033 T1	2. 23144E-02	55050 T1	1. 13271E-01	55050 T2	5. 63102E-03	55050 T3	6. 63259E-03
	55050 R3	9. 96415E-02	955050 T1	3. 43680E-02	955050 T3	7. 17227E-03	56099 T1	4. 51618E-03	56099 T2	3. 50220E-03
	56111 T1	3. 82316E-03	56111 T2	3. 50777E-03	56111 T3	3. 46221E-03	52500 T3	1. 29105E-02		
COLUMN	41									
	5702 T1	9. 76575E-02	15411 T1	5. 14339E-01	15411 T3	3. 64932E-02	15411 R2	6. 57080E-02	15413 T1	1. 99652E-02
	15415 T1	4. 64925E-02								
COLUMN	42									
	2499 T2	7. 31492E-02	2499 T3	4. 77880E-03	2499 R1	6. 83023E-03	5702 T1	3. 55035E-02	5702 T2	1. 22485E-02
	5702 T3	6. 45270E-03	8401 R1	1. 57290E-01	8401 R3	9. 67524E-02	14303 R1	6. 02510E-03	15411 T1	1. 33610E-02
	25899 T2	1. 79708E-02	54757 T2	5. 33348E-03	54758 T2	5. 33351E-03	54759 T2	2. 79410E-02	54760 T2	2. 84433E-02
	954759 T2	2. 12933E-02	21251 T3	7. 88030E-03	924003 T3	1. 40925E-02	21250 T3	1. 33127E-02	24738 T3	5. 18531E-03
	924002 T2	1. 62681E-02	924002 T3	7. 63550E-03	924002 R2	8. 73933E-03	206002 T1	1. 21053E-02	206003 T1	7. 04012E-03
	55033 T1	1. 39227E-02	55050 T1	5. 06051E-02	55050 R1	1. 31073E-02	955050 T1	2. 93102E-02	52500 T2	7. 22123E-03

820019-17

Figure 7. AAH Kinetic Energy Distribution (Sheet 5 of 5)

TABLE 2. AAH MODE SUMMARY TABLE BASED ON KINETIC ENERGY RESULTS

Mode No.	NASTRAN Results (Hz)	Modal Description
15	4.02	First Torsional
17	4.70	First Symmetric Wing Bending
19	4.77	Local Engine
22	5.21	Local Engine
23	5.39	First Antisymmetric Wing Bending
24	5.48	First Vertical Bending
36	7.59	First Antisymmetric Wing/Pylon Torsion
37	7.89	First Symmetric Wing/Pylon Torsion
42	9.23	First Lateral Bending



820019-20

Figure 8. First Torsional

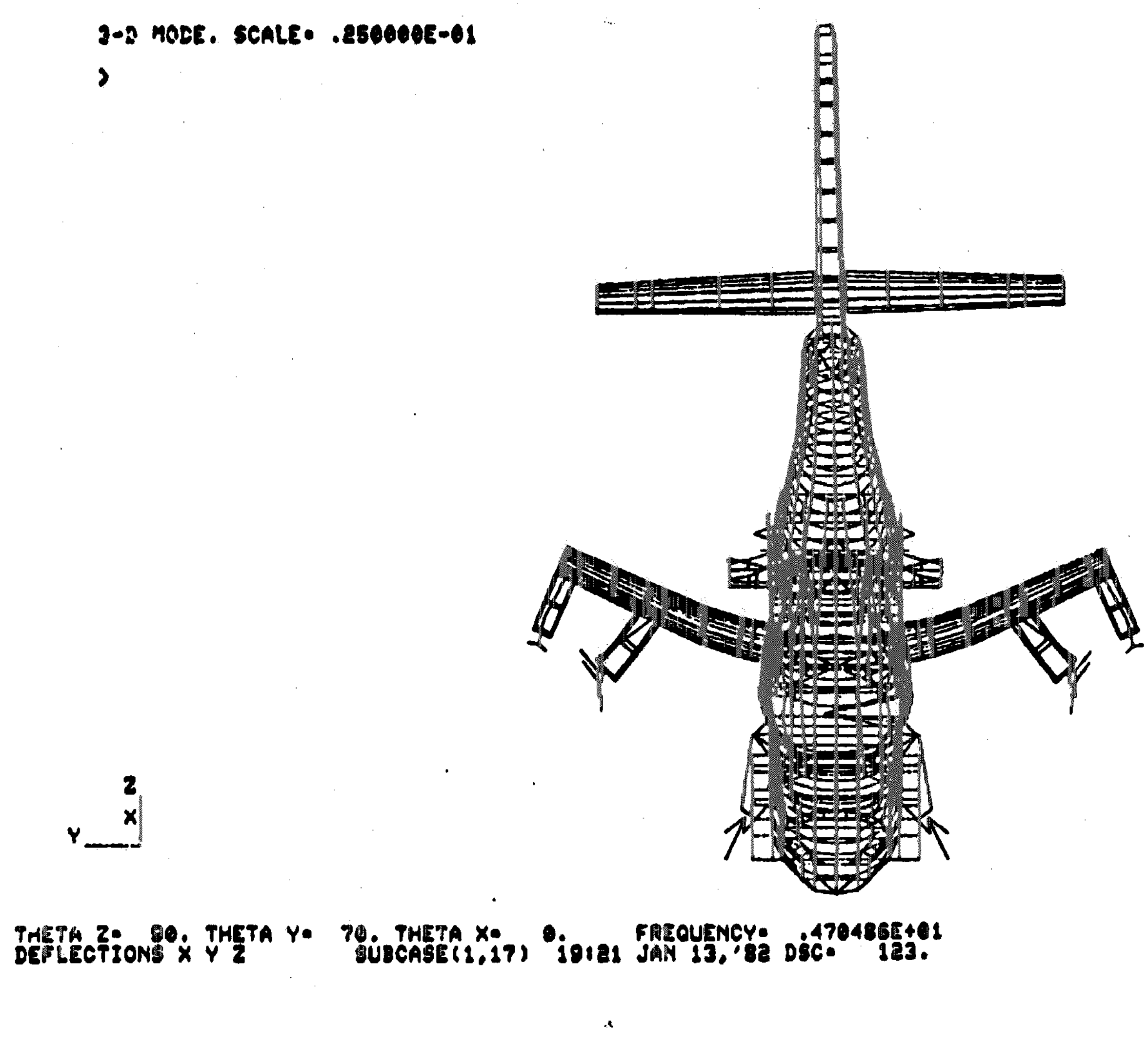
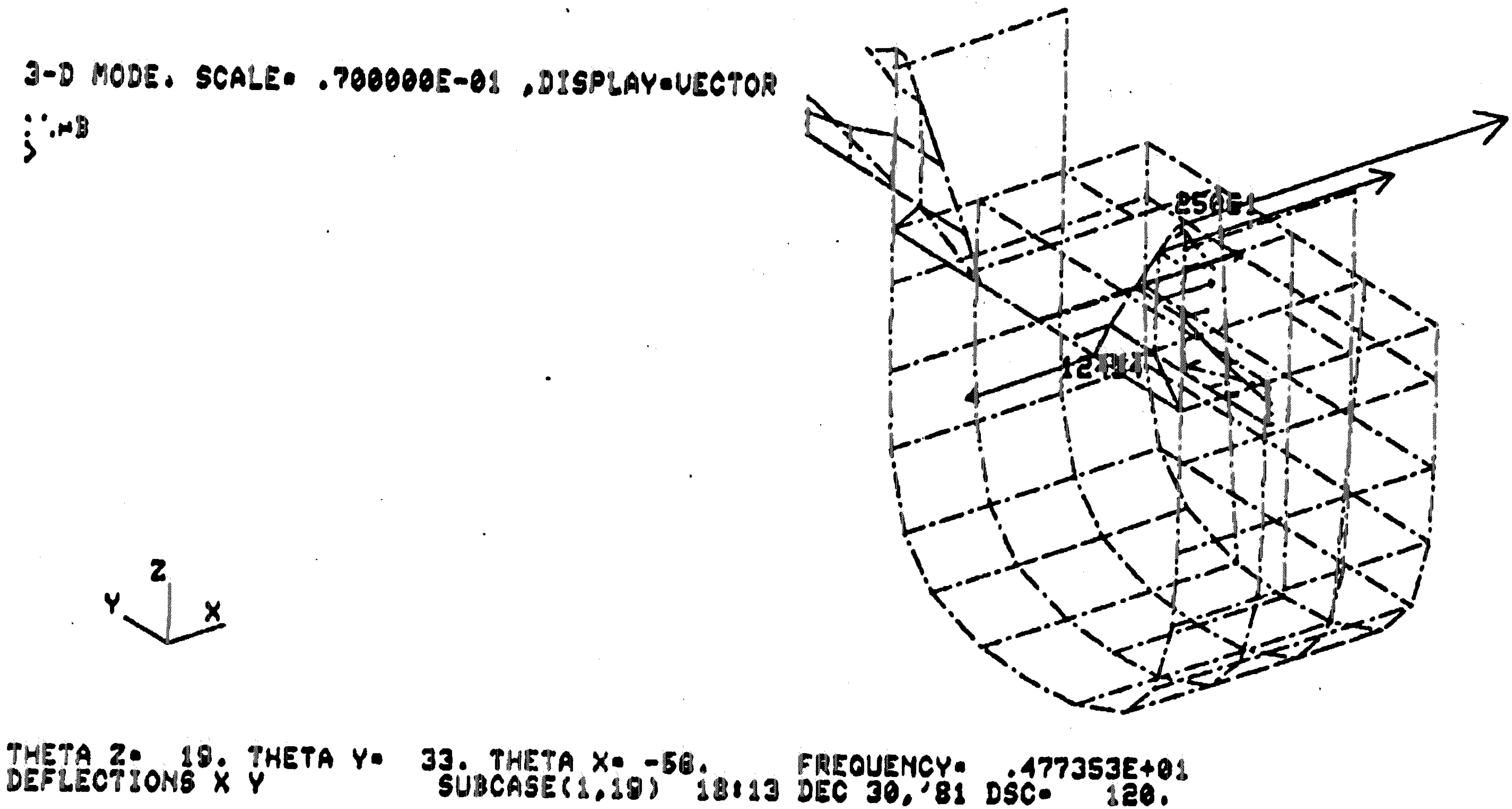
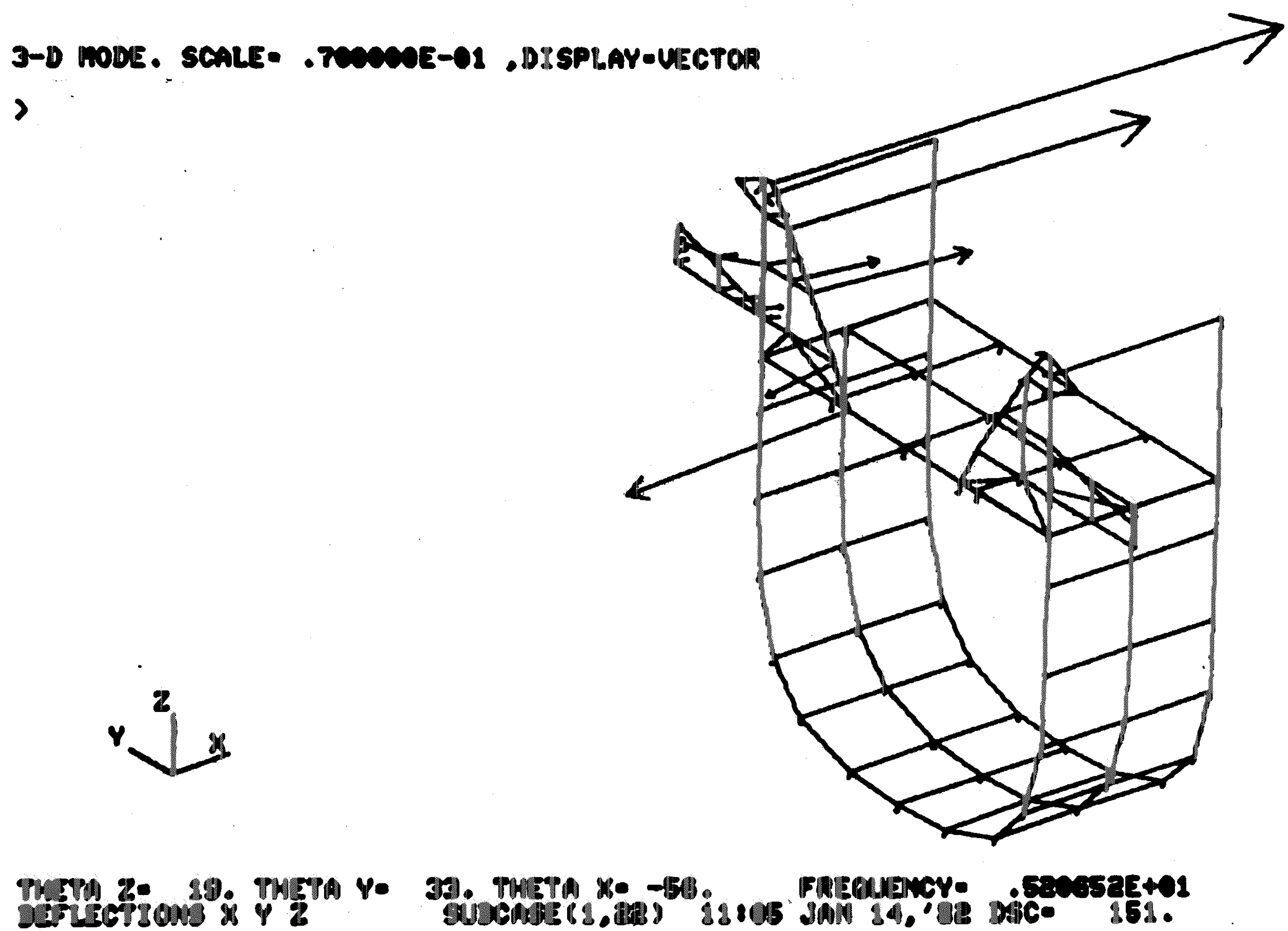


Figure 9. First Symmetric Wing Bending



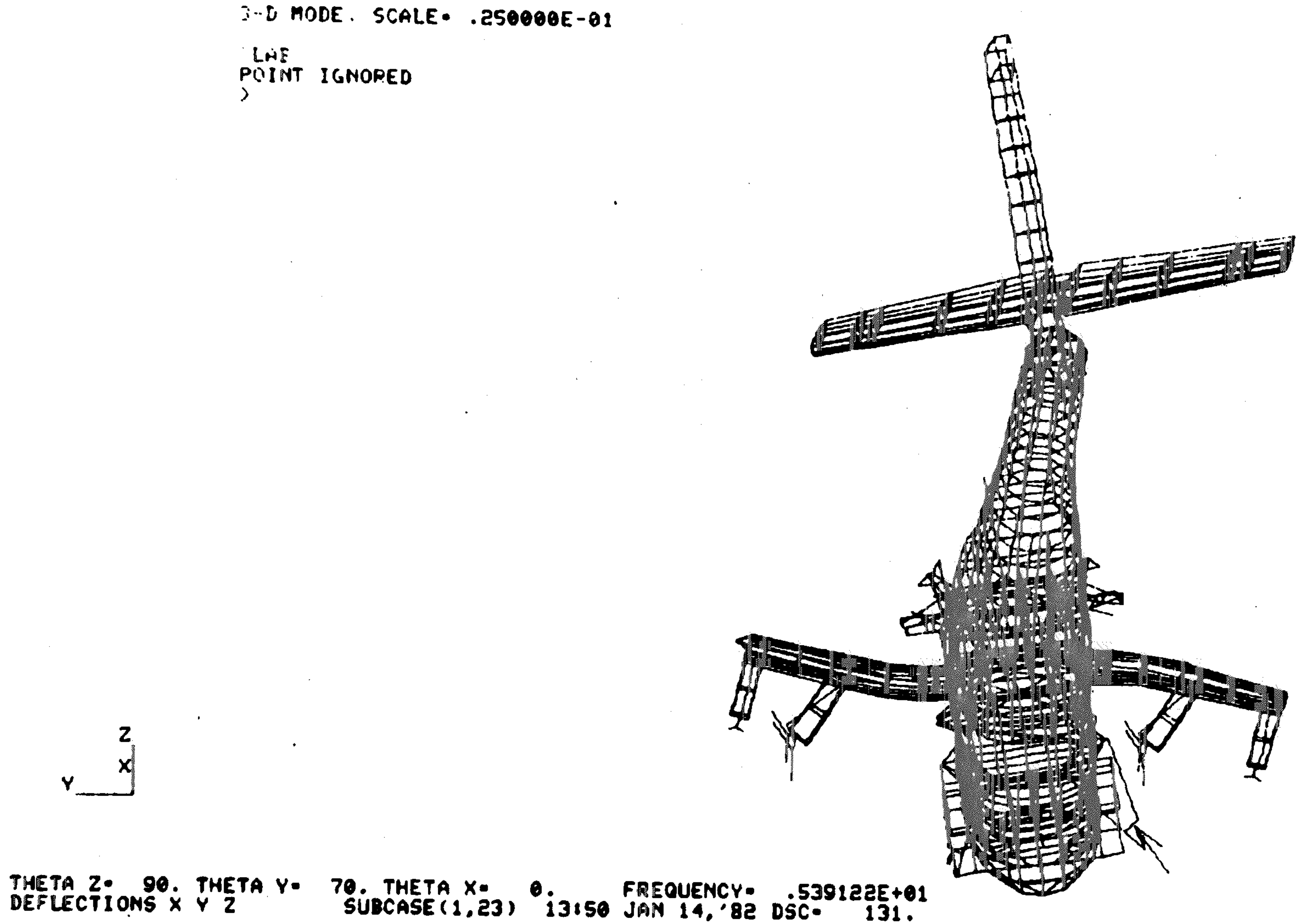
820019-22

Figure 10. Local Engine



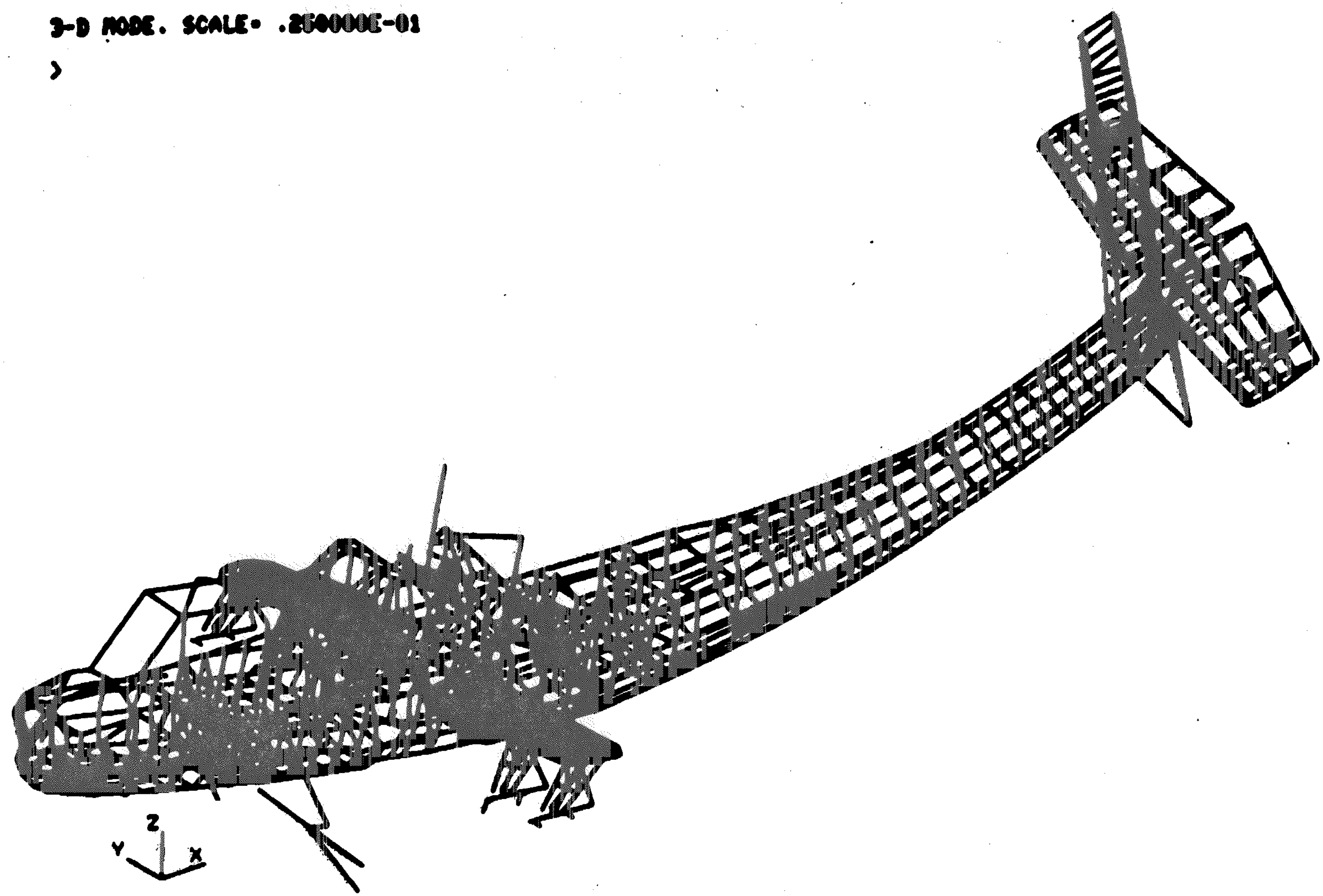
820019-23

Figure 11. Local Engine



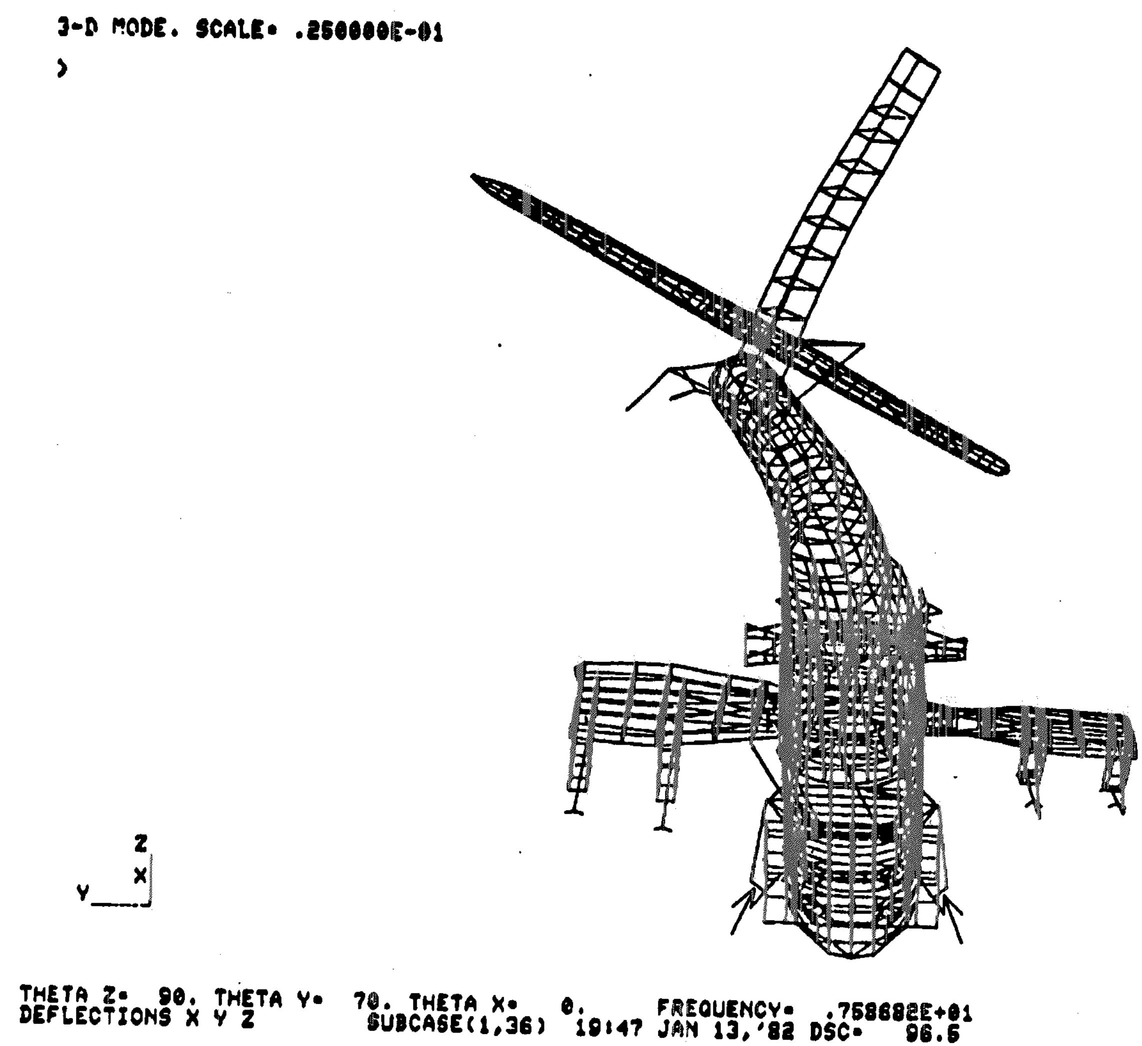
820019-4

Figure 12. First Antisymmetric Wing Bending



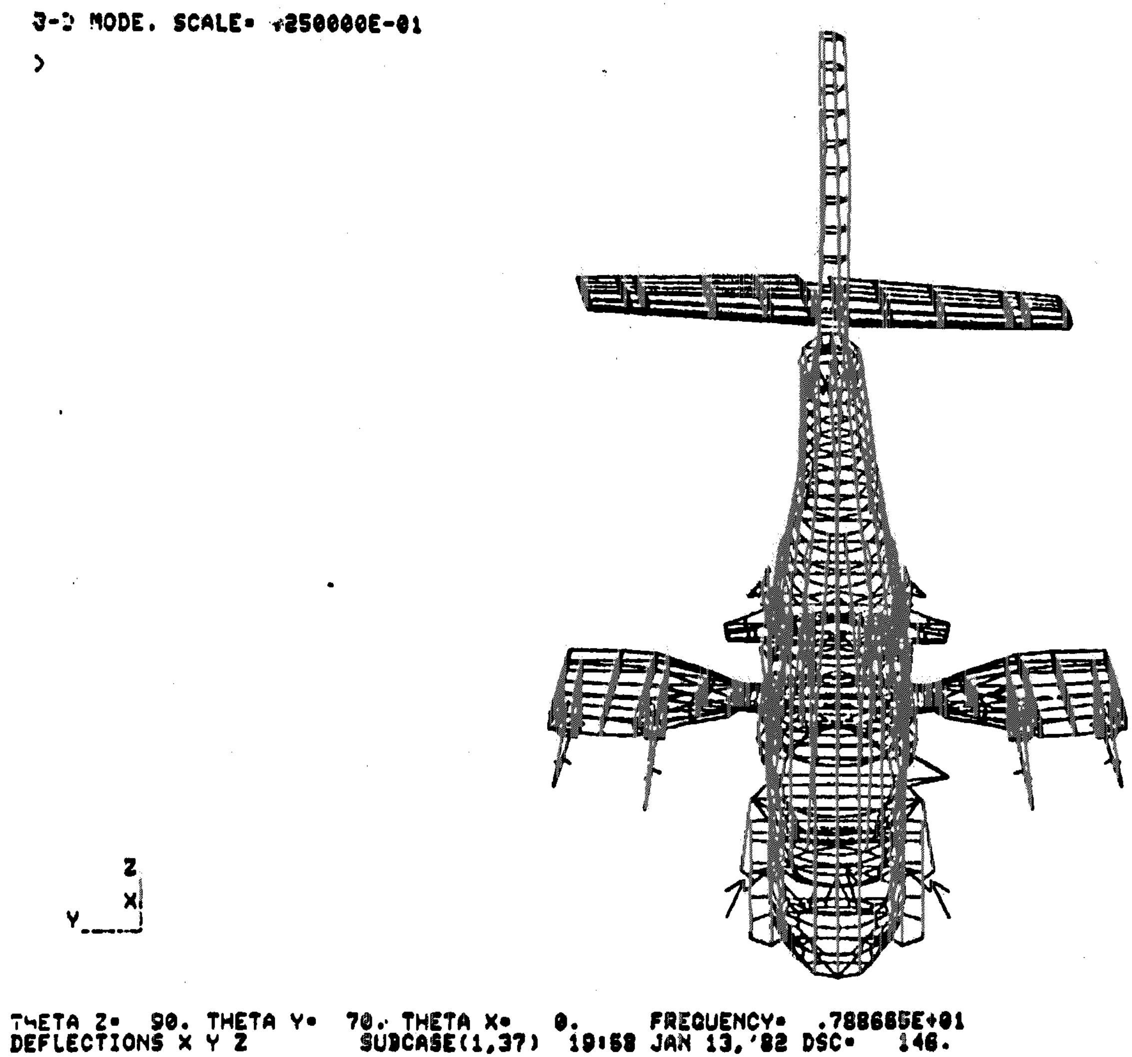
820019-19

Figure 13. First Vertical Bending



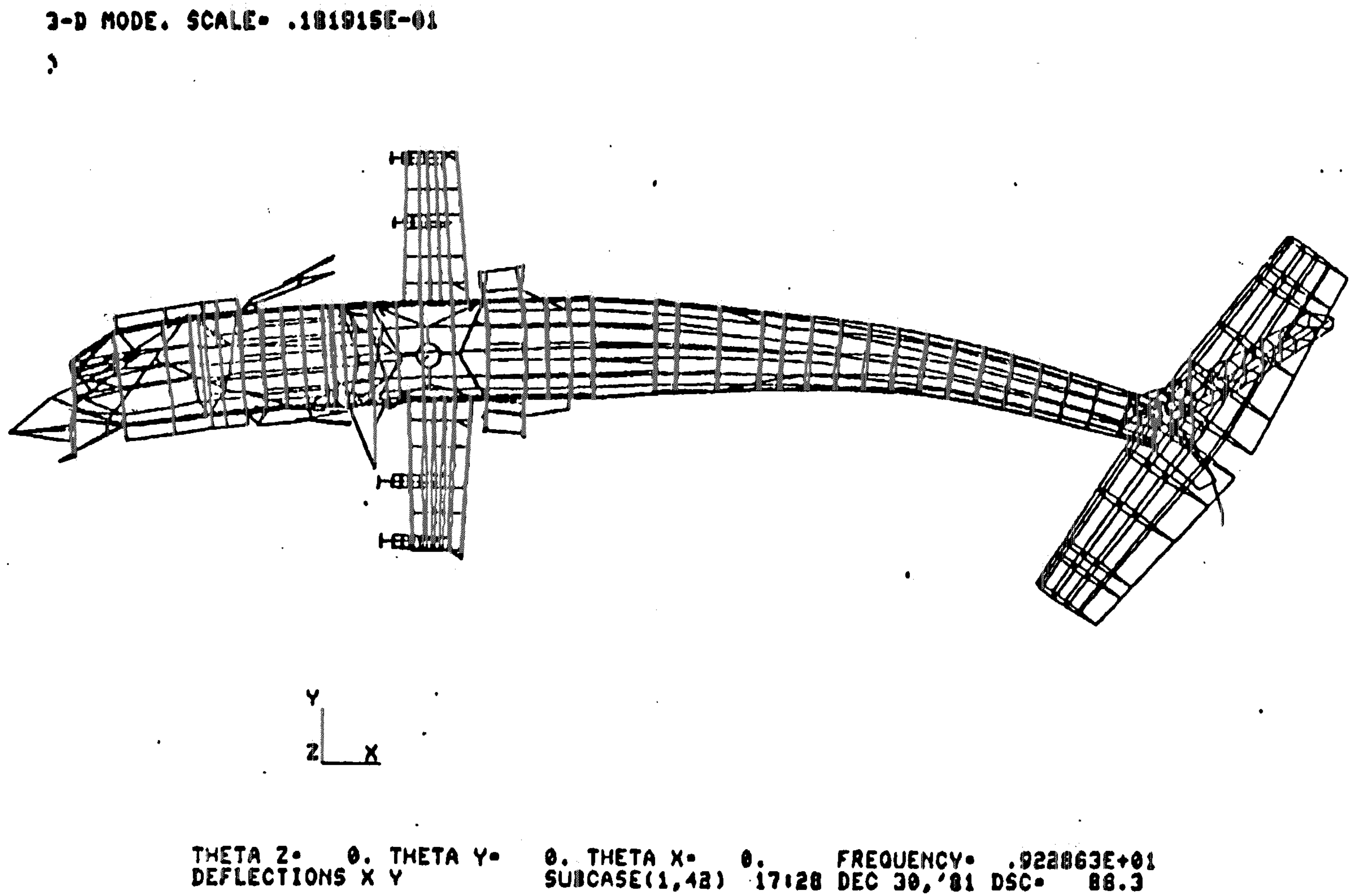
820019-24

Figure 14. First Antisymmetric Wing/Pylon Torsion



820019-25

Figure 15. First Symmetric Wing/Pylon Torsion



820019-26

Figure 16. First Lateral Bending

MODE NUMBER 7	FREQUENCY EQUALS		1.4140E-01 Hz
	ID	KE	DISP
1	262-T1	72.07	4.3136E-01
2	10004-R2	8.20	8.9917E-05
3	10006-T2	7.56	-3.0228E-05
4	193-T1	2.37	3.3316E-01
5	231-R2	1.78	3.7868E-01
6	222-T2	1.66	3.6391E-01
7	263-T3	1.19	5.5441E-02
8	10002-T1	0.90	-4.6619E-03
9	241-R3	0.75	3.8368E-01
10	266-R2	0.51	1.0280E-03
11	133-T2	0.48	1.0588E-01
12	183-T1	0.39	2.9929E-01
13	212-T1	0.30	3.4925E-01
14	203-T1	0.29	3.4108E-01
15	173-T3	0.26	2.5161E-01
16	163-T2	0.18	2.0481E-01
17	10005-R2	0.14	4.2413E-06
18	143-R1	0.13	1.1495E-01
19	153-T1	0.11	1.5917E-01
20	192-R1	0.11	7.0932E-02

Figure 17. Modal Kinetic Energy