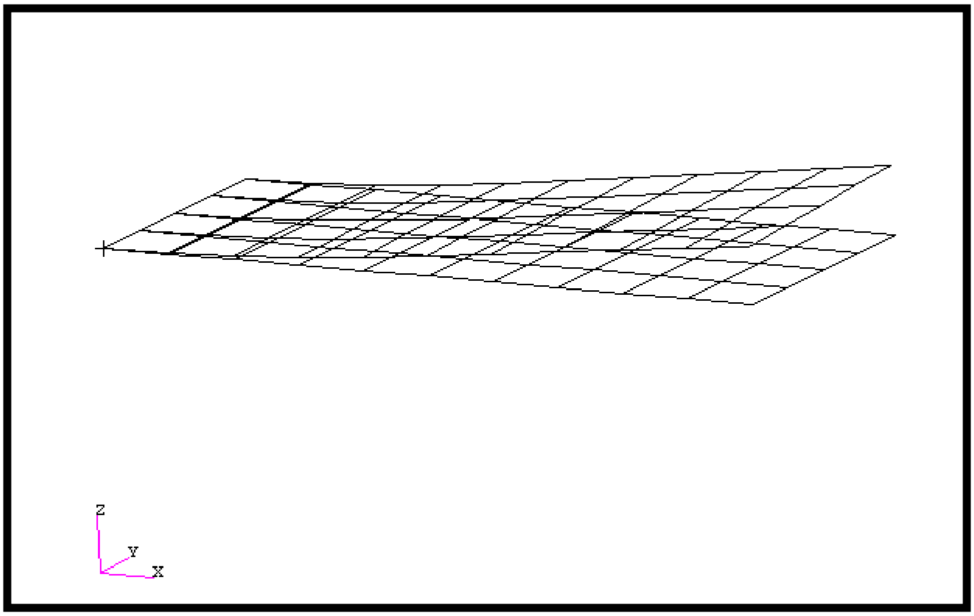
WORKSHOP PROBLEM 10

Random Analysis

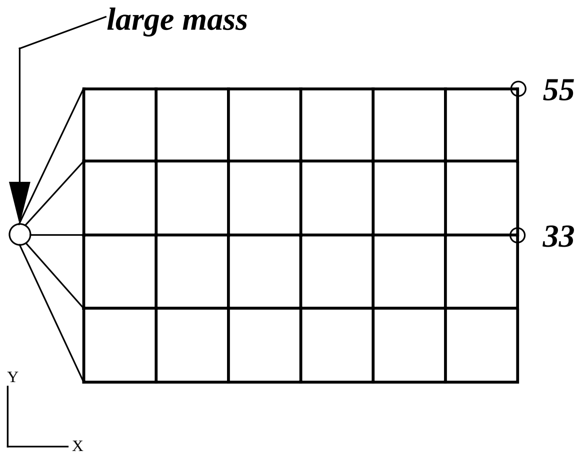


Objectives:

- Define a frequency-varying excitation.
- Define load set power spectral density functions.
- Produce a MSC/NASTRAN input file from a dynamic math model created in Workshop 1.
- Submit the file for random analysis in MSC/NASTRAN.
- Compute nodal displacements for desired frequency domain.

Model Description:

For the plate model, enforce a base motion in the z-direction described by the following power spectral density, (PSD).



Autospectra of the Base Excitation	
Frequency (Hz)	**G^2/Hz**
20	**0.1**
30	**1**
100	**1**
500	**0.1**
1000	**0.1**

Use the modal method with a large mass attached to the edge with an RBE2 entry.

Below is a finite element representation of the flat plate. It also contains the loads and boundary constraints.

Determine:

- The response displacement and acceleration PSD at the drive location, (the large mass).
- The displacement PSD at the corner and center of the free edge, (Grids 33 and 55).
- Use modal solution.
- Assume a constant critical damping ratio of 3% across the whole frequency range.

Suggested Exercise Steps:

- Reference a previously created dynamic math model, **plate.bdf**, by using the INCLUDE statement.
- Attach the large mass to the edge of the plate (CONM2 and RBE2).
- Specify modal damping as a tabular function of natural frequency (TABDMP1).
- Define the frequency-varying tip load (DAREA and RLOAD2).
- Define a set of frequencies to be used in the solution (FREQ, FREQ1, and FREQ 4).
- Specify Spectral Density (RANDPS and TABRND1).
- Prepare the model for a direct transient analysis (SOL 111).
- Request acceleration responses at base, tip center, and opposite corner.
- Generate an input file and submit it to the MSC/NASTRAN solver for direct transient analysis.
- Review the results.

```
ID SEMINAR,PROB10
```

```
CEND
```

BEGIN BULK

1	2	3	4	5	6	7	8	9	10

1	2	3	4	5	6	7	8	9	10

ENDDATA

Generating an input file for MSC/NASTRAN Users:

MSC/NASTRAN users can generate an input file using the data from pages 10-3 (general model description). The result should be similar to the output below.

1. MSC/NASTRAN input file: **prob10.dat**.

```
ID SEMINAR, PROB10
SOL 111
TIME 30
CEND
TITLE= RANDOM ANALYSIS - BASE EXCITATION
SUBTITLE= USING THE MODAL METHOD WITH LANCZOS
ECHO= UNSORTED
SPC= 101
SET 111= 33, 55, 9999
ACCELERATION(SORT2, PHASE)= 111
METHOD= 100
FREQUENCY= 100
SDAMPING= 100
RANDOM= 100
DLOAD= 100
$
OUTPUT(XYPLOT)
XTGRID= YES
YTGRID= YES
XBGRID= YES
YBGRID= YES
YTLOG= YES
XTITLE= FREQUENCY
YTTITLE= ACCEL RESPONSE BASE, MAGNITUDE
YBTITLE= ACCEL RESPONSE AT BASE, PHASE
XYPLOT ACCEL RESPONSE / 9999 (T3RM, T3IP)
YTTITLE= ACCEL RESPONSE AT TIP CENTER, MAGNITUDE
YBTITLE= ACCEL RESPONSE AT TIP CENTER, PHASE
XYPLOT ACCEL RESPONSE / 33 (T3RM, T3IP)
YTTITLE= ACCEL RESPONSE AT OPPOSITE CORNER, MAGNITUDE
YBTITLE= ACCEL RESPONSE AT OPPOSITE CORNER, PHASE
XYPLOT ACCEL RESPONSE / 55 (T3RM, T3IP)
$
$ PLOT OUTPUT IS ONLY MEANS OF VIEWING PSD DATA
$
XGRID= YES
YGRID= YES
```

```
XLOG= YES
YLOG= YES
YTITLE= ACCEL P S D AT LOADED CORNER
XYPLOT ACCEL PSDF / 9999(T3)
YTITLE= ACCEL P S D AT TIP CENTER
XYPLOT ACCEL PSDF / 33(T3)
YTITLE= ACCEL P S D AT OPPOSITE CORNER
XYPLOT ACCEL PSDF / 55(T3)
$
BEGIN BULK
PARAM,COUPMASS,1
PARAM,WTMASS,0.00259
$
INCLUDE ’plate.bdf’
$
GRID, 9999, , 0., 0., 0.
$
RBE2, 101, 9999, 12345, 1, 12, 23, 34, 45
$
SPC1, 101, 12456, 9999
$
CONM2, 6000, 9999, , 1.0E8
$
$ EIGENVALUE EXTRACTION PARAMETERS
$
EIGRL, 100 , , 2000.
$
$ SPECIFY MODAL DAMPING
$
TABDMP1, 100, CRIT,
+, 0., .03, 10., .03, ENDT
$
$ POINT LOADING AT TIP CENTER
$
RLOAD2, 100, 600, , , 310
$
TABLED1, 310,
+, 10., 1., 1000., 1., ENDT
$
DAREA, 600, 9999, 3, 1.E8
$
$ SPECIFY FREQUENCY STEPS
$
```

```
FREQ,100,30.
FREQ1,100,20.,20.,50
FREQ4,100,20.,1000.,.03,5
$
$ SPECIFY SPECTRAL DENSITY
$
RANDPS, 100, 1, 1, 1., 0., 111
$
TABRND1, 111,LOG,LOG
+, 20., 0.1, 30., 1., 100., 1., 500., .1,
+, 1000., .1, ENDT
$
ENDDATA
```

Submitting the input file:

2. Submit the input file to MSC/NASTRAN for analysis.

   To submit the MSC/NASTRAN **.dat** file, find an available UNIX shell window and at the command prompt enter **nastran prob10 scr=yes**. Monitor the run using the UNIX **ps** command.

3. When the run is completed, use **plotps** utility to create a postscript file, **prob10.ps**, from the binary plot file **prob10.plt**. The nonlinear force and displacement plots are shown on the following pages.

4. When the run is completed, edit the **prob10.f06** file and search for the word **FATAL**. If no matches exist, search for the word **WARNING**. Determine whether existing WARNING messages indicate modeling errors.

Comparison of Results

5. Compare the plot made from the exercise with the plots on the following pages.

Figure 10.1

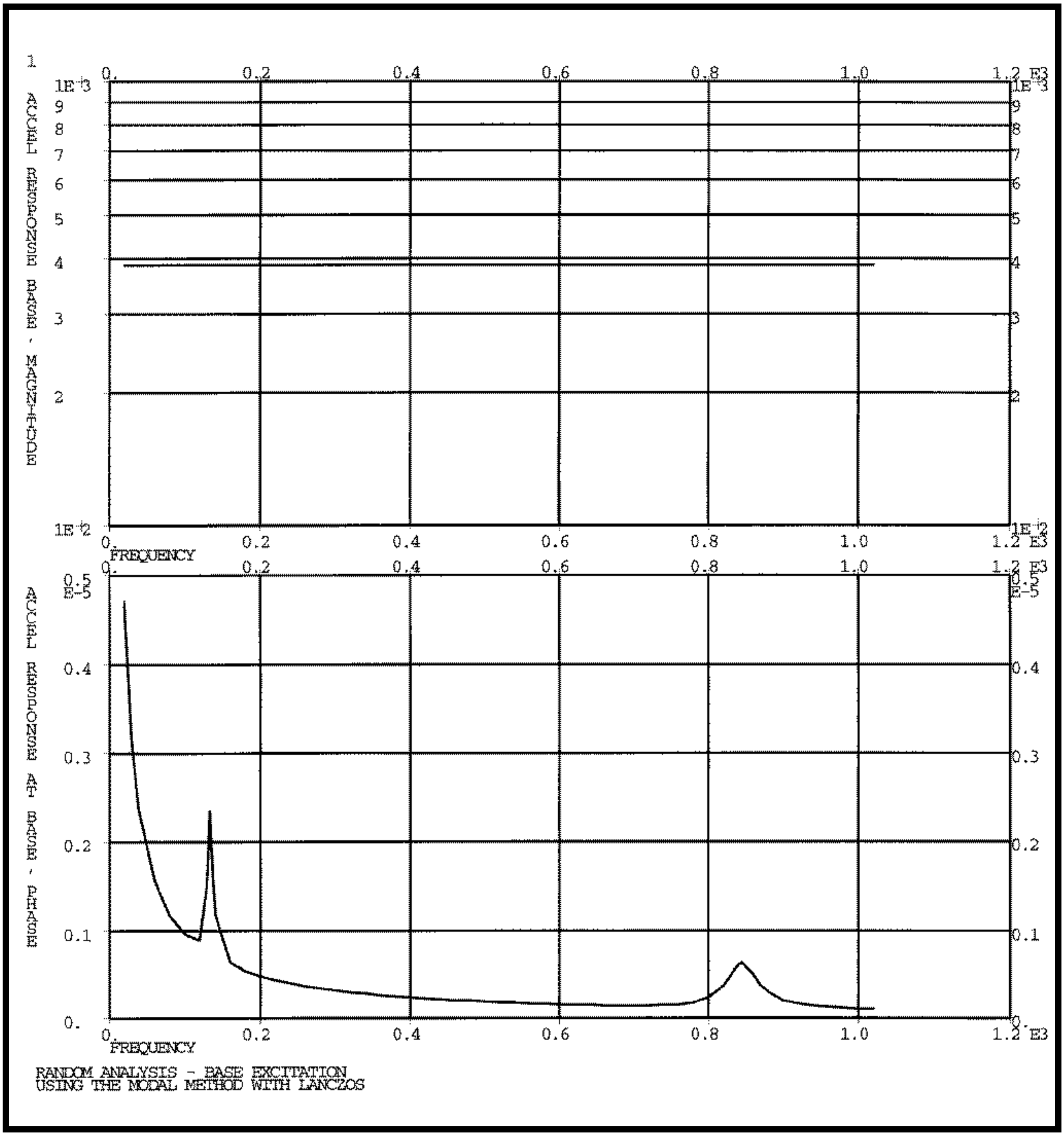

ACCEL RESPONSE BASE - MAGNITUDE
ACCEL RESPONSE AT BASE - PHASE
FREQUENCY
1E-3
1E-2
0.5 E-5
E3
RANDOM ANALYSIS - BASE EXCITATION
USING THE MODAL METHOD WITH LANCZOS

Figure 10.2

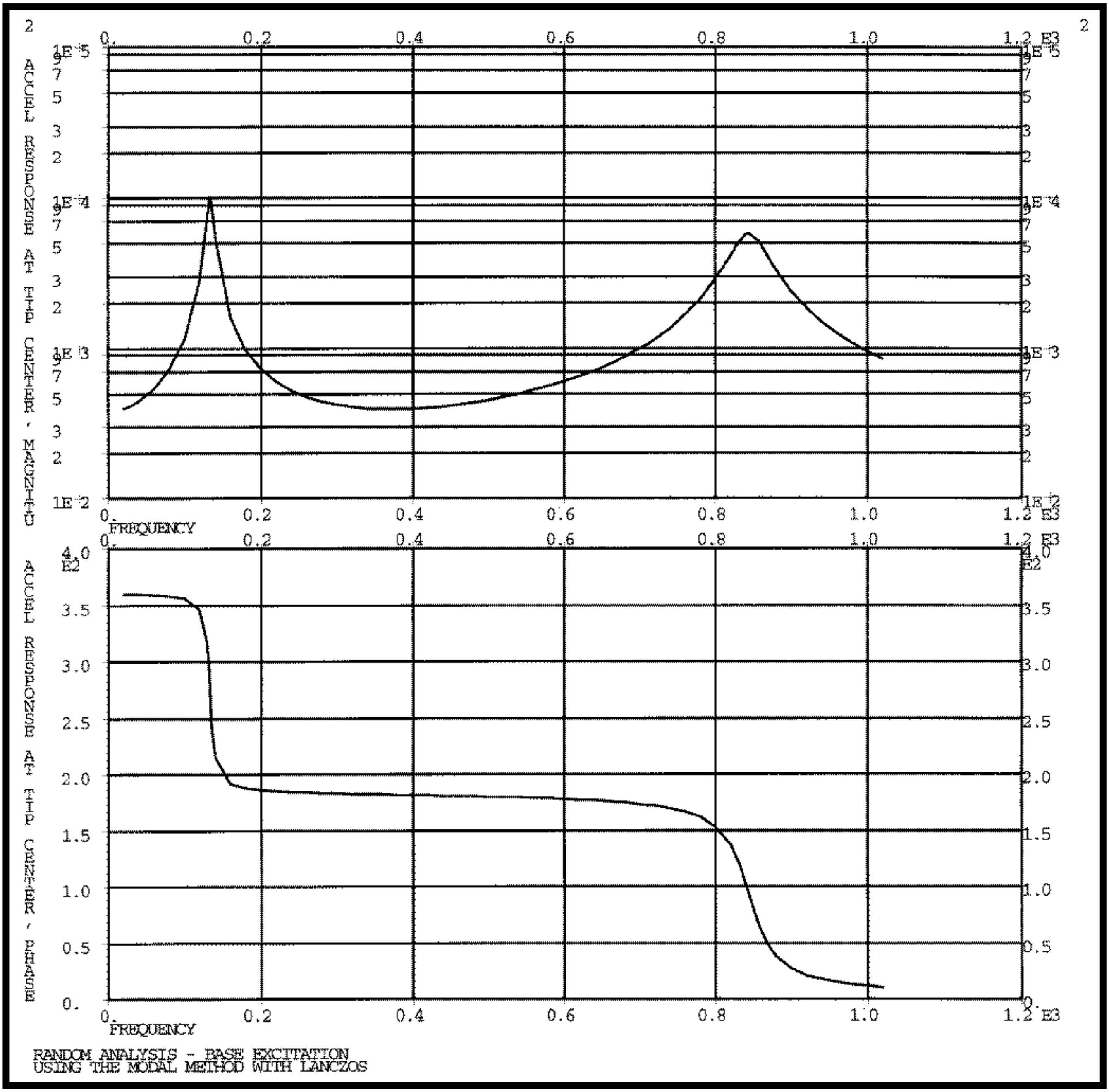

ACCEL RESPONSE AT TIP CENTER, MAGNITU
ACCEL RESPONSE AT TIP CENTER, PHASE
FREQUENCY
0. 0.2 0.4 0.6 0.8 1.0 1.2 E3
1E-5 1E-4 1E-3 1E-2
4.0 E2 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.
RANDOM ANALYSIS - BASE EXCITATION
USING THE MODAL METHOD WITH LANCZOS

Figure 10.3

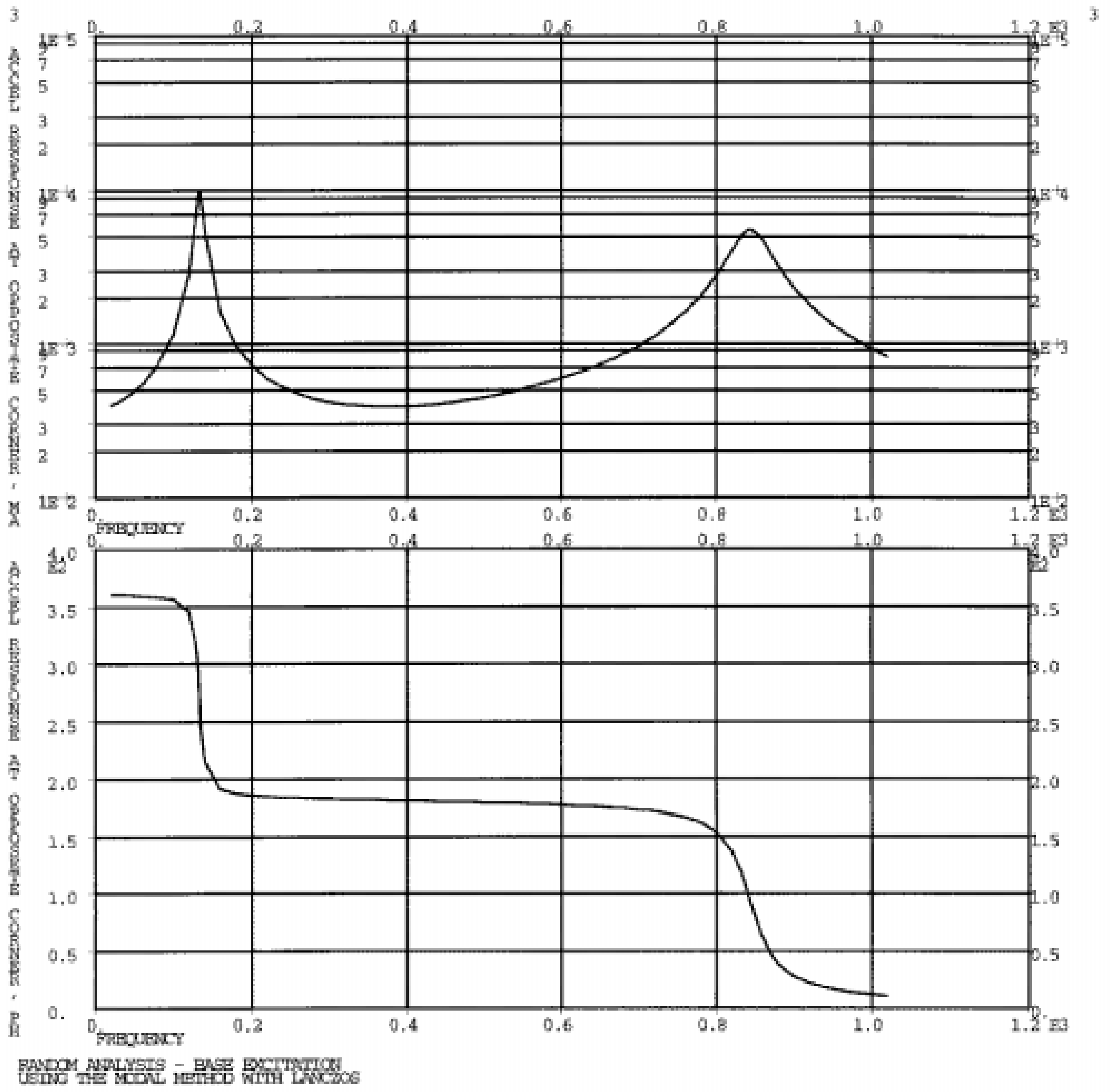

ACCEL RESPONSE AT OPPOSITE CORNER - MA
ACCEL RESPONSE AT OPPOSITE CORNER - PH
FREQUENCY
FREQUENCY
0. 0.2 0.4 0.6 0.8 1.0 1.2 E3
1E-5
1E-4
1E-3
1E-2
4.0 E2
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.
RANDOM ANALYSIS - BASE EXCITATION
USING THE MODAL METHOD WITH LANCZOS

Figure 10.4

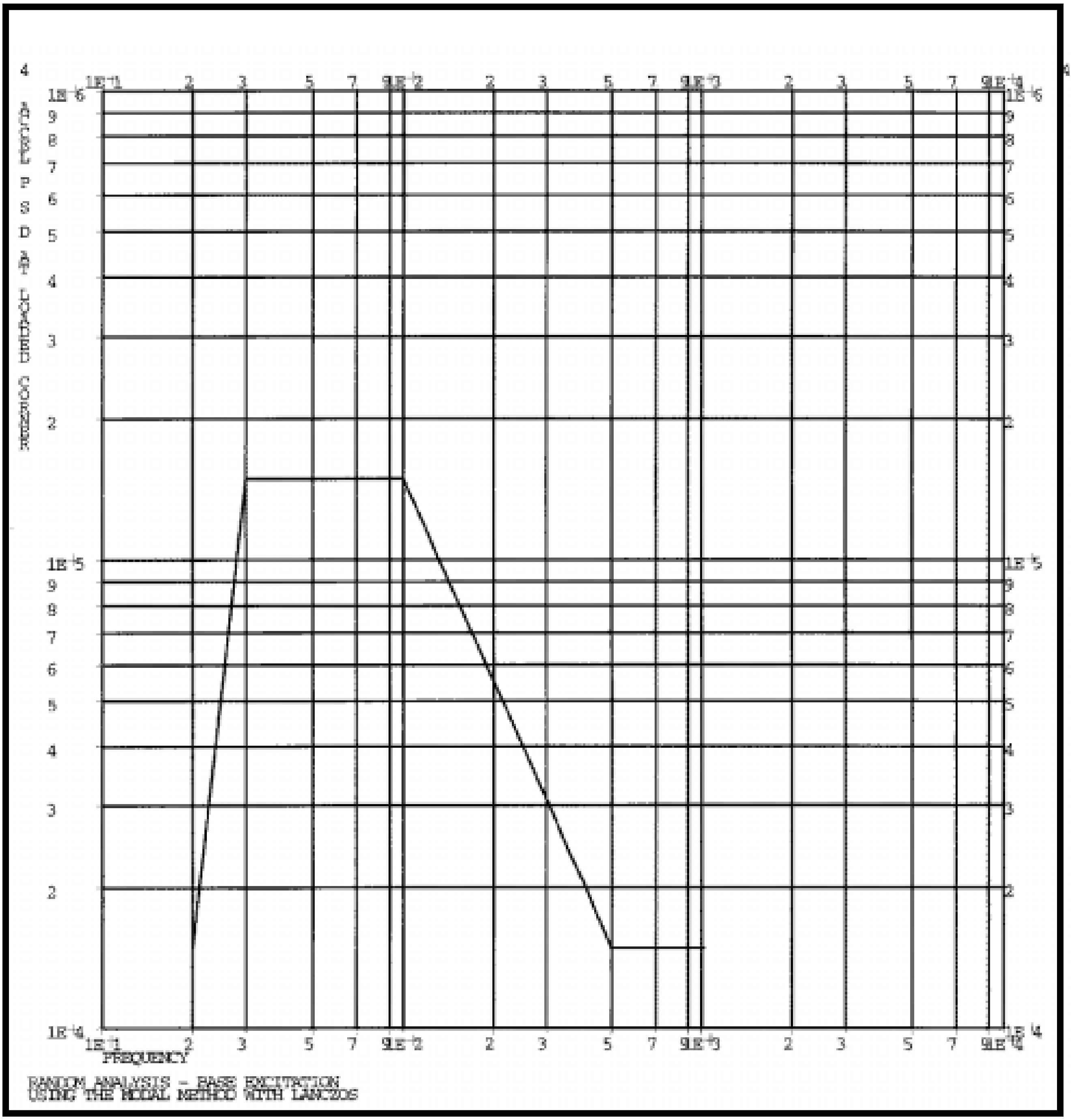

ACCEL P S D AT LOADED CORNER
FREQUENCY
RANDOM ANALYSIS - BASE EXCITATION
USING THE MODAL METHOD WITH LANCZOS

Figure 10.5

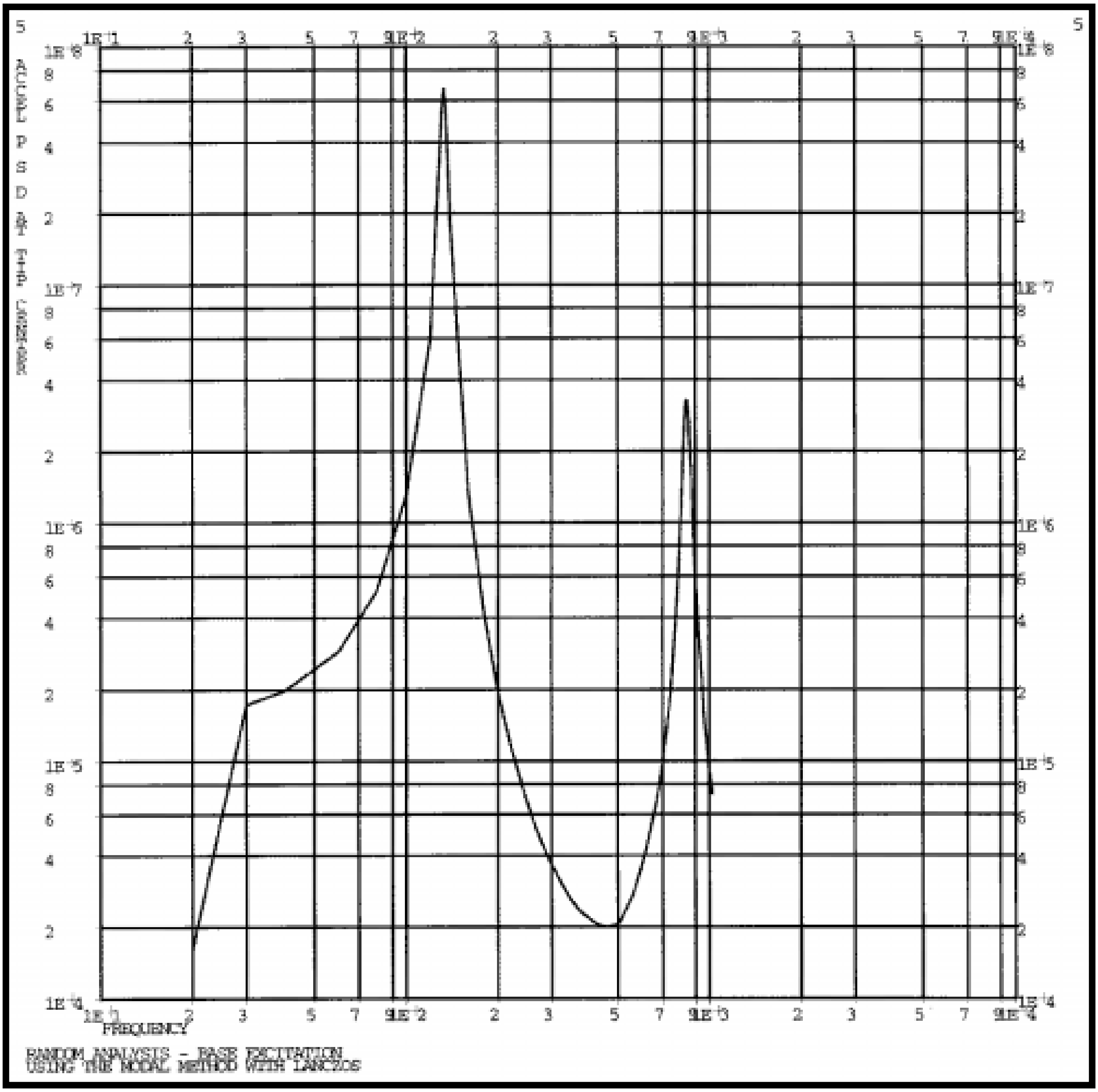
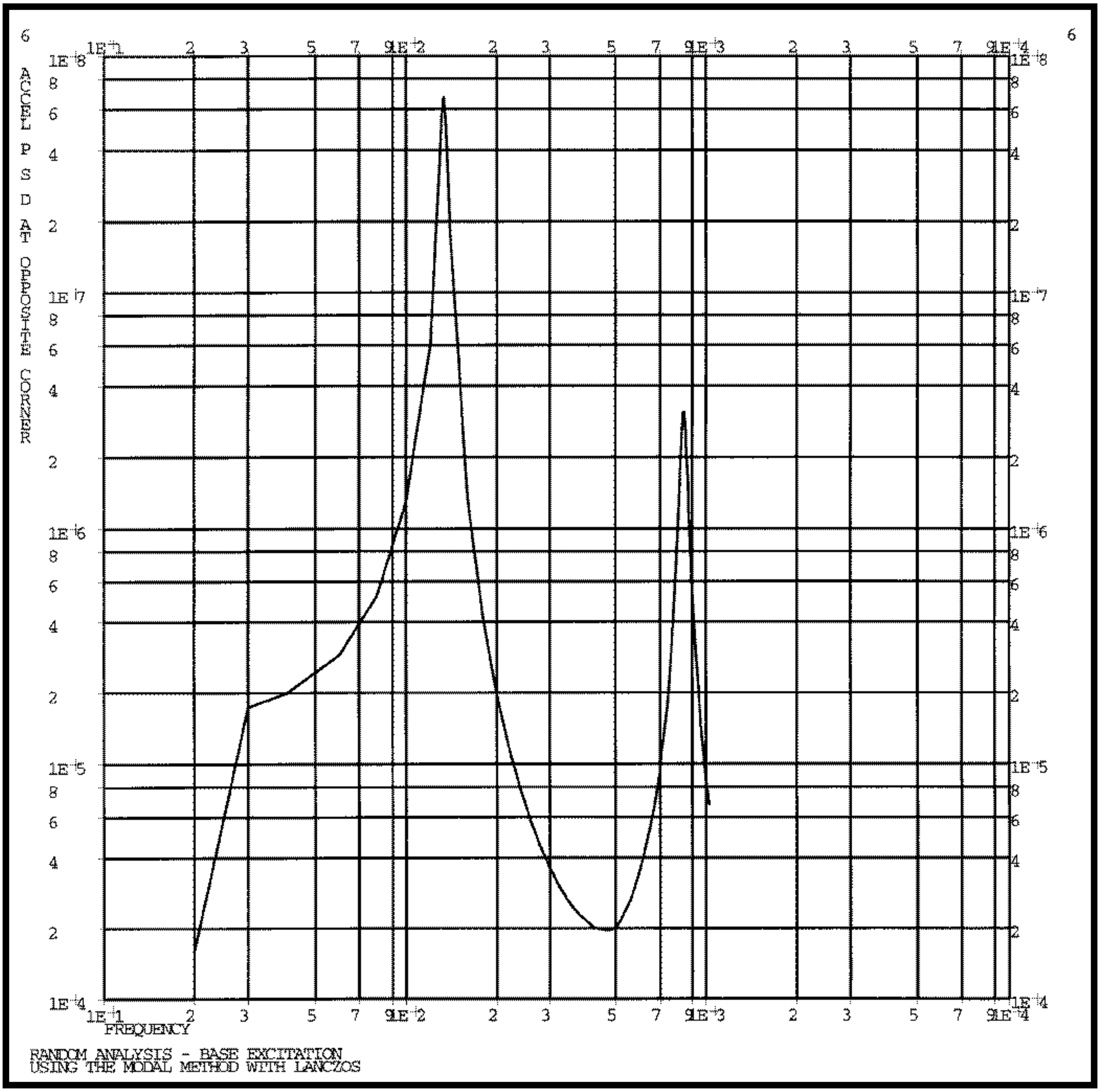

ACCEL PSD RESPONSE
FREQUENCY
RANDOM ANALYSIS - BASE EXCITATION
USING THE MODAL METHOD WITH LANCZOS

Figure 10.6


ACCEL PSD AT OPPOSITE CORNER
FREQUENCY
RANDOM ANALYSIS - BASE EXCITATION
USING THE MODAL METHOD WITH LANCZOS