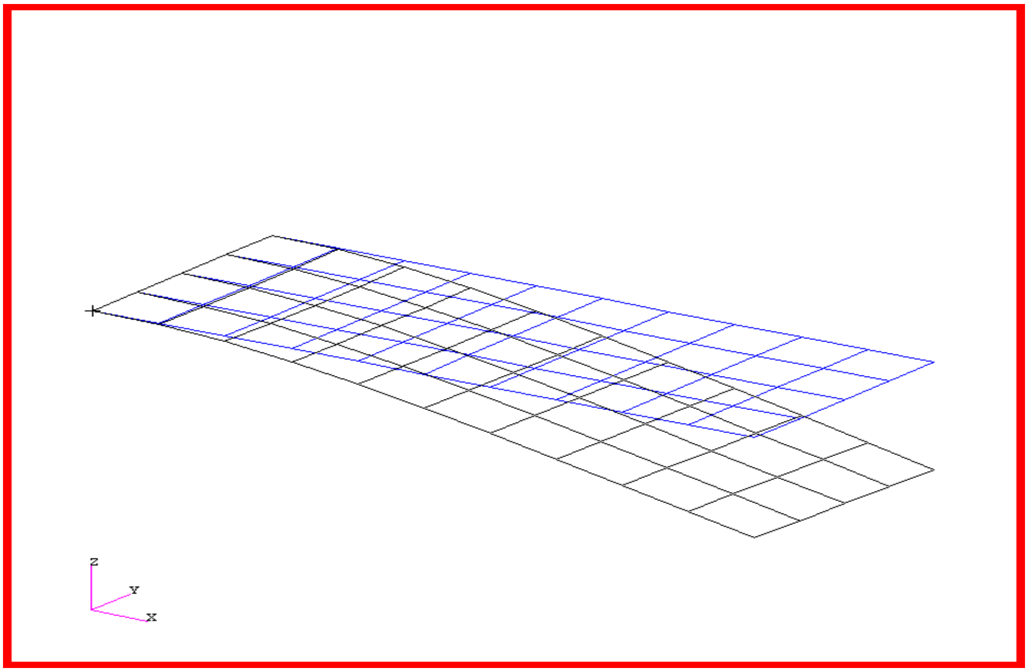
WORKSHOP PROBLEM 11

Random Analysis



Objectives:

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

Model Description:

Using the modal method, determine the displacement response spectrum of the tip center point due to the input spectrum of the pressure and point loads listed below. Solve using the complex matrix representation [Sab] for the cross spectrum.

Table 11.1

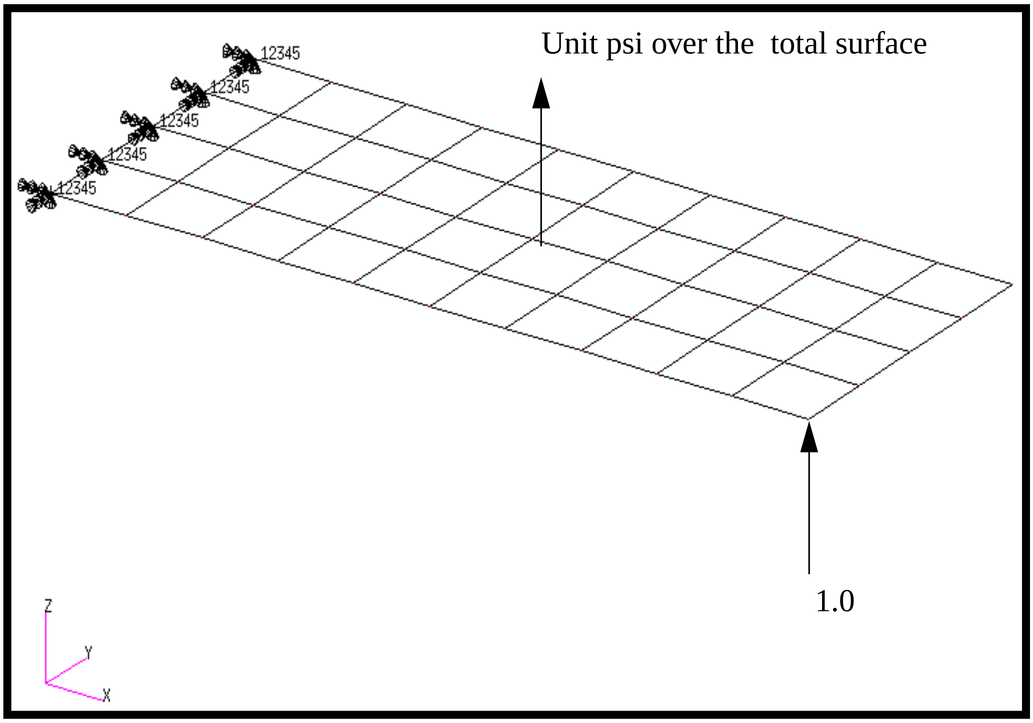
Autospectra of Pressure Load		**Autospectra of Corner Load**	
Frequency (Hz)	**psi^2/Hz**	**Frequency (Hz)**	**lb^2/Hz**
20	0.1	20	0.5
30	1	30	2.5
100	1	500	2.5
500	0.1	1000	0
1000	0.1		

Table 11.2

Cross-Spectrum of Pressure and Corner Loads Real/ Imaginary		
Frequency (Hz)	**Real Part**	**Imaginary Part**
20	-0.099619	0.007816
100	-0.498097	0.043579
500	0.070711	-0.070711
1000	0	0

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

Figure 11.1-Loads and Boundary Conditions



Suggested Exercise Steps:

- Reference a previously created dynamic math model, **plate.bdf**, by using the INCLUDE statement.
- Specify modal damping as a tabular function of natural frequency (TABDMP1).
- Define the frequency-varying pressure loading (PLOAD2, LSEQ and RLOAD2).
- Define the frequency-varying tip load (DAREA and RLOAD2).
- Define a set of frequencies to be used in the solution (FREQ1).
- Specify spectral density (RANDPS and TABRND1).
- Prepare the model for a random analysis (SOL 111).
- Request displacement response at loaded corner, tip center, and opposite corner.
- Generate an input file and submit it to the MSC/NASTRAN solver for random analysis.
- Review the results, specifically the nodal displacements.

```
ID SEMINAR,PROB11
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 11-3 (general model description). The result should be similar to the output below.

1. MSC/NASTRAN input file: **prob11.dat**.

```
ID SEMINAR, PROB11
SOL 111
TIME 30
CEND
TITLE= FREQUENCY RESPONSE WITH PRESSURE AND POINT LOADS
SUBTITLE= USING THE MODAL METHOD WITH LANCZOS
ECHO= UNSORTED
SPC= 1
SET 111= 11, 33, 55
DISPLACEMENT(SORT2, PHASE)= 111
METHOD= 100
FREQUENCY= 100
SDAMPING= 100
RANDOM= 100
SUBCASE 1
LABEL= PRESSURE LOAD
DLOAD= 100
LOADSET= 100
SUBCASE 2
LABEL CORNER LOAD
DLOAD= 200
LOADSET= 100
$
OUTPUT (XYPLOT)
$
XTGRID= YES
YTGRID= YES
XBGRID= YES
YBGRID= YES
YTLOG= YES
YBLOG= NO
XTITLE= FREQUENCY (HZ)
YTTITLE= DISPLACEMENT RESPONSE AT LOADED CORNER, MAGNITUDE
YBTITLE= DISPLACEMENT RESPONSE AT LOADED CORNER, PHASE
XYPLOT DISP RESPONSE / 11 (T3RM, T3IP)
YTTITLE= DISPLACEMENT RESPONSE AT TIP CENTER, MAGNITUDE
```

```
YBTITLE= DISPLACEMENT RESPONSE AT TIP CENTER, PHASE
XYPLOT DISP RESPONSE / 33 (T3RM, T3IP)
YTTITLE= DISPLACEMENT RESPONSE AT OPPOSITE CORNER, MAGNITUDE
YBTITLE= DISPLACEMENT RESPONSE AT OPPOSITE CORNER, PHASE
XYPLOT DISP RESPONSE / 55 (T3RM, T3IP)
$
$ PLOT OUTPUT IS ONLY MEANS OF VIEWING PSD DATA
$
XGRID= YES
YGRID= YES
XLOG= YES
YLOG= YES
YTITLE= DISP P S D AT LOADED CORNER
XYPLOT DISP PSDF / 11(T3)
YTITLE= DISP P S D AT TIP CENTER
XYPLOT DISP PSDF / 33(T3)
YTITLE= DISP P S D AT OPPOSITE CORNER
XYPLOT DISP PSDF / 55(T3)
$
BEGIN BULK
$
PARAM,COUPMASS,1
$
PARAM,WTMASS,0.00259
$
$ MODEL DESCRIBED IN NORMAL MODES EXAMPLE
$
INCLUDE 'plate.bdf'
$
$ EIGENVALUE EXTRACTION PARAMETERS
$
EIGRL, 100, 10., 2000.
$
$ SPECIFY MODAL DAMPING
$
TABDMP1, 100, CRIT,
+, 0., .03, 10., .03, ENDT
$
$ FIRST LOADING
$
RLOAD2, 100, 300, , , 310
$
TABLED1, 310,
+, 10., 1., 1000., 1., ENDT
$
```

```
$ UNIT PRESSURE LOAD TO PLATE
$
LSEQ, 100, 300, 400
$
PLOAD2, 400, 1., 1, THRU, 40
$
$ SECOND LOADING
$
RLOAD2, 200, 600, , , 310
$
$ POINT LOAD AT TIP CENTER
$
DAREA, 600, 11, 3, 1.
$
$ SPECIFY FREQUENCY STEPS
$
FREQ1, 100, 20., 20., 49
$
$ SPECIFY SPECTRAL DENSITY
$
RANDPS, 100, 1, 1, 1., 0., 100
RANDPS, 100, 2, 2, 1., 0., 200
RANDPS, 100, 1, 2, 1., 0., 300
RANDPS, 100, 1, 2, 0., 1.0, 400
$
TABRND1, 100,
+, 20., 0.1, 30., 1., 100., 1., 500., .1,
+, 1000., .1, ENDT
$
TABRND1, 200,
+, 20., 0.5, 30., 2.5, 500., 2.5, 1000., 0.,
+, ENDT
$
TABRND1, 300,
+, 20., -.099619, 100., -.498097, 500., .070711, 1000., 0.,
+, ENDT
$
TABRND1, 400,
+, 20., .0078158, 100., .0435791, 500., -.70711, 1000., 0.,
+, ENDT
$
ENDDATA
```

Submitting the input file for analysis:

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

   2a. To submit the MSC/NASTRAN **.dat** file, find an available UNIX shell window and at the command prompt enter **nastran prob11 scr=yes**. Monitor the run using the UNIX **ps** command.

3. When the run is completed, use **plotps** utility to create a postscript file, **prob11.ps**, from the binary plot file **prob11.plt**. Compare the results with the plots below.

Figure 11.2

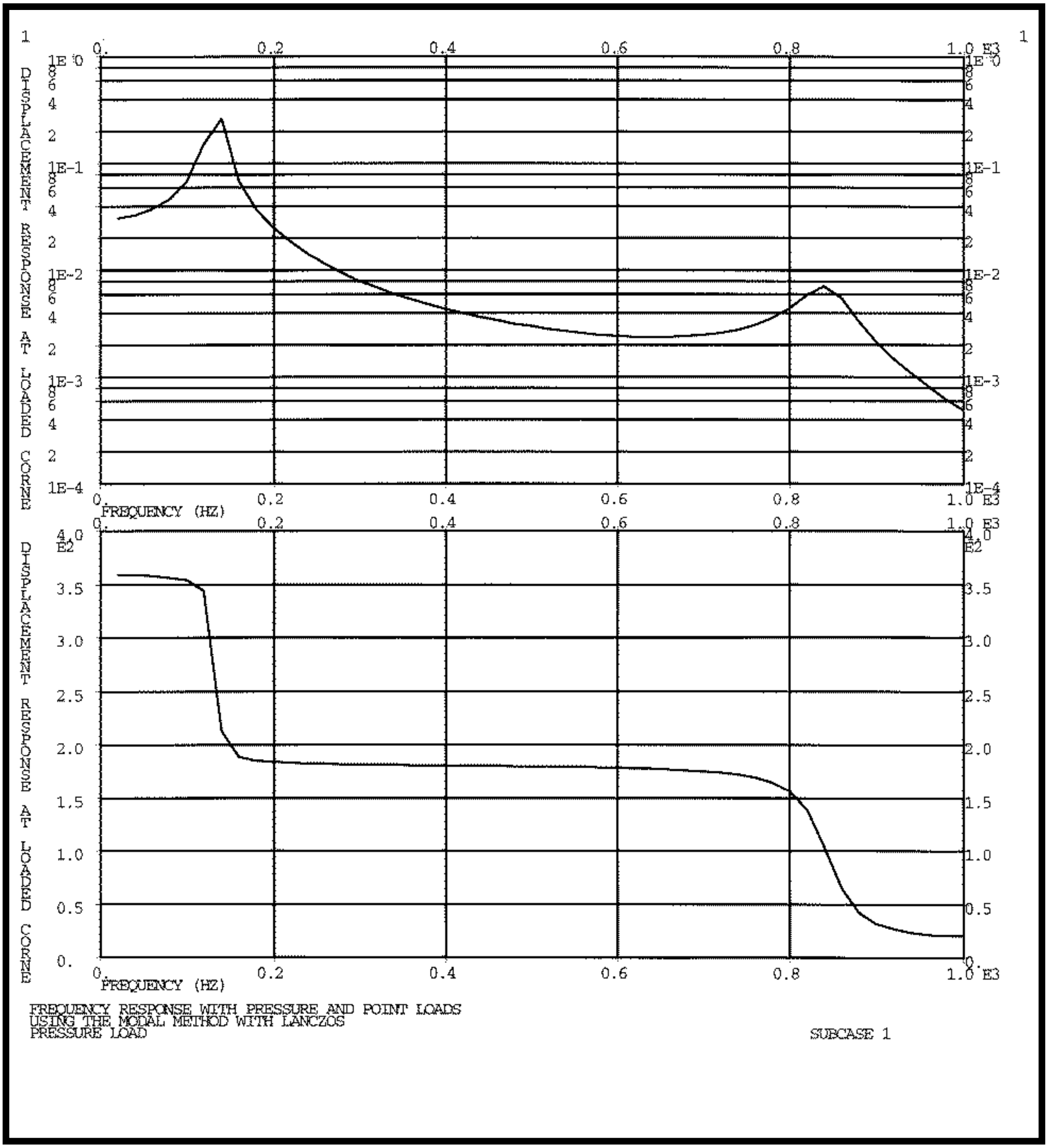

DISPLACEMENT RESPONSE AT LOADED CORNE
FREQUENCY (HZ)
DISPLACEMENT RESPONSE AT LOADED CORNE
FREQUENCY (HZ)
FREQUENCY RESPONSE WITH PRESSURE AND POINT LOADS
USING THE MODAL METHOD WITH LANCZOS
PRESSURE LOAD
SUBCASE 1

Figure 11.3

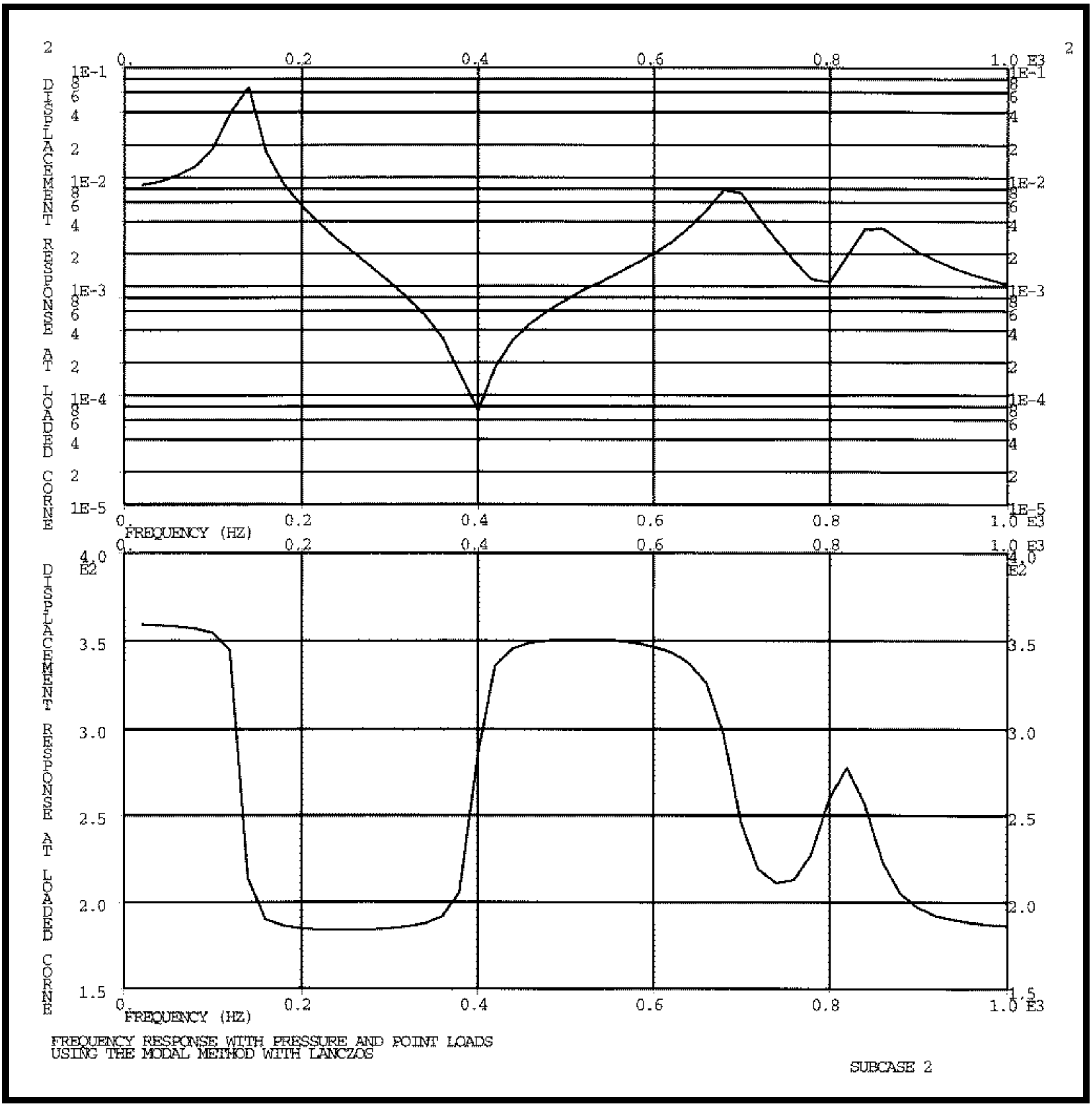
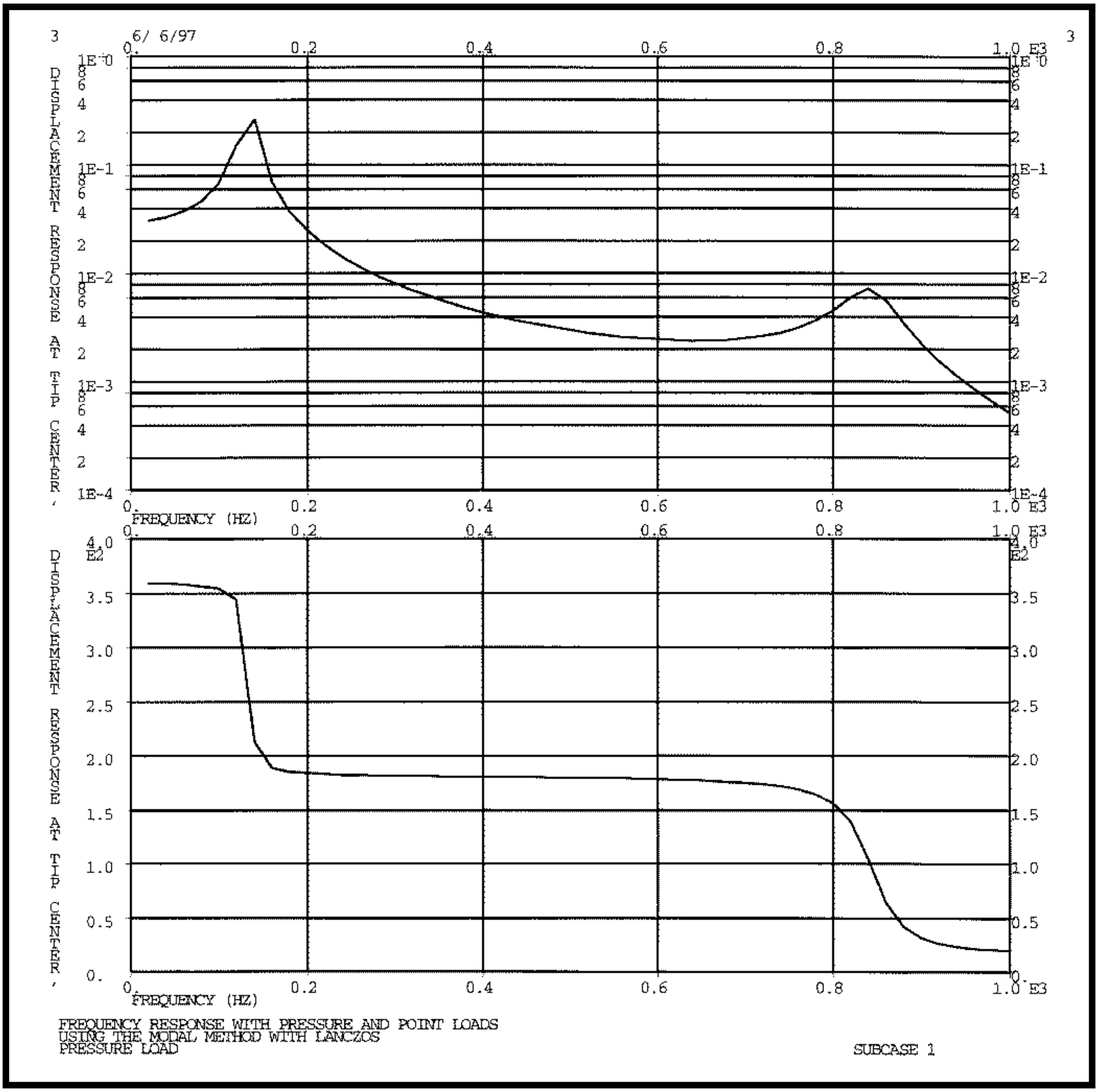

DISPLACEMENT RESPONSE AT LOADED CORNE
FREQUENCY (HZ)
DISPLACEMENT RESPONSE AT LOADED CORNE
FREQUENCY (HZ)
FREQUENCY RESPONSE WITH PRESSURE AND POINT LOADS
USING THE MODAL METHOD WITH LANCZOS
SUBCASE 2

Figure 11.4



6/ 6/97
DISPLACEMENT RESPONSE AT TIP CENTER,
FREQUENCY (HZ)
1E 0
1E-1
1E-2
1E-3
1E-4
0. 0.2 0.4 0.6 0.8 1.0 E3
4.0 E2
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.
FREQUENCY RESPONSE WITH PRESSURE AND POINT LOADS
USING THE MODAL METHOD WITH LANCZOS
PRESSURE LOAD
SUBCASE 1

Figure 11.5

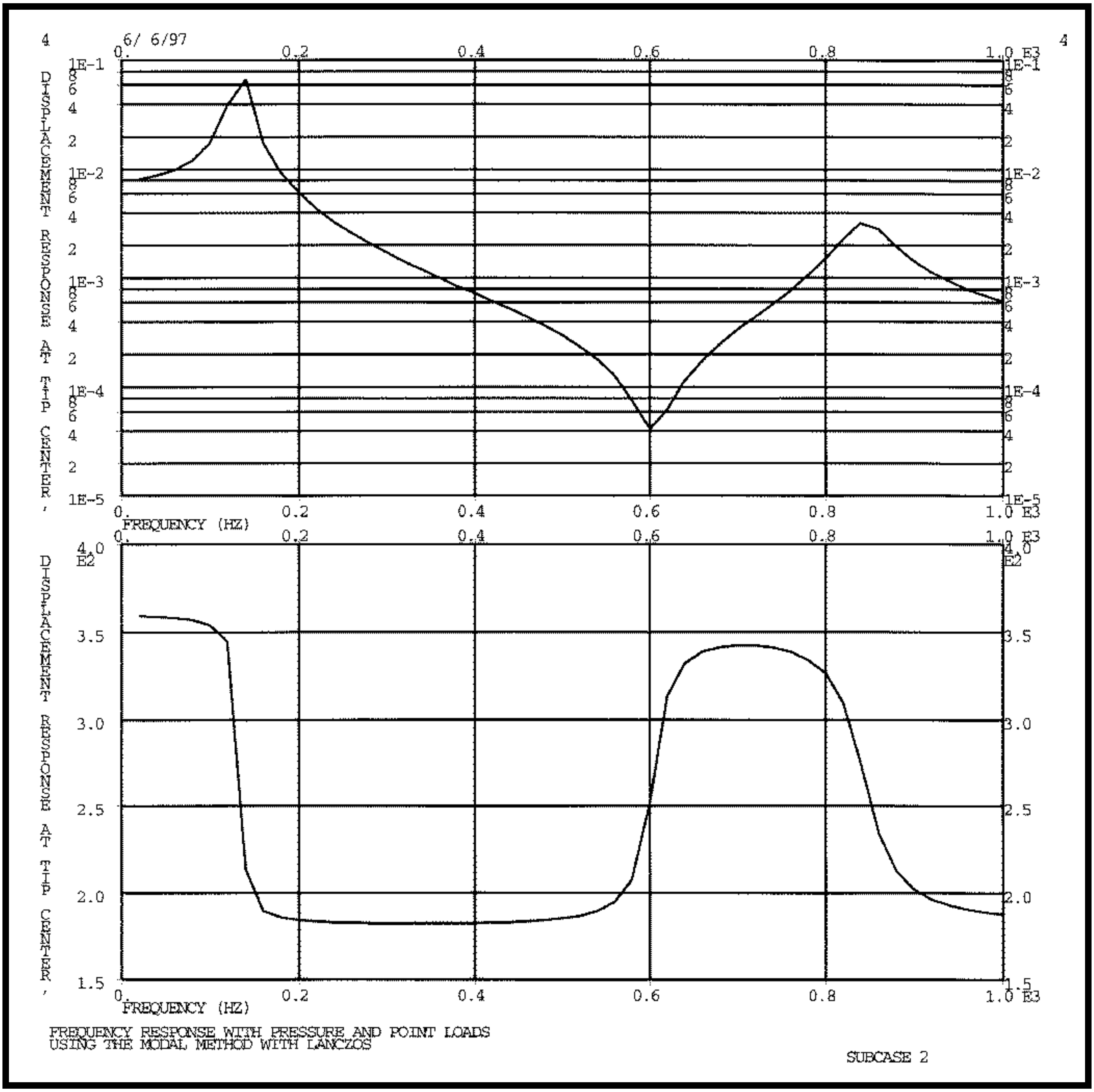

6/ 6/97
DISPLACEMENT RESPONSE AT TIP CENTER,
FREQUENCY (HZ)
FREQUENCY RESPONSE WITH PRESSURE AND POINT LOADS
USING THE MODAL METHOD WITH LANCZOS
SUBCASE 2

Figure 11.6

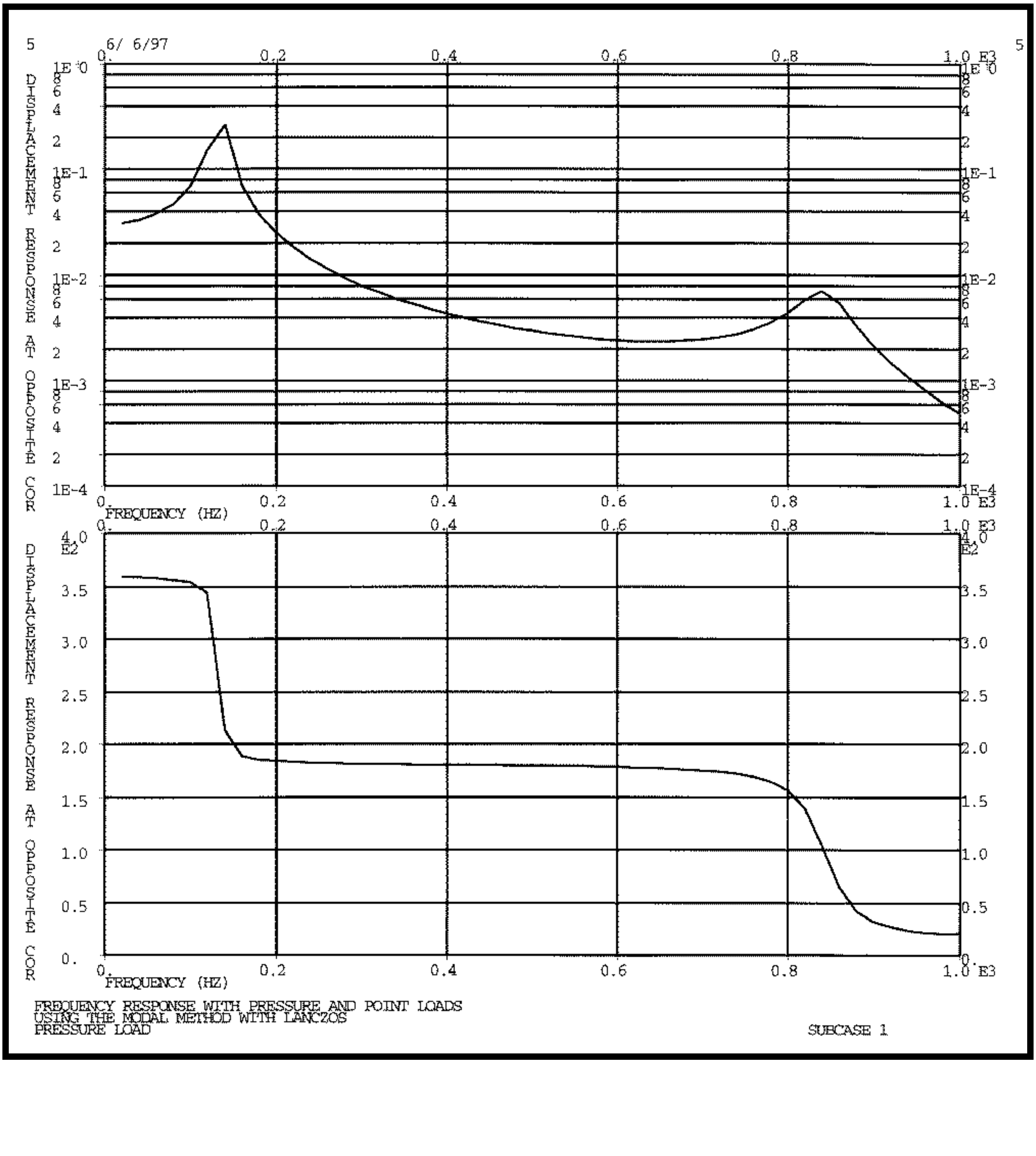

6/ 6/97
DISPLACEMENT RESPONSE AT OPPOSITE COR
FREQUENCY (HZ)
0. 0.2 0.4 0.6 0.8 1.0 E3
1E 0
1E-1
1E-2
1E-3
1E-4
4.0 E2
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.
FREQUENCY RESPONSE WITH PRESSURE AND POINT LOADS
USING THE MODAL METHOD WITH LANCZOS
PRESSURE LOAD
SUBCASE 1

Figure 11.7

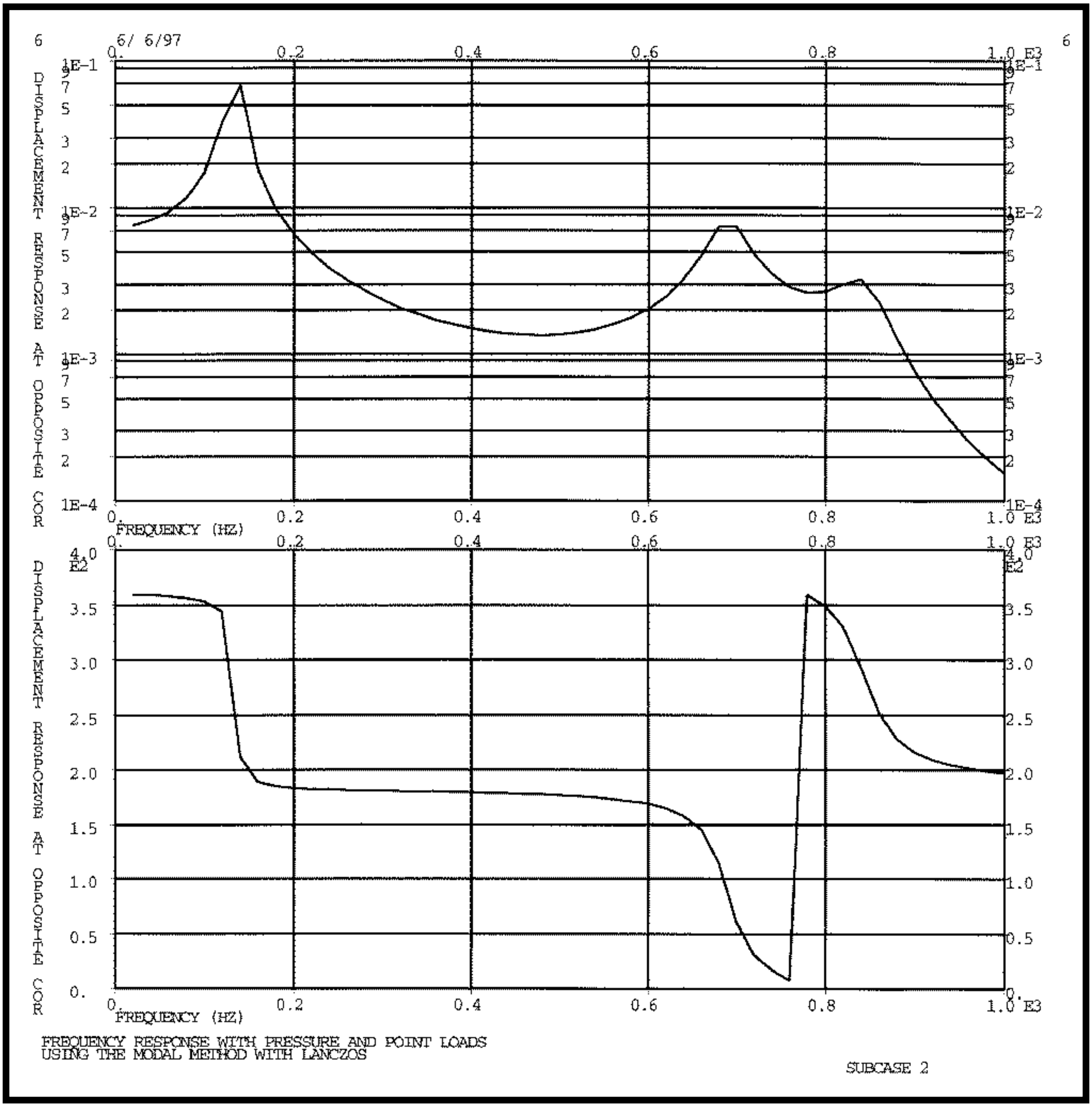

6/ 6/97
DISPLACEMENT RESPONSE AT OPPOSITE COR
FREQUENCY (HZ)
FREQUENCY RESPONSE WITH PRESSURE AND POINT LOADS
USING THE MODAL METHOD WITH LANCZOS
SUBCASE 2

Figure 11.8

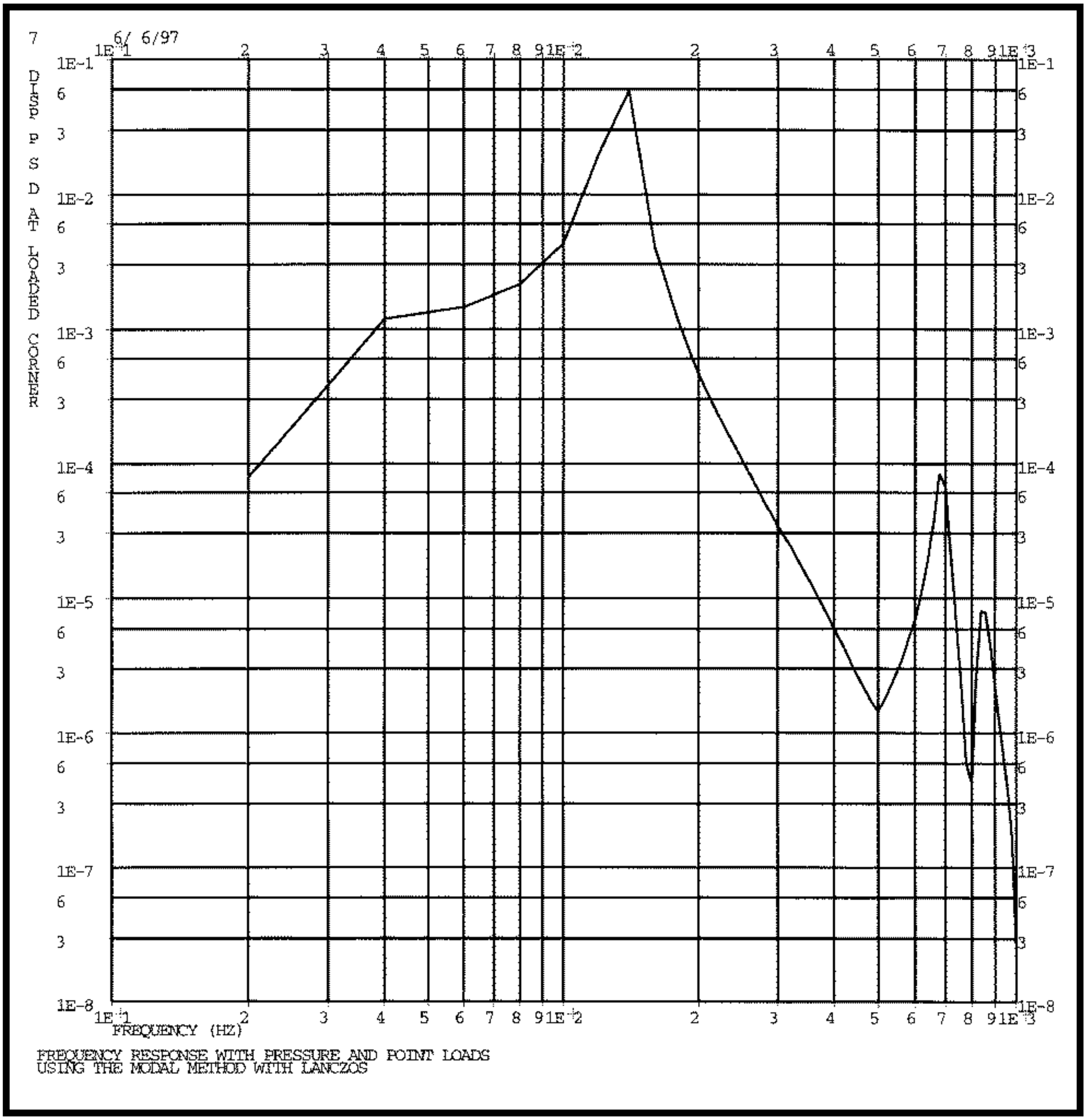

6/ 6/97
DISP P S D AT LOADED CORNER
FREQUENCY (HZ)
FREQUENCY RESPONSE WITH PRESSURE AND POINT LOADS
USING THE MODAL METHOD WITH LANCZOS

Figure 11.9

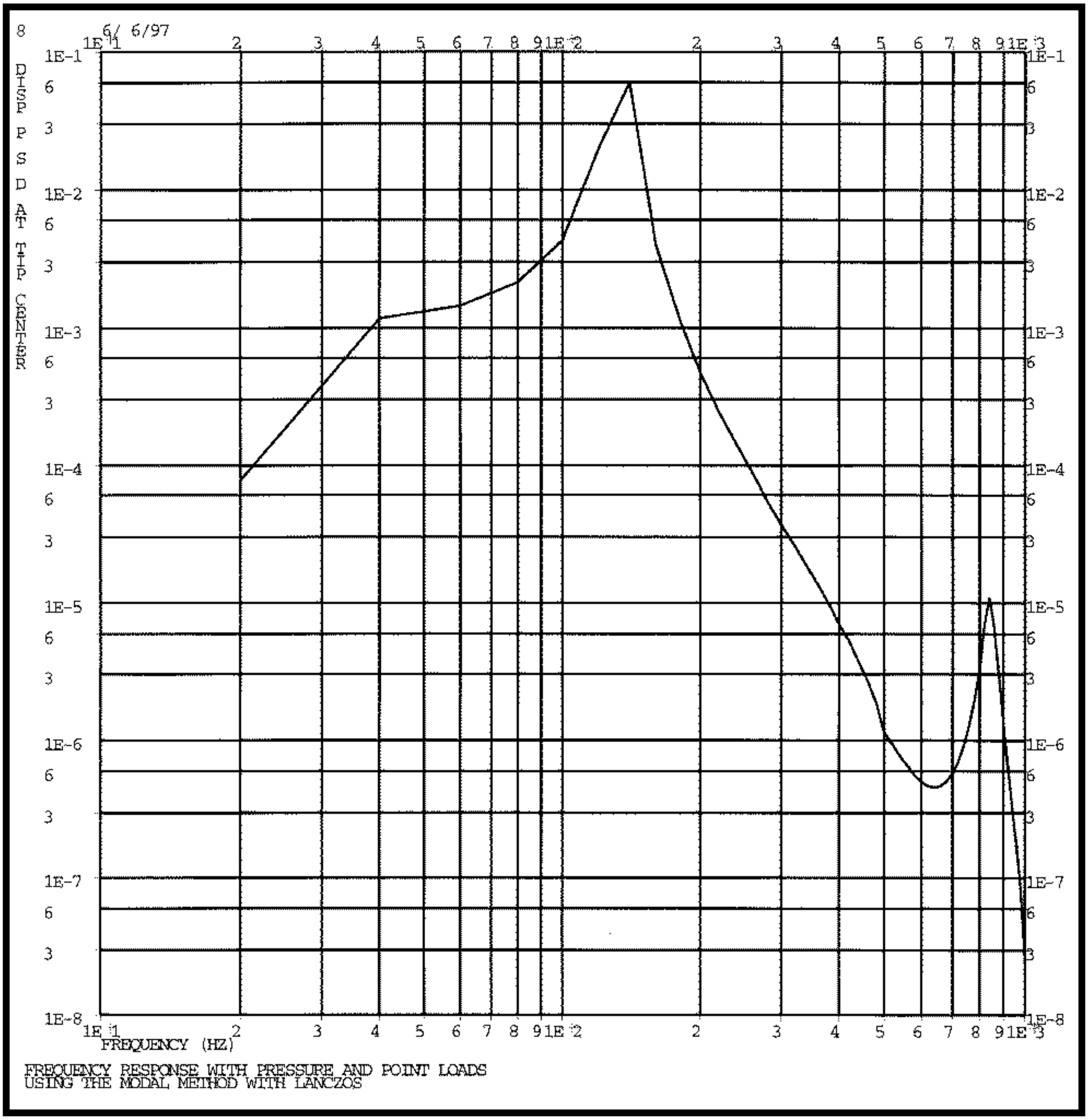
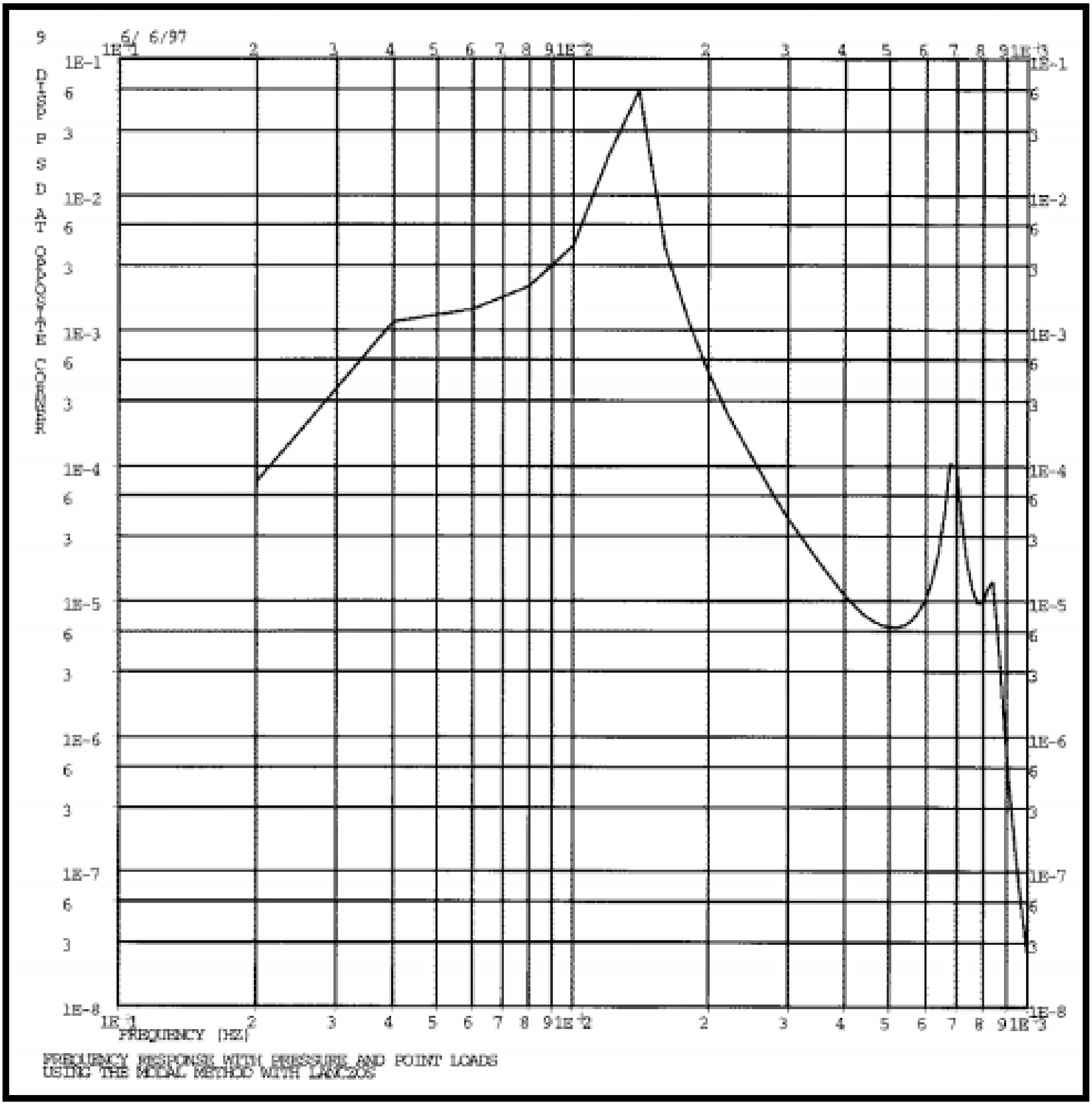

6/ 6/97
DISP P S D AT TIP CENTER
FREQUENCY (HZ)
FREQUENCY RESPONSE WITH PRESSURE AND POINT LOADS
USING THE MODAL METHOD WITH LANCZOS

Figure 11.10


6/ 6/97
DISP PSD AT OPPOSITE CORNER
FREQUENCY (HZ)
FREQUENCY RESPONSE WITH PRESSURE AND POINT LOADS
USING THE MODAL METHOD WITH LANCZOS