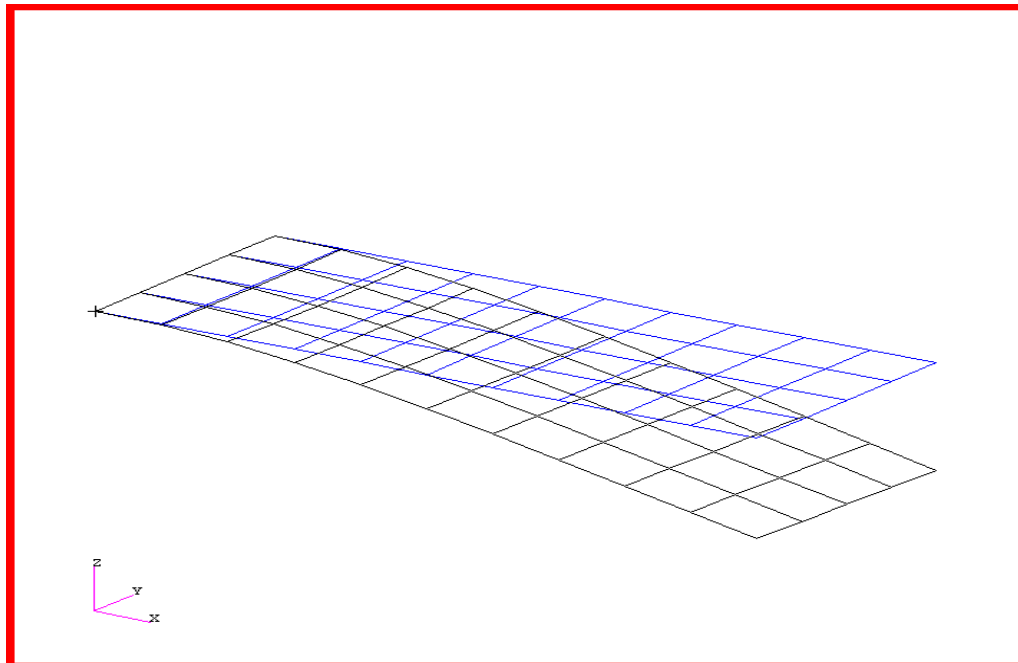

WORKSHOP 24

Modal Frequency Response Analysis



Objectives:

- Define a frequency-varying excitation.
- Produce a MSC.Nastran input file from a dynamic math model created in Workshop 19.
- Submit the file for analysis in MSC.Nastran.
- Compute nodal displacements for desired frequency domain.

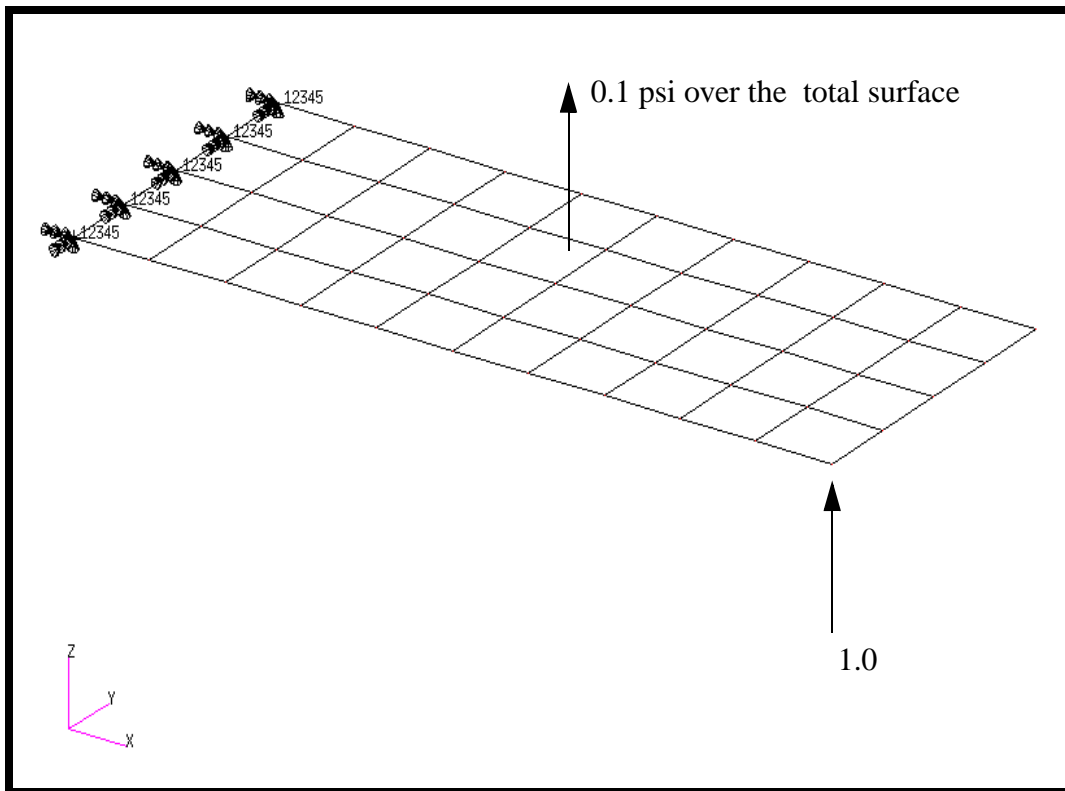


Model Description:

Using the modal method, determine the frequency response of the flat rectangular plate, created in Workshop 19, excited by a 0.1 psi pressure load over the total surface of the plate and a 1.0 lb. force at a corner of the tip lagging 45°. Use a modal damping of $\xi = 0.03$. Use a frequency step of 20 hz between a range of 20 and 1000 hz; in addition, specify five evenly spaced excitation frequencies between the half power points of each resonant frequency between the range of 20-1000 hz.

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

Figure 24.1-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, FREQ4).
- Prepare the model for a direct transient analysis (SOL 111).
- Define the dynamic load phase lead modal frequency response (DPHASE).
- Request response in terms of nodal displacement at Grids 11, 33, and 55.
- Generate an input file and submit it to the MSC.Nastran solver for direct transient analysis.
- Review the results, specifically the nodal displacements and phase angles.

Exercise Procedure:

1. Users who are not utilizing MSC.Patran for generating an input file should go to Step 10, otherwise, proceed to step 2.

2. Create a new database called **prob24.db**.

File/New Database

New Database Name

prob24

OK

In the *New Model Preference* form set the following:

Tolerance

◆ **Default**

Analysis Code:

MSC/NASTRAN

Analysis Type:

Structural

OK

3. Create the model by importing an existing MSC.Nastran input file, (**plate.bdf**).

◆ Analysis

Action:

Read Input file

Object:

Model Data

Method

Translate

Select Input File...

Select File

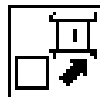
plate.bdf

OK

Apply

OK

4. Activate the entity labels by selecting the Show Labels icon on the toolbar.



Show Labels

5. Create a time dependent load case for the transient response.

◆ **Load Cases**

<i>Action:</i>	<input type="text" value="Create"/>
<i>Load Case Name:</i>	<input type="text" value="frequency_dependent"/>
<i>Load Case Type:</i>	<input type="text" value="Time Dependent"/>
<i>Assign/Prioritize Loads/BCs</i> <i>(Highlight the following:)</i>	<input type="text" value="Displ_spc1.1"/>
<input type="text" value="OK"/>	
<input type="text" value="Apply"/>	

6. Create the frequency dependent field for the transient response.

◆ **Fields**

<i>Action:</i>	<input type="text" value="Create"/>
<i>Object:</i>	<input type="text" value="Non Spatial"/>
<i>Method</i>	<input type="text" value="Tabular Input"/>
<i>Field Name</i>	<input type="text" value="frequency_dependent_load"/>

■ **Frequency (f)**

<input type="text" value="[Options...]"/>	
<i>Maximum Number of f</i>	<input type="text" value="2"/>
<input type="text" value="OK"/>	
<input type="text" value="Input Data..."/>	

Enter the *_Time/Frequency Scalar Table Data* form with the data below.

	<i>Freq (f)</i>	<i>Value</i>
<input type="text" value="1"/>	<input type="text" value="10."/>	<input type="text" value="1.0"/>
<input type="text" value="2"/>	<input type="text" value="1000."/>	<input type="text" value="1.0"/>
<input type="text" value="OK"/>		
<input type="text" value="Apply"/>		

7. Create the frequency dependent unit force.

◆ **Loads/BCs**

Action:

Create

Object:

Pressure

Type:

Element Uniform

New Set Name

pressure

Target Element Type:

2D

Input Data...

Top Surf Pressure

-0.1

* *Time/Freq. Dependence*
(Select from the *Time Dependent Fields* box.)

f:frequency_dependent_load

OK

Select Application Region...

■ **FEM**

Select 2D Elements or Edge:

Elem 1:40

Add

OK

Apply

To better visualize the model, hide the labels using the following toolbar icon:



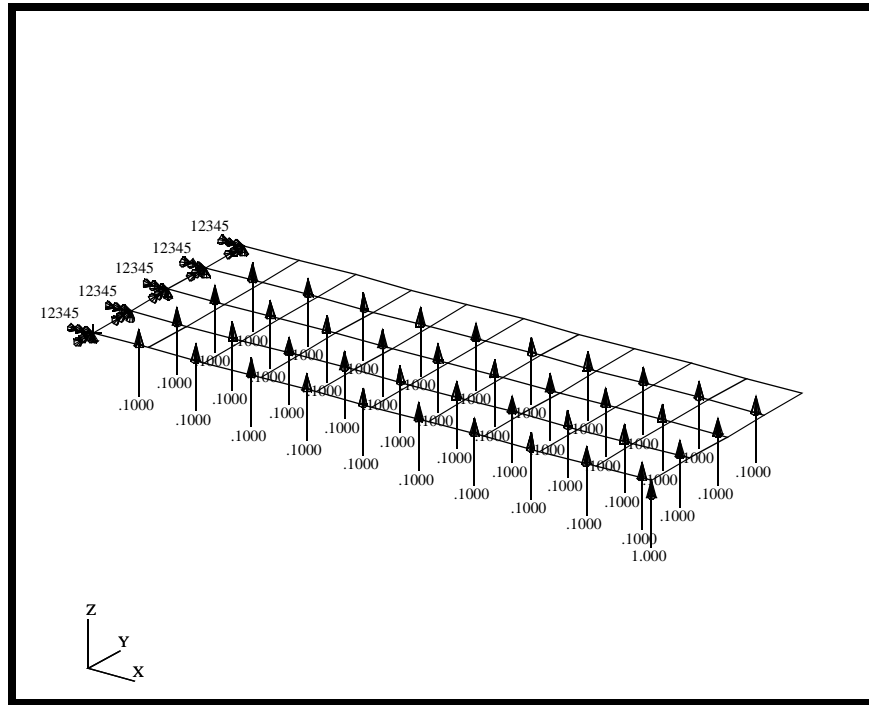
Hide Labels



Iso 3 View

The model should be similar to Figure 24.2.

Figure 24.2



In order to make the next step easier, turn the entity labels back on.



Show Labels

8. Create forces.

◆ Load/BCs

Action:

Create

Object:

Force

Type:

Nodal

New Set Name

force

Input Data...

Force <F1 F2 F3>

<0, 0, 1>

* Time/Freq. Dependence:
(Select from the Time Dependent Fields box.)

f:frequency_dependent_load

OK

Select Application Region...

■ **FEM**

Select Nodes

Node 11

Add

OK

Apply

9. Now you are ready to generate an input file for analysis

Click on the **Analysis** radio button on the Top Menu Bar and complete the entries as shown here.

◆ **Analysis**

Action:

Analyze

Object:

Entire Model

Method

Analysis Deck

Job Name

prob24

Solution Type...

Solution Type:

◆ **FREQUENCY RESPONSE**

Solution Parameters...

Formulation:

Modal

Mass Calculation:

Coupled

Wt.-Mass Conversion =

0.00259

Eigenvalue Extraction...

Frequency Range of Interest:

Lower =

10.

Upper =

2000.

OK

OK

OK

Direct Text Input...

◆ **Case Control Section**

SDAMPING = 100

◆ **Bulk Data Section**

(Each line in the box is a separate line to input!)

**TABDMP1, 100, CRIT,
, 0., .03, 10., .03, ENDT
FREQ4, 2, 20., 1000., .03, 5**

OK

Subcase Create...

Available Subcases

frequency_dependent

Subcase Parameters...

Starting Frequency =

20

Ending Frequency =

1000

of Freq. Increments =

49

OK

Output Requests...

Under *Output Requests*, highlight:

SPCFORCES(SORT1,Real)=All FEM

Delete

OK

Apply

Cancel

Subcase Select...

*Subcases Selected:
(Click to de-select.)*

Default

Subcases for Solution Sequence:

111

(Click to select.)

frequency_dependent

OK

Apply

NOTE: Not so Fast!! Before submitting the job, we still need to define the phase lead.

An input file called **prob24.bdf** will be generated. This process of translating your model into an input file is called the Forward Translation. The Forward Translation is complete when the Heartbeat turns green.

10. However, since the phase lead term in the equation of the dynamic loading function (DPHASE) is currently not supported by PATRAN, you will need to manually edit the file to insert the appropriate phase for the point load.

Search for:

```
RLOAD1      8          9                      1
```

Insert the identification number of the DPHASE entry in the 5th field. The revised RLOAD1 card should look as follows;

```
RLOAD1      8          9                92      1
```

Also, insert the necessary DPHASE card;

```
DPHASE      92        11          3          -45.
```

(NOTE: The placement of the numbers must fit the within the allotted 8 character "cell" widths)

MSC.Patran users should now proceed to Step 12.

Generating an input file for MSC.Nastran Users:

MSC.Nastran users can generate an input file using the data from pages 24-3 (general model description). The result should be similar to the output below.

11. MSC.Nastran input file: **prob24.dat**.

```
ID SEMINAR, PROB24
SOL 111
TIME 30
CEND
TITLE = FREQUENCY RESPONSE WITH PRESSURE AND POINT LOADS
SUBTITLE = USING THE MODAL METHOD WITH LANCZOS
ECHO = UNSORTED
SEALL = ALL
SPC = 1
SET 111 = 11, 33, 55
DISPLACEMENT(PHASE, PLOT) = 111
METHOD = 100
FREQUENCY = 100
SDAMPING = 100
SUBCASE 1
DLOAD = 100
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)
$
BEGIN BULK
$
$ PARAMETERS FOR POST-PROCESSING
PARAM,COUPMASS,1
PARAM,WTMASS,0.00259
$
$ PLATE 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
$
$ APPLY UNIT PRESSURE LOAD TO PLATE
$
LSEQ, 100, 300, 400
$
PLOAD2, 400, 1., 1, THRU, 40
$
$ APPLY PRESSURE LOAD
$
RLOAD2, 400, 300, , ,310
$
TABLED1, 310,
, 10., 1., 1000., 1., ENDT
$
$ POINT LOAD
$
$ IF 'DAREA' CARDS ARE REFERENCED, THEN
$ 'DPHASE' AND 'DELAY' CAN BE USED
$
RLOAD2, 500, 600, , 320, 310
$
DPHASE, 320, 11, 3, -45.
$

```

```
$  
DAREA, 600, 11, 3, 1.0  
$  
$ COMBINE LOADS  
$  
DLOAD, 100, 1., .1, 400, 1.0, 500  
$  
$ SPECIFY FREQUENCY STEPS  
$  
FREQ1, 100, 20., 20., 49  
FREQ4, 100, 20., 1000., .03, 5  
$  
ENDDATA
```

Submitting the input file for analysis:

12. Submit the input file to MSC.Nastran for analysis.
 - 12a. To submit the MSC.Patran **.bdf** file, find an available UNIX shell window. At the command prompt enter **nastran prob24.bdf scr=yes**. Monitor the run using the UNIX **ps** command.
 - 12b. To submit the MSC.Nastran **.dat** file, find an available UNIX shell window and at the command prompt enter **nastran prob24 scr=yes**. Monitor the run using the UNIX **ps** command.
13. When the run is completed, use **plotps** utility to create a postscript file, **prob24.ps**, from the binary plot file **prob24.plt**. The displacement response plots for Grids 11, 33 and 55 are shown in figures 24.2 to 24.4.
14. When the run is completed, edit the **prob24.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.

For MSC.Nastran users only. MSC.Patran users should skip to step 16.

15. While still editing **prob24.f06**, search for the word:

XY - OUTPUT SUMMARY (spaces are necessary).

Displacement at Grid 11

Frequency (X) Displacement (Y)

140 = _____

440 = _____

Displacement at Grid 33

Frequency (X) Displacement (Y)

140 = _____

660 = _____

Displacement at Grid 55

Frequency (X) Displacement (Y)

140 = _____

1000 = _____

Comparison of Results

16. Compare the results obtained in the .f06 file with the following results:

REAL EIGENVALUES									
XY - OUTPUT SUMMARY (RESPONSE)									
SUBCASE	CURVE	FRAME		XMIN-FRAME/	XMAX-FRAME/	YMIN-FRAME/	X FOR	YMAX-FRAME/	X F
ID	TYPE	NO.	CURVE ID.	ALL DATA	ALL DATA	ALL DATA	YMIN	ALL DATA	YM
1	DISP	1	11(5,--)	2.000000E+01	1.000000E+03	3.481836E-04	4.400000E+02	1.699121E-01	1.336996E-01
				2.000000E+01	1.000000E+03	3.481836E-04	4.400000E+02	1.699121E-01	1.336996E-01
1	DISP	1	11(--, 11)	2.000000E+01	1.000000E+03	1.390213E+02	1.000000E+03	3.258276E+02	2.000000E+00
				2.000000E+01	1.000000E+03	1.390213E+02	1.000000E+03	3.258276E+02	2.000000E+00
1	DISP	2	33(5,--)	2.000000E+01	1.000000E+03	2.271459E-04	6.600000E+02	1.700317E-01	1.336996E-01
				2.000000E+01	1.000000E+03	2.271459E-04	6.600000E+02	1.700317E-01	1.336996E-01
1	DISP	2	33(--, 11)	2.000000E+01	1.000000E+03	1.385571E+02	1.000000E+03	3.263339E+02	2.000000E+00
				2.000000E+01	1.000000E+03	1.385571E+02	1.000000E+03	3.263339E+02	2.000000E+00
1	DISP	3	55(5,--)	2.000000E+01	1.000000E+03	1.278678E-04	1.000000E+03	1.696787E-01	1.336996E-01
				2.000000E+01	1.000000E+03	1.278678E-04	1.000000E+03	1.696787E-01	1.336996E-01
1	DISP	3	55(--, 11)	2.000000E+01	1.000000E+03	1.687413E+01	7.001384E+02	3.573561E+02	7.104853E+00
				2.000000E+01	1.000000E+03	1.687413E+01	7.001384E+02	3.573561E+02	7.104853E+00

17. MSC.Nastran Users have finished this exercise. MSC.Patran Users should proceed to the next step.

18. Proceed with the Reverse Translation process, that is importing the **prob24.op2** results file into MSC.Patran. To do this, return to the Analysis form and proceed as follows.

◆ **Analysis**

<i>Action:</i>	<input type="text" value="Read Output2"/>
<i>Object:</i>	<input type="text" value="Result Entities"/>
<i>Method</i>	<input type="text" value="Translate"/>
<input type="text" value="Select Results File..."/>	
<i>Select File</i>	<input type="text" value="prob24.op2"/>
<input type="text" value="OK"/>	
<input type="text" value="Apply"/>	

19. Plot the results in XY Plots.

The first plot is the Displacement versus Frequency plot at Node 11.

◆ **Results**

<i>Action:</i>	<input type="text" value="Create"/>
<i>Object:</i>	<input type="text" value="Graph"/>
<i>Select Results Cases</i>	<input type="text" value="Frequency_dependent_0 of 65 subcases"/>
<i>Filter Method</i>	<input type="text" value="All"/>
<input type="text" value="Filter"/>	
<input type="text" value="Apply"/>	
<input type="text" value="Close"/>	
<i>Select y Result:</i>	<input type="text" value="Displacement, Translational"/>
<i>Quantity:</i>	<input type="text" value="Z Component"/>
<i>x:</i>	<input type="text" value="Global Variable"/>
<i>Variable:</i>	<input type="text" value="Frequency"/>

Plot Options

Complex No. as:

Magnitude

Display Attributes

y axis scale

Log

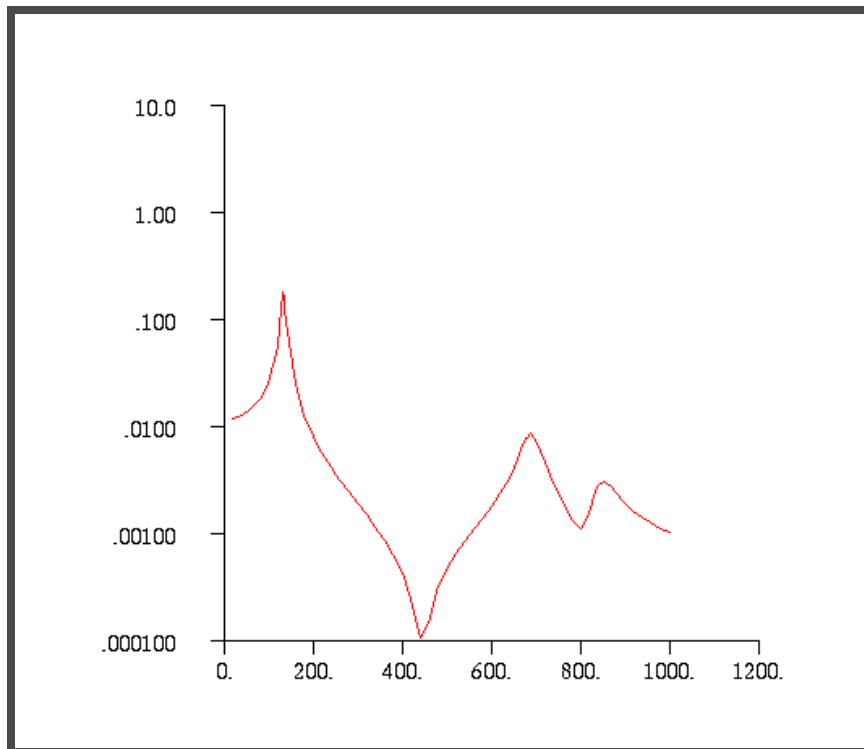
Target Entities

Select Nodes:

Nodes 11

Apply

Figure 24.3-Displacement Response at Loaded Corner



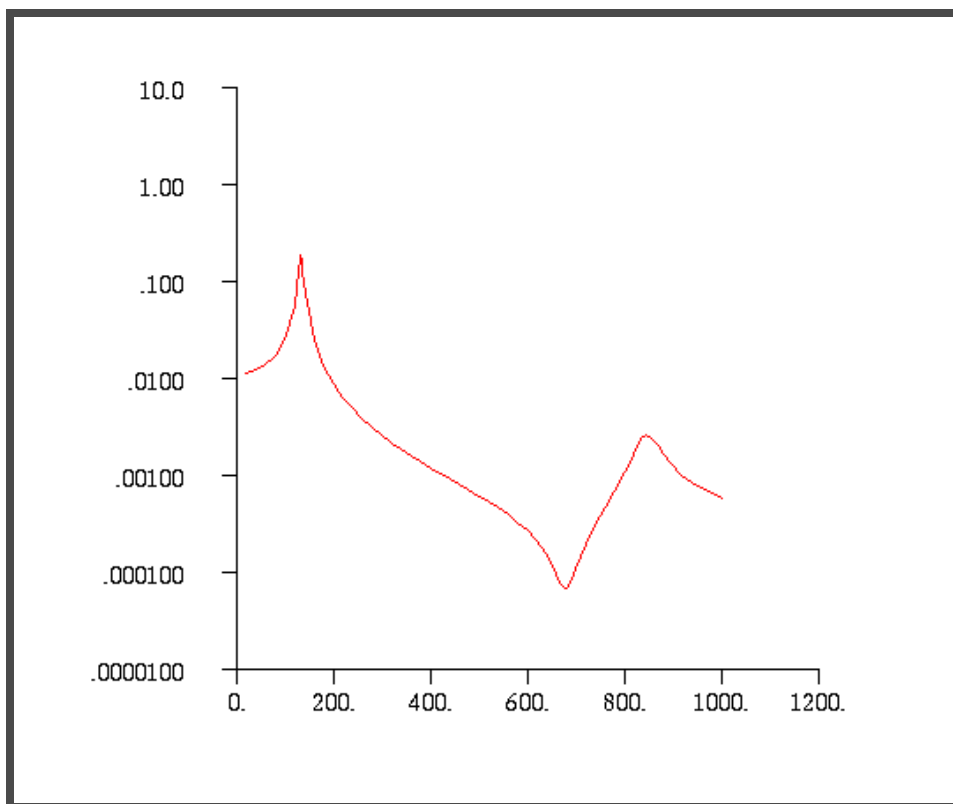
The second plot is the Displacement versus Frequency at Node 33..

Select Nodes:

Node 33

Apply

Figure 24.4-Displacement Response at Tip Center



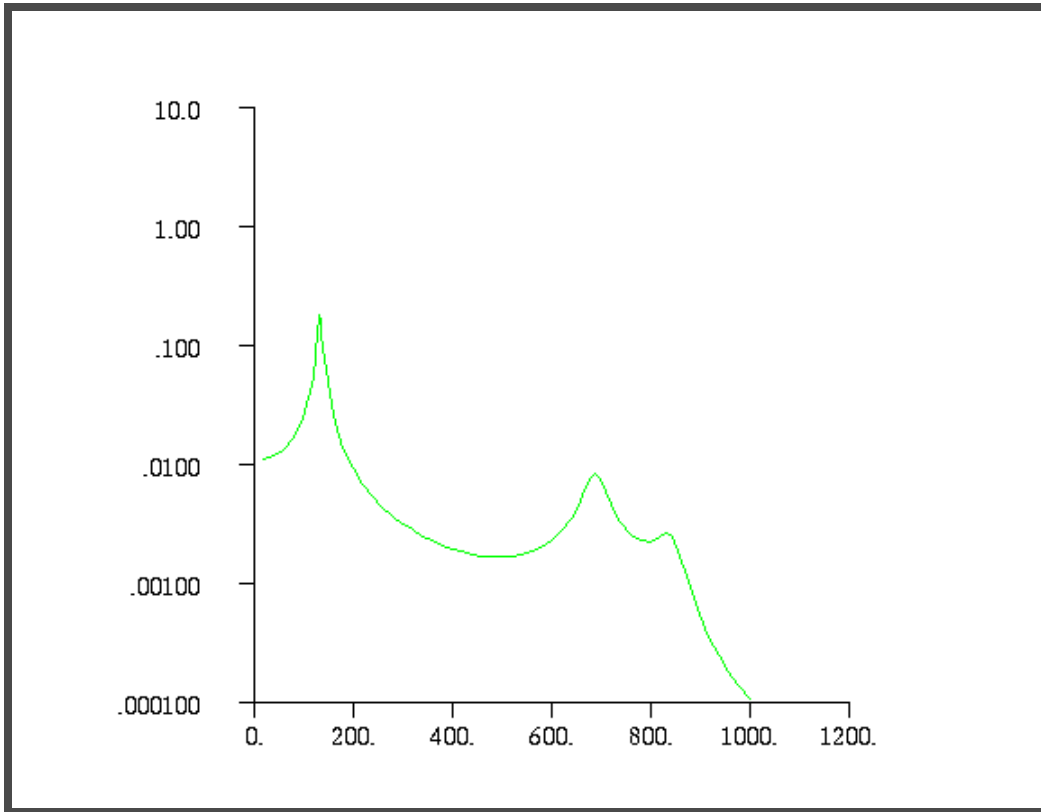
The third plot is the Displacement versus Frequency at Node 55.

Select Nodes:

Node 55

Apply

Figure 24.5-Displacement Response at Opposite Corner



Quit MSC.Patran when you have completed this exercise.