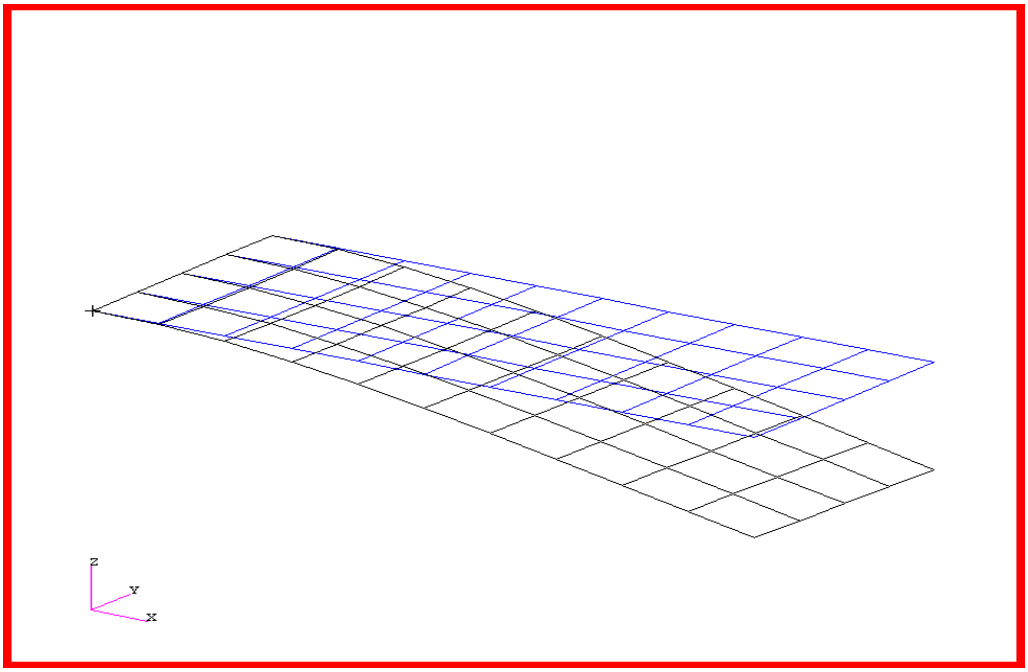
WORKSHOP PROBLEM 5

Direct Frequency Response Analysis



Objectives:

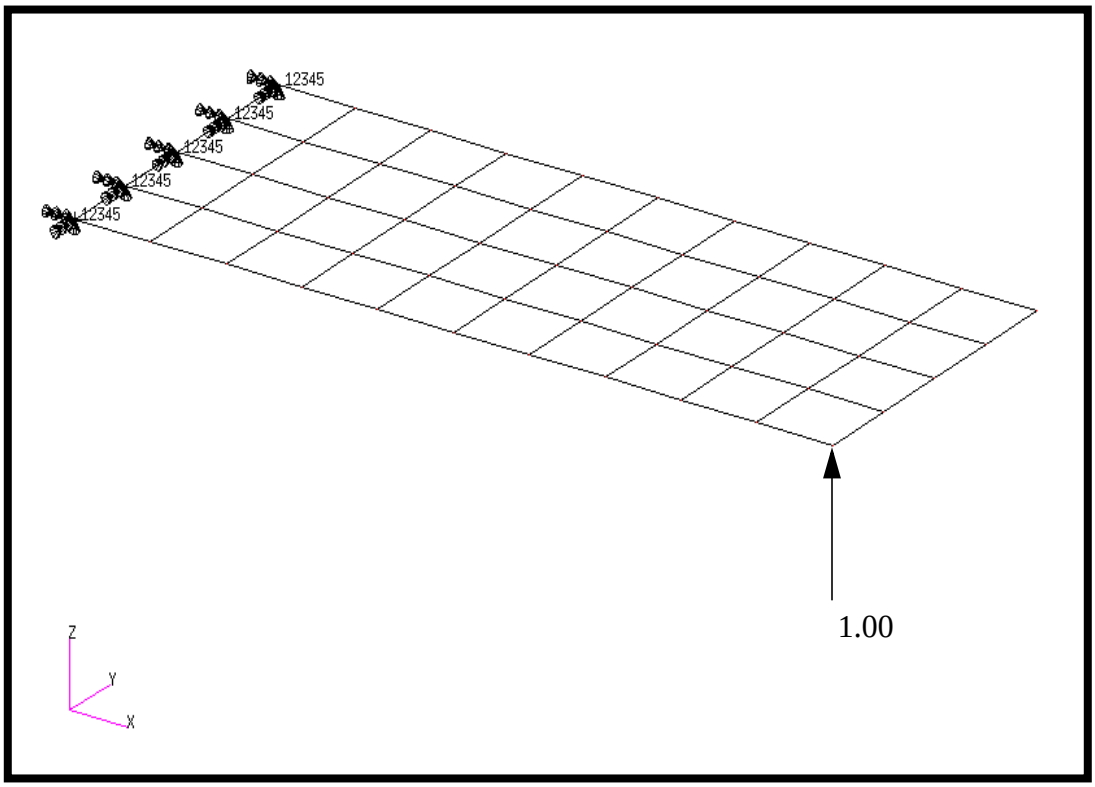
- Define frequency-varying excitation.
- Produce a MSC/NASTRAN input file from dynamic math model created in Workshop 1.
- Submit the file for analysis in MSC/NASTRAN.
- Compute nodal displacements for desired frequency domain.

Model Description:

Using the direct method, determine the frequency response of the flat rectangular plate, created in Workshop 1, under frequency-varying excitation. This example structure shall be excited by a unit load at a corner of the tip. Use a frequency step of 20 Hz between a range of 20 and 1000 Hz. Use structural damping of g=0.06.

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

Figure 5.1-Loads and Boundary Conditions



Suggested Exercise Steps:

- Reference previously created dynamic math model, **plate.bdf**, by using the INCLUDE statement
- Define the frequency-varying tip load (DAREA and RLOAD2).
- Define a set of frequencies to be used in the solution (FREQ1).
- Prepare the model for a direct frequency response analysis (SOL 108).
- Specify the structural damping.
  - PARAM, G, 0.06
- 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.

```
ID SEMINAR,PROB5
```

```
CEND
```

```
BEGIN BULK
```

1	2	3	4	5	6	7	8	9	10

1	2	3	4	5	6	7	8	9	10

ENDDATA

Exercise Procedure:

1. Users who are not utilizing MSC/PATRAN for generating an input file should go to Step 9, otherwise, proceed to step 2.

2. Create a new database called **prob5.db**.

   File/New Database

   New Database Name: **prob5**

   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 ...

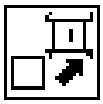
   plate.bdf

   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**

Action:	**Create**
Load Case Name:	**frequency_response**
Load Case Type:	**Time Dependent**
Assign/Prioritize Loads/BCs *(Highlight the following:)*	**Displ_spc1.1**

OK

Apply

6. Create a frequency dependent field for the frequency dependent load.

◆ **Fields**

Action:	**Create**
Object:	**Non Spatial**
Method:	**Tabular Input**
Field Name	**frequency_dependent_load**

■ **Frequency (f)**

[Options ...]

Maximum Number of f: **2**

OK

Input Data...

Using the data in the table below, enter the values describing the time dependent force into the ***Time/Frequency Scalar Table Data*** form.

	Freq (f)	Value
1	0	1.0
2	1000	1.0

OK

Apply

7. Create the frequency dependent unit force.

◆ **Load/BCs**

Action: **Create**

Object: **Force**

Type: **Nodal**

New Set Name: **unit_force**

Input Data...

Spatial Dependence/Force: **<0 0 1>**

Time Dependence: **f:frequency_dependent_load**
*(Select from the **Time Dependent Fields** box)*

OK

Select Application Region...

■ **FEM**

Select Nodes: **Node 11**

Add

OK

Apply

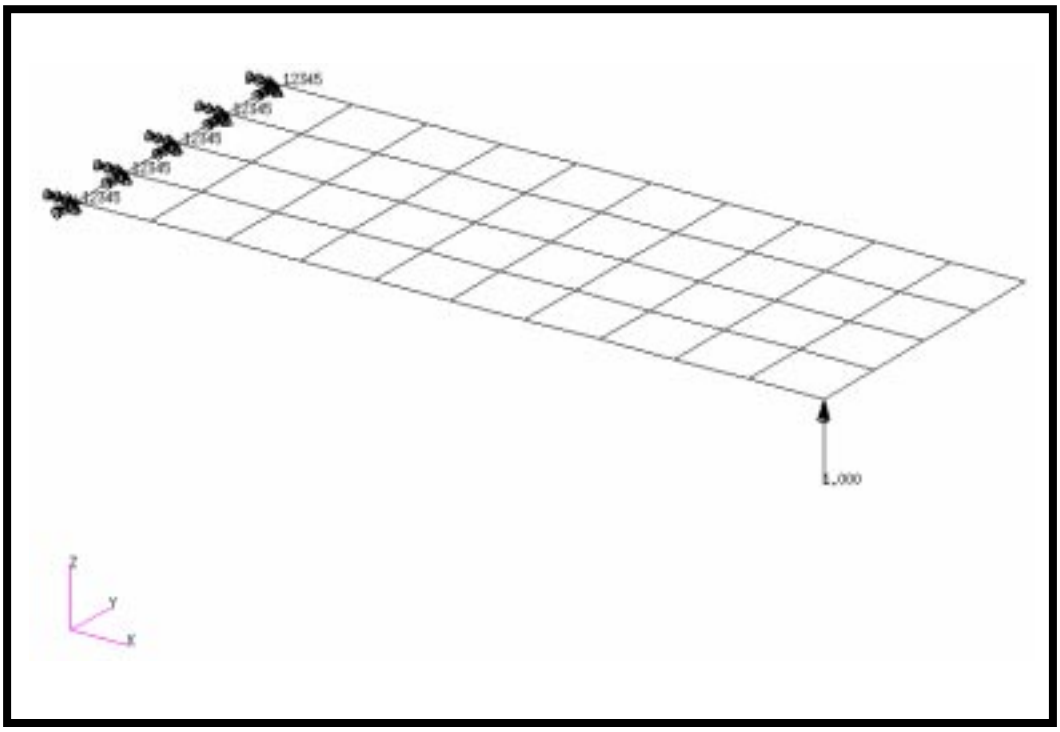
To better visualize the model, hide the entity labels and switch to an isometric view using the icons below:

Hide Labels

Iso 3 View

The model should be similar to Figure 5.2.

Figure 5.2



8. 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	**prob5**
Solution Type...	
Solution Type:	◆ **FREQUENCY RESPONSE**
Solution Parameters...	
Formulation:	**Direct**
Mass Calculation:	**Coupled**
Wt.-Mass Conversion=	**0.00259**

Struct. Damping Coeff. = **0.06**

OK

OK

Subcase Create ...

Available Subcases **frequency_response**

Subcase Parameters...

Starting Frequency = **20**

Ending Frequency = **1000**

# of Freq. Increments = **49**

OK

Output Requests...

Form Type: **Advanced**

under *Output Request* highlight: **SPCFORCES(SORT1,Real)=All FEM**

Delete

Output Requests: select **DISPLACEMENT(...**

Sorting: **By Freq/Time**

Modify

OK

Apply

Cancel

Subcase Select ...

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

Subcases for Solution Sequence: 108 **frequency_response**
(Click to select.)

OK

Apply

An input file called **prob5.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. MSC/PATRAN users should now proceed to Step 10.

Generating an input file for MSC/NASTRAN Users:

MSC/NASTRAN users can generate an input file using the data from page 5-3 (Model Description). The result should be similar to the output below.

9. MSC/NASTRAN input file: **prob5.dat**

```
ID SEMINAR, PROB5
SOL 108
TIME 30
CEND
TITLE = FREQUENCY RESPONSE DUE TO UNIT FORCE AT TIP
ECHO = UNSORTED
SPC = 1
SET 111 = 11, 33, 55
DISPLACEMENT(SORT2, PHASE) = 111
SUBCASE 1
DLOAD = 500
FREQUENCY = 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
PARAM, COUPMASS, 1
PARAM, WTMASS, 0.00259
$
$ PLATE MODEL DESCRIBED IN NORMAL MODES EXAMPLE
$
INCLUDE 'plate.bdf'
```

```
$
$ SPECIFY STRUCTURAL DAMPING
$
PARAM, G, 0.06
$
$ APPLY UNIT FORCE AT TIP POINT
$
RLOAD2, 500, 600, , ,310
$
DAREA, 600, 11, 3, 1.0
$
TABLED1, 310,
, 0., 1., 1000., 1., ENDT
$
$ SPECIFY FREQUENCY STEPS
$
FREQ1, 100, 20., 20., 49
$
ENDDATA
```

Submitting the input file for analysis:

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

    10a. To submit the MSC/PATRAN **.bdf** file, find an available UNIX shell window. At the command prompt enter **nastran prob5.bdf scr=yes**. Monitor the run using the UNIX **ps** command.

    10b. To submit the MSC/NASTRAN **.dat** file, find an available UNIX shell window and at the command prompt enter **nastran prob5 scr=yes**. Monitor the run using the UNIX **ps** command.

11. When the run is completed, use **plotps** utility to create a postscript file, **prob5.ps**, from the binary plot file, **prob5.plt**. The displacement response plots for Grids 11, 33 and 55 are shown in figures 5-2 to 5-7.

12. When the run is completed, edit the **prob5.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.

13. While still editing **prob5.f06**, search for the word:

X Y - O U T P U T S U M M A R Y (spaces are necessary).

Displacement at Grid 11

Frequency (X) Displacement (Y)

140 = _____

380 = _____

Displacement at Grid 33

Frequency (X) Displacement (Y)

140 = _____

600 = _____

Displacement at Grid 55

Frequency (X) Displacement (Y)

140 = _____

1000 = _____

Comparison of Results

14. Compare the results obtained in the **.f06** file with the results on the following page:

POINT-ID = 11

C O M P L E X D I S P L A C E M E N T V E C T O R
(MAGNITUDE/PHASE)

FREQUENCY	TYPE	T1	T2	T3	R1	R2	R3
2.000000E+01	G	0.0	0.0	8.817999E-03	6.435859E-04	2.632016E-03	0.0
		0.0	0.0	356.4954	176.5664	176.5000	0.0
4.000000E+01	G	0.0	0.0	9.404316E-03	6.434991E-04	2.795561E-03	0.0
		0.0	0.0	356.2596	176.5677	176.2785	0.0
9.799999E+02	G	0.0	0.0	9.965085E-04	2.691742E-04	4.097779E-04	0.0
		0.0	0.0	187.6832	7.8008	15.1581	0.0
1.000000E+03	G	0.0	0.0	8.803170E-04	2.354656E-04	3.317750E-04	0.0
		0.0	0.0	186.9299	8.2146	14.6645	0.0

POINT-ID = 33

C O M P L E X D I S P L A C E M E N T V E C T O R
(MAGNITUDE/PHASE)

FREQUENCY	TYPE	T1	T2	T3	R1	R2	R3
2.000000E+01	G	0.0	0.0	8.183126E-03	5.993295E-04	2.443290E-03	0.0
		0.0	0.0	356.4899	176.5639	176.4950	0.0
4.000000E+01	G	0.0	0.0	8.768992E-03	6.006200E-04	2.606561E-03	0.0
		0.0	0.0	356.2376	176.5565	176.2581	0.0
9.799999E+02	G	0.0	0.0	6.867234E-04	3.836353E-04	5.393046E-04	0.0
		0.0	0.0	188.0180	5.5597	10.0794	0.0
1.000000E+03	G	0.0	0.0	6.062436E-04	3.454144E-04	4.648783E-04	0.0
		0.0	0.0	186.8358	5.4959	8.8514	0.0

POINT-ID = 55

C O M P L E X D I S P L A C E M E N T V E C T O R
(MAGNITUDE/PHASE)

FREQUENCY	TYPE	T1	T2	T3	R1	R2	R3
2.000000E+01	G	0.0	0.0	7.606255E-03	5.587703E-04	2.371172E-03	0.0
		0.0	0.0	356.4844	176.5612	176.4928	0.0
4.000000E+01	G	0.0	0.0	8.190030E-03	5.613805E-04	2.534562E-03	0.0
		0.0	0.0	356.2155	176.5442	176.2492	0.0
9.799999E+02	G	0.0	0.0	2.558788E-04	4.612964E-04	5.702980E-04	0.0
		0.0	0.0	193.1958	4.6290	9.0143	0.0
1.000000E+03	G	0.0	0.0	2.144666E-04	4.204372E-04	4.981144E-04	0.0
		0.0	0.0	190.6200	4.3746	7.6762	0.0

15. **MSC/NASTRAN Users have finished this exercise. MSC/PATRAN Users should proceed to the next step.**

16. Proceed with the Reverse Translation process, that is importing the **prob5.op2** results file into MSC/PATRAN. To do this, return to the Analysis form and proceed as follows.

◆ **Analysis**

Action: **Read Output2**

Object: **Result Entities**

Method: **Translate**

Select Results File...

Select Available Files **prob5.op2**

OK

Apply

17. Plot the results in XY plots.

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

◆ **Results**

Form Type: **Advanced**

Select Result Cases
(Highlight all cases.)

Get Results

Select Result **1.1-Displacements, Translational**

Plot Type: **XY Plot**

Plot Type Options...

Result XY Plot Types **Results Versus Global Variables**

Global Var...

Global Variable: **1-Frequency**

Apply

Result (Y)...

Results	**1.1-Displacements, Translational**
Vector Component	❒ **X** ❒ **Y** ■ **Z**
Numerical Form for Complex Results	■ **Mag.**

OK

Node IDs	**Node 11**

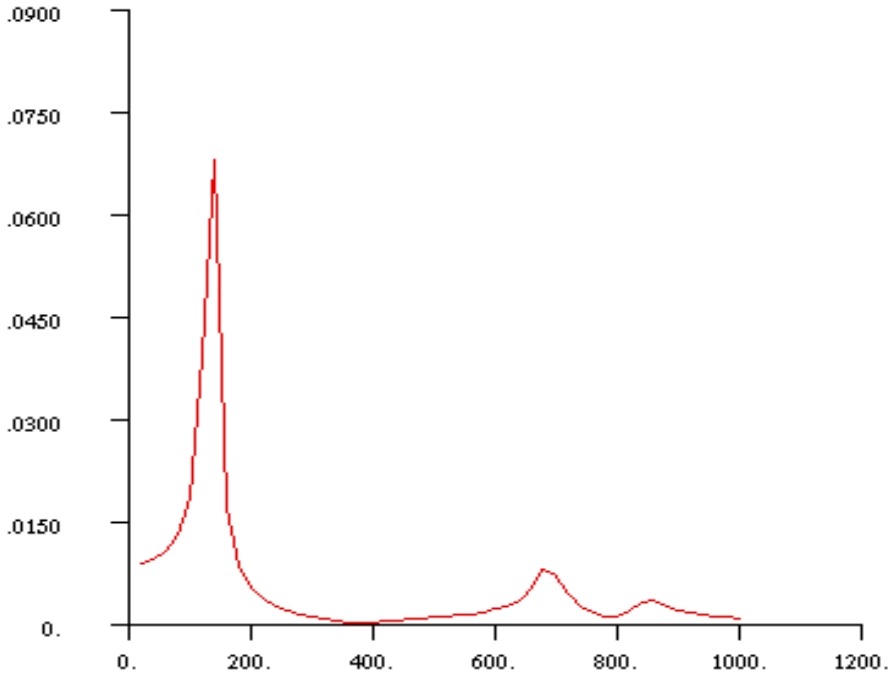
Apply...

New Title or Title Filter	**Displacement vs Frequency at Node 11**

Rename

Apply

Figure 5.3-Displacement Response at Node 11



The next step is to make the plot of Phase versus Frequency. Return to the ***Results Display*** form. If the ***Curves for XY Plot*** form and the ***Result XY Plot Options*** form are still open, close them by pushing the **Cancel** button.

Plot Type Options...

Result (Y)...

Result	**1.1-Displacements, Translational**
Vector Component	❒ **X** ❒ **Y** ■ **Z**
Numerical Form for Complex Results	■ **Phase**

OK

Node IDs	**Node 11**

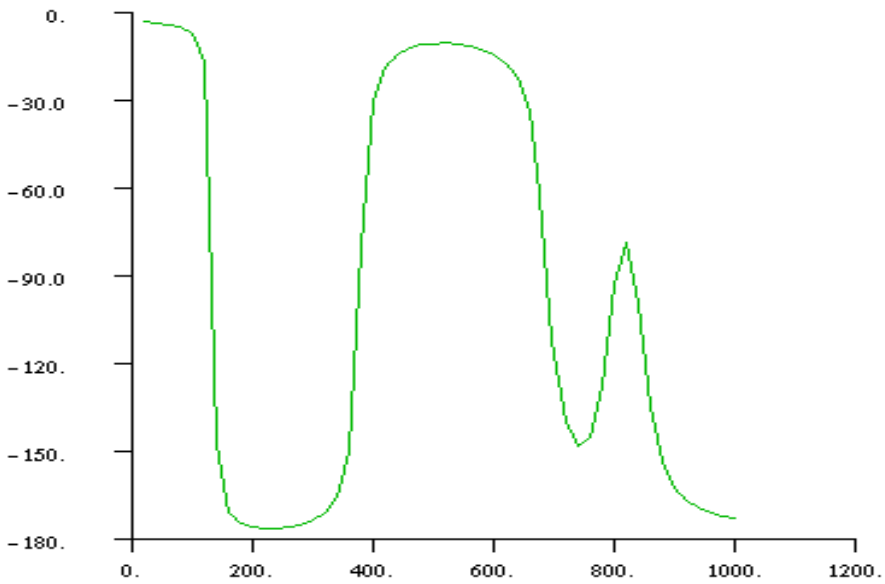
Apply...

Result XY Window Name:	**XYWindow2**
New Title or Title Filter	**Phase vs Frequency at Node 11**

Rename

Apply

Figure 5.4-Phase Angle at Node 11



Repeat the above steps of plotting the XY plots of Node 11 for Node 33 and 55. Once again, push **Cancel** to remove any miscellaneous forms until the ***Results Display*** form.

Plot Type Options...

Result (Y)...

Numerical Form for Complex Results ■ **Mag.**

OK

Node IDs **Node 33**

Apply...

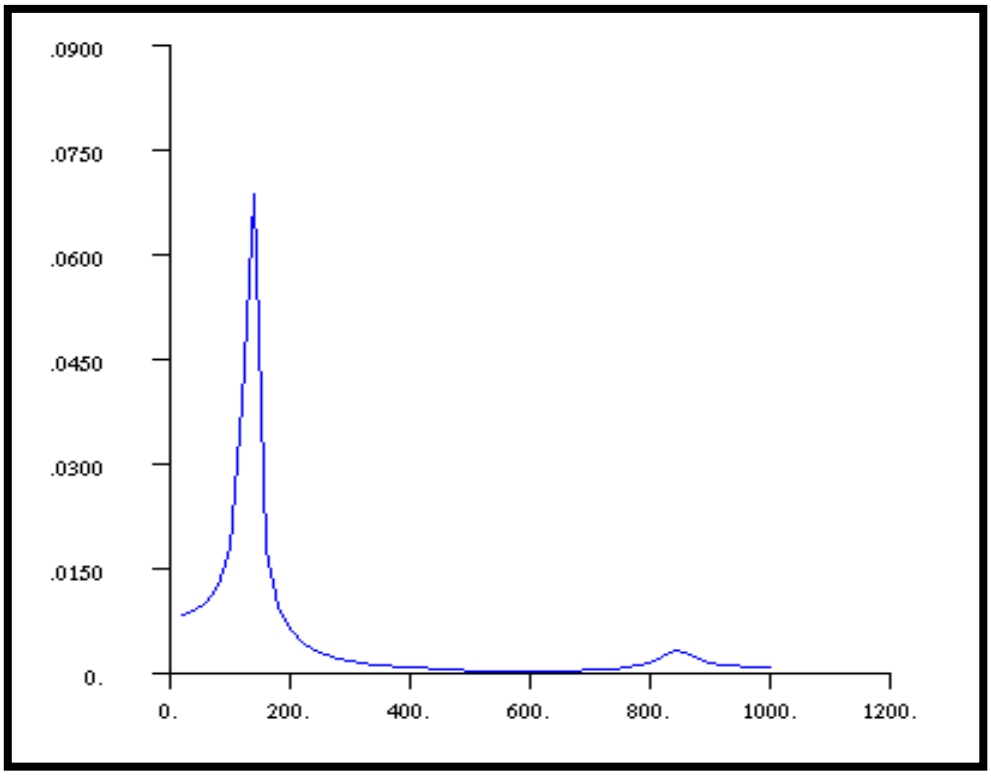
Result XY Window Name: **XYWindow3**

New Title or Title Filter **Displacement vs Frequency at Node 33**

Rename

Apply

Figure 5.5-Displacement Response at Node 33



Plot Type Options...

Result (Y)...

Numerical Form for Complex Results ■ **Phase**

OK

Node IDs **Node 33**

Apply

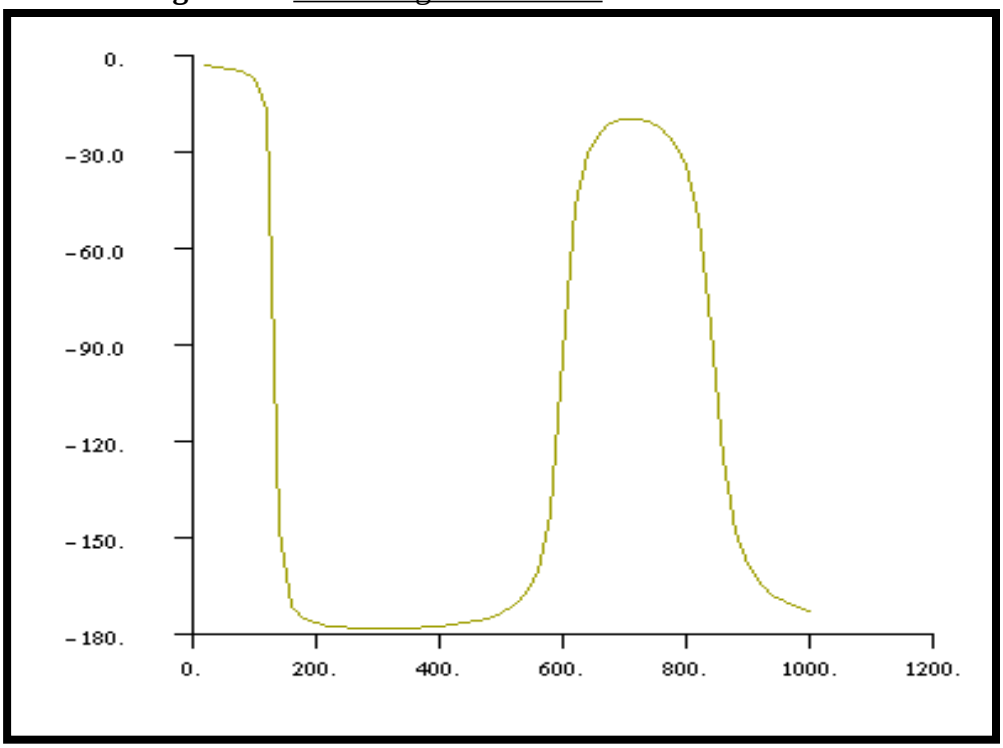
Result XY Window Name: **XYWindow4**

New Title or Title Filter **Phase vs Frequency at Node 33**

Rename

Apply

Figure 5.6-Phase Angle at Node 33



Plot Type Options...

Result (Y)...

Numerical Form for Complex Results ■ **Mag.**

OK

Node IDs **Node 55**

Apply...

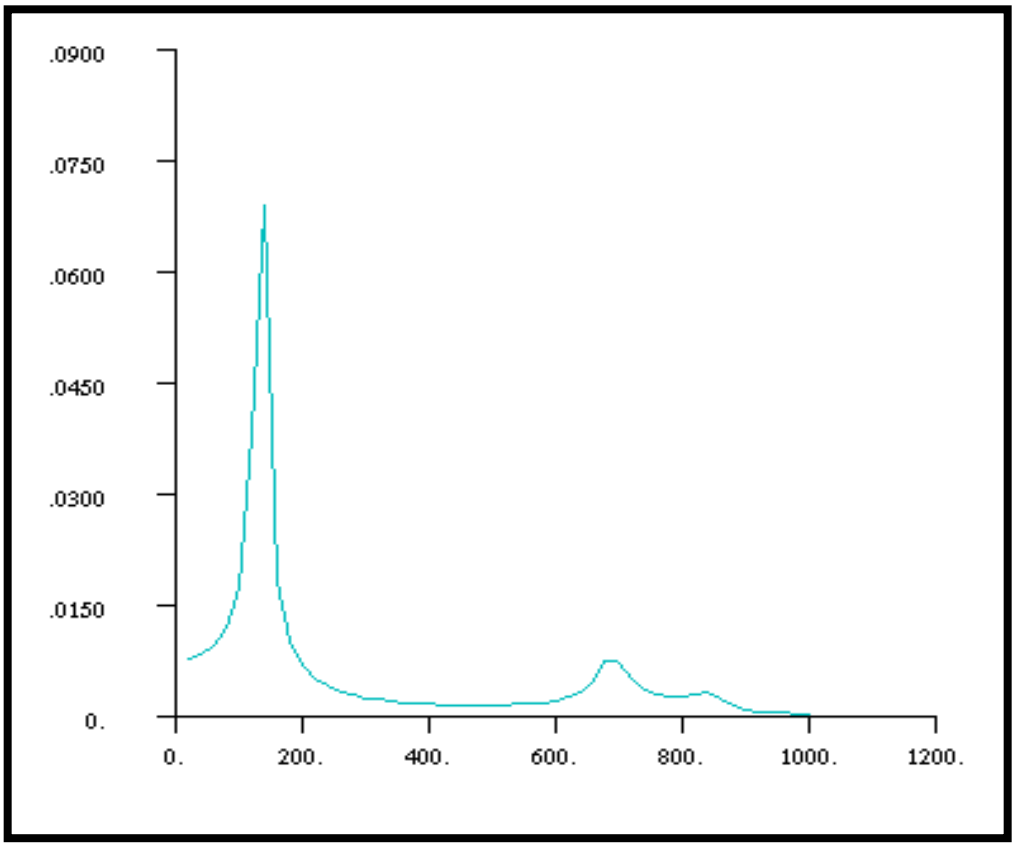
Result XY Window Name: **XYWindow5**

New Title or Title Filter **Displacement vs Frequency at Node 55**

Rename

Apply

Figure 5.7-Displacement Response at Node 55



Plot Type Options...

Result (Y)...

Numerical Form for Complex Results ■ **Phase**

OK

Node IDs **Node 55**

Apply...

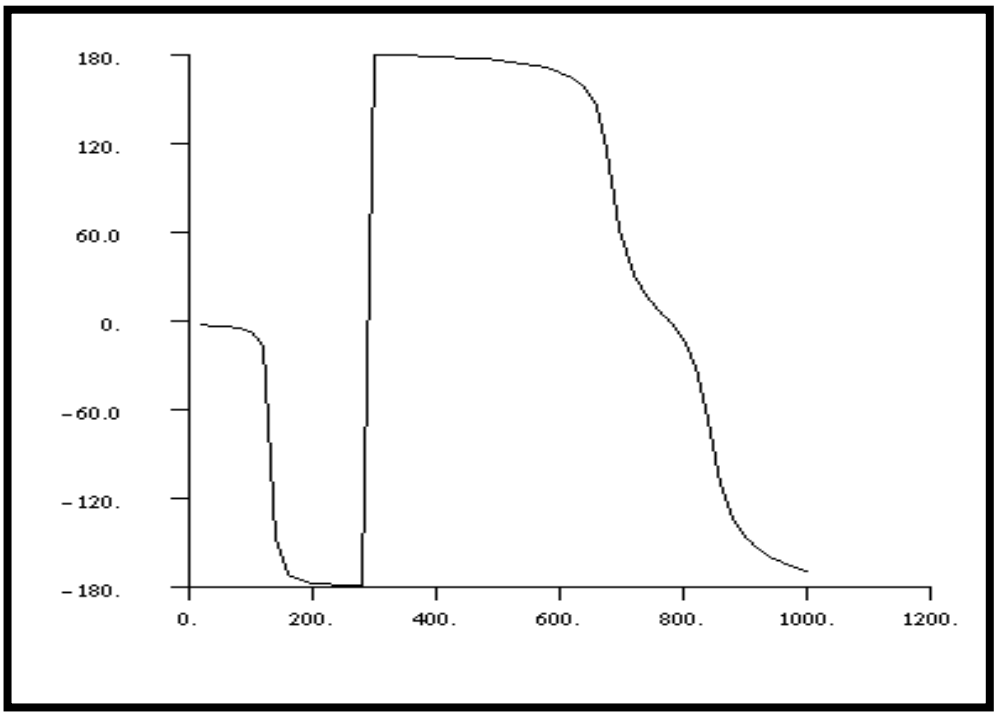
Result XY Window Name: **XYWindow6**

New Title or Title Filter **Phase vs Frequency at Node 55**

Rename

Apply

Figure 5.8-Phase Angle at Node 55



Quit MSC/PATRAN when you have completed this exercise.