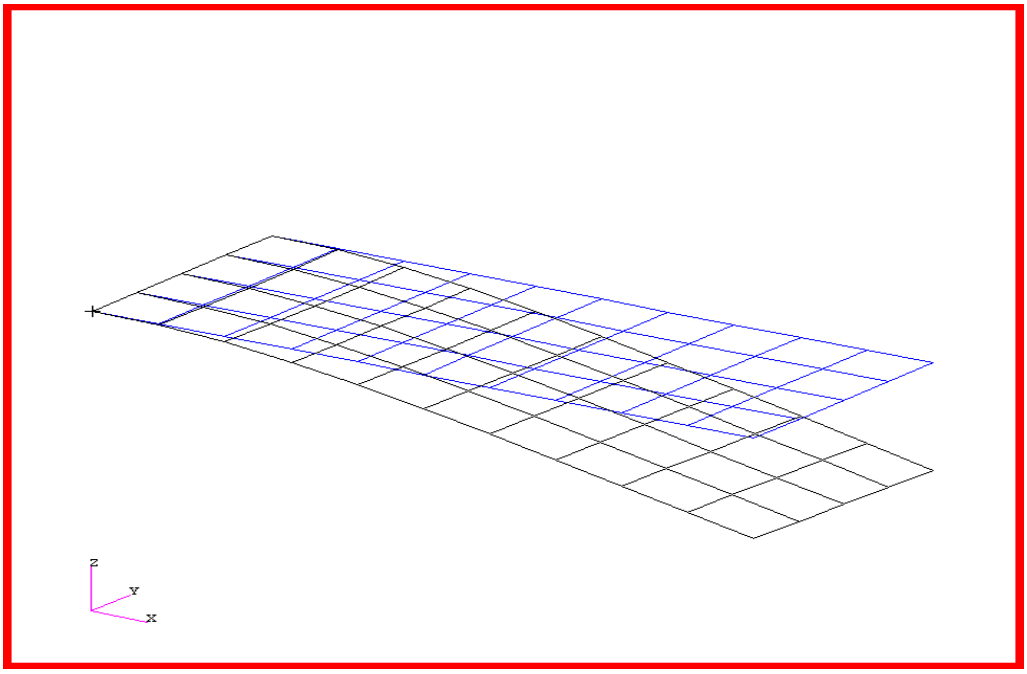
WORKSHOP 5

Direct Frequency Response Analysis



Objectives:

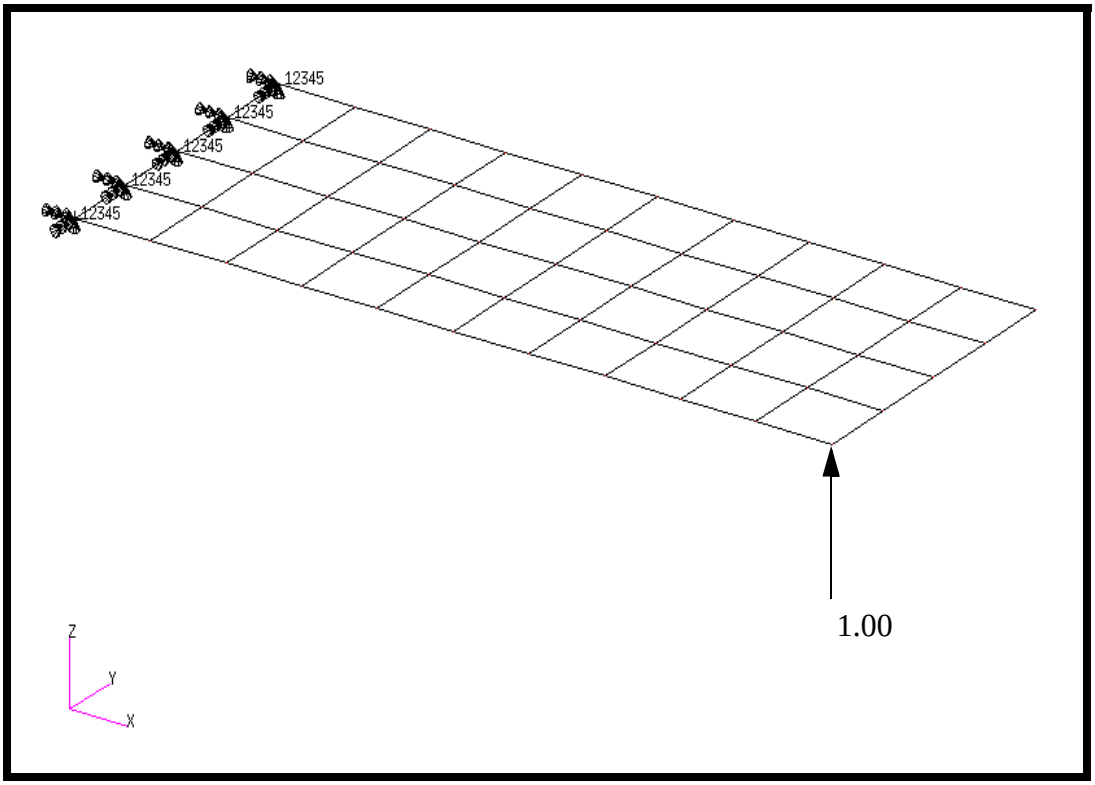
- Define frequency-varying excitation.
- Produce a MSC.Nastran input file from dynamic math model created in Workshop 1.
- Submit the file for analysis in MSC.Nastran.
- Compute nodal displacements for desired frequency domain.

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

New Database Name: **prob5**

OK

In the *New Model Preferences* 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 ...

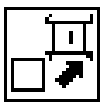
plate.bdf

OK

Apply

OK

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



Show Labels

5. Create a frequency dependent load case for the frequency 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**
Active Independent Variables	■ **Frequency (f)**

[Options ...]

Maximum Number of f: **2**

OK

Input Data...

Using the data in the table below, enter the values describing the frequency 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/Freq. 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

Action: **Plot Markers**

Under ***Assigned Load/BC Sets***, highlight:

Displ_spc1.1

Force_unit_force

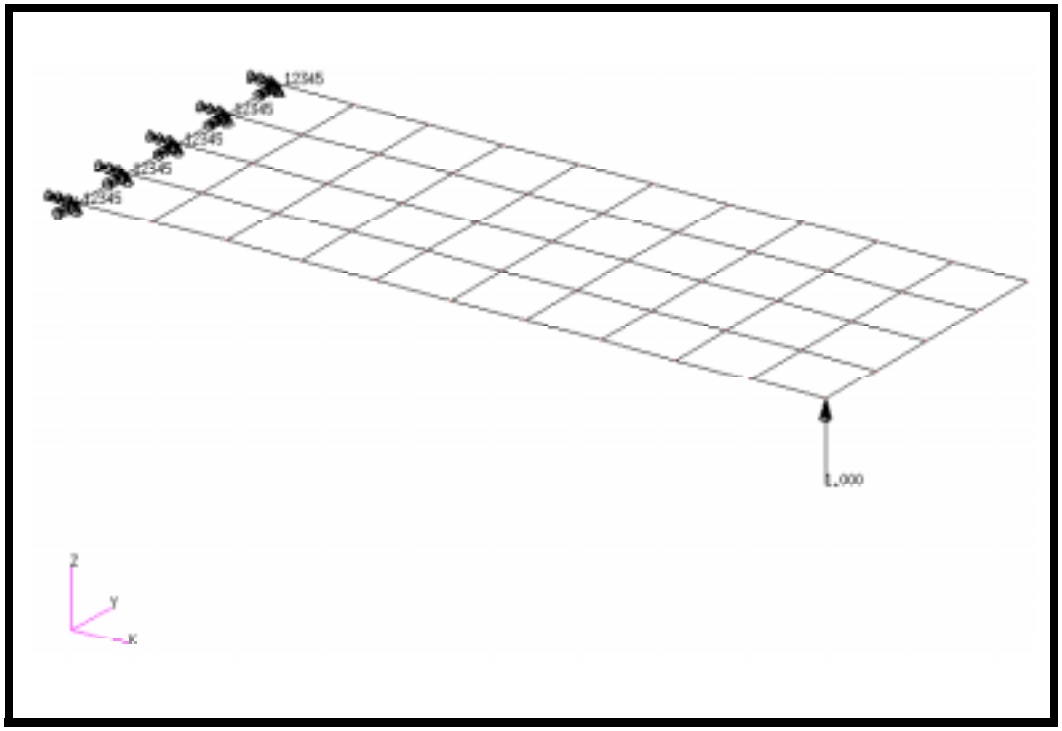
Under ***Select Groups***, highlight:

default_group

Apply

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**

Translation Parameters...

Data Output: **XDB and Print**

OK

Solution Type...

Solution Type: **◆ FREQUENCY RESPONSE**

Formulation: **Direct**

Solution Parameters...

Mass Calculation: **Coupled**

Wt.-Mass Conversion= **0.00259**

Struct. Damping Coeff. = **0.06**

OK

OK

Subcase Create ...

Available Subcases **frequency_response**

Subcase Parameters...

DEFINE FREQUENCIES...

Starting Frequency = **20**
(Hit Return to Input Data.)

Ending Frequency = **1000**
(Hit Return to Input Data.)

# of Freq. Increments = **49**
(Hit Return to Input Data.)

OK

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 = _____

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

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

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

◆ **Analysis**

Action:	**Attach XDB**
Object:	**Result Entities**
Method:	**Local**

Select Results File...

Select Available Files	**prob5.xdb**

OK

Apply

17. Plot the results in XY plots.

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

◆ **Results**

Action:	**Create**
Object:	**Graph**
Method:	**y vs x**
Select Results Cases	**Frequency_response, 0 of 50 subcases**
Filter Method	**All**

Filter

Apply

Close

Select Y result:	**Displacement, Translational**
Quanity:	**Z Component**

x: **Global Variable**

Variable: **Frequency**

Target Entities

Select Nodes: **Node 11**

Select the Plot Options by clicking on the icon:

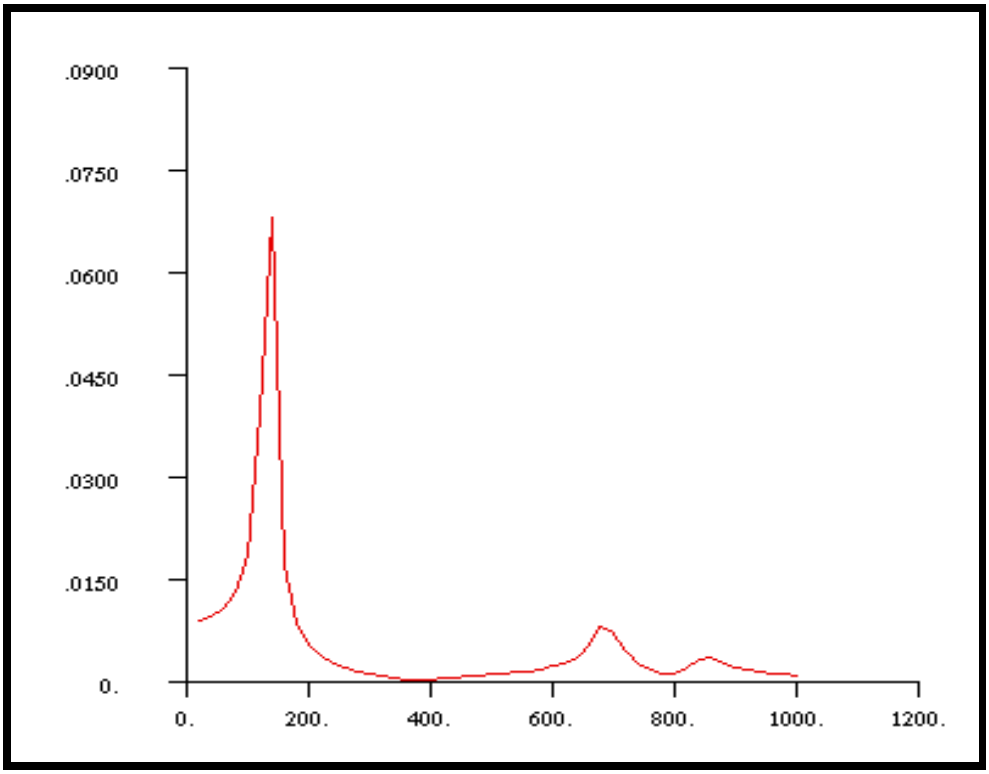
Plot Options

Plot Options

Complex No as: **Magnitude**

Apply

Figure 5.3-Displacement Response at Node 11



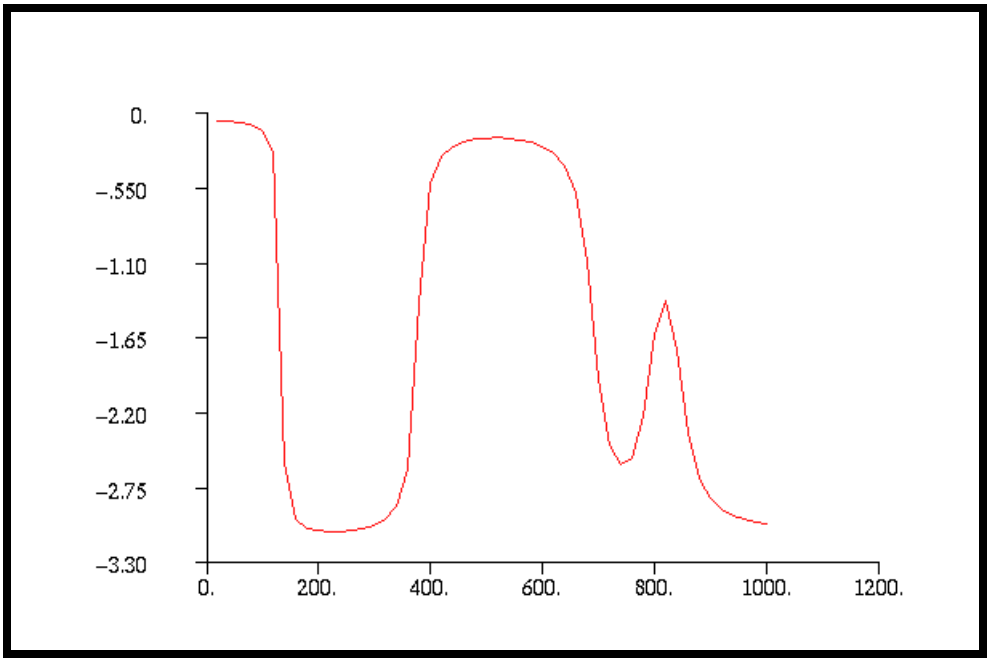
The next step is to make the plot of Phase versus Frequency.

Plot Options

Complex No as: **Phase:**

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 Options

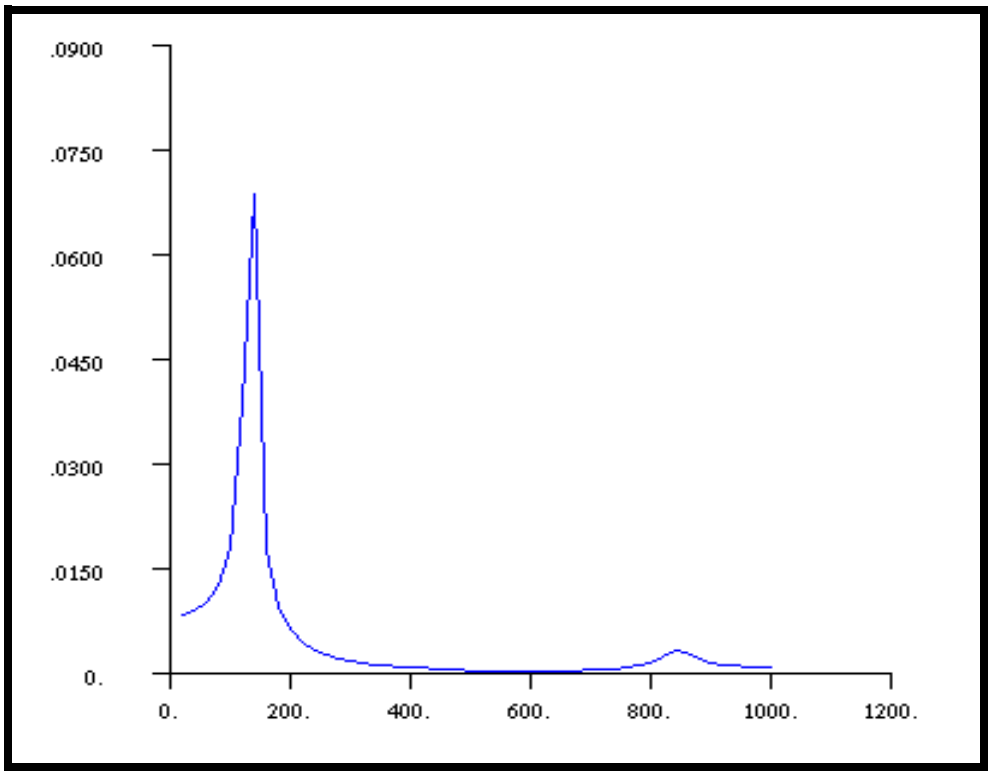
Complex No as: **Magnitude**

Target Entities:

Select Nodes: **Node 33**

Apply

Figure 5.5-Displacement Response at Node 33

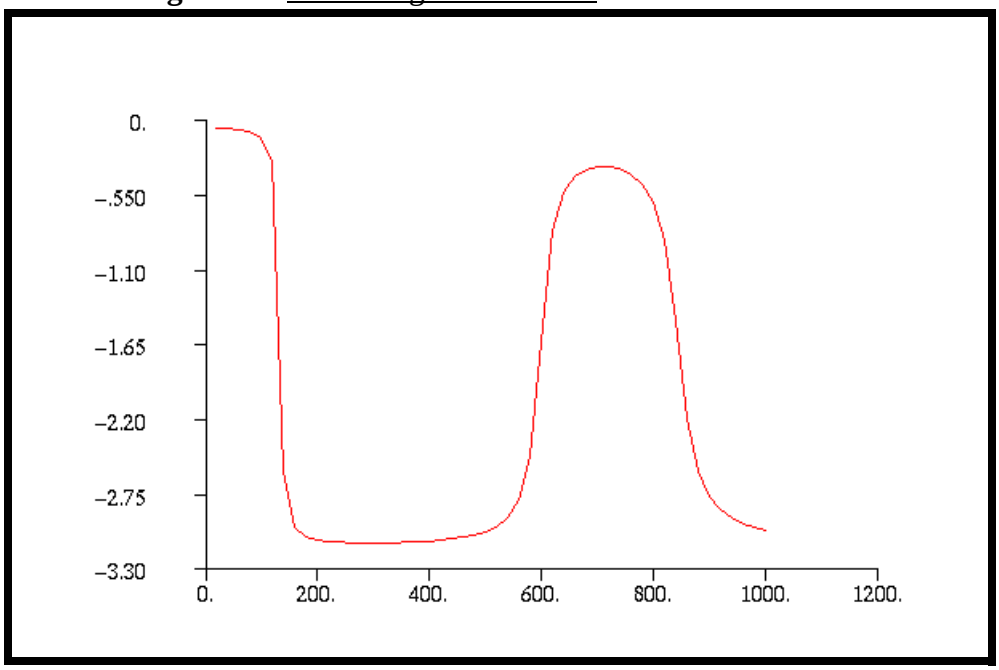


Plot Options

Complex No as: **Phase**

Apply

Figure 5.6-Phase Angle at Node 33



Plot Options

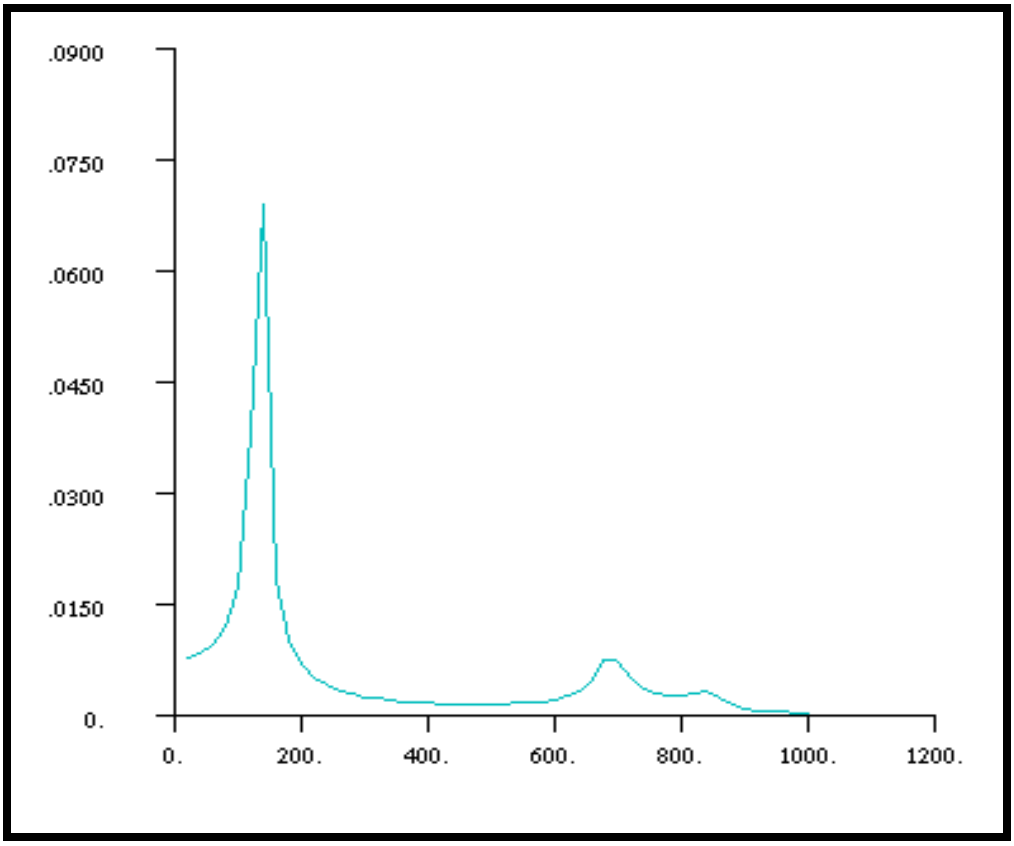
Complex No as **Phase**

Target Entities:

Select Nodes: **Node 55**

Apply

Figure 5.7-Displacement Response at Node 55

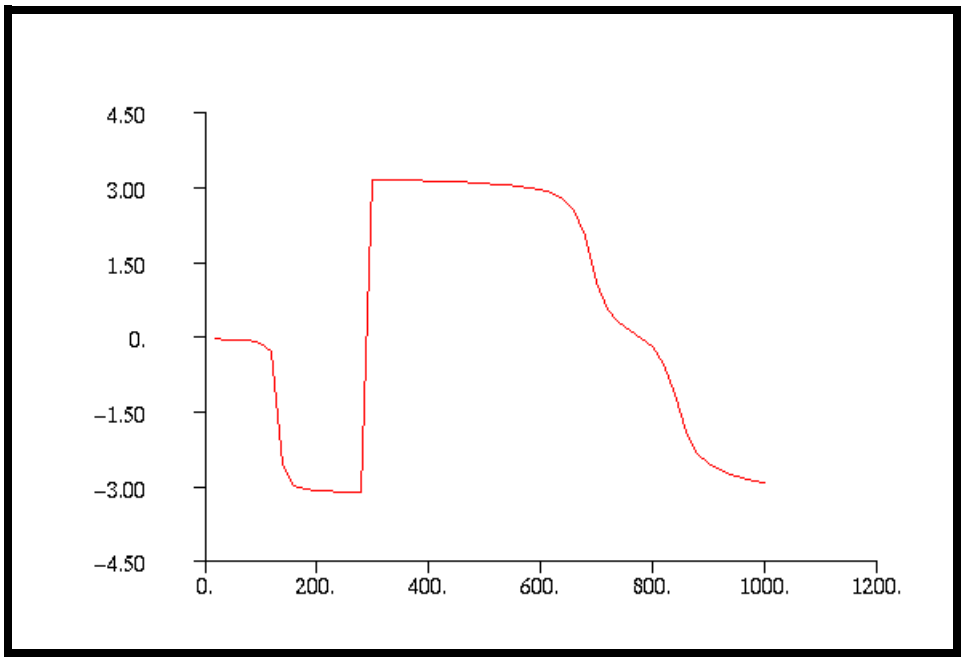


Plot Options

Complex No as: **Phase**

Apply

Figure 5.8-Phase Angle at Node 55



Quit MSC.Patran when you have completed this exercise.