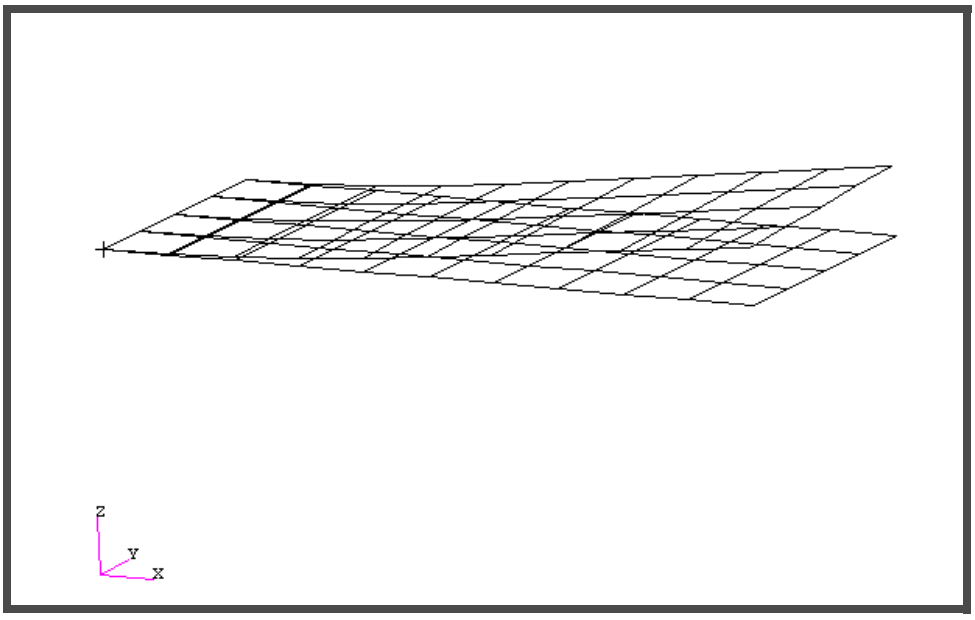
WORKSHOP 3

Direct Transient Response Analysis



Objectives

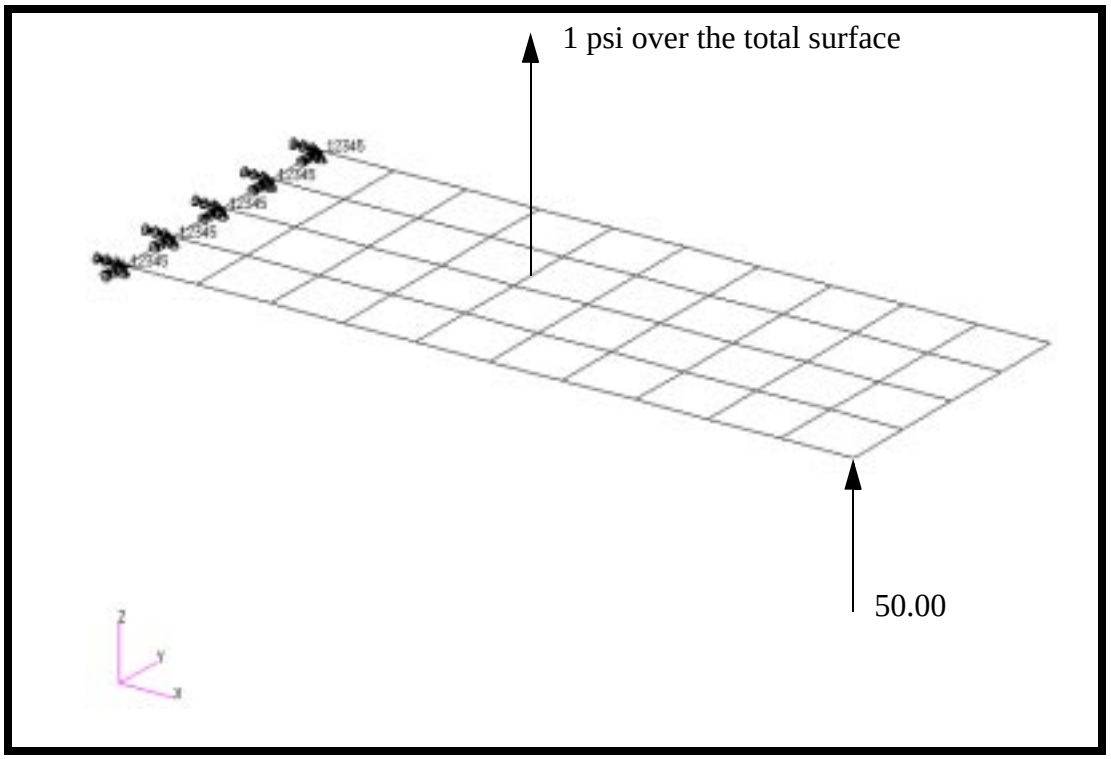
- Define time-varying excitation.
- Produce a MSC.Nastran input file from dynamic math model created in Workshop 1.
- Submit the file for analysis in MSC.Nastran.
- Compute nodal displacements for desired time domain.

Model Description:

Using the direct method, determine the transient response of the flat rectangular plate, created in Workshop 1, under time-varying excitation. This example structure shall be excited by 1 psi pressure load over the total surface of the plate varying at 250Hz. In addition, a 50 lb force is applied at a corner of the tip also varying at 250Hz but out-of-phase with the pressure load. Both time dependent dynamic loads are applied for the duration of 0.008 seconds only. Use structural damping of g=0.06 and convert this damping to equivalent viscous damping at 250Hz. Carry the analysis for 0.04 seconds.

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

Figure 3.1-Loads and Boundary Conditions



Suggested Exercise Steps

- Reference previously created dynamic math model, **plate.bdf**, by using the INCLUDE statement.
- Define the time-varying pressure loading (PLOAD2, LSEQ and TLOAD2). (Hint, be certain to specify phase angle since the applied loads are out-of-phase).
- Define the time-varying tip load (DAREA and TLOAD2). (Again, be certain to specify the phase angle).
- Combine the time-varying loads (DLOAD).
- Specify integration time steps (TSTEP).
- Prepare the model for a direct transient analysis (SOL 109).
- Specify the structural damping and convert this damping to equivalent viscous damping.
  - PARAM, G, 0.06
  - PARAM, W3, 1571.0
- Request response in terms of nodal displacement at grid points 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 xy-plot output.

```
ID SEMINAR,PROB3
```

```
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 13, otherwise, proceed to step 2.

2. Open a new database named **prob3.db**.

   File/New

   New Database Name **prob3**

   OK

   In the *New Model Preferences* form, set the following:

   Tolerance ◆ **Default**

   Analysis Code: **MSC/NASTRAN**

   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 tool-bar.

    **Show Labels**

5. Add the pre-defined constraints into the default load case.

◆ **Load Cases**

Action:	**Create**
Load Case Name	**transient_response**
Load Case Type:	**Time Dependent**
Assign/Prioritize Loads/BCs	
Select Individual Load/BCs *(Select from menu.)*	**Displ_spc1.1**
OK	
Apply	

6. Create a time-dependent field for the transient response of the pressure loading.

◆ **Fields**

Action:	**Create**
Object:	**Non Spatial**
Method	**Tabular Input**
Field Name	**time_dependent_pressure**
[Options ...]	
Maximum Number of t	**21**
OK	
Input Data ...	
Map Function to Table...	
PCL Expression f'(t):	**sind(360.*250.*'t)**
Start Time	**0.0**
End Time	**0.008**
Number of Points	**20**
Apply	

Cancel

In the ***Time/Frequency Scalar Table Data*** window, add the following to Row 21:

	Time(t)	Value
21	**0.04**	**0.0**

OK

Apply

7. Create another time-dependent field for the transient response of the nodal force.

◆ **Fields**

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

[Options ...]

Maximum Number of t	**21**

OK

Input Data ...

Map Function to Table...

PCL Expression f'(t)	**-sind(360*250*'t)**
Start Time	**0.0**
End Time	**0.008**
Number of Points	**20**

Apply

Cancel

In the ***Time/Frequency Scalar Table Data*** window, add the following to Row 21:

	Time(t)	Value
21	0.04	0.0

OK

Apply

8. Create the time dependent pressure.

◆ **Loads/BCs**

Action:	**Create**
Object:	**Pressure**
Type:	**Element Uniform**
New Set Name	**pressure**
Target Element Type:	**2D**

Input Data...

Top Surf Pressure	**-1**

Note: The default direction of pressure in MSC.Patran is opposite from default MSC.Nastran assumption.

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

OK

Select Application Region...

◆ **FEM**

Select 2D Elements or Edge *(Select all elements)*	**Elem 1:40**

Add

OK

Apply

9. Create the time-dependent nodal force.

◆ **Loads/BCs**

Action:	**Create**
Object:	**Force**
Type:	**Nodal**
New Set Name	**force**

Input Data...

Spatial Dependence Force <F1 F2 F3>	**<0 0 50>**
** Time/Freq. Dependence:* *(Select from the **Time Dependent Fields** box)*	**f:time_dependent_force**

OK

Select Application Region...

◆ **FEM**

Select Nodes	**Node 11**

Add

OK

Apply

To simplify the view, turn off the entity labels using the toolbar.

 **Hide Labels**

In addition, switch to a 3 view isometric view point.

 **Iso 3 View**

Action:	**Plot Markers**

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

Displ_spc1.1

Force_force

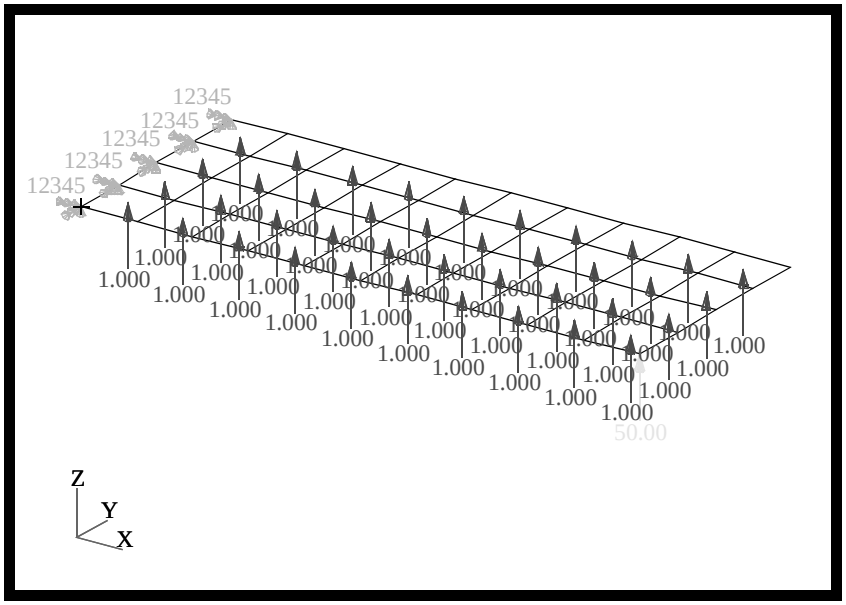
Press_pressure

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

default_group

The result should be similar to **Figure 3.2**.

Figure 3.2-The model with loads and boundary conditions applied.



10. Create the analysis.

◆ **Analysis**

Action:	**Analyze**
Object:	**Entire Model**
Method:	**Analysis Deck**
Job Name	**prob3**

Solution Type...

Translation Parameters...

Data Output:	**XDB and Print**

OK

Solution Type:	◆ **TRANSIENT RESPONSE**

Formulation: **Direct**

Solution Parameters...

Mass Calculation: **Coupled**

Wt.-Mass Conversion = **.00259**

Struct. Damping Coeff. = **0.06**

W3, Damping Factor = **1571**

OK

OK

Subcase Create...

Available Subcases **transient_response**
(Select from menu.)

Subcase Parameters...

Time Recovery Points **DEFINE TIME STEPS ...**

Number of Time Steps = **100**

Delta - T **.0004**
(Hit Return to Input Data.

OK

OK

Output Requests...

Form Type: **Advanced**

Under ***Output Requests***, highlight:

SPCFORCES(SORT1,Real)=All FEM

Delete

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

Options/Sorting: **By Freq/Time**

Modify

OK

Apply

Cancel

Subcase Select...

Subcases Selected:
(Click to de-select.)

Default

Subcases for Solution Sequence: 109
(Click to select.)

transient_response

OK

Apply

An MSC.Nastran input file called **prob3.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 proceed to step 14.

Generating an input file for MSC.Nastran Users:

MSC.Nastran users can generate an input file using the data previously stated. The result should be similar to the output below.

11. MSC.Nastran input file: **prob3.dat**

```
ID SEMINAR, PROB3
SOL 109
TIME 30
CEND
TITLE= TRANSIENT RESPONSE WITH TIME DEPENDENT PRESSURE AND POINT LOADS
SUBTITLE= USE THE DIRECT METHOD
ECHO= PUNCH
SPC= 1
SET 1= 11, 33, 55
DISPLACEMENT= 1
SUBCASE 1
DLOAD= 700 $ SELECT TEMPORAL COMPONENT OF TRANSIENT LOADING
LOADSET= 100 $ SELECT SPACIAL DISTRIBUTION OF TRANSIENT LOADING
TSTEP= 100 $ SELECT INTEGRATION TIME STEPS
$
OUTPUT (XYPLOT)
XGRID=YES
YGRID=YES
XTITLE= TIME (SEC)
YTITLE= DISPLACEMENT RESPONSE AT LOADED CORNER
XYPLOT DISP RESPONSE / 11 (T3)
YTITLE= DISPLACEMENT RESPONSE AT CENTER TIP
XYPLOT DISP RESPONSE / 33 (T3)
YTITLE= DISPLACEMENT RESPONSE AT OPPOSITE CORNER
XYPLOT DISP RESPONSE / 55 (T3)
$
BEGIN BULK
PARAM, COUPMASS, 1
PARAM, WTMASS, 0.00259
$
$ PLATE MODEL DESCRIBED IN NORMAL MODES EXAMPLE
$
INCLUDE 'plate.bdf'
$
$ SPECIFY STRUCTURAL DAMPING
$ 3 PERCENT AT 250 HZ. = 1571 RAD/SEC.
$
PARAM, G, 0.06
```

```
PARAM, W3, 1571.
$
$ APPLY UNIT PRESSURE LOAD TO PLATE
$
LSEQ, 100, 300, 400
$
PLOAD2, 400, 1., 1, THRU, 40
$
$ VARY PRESSURE LOAD (250 HZ)
$
TLOAD2, 200, 300, , 0, 0., 8.E-3, 250., -90.
$
$ APPLY POINT LOAD OUT OF PHASE WITH PRESSURE LOAD
$
TLOAD2, 500, 600, , 0, 0., 8.E-3, 250., 90.
$
DAREA, 600, 11, 3, 1.
$
$ COMBINE LOADS
$
DLOAD, 700, 1., 1., 200, 50., 500
$
$ SPECIFY INTERGRATION TIME STEPS
$
TSTEP, 100, 100, 4.0E-4, 1
$
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 for analysis, find an available UNIX shell window. At the command prompt enter: **nastran prob3.bdf scr=yes**. Monitor the run using the UNIX **ps** command.

    12b. To submit the MSC.Nastran **.dat** file for analysis, find an available UNIX shell window. At the command prompt enter: **nastran prob3 scr=yes**. Monitor the run using the UNIX **ps** command.

13. When the run is completed, use **plotps** utility to create a postscript file, **prob3.ps**, from the binary plot file **prob3.plt**. The displacement response plots for Grids 11, 33 and 55 are shown in figures 3.2, 3.3 and 3.4**.**

14. Edit the **prob3.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.

15. While still editing **prob3.f06**, search for the word:

D I S P L (spaces are necessary)

Displacement at Grid 11

Time T3

.0024 = _____

.0052 = _____

.02 = _____

Displacement at Grid 33

Time T3

.0024 = _____

.0052 = _____

.02 = _____

Displacement at Grid 55

Time	T3
.0024	= _____
.0052	= _____
.02	= _____

Comparison of Results

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

```
    POINT-ID =        11
                                            D I S P L A C E M E N T   V E C T O R

    TIME       TYPE          T1             T2             T3             R1             R2             R3
0.0              G      0.0            0.0            0.0            0.0            0.0            0.0
4.000000E-04     G      0.0            0.0           -2.173625E-02   1.104167E-02   1.050818E-02   0.0
8.000000E-04     G      0.0            0.0           -7.204904E-02   2.847414E-02   2.852519E-02   0.0
1.200000E-03     G      0.0            0.0           -1.433462E-01   4.082027E-02   4.915178E-02   0.0
     .
     .
     .
3.879996E-02     G      0.0            0.0           -3.726422E-02  -6.629907E-05   1.039267E-02   0.0
3.919996E-02     G      0.0            0.0           -2.122380E-02  -1.431050E-05   5.916678E-03   0.0
3.959996E-02     G      0.0            0.0           -2.998187E-03  -7.089762E-06   8.371174E-04   0.0
3.999996E-02     G      0.0            0.0            1.535974E-02   5.380207E-06  -4.281030E-03   0.0

    POINT-ID =        33
                                            D I S P L A C E M E N T   V E C T O R

    TIME       TYPE          T1             T2             T3             R1             R2             R3
0.0              G      0.0            0.0            0.0            0.0            0.0            0.0
4.000000E-04     G      0.0            0.0           -1.122398E-02   9.220218E-03   6.138594E-03   0.0
8.000000E-04     G      0.0            0.0           -4.424753E-02   2.576699E-02   2.014980E-02   0.0
1.200000E-03     G      0.0            0.0           -1.030773E-01   3.819036E-02   3.922388E-02   0.0
     .
     .
     .
3.879996E-02     G      0.0            0.0           -3.729695E-02   1.898676E-05   1.037927E-02   0.0
3.919996E-02     G      0.0            0.0           -2.121863E-02   3.488550E-05   5.907703E-03   0.0
3.959996E-02     G      0.0            0.0           -3.002583E-03  -2.228106E-07   8.361273E-04   0.0
3.999996E-02     G      0.0            0.0            1.535096E-02  -3.032754E-05  -4.274252E-03   0.0

    POINT-ID =        55
                                            D I S P L A C E M E N T   V E C T O R

    TIME       TYPE          T1             T2             T3             R1             R2             R3
0.0              G      0.0            0.0            0.0            0.0            0.0            0.0
4.000000E-04     G      0.0            0.0           -2.849185E-03   7.791447E-03   4.611430E-03   0.0
8.000000E-04     G      0.0            0.0           -1.992890E-02   2.322436E-02   1.681028E-02   0.0
1.200000E-03     G      0.0            0.0           -6.643156E-02   3.540079E-02   3.501805E-02   0.0
     .
     .
     .
3.879996E-02     G      0.0            0.0           -3.722652E-02   1.035188E-04   1.039059E-02   0.0
3.919996E-02     G      0.0            0.0           -2.115454E-02   8.268487E-05   5.912832E-03   0.0
3.959996E-02     G      0.0            0.0           -2.998628E-03   6.654292E-06   8.371378E-04   0.0
3.999996E-02     G      0.0            0.0            1.529953E-02  -6.482315E-05  -4.277684E-03   0.0
```

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 attaching the **prob3.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 File	**prob3.xdb**

OK

Apply

When the translation is complete bring up the **Results** form.

◆ **Results**

Action:	**Create**
Object:	**Graph**
Select Results Cases	**Transient_response, 0 of 101 subcases**
Filter Method	**All**

Filter

Apply

Close

y:	**Result**
Select y Result:	**Displacement, Translational**
Quanity:	**Z Component**
x:	**Global Variable**
Variable:	**Time**

Select the **target entities** form by clicking on this Icon

 **Target Entities**

Target Entities

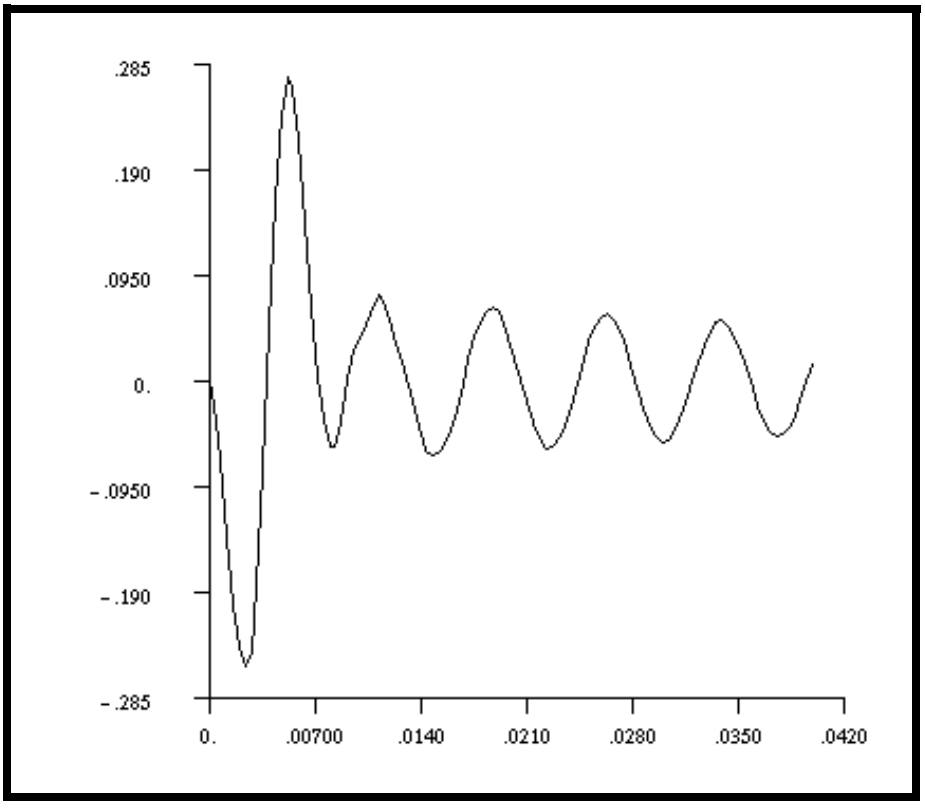
Select Nodes: **Node 11**

Apply

You may reset the graphics by clicking on this icon :

 **Reset Graphics**

Figure 3.3-Displacement Response at Node 11

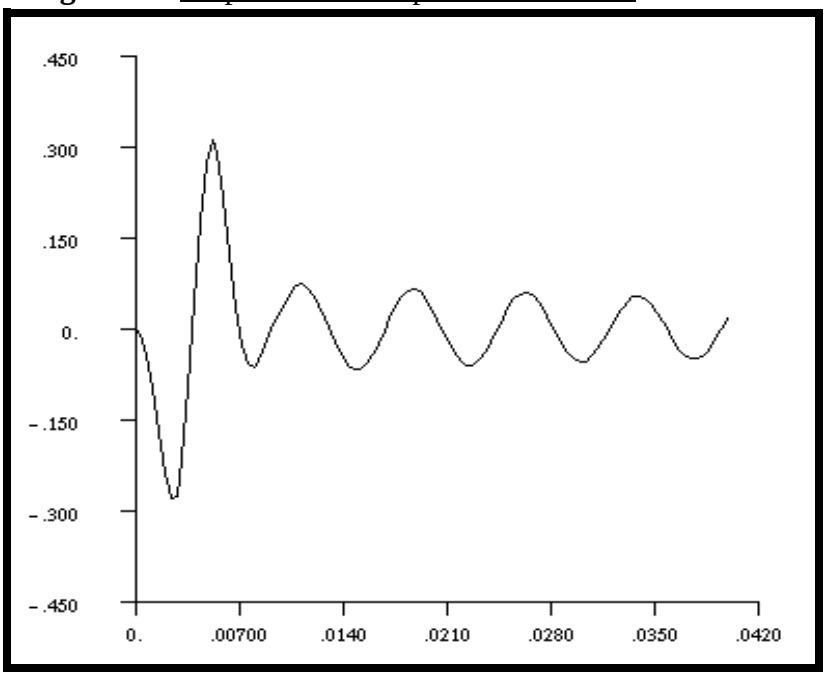


To Plot Node 33 and 55, simply select them..

Select Nodes: **Node 33**

Apply

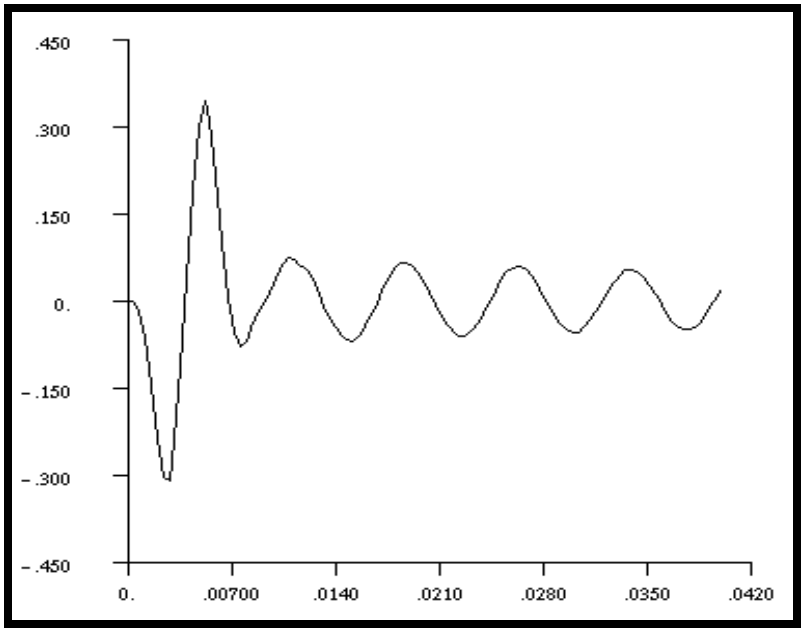
Figure 3.4-Displacement Response at Node 33



Select Nodes: **Node 55**

Apply

Figure 3.5-Displacement Response at Node 55



Quit MSC.Patran when you are finished with this exercise.