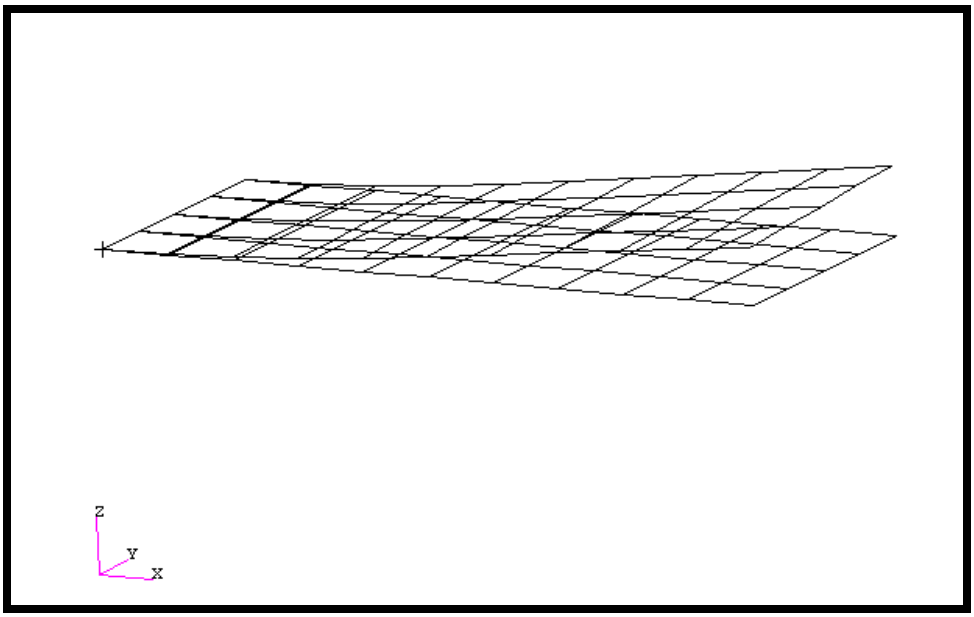
WORKSHOP PROBLEM 3

Direct Transient Response Analysis



Objectives

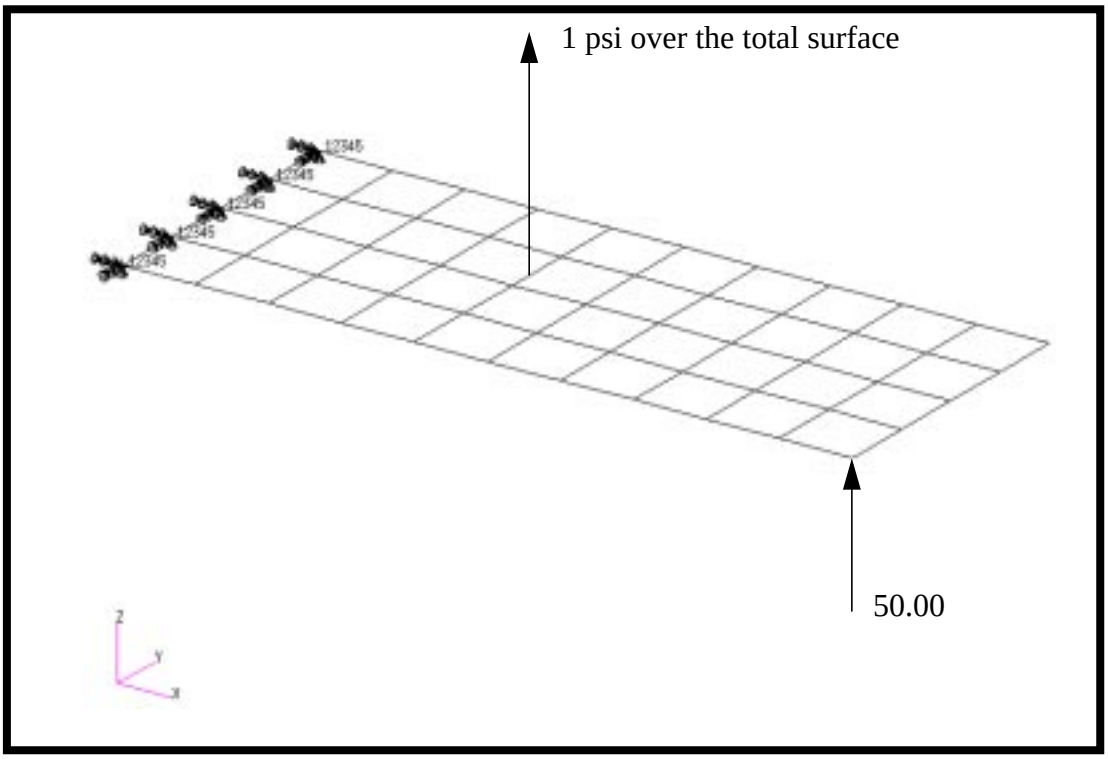
- Define time-varying excitation.
- Produce a MSC/NASTRAN input file from dynamic math model created in Workshop 1.
- Submit the file for analysis in MSC/NASTRAN.
- Compute nodal displacements for desired time domain.

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 Database

   New Database Name **prob3**

   OK

   In the *New Model Preference* 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 Load/BCs to Add to Spreadsheet *(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(90000.*'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(90000.*'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 Dependence: **f:time_dependent_pressure**
*(Select from the **Time Dependent Fields** box)*

OK

Select Application Region...

◆ **FEM**

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

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 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.

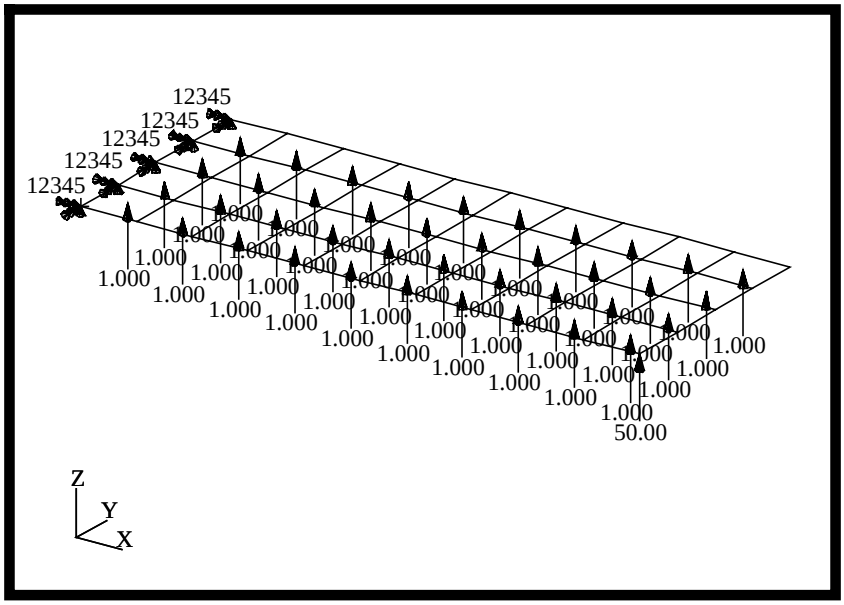
 **Hide Labels**

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

 **Iso 3 View**

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...

Solution Type:	◆ **TRANSIENT RESPONSE**

Solution Parameters...

Formulation:	**Direct**
Mass Calculation:	**Coupled**
Wt.-Mass Conversion =	**.00259**
Struct. Damping Coeff. =	**0.06**
W3, Damping Factor =	**1571**

OK

OK

Direct Text Input...

Clear

OK

Subcase Create...

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

Subcase Parameters...

Ending Time = — **.04**

Number of Time Steps = — **100**

OK

Output Requests...

Form Type: — **Advanced**

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

SPCFORCES(SORT1,Real)=All FEM

Delete

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

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 results on the following page:

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 importing the **prob3.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 File **prob3.op2**

OK

Apply

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

◆ **Results**

Form Type: **Advanced**

Select Results Cases
(Highlight all.)

Get Results

Select Result **1.1 Displacements, Translational**

Plot Type **XY Plot**

Plot Type Options...

Global Var...

Global Variables **1-Time**

Apply

Result(Y)...

Results **1.1-Displacements, Translational**

Vector Component ❒ **X** ❒ **Y** ■ **Z**

OK

Node IDs **Node 11**

Apply

New Title or Title Filter

Displacement Response At Loaded Corner

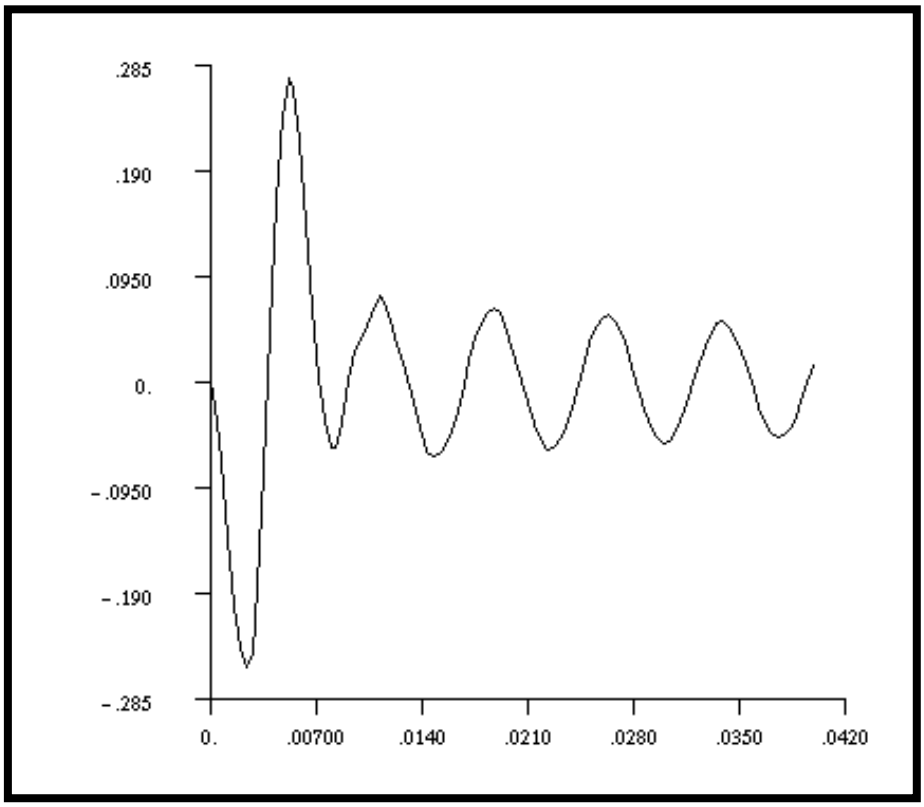
Rename

Apply

You may reset the graphics by clicking on this icon:

Reset Graphics

Figure 3.3-Displacement Response at Node 11



Repeat the above steps for plotting the xy plots of Node 11, Node 33 and Node 55. 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...

Global Var...

Global Variables **1-Time**

Apply

Result(Y)...

Results **1.1-Displacements, Translational**

Vector Component ❒ **X** ❒ **Y** ■ **Z**

OK

Node IDs **Node 33**

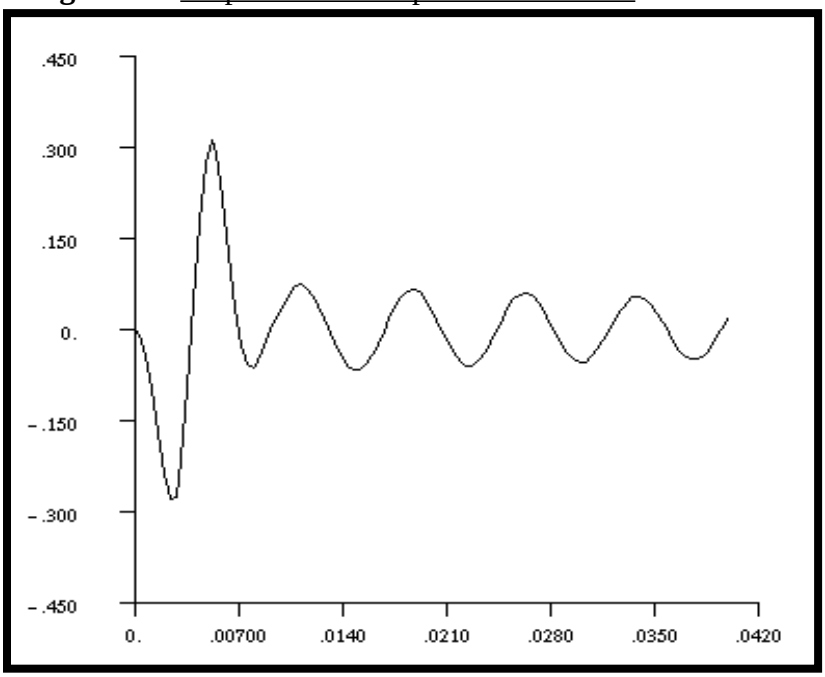
Apply

New Title or Title Filter **Displacement Response at Tip Center**

Rename

Apply

Figure 3.4-Displacement Response at Node 33



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 Option...

Global Var...

Global Variables **1. Time**

Apply

Result(Y)...

Results **1.1-Displacements, Translational**

Vector Component ❒ **X** ❒ **Y** ■ **Z**

OK

Node IDs **Node 55**

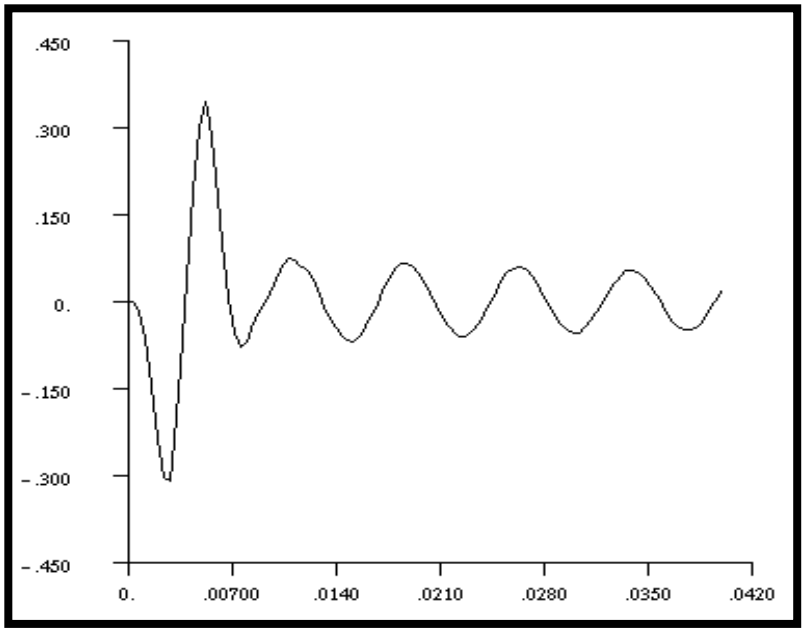
Apply

New Title or Title Filter **Displacement Response at Opposite Corner**

Rename

Apply

Figure 3.5-Displacement Response at Node 55



Quit MSC/PATRAN when you are finished with this exercise.