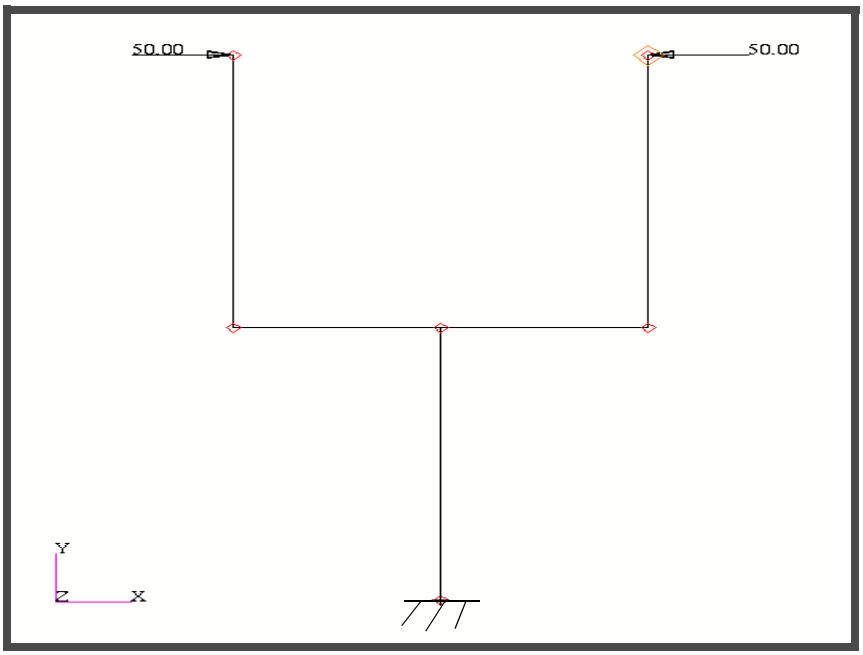
WORKSHOP 6b

Multipoint Constraints
Relative Motion



Objectives

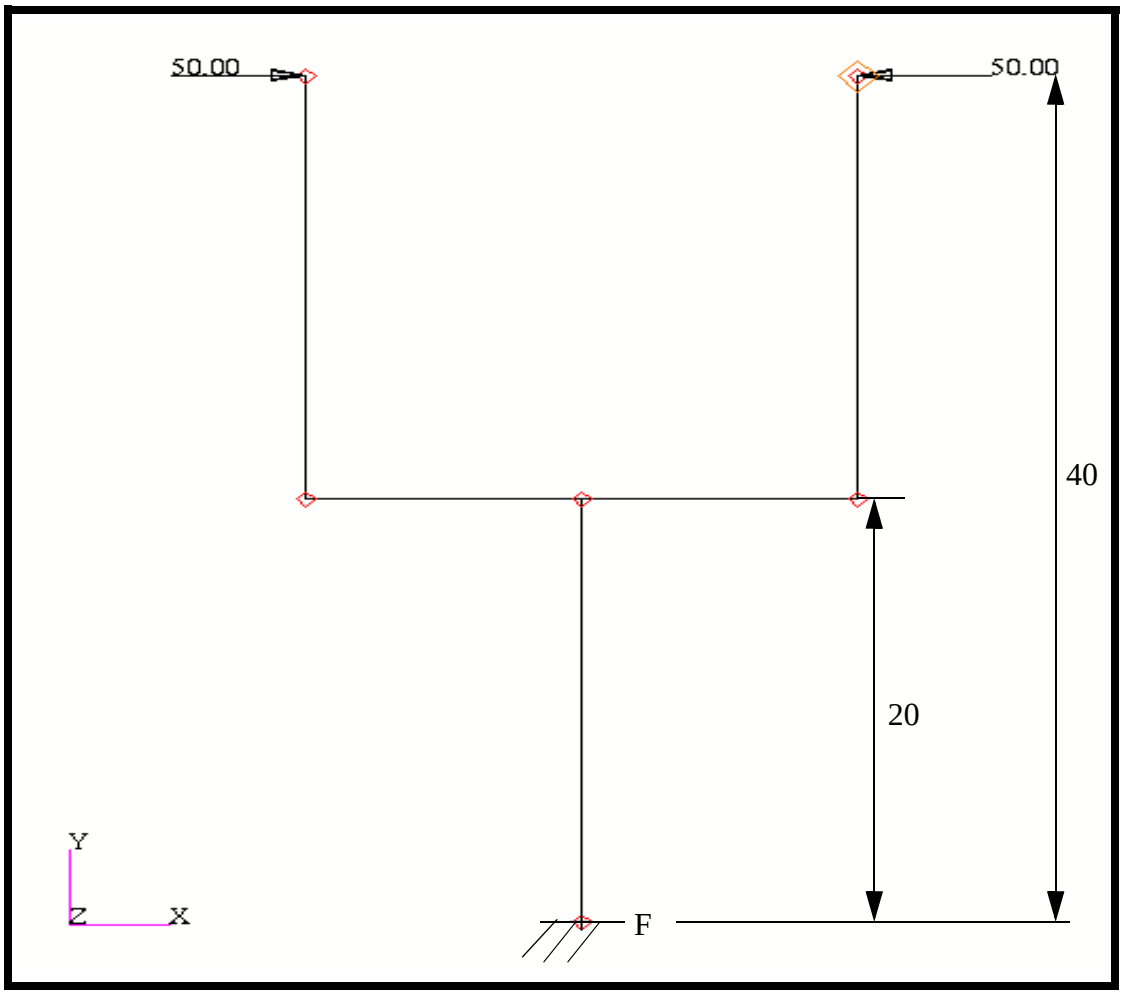
- Define time-varying excitation.
- Create a MSC.Nastran dynamic math model.
- Submit the file for analysis in MSC.Nastran.
- Compute nodal displacements for desired time domain.

Model Description:

Using the direct method, determine the transient response of the structure, under time-varying excitation. This example structure shall be excited by a 50 lb force applied at the left. Additionally, a negative 50lbs force is applied at the right also varying at 250Hz. 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. We will add an MPC equation to calculate the relative motion between the two tip points in the x direction.

Below is a finite element representation of the structure. It also contains the loads and boundary conditions.

Figure 6b.1-Loads and Boundary Conditions



Suggested Exercise Steps

- Use Model from 6.
- Add a node and an MPC equation for relative motion calculation.

```
ID SEMINAR,PROB6B
```

```
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 database created in Problem 6a named **prob6a.db**.

   File/Open Database

   Existing Database Name **prob6a**

   OK

3. Activate the entity labels by selecting the Show Labels icon on the tool-bar.

    **Show Labels**

4. Create a new node.

   We wish to calculate the relative motion between nodes 5 and 6 in the x direction. We will create a new node, 1000, as an extra degree of freedom to store the results of the MPC equation. The equation is:

   $$1000_x = 6_x - 5_x$$

   Nastran requires the equation be written in the form:

   $$0 = 1000_x + 5_x - 6_x$$

   The location of Node 1000 is arbitrary. We choose to place it between Nodes 5 and 6 to make the graphical representations neat.

   ◆ **Finite Elements**

   Action: **Create**

   Object: **Node**

   Method: **Edit**

   Click ❑ **Associate with Geometry** (turn off).

   Whenever possible click ❑ **Auto Execute** (turn off).

   Node ID List: **1000**

Node Location List: **[0 40 0]**

Apply

5. Create a dependent node.

◆ **Finite Elements**

Action: **Create**

Object: **MPC**

Type: **Explicit**

MPC ID: **1**

Define Terms...

Whenever possible click ❑ **Auto Execute** (turn off).

◆ **Create Dependent**

Node List: **Node 1000**

DOFs: **UX**

Apply

◆ **Create Independent**

Coefficient: **1.0**

Node List: **Node 5**

DOFs: **UX**

Apply

◆ **Create Independent**

Coefficient: **-1.0**

Node List: **Node 6**

DOFs: **UX**

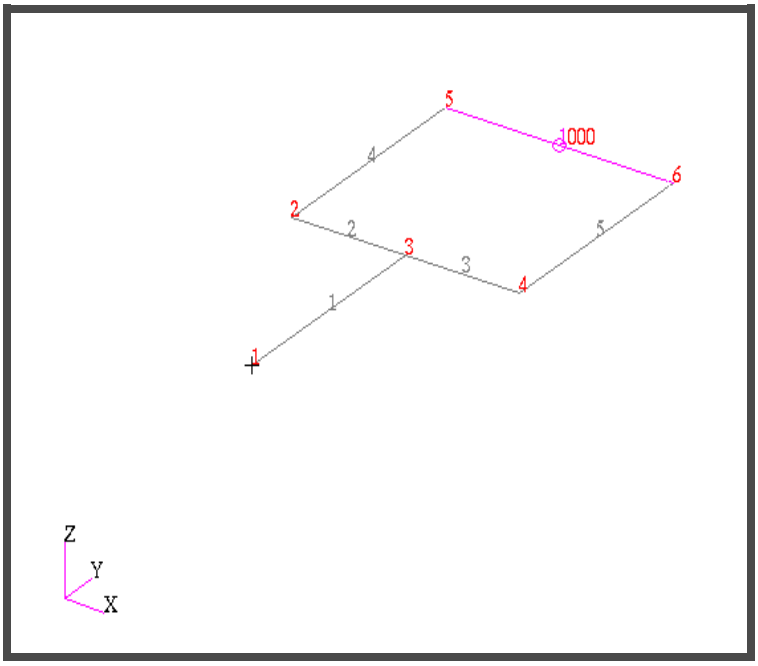
Apply

Cancel

Apply

Right now the figure should look like the following:

Figure 6b.2 - Model with a dependent node



6. Create the analysis.

◆ **Analysis**

Action: **Analyze**

Object: **Entire Model**

Method: **Analysis Deck**

Job Name **prob6b**

Translation Parameters...

Data Output: **XDB and Print**

OK

Solution Type...

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**

Output Requests: **DISPLACEMENT(...**
(Select from menu.)

Sorting: **By Freq/Time**

Modify

OK

Apply

Yes

Cancel

Subcase Select...

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

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

transient_response

OK

Apply

An MSC.Nastran input file called **prob6b.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 13.

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.

7. MSC.Nastran input file: **prob6b.dat**

```
SOL 109
TIME 600
CEND
Title    = NAS105 Problem 4a
Subtitle = MPC for X relative motion
$--
   TSTEP = 1
$--
   LOADSET = 1
   DLOAD   = 1
$--
   SPC = 1
   MPC = 11
$--
   DISP = ALL
   SPCF = ALL
$--
BEGIN BULK
$--
$--  Solution Parameters
PARAM   POST    0
PARAM   COUPMASS+1
PARAM   WTMASS  0.00259
PARAM   G       0.06
PARAM   W3      1571.
$--
$--  Solution time step control
TSTEP    1       100     4.-4
$--
$--  Structural Model
MAT1    1       29.+6           0.3     0.286
PBAR    1       1       .1      1.      1.      2.
$--
CBAR    1       1       1       3       0.      0.      1.
CBAR    2       1       2       3       0.      0.      1.
CBAR    3       1       3       4       0.      0.      1.
CBAR    4       1       2       5       0.      0.      1.
CBAR    5       1       4       6       0.      0.      1.
```

```
$--
$           2           3           4           5           6           789
GRID    1                0.      0.      0.
GRID    2               -10.     20.     0.
GRID    3                0.      20.     0.
GRID    4                10.     20.     0.
GRID    5               -10.     40.     0.
GRID    6                10.     40.     0.
$--
$--  GRID and MPC for X relative motion calculation
$--
GRID    1000            0.      40.     0.
MPC     11      1000    1       1.0     5       1       1.0
                6       1       -1.0
$--
$--  Dynamic loading using static load entries
$--
FORCE   3       5       0        50.    -1.      0.      0.
FORCE   3       6       0        50.     1.      0.      0.
$--
LSEQ    1       9       3
$--
$           2           3           4           5           6           789
TLOAD2  1       9               0       0.      0.008   250.
$--
$--  Constraint
SPC1    1       123456  1
$--
ENDDATA
```

Submitting the input file for analysis:

8. Submit the input file to MSC.Nastran for analysis.

   8a. To submit the MSC.Patran **.bdf** file for analysis, find an available UNIX shell window. At the command prompt enter: **nastran prob6b.bdf scr=yes**. Monitor the run using the UNIX **ps** command.

   8b. To submit the MSC.Nastran **.dat** file for analysis, find an available UNIX shell window. At the command prompt enter: **nastran prob6b scr=yes**. Monitor the run using the UNIX **ps** command.

9. When the run is completed, use **plotps** utility to create a postscript file, **prob6b.ps**, from the binary plot file **prob6b.plt**.

10. Edit the **prob6b.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.

11. While still editing **prob6b.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

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

```
 POINT-ID =       5

                                      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      2.229567E-03   1.852986E-04   0.0            0.0            0.0            -1.468097E-04
 8.000000E-04   G      7.711042E-03   8.842333E-04   0.0            0.0            0.0            -4.687812E-04
 1.200000E-03   G      1.437563E-02   2.086459E-03   0.0            0.0            0.0            -8.402162E-04
      .                 .              .              .              .              .              .
      .                 .              .              .              .              .              .
 3.879996E-02   G      2.687579E-04   6.445742E-05   0.0            0.0            0.0            -1.467883E-05
 3.919996E-02   G      1.092948E-04   2.688303E-05   0.0            0.0            0.0            -5.964874E-06
 3.959996E-02   G      -1.340360E-04  -3.192633E-05  0.0            0.0            0.0            7.322114E-06
 3.999996E-02   G      -2.363959E-04  -5.727933E-05  0.0            0.0            0.0            1.290737E-05

 POINT-ID =       6

                                      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      -2.229567E-03  1.852986E-04   0.0            0.0            0.0            1.468097E-04
 8.000000E-04   G      -7.711042E-03  8.842333E-04   0.0            0.0            0.0            4.687812E-04
 1.200000E-03   G      -1.437563E-02  2.086459E-03   0.0            0.0            0.0            8.402162E-04
      .                 .              .              .              .              .              .
      .                 .              .              .              .              .              .
 3.879996E-02   G      -2.687579E-04  6.445742E-05   0.0            0.0            0.0            1.467883E-05
 3.919996E-02   G      -1.092948E-04  2.688303E-05   0.0            0.0            0.0            5.964874E-06
 3.959996E-02   G      1.340360E-04   -3.192633E-05  0.0            0.0            0.0            -7.322114E-06
 3.999996E-02   G      2.363959E-04   -5.727933E-05  0.0            0.0            0.0            -1.290737E-05

 POINT-ID =    1000

                                      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      4.459133E-03   0.0            0.0            0.0            0.0            0.0
 8.000000E-04   G      1.542208E-02   0.0            0.0            0.0            0.0            0.0
 1.200000E-03   G      2.875126E-02   0.0            0.0            0.0            0.0            0.0
      .                 .              .              .              .              .              .
      .                 .              .              .              .              .              .
 3.879996E-02   G      5.375202E-04   0.0            0.0            0.0            0.0            0.0
 3.919996E-02   G      2.185929E-04   0.0            0.0            0.0            0.0            0.0
 3.959996E-02   G      -2.680710E-04  0.0            0.0            0.0            0.0            0.0
 3.999996E-02   G      -4.727929E-04  0.0            0.0            0.0            0.0            0.0
```

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

14. Proceed with the Reverse Translation process, that is importing the **prob6b.op2** results file into MSC.Patran. To do this, return to the Analysis form and proceed as follows:

◆ **Analysis**

Action:	**Delete**
Object:	**XDB Attachment**
Existing Files: *(Select from menu.)*	**A1:/tmp_mnt/...**

Apply

Yes

◆ **Analysis**

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

Select Results File...

Select File	**prob6b.xdb**

OK

Apply

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

◆ **Results**

Action:	**Create**
Object:	**Graph**
Select Results Cases *(By double clicking.)*	**Transient_response, 0 of 101 subcases**
Filter Method	**All**

Filter

Apply

Close

Y:	**Result**
Select Y Result:	**Displacement, Translational**
Quanity:	**X Component**
X:	**Global Variable**
Variable:	**Time**

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

Target Entities

Target Enities

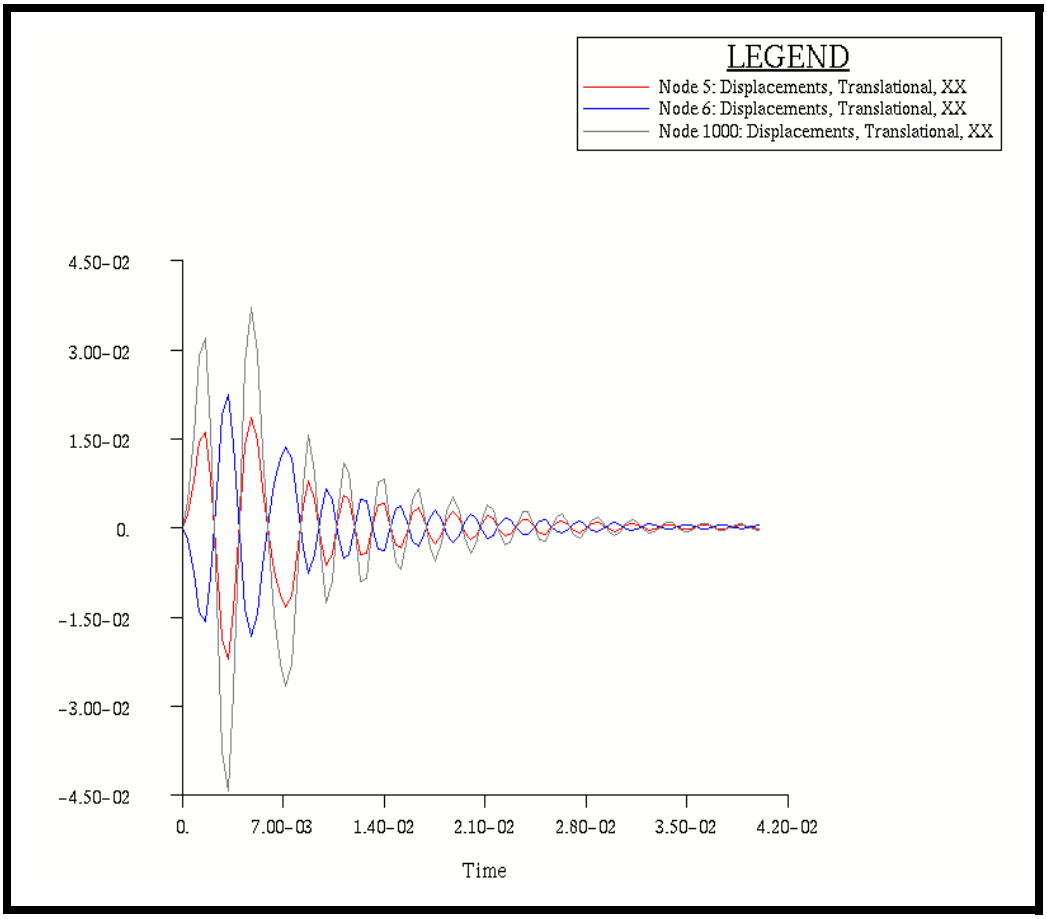
Select Nodes:	**Node 5 6 1000**

Apply

You may reset the graphics by clicking on this icon :

Reset Graphics

Figure 6b.5-Displacement Response at Node 5, Node 6 and Node 1000



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