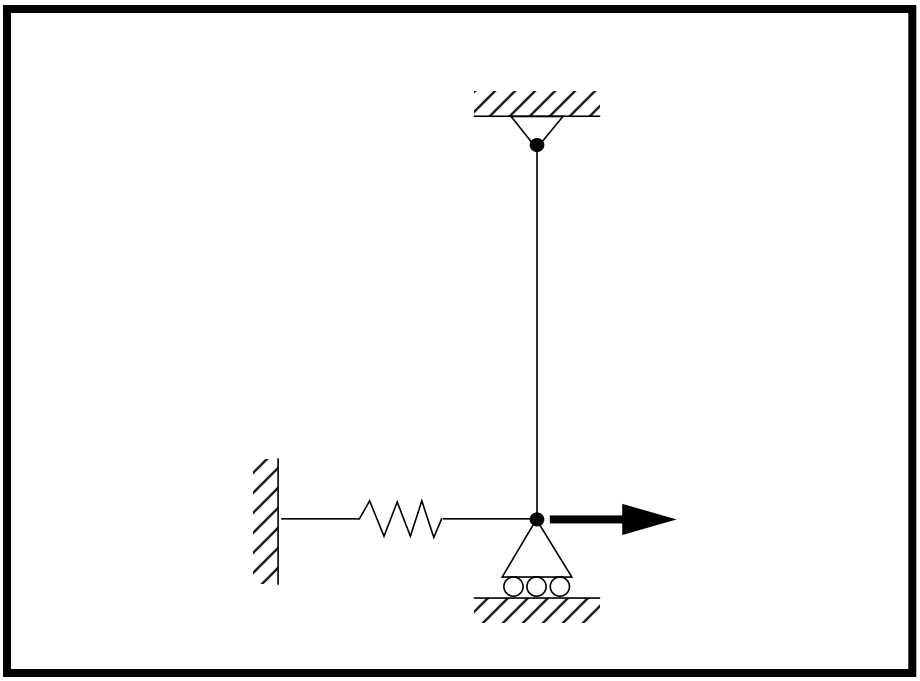
WORKSHOP PROBLEM 1d

Spring Element with Nonlinear Analysis Parameters (Restart a Multi-Step Analysis)

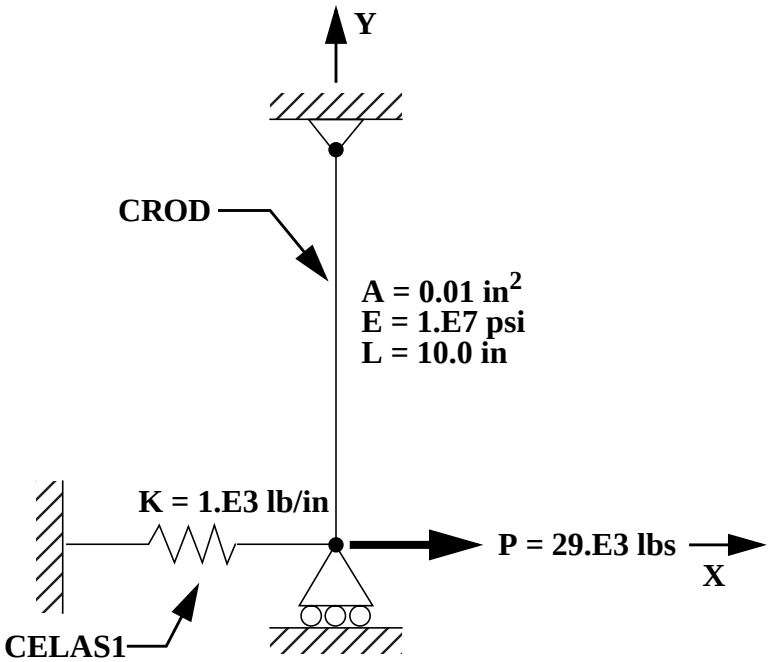


Objectives:

- Demonstrate the use of the restart feature on the previous analysis by introducing an intermediate load case and using the data obtained from the first part of the previous analysis.

Model Description:

For the structure below:



Add Case Control commands and Bulk Data Entries to:

1. Add a new subcase before the third subcase and restart the analysis from a $20x10^3$ lbs load in the new subcase with 8 increments. Restarting a job with increased increments is a common practice when dealing with convergence problems.

Suggested Exercise Steps:

- Modify the existing MSC/NASTRAN input file by adding the subcase and appropriate restart analysis control parameters and saving it as **prob1d.dat**.
- Request the data stored in **prob1c** analysis run to be used in the current analysis (ASSIGN, RESTART).
- Designate the appropriate restart parameters (LOOPID, SUBID).
- Add a new subcase before the third subcase with the appropriate nonlinear analysis parameters (SUBCASE, NLPARM).
- Delete all entries in the existing Bulk Data section, and add the new NLPARM entry.
- Generate an input file and submit it to the MSC/NASTRAN solver for nonlinear static analysis.
- Review the results.

Input File from Workshop 1c for Modification:

prob1c.dat

```
ASSIGN OUTPUT2 = 'prob1c.op2' , UNIT=12
ID NAS103, WORKSHOP 1C SOLUTION
TIME 10
SOL  106 $ NONLIN
CEND
TITLE=SIMPLE ROD SPRING - COLD ANALYSIS AND RESTART WORKSHOP
SUBTITLE=GEOMETRIC NONLINEAR
ECHO=BOTH
DISP=ALL
OLOAD=ALL
FORCE=ALL$
SPCF=ALL
$ APPLY X LOAD
$
SUBCASE 10 $ LOAD=16.E03
 LABEL=APPLY LOAD P IN X DIRECTION = 16E+03
 LOAD=1
 NLPARM=10
SUBCASE 20 $ LOAD=24.E03
 LABEL=APPLY LOAD P IN X DIRECTION = 24E+03
 LOAD=2
 NLPARM=20
SUBCASE 30 $ LOAD=29.E03
 LABEL=APPLY LOAD P IN X DIRECTION = 29E+03
 LOAD=3
 NLPARM=30
OUTPUT(PLOT)
  SET 1 ALL
  MAXI DEFO 5.
  AXES Z, X, Y
  VIEW  0., 0., 0.
  FIND SCALE ORIGIN 1 SET 1
  PLOT STATIC 0 MAXIMUM DEFORMATION 5. SET 1
BEGIN BULK
PARAM, POST, -1
PARAM, PATVER, 3.0
GRID, 1, 0, 0.0, 0.0, 0.0,  , 23456
GRID, 3, 0, 0.0, 10.0, 0.0,  , 123456
CROD, 3, 3, 3, 1
```

```
CELAS1, 2, 2, 1, 1, 0
PROD, 3, 3, .01
PELAS, 2, 1.0E3
MAT1, 3, 1.0E7
FORCE, 1, 1, 0, 1.6E4, 1.0
FORCE, 2, 1, 0, 2.4E4, 1.0
FORCE, 3, 1, 0, 2.9E4, 1.0
PARAM, LGDISP,1
NLPARM, 10, 4,  , SEMI,  ,  ,  , YES, +
+,  ,  ,  ,  , 0, 0,  ,  , +
+, 0
NLPARM, 20, 8,  , AUTO,  ,  , W, YES
NLPARM, 30, 2
ENDDATA
```

Exercise Procedure:

1. Users who are not utilitizing MSC/PATRAN for generating an input file should go to Step 4, otherwise, proceed to step 2.

2. Open the existing database called **prob1a.db**.

File/Open...

Database List: **prob1a**

OK

3. Set up the new subcase and restart parameters through the analysis form.

◆ **Analysis**

Action: **Analyze**

Object: **Restart**

Method: **Analysis Deck**

Select an Initial Job **prob1c**

Restart Job Name **prob1d**

Subcase Create ...

Subcase Name **case_2a**

Available Load Cases **case_2**

Subcase Parameters...

Number of Increments **8**

Matrix Update Method: **Automatic**

OK

Output Requests ...

Form Type: **Advanced**

Output Requests: **STRESS(SORT1...**

Delete

Select Result Type **Element Forces**

Create

Intermediate Output Option: **Yes**

OK

Apply

Cancel

Subcase Select...

Double click on the ◆ **Unselect All** radio button to clear all the selected subcases.

Next, select the following subcases in this order:.

Subcases for Solution Sequence:

case_1
case_2
case_2a
case_3

OK

Restart Parameters...

Start from Version Number = **1**

Start from Increment Number (LOOPID) = **8**

Start from Subcase Number (SUBID+1) = **3**

■ **Save Old Restart Data**

OK

Apply

Another input file called **prob1d.bdf** will be generated.
MSC/PATRAN users should now proceed to **Step 5**.

Generating an input file for MSC/NASTRAN Users:

4. MSC/NASTRAN users can generate an input file using the the input file from the previous exercise (**prob1c.dat**). The result should be similar to the output below (**prob1d.dat**):

```
ASSIGN OUTPUT2 = 'prob1d.op2' , UNIT=12
ASSIGN MASTER = 'prob1c.MASTER'
RESTART VERSION=1,KEEP
ID NAS103, WORKSHOP 1D SOLUTION
TIME 10
SOL  106 $ NONLIN
CEND
TITLE=SIMPLE ROD SPRING - COLD ANALYSIS AND RESTART WORKSHOP
SUBTITLE=GEOMETRIC NONLINEAR
ECHO=BOTH
PARAM,LOOPID,8
PARAM,SUBID,3
DISP=ALL
OLOAD=ALL
FORCE=ALL$
SPCF=ALL
$ APPLY X LOAD
$
SUBCASE 10 $ LOAD=16.E03
 LABEL=APPLY LOAD P IN X DIRECTION = 16E+03
 LOAD=1
 NLPARM=10
SUBCASE 20 $ LOAD=24.E03
 LABEL=APPLY LOAD P IN X DIRECTION = 24E+03
 LOAD=2
 NLPARM=20
SUBCASE 21
 LOAD=2
 NLPARM=21
SUBCASE 30 $ LOAD=29.E03
 LABEL=APPLY LOAD P IN X DIRECTION = 29E+03
 LOAD=3
 NLPARM=30
OUTPUT(PLOT)
  SET 1 ALL
  MAXI DEFO 5.
```

```
  AXES Z, X, Y
  VIEW  0., 0., 0.
  FIND SCALE ORIGIN 1 SET 1
  PLOT STATIC 0 MAXIMUM DEFORMATION 5. SET 1
BEGIN BULK
NLPARM, 21, 8,  , AUTO,  ,  ,  , YES
ENDDATA
```

Submit the input file for analysis:

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

   5a. To submit the MSC/PATRAN **.bdf** file, find an available UNIX shell window. At the command prompt enter **nastran prob1d.bdf scr=yes**. Monitor the analysis using the UNIX **ps** command.

   5b. To submit the MSC/NASTRAN **.dat** file, find an available UNIX shell window and at the command prompt enter **nastran prob1d.dat scr=yes**. Monitor the analysis using the UNIX **ps** command.

6. When the analysis is completed, edit the **prob1d.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.

6a. While still editing **prob1d.f06**, search for the word:

D I S P L A C E (spaces are necessary).

What is the x-displacement of the guided end at the end of the restart?

T1 = _____

Comparison of Results:

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

SUBCASE 1
LOAD STEP = 1.00000E+00

D I S P L A C E M E N T   V E C T O R

POINT ID.	TYPE	T1	T2	T3	R1	R2	R3
1	G	6.300765E+00	0.0	0.0	0.0	0.0	0.0
2	G	0.0	0.0	0.0	0.0	0.0	0.0

SUBCASE 2
LOAD STEP = 1.50000E+00

D I S P L A C E M E N T   V E C T O R

POINT ID.	TYPE	T1	T2	T3	R1	R2	R3
1	G	7.062655E+00	0.0	0.0	0.0	0.0	0.0
2	G	0.0	0.0	0.0	0.0	0.0	0.0

SUBCASE 3
LOAD STEP = 3.00000E+00

D I S P L A C E M E N T   V E C T O R

POINT ID.	TYPE	T1	T2	T3	R1	R2	R3
1	G	7.751178E+00	0.0	0.0	0.0	0.0	0.0
2	G	0.0	0.0	0.0	0.0	0.0	0.0

SUBCASE 4
LOAD STEP = 4.00000E+00

D I S P L A C E M E N T   V E C T O R

POINT ID.	TYPE	T1	T2	T3	R1	R2	R3
1	G	8.540173E+00	0.0	0.0	0.0	0.0	0.0
2	G	0.0	0.0	0.0	0.0	0.0	0.0

8. This ends the exercise for MSC/NASTRAN users. MSC/PATRAN users should proceed to the next step.

9. Open a new database to import the results.

First, close the present database.

File/Close

Next, create a new database titled **prob1d.db**

File/New...

New Database Name: **prob1d**

OK

In the **New Model Preference** form set the following:

Tolerance: ● **Default**

Analysis Code: **MSC/NASTRAN**

Analysis Type: **Structural**

OK

10. Proceed with the Reverse Translation process, that is, importing the **prob1d.op2** results file into MSC/PATRAN. To do this, return to the **Analysis** form and proceed as follows:

◆ **Analysis**

Action: **Read Output2**

Object: **Both**

Method: **Translate**

Select Results File...

Selected Results File: **prob1d.op2**

OK

Apply

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

Now we will generate the fringe plot of the model.

◆ **Results**

Action:	**Create**
Object:	**Fringe**

Now click on the **Select Results** icon.

 **Select Results**

Select Result Case(s)	*(Seqentially select the result cases.)*
Select Fringe Result	**Displacements, Translational**
Quantity:	**Magnitude**

Next click on the **Target Entities** icon.

 **Target Entities**

Target Entity:	**Current Viewport**

Click on the **Display Attributes** icon.

 **Display Attributes**

Style:	**Discrete/Smooth**
Display:	**Free Edges**

For better visual quality of the fringe plot, change the width of the line.

Width:	*(Select the third line from top.)*

Now click on the **Plot Options** icon.

Plot Options

Coordinate Transformation:	**None**
Scale Factor	**1.0**

Apply

The final fringe plot displaying the physical deformation of the model can be created as follows:

◆ **Results**

Action:	**Create**
Object:	**Deformation**

Now click on the **Select Results** icon.

Select Results

Select Result Case(s)	*(Seqentially select the result cases.)*
Select Fringe Result	**Displacements, Translational**
Show As:	**Resultant**

Click on the **Display Attributes** icon.

Display Attributes

In order to see the deformation results accurately, set the display scale factor to actual deformation (=1).

Line Width:	*(Select the third line from top.)*
● *True Scale*	
Scale Factor	**1.0**
■ *Show Undeformed*	
Line Width:	*(Select the third line from top.)*

Now click on the **Plot Options** icon .

Plot Options

Coordinate Transformation:	**None**
Scale Factor	**1.0**

Apply

As you look at each result case, you will notice that the change in deflection lessens as more of the loading force is axially distributed. This is the benefit of running a nonlinear geometric analysis, which accounts for large displacements that change the distribution of the force along the beam.

Quit MSC/PATRAN when you have completed this exercise.

MSC/PATRAN .bdf file: prob1d.bdf

```
$ NASTRAN input file created by the MSC MSC/NASTRAN input file
$ translator ( MSC/PATRAN Version 7.5 ) on January   16, 1998 at
$ 11:51:40.
ASSIGN OUTPUT2 = ‘prob1d.op2’, UNIT = 12
$ Direct Text Input for File Management Section
ASSIGN MASTER=’prob1c.MASTER’
RESTART VERSION=1,KEEP
$ Nonlinear Static Analysis, Database
SOL 106
TIME 600
$ Direct Text Input for Executive Control
CEND
SEALL = ALL
SUPER = ALL
TITLE = MSC/NASTRAN job created on 16-Jan-98 at 11:51:35
PARAM,LOOPID,8
PARAM,SUBID,3
ECHO = NONE
MAXLINES = 999999999
$ Direct Text Input for Global Case Control Data
SUBCASE 1
$ Subcase name : case_1
  SUBTITLE=case_1
  NLPARM = 1
  SPC = 2
  LOAD = 2
  DISPLACEMENT(SORT1,REAL)=ALL
  SPCFORCES(SORT1,REAL)=ALL
  FORCE(SORT1,REAL,BILIN)=ALL
$ Direct Text Input for this Subcase
SUBCASE 2
$ Subcase name : case_2
  SUBTITLE=case_2
  NLPARM = 2
  SPC = 2
  LOAD = 4
  DISPLACEMENT(SORT1,REAL)=ALL
  SPCFORCES(SORT1,REAL)=ALL
  FORCE(SORT1,REAL,BILIN)=ALL
$ Direct Text Input for this Subcase
SUBCASE 3
$ Subcase name : case_2a
  SUBTITLE=case_2
  NLPARM = 3
```

```
  SPC = 2
  LOAD = 6
  DISPLACEMENT(SORT1,REAL)=ALL
  SPCFORCES(SORT1,REAL)=ALL
  FORCE(SORT1,REAL,BILIN)=ALL
$ Direct Text Input for this Subcase
SUBCASE 4
$ Subcase name : case_3
  SUBTITLE=case_3
  NLPARM = 4
  SPC = 2
  LOAD = 8
  DISPLACEMENT(SORT1,REAL)=ALL
  SPCFORCES(SORT1,REAL)=ALL
  FORCE(SORT1,REAL,BILIN)=ALL
$ Direct Text Input for this Subcase
BEGIN BULK
/,1,999999
PARAM    POST    -1
PARAM    PATVER  3.
PARAM    AUTOSPC NO
PARAM   COUPMASS -1
PARAM    K6ROT   100.
PARAM    WTMASS  1.
PARAM    LGDISP  1
PARAM,NOCOMPS,-1
PARAM   PRTMAXIM YES
NLPARM   1       4           SEMI    5       25      PW      YES     +       A
+       A       .001    1.-7
NLPARM   2       8           AUTO    5       25      W       YES     +       B
+       B               1.-7
NLPARM   3       8           AUTO    5       25      PW      YES     +       C
+       C       .001    1.-7
NLPARM   4       5           AUTO    5       25      PW      NO      +       D
+       D       .001    1.-7
$ Direct Text Input for Bulk Data
$ Elements and Element Properties for region : prop_1
PROD     1       1       .01
CROD     1       1       1       2
$ Elements and Element Properties for region : prop_2
PELAS    2       1000.
CELAS1   2       2       1       1
$ Referenced Material Records
```

```
$ Material Record : mat_1
$ Description of Material : Date: 19-Jun-97          Time: 15:12:40
MAT1     1       1.+7
$ Nodes of the Entire Model
GRID     1              0.      0.      0.
GRID     2              0.      10.     0.
$ Loads for Load Case : case_1
SPCADD   2       10      12
LOAD     2       1.      1.      1
$ Loads for Load Case : case_2
LOAD     4       1.      1.      5
$ Loads for Load Case : case_2
LOAD     6       1.      1.      5
$ Loads for Load Case : case_3
LOAD     8       1.      1.      7
$ Displacement Constraints of Load Set : constraint_1
SPC1     10      123456  2
$ Displacement Constraints of Load Set : constraint_2
SPC1     12      23456   1
$ Nodal Forces of Load Set : load_3
FORCE    7       1       0       29000.  1.      0.      0.
$ Nodal Forces of Load Set : load_1
FORCE    1       1       0       16000.  1.      0.      0.
$ Nodal Forces of Load Set : load_2
FORCE    5       1       0       24000.  1.      0.      0.
$ Referenced Coordinate Frames
ENDDATA 6b9c8805
```