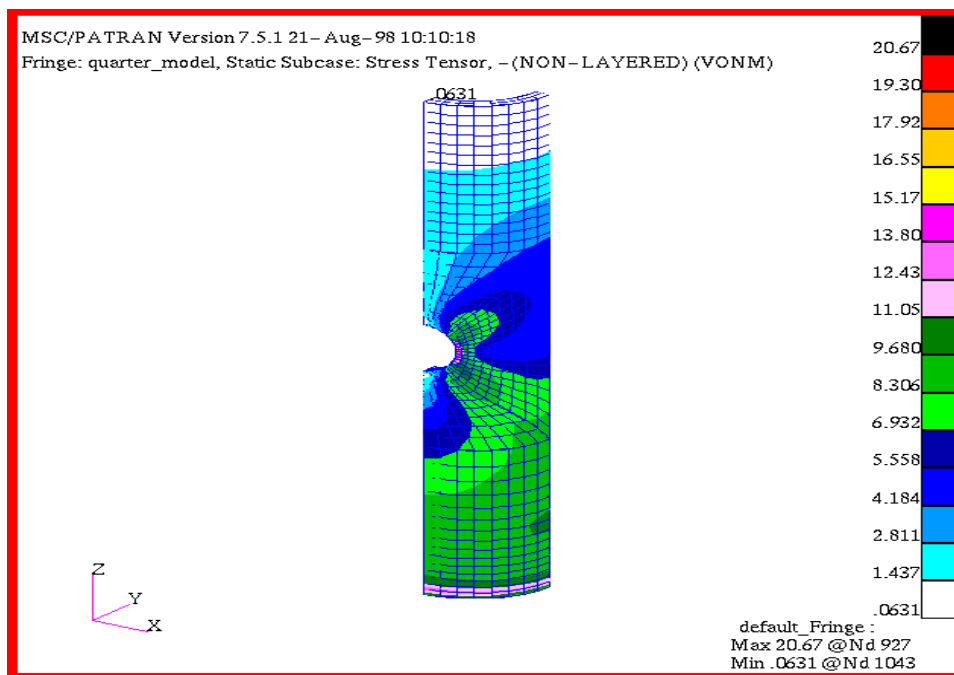


APPENDIX C3

Definition of Weight and Inertia Loading



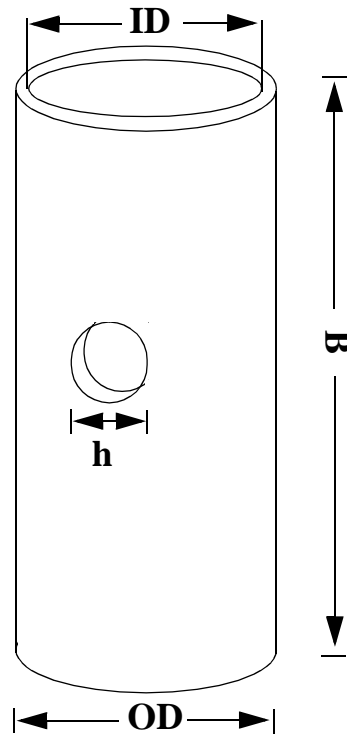
Objectives:

- Create an axisymmetric model.
- Apply axisymmetric boundary conditions.
- Analyze the axisymmetric model.
- Compare result to the full model.



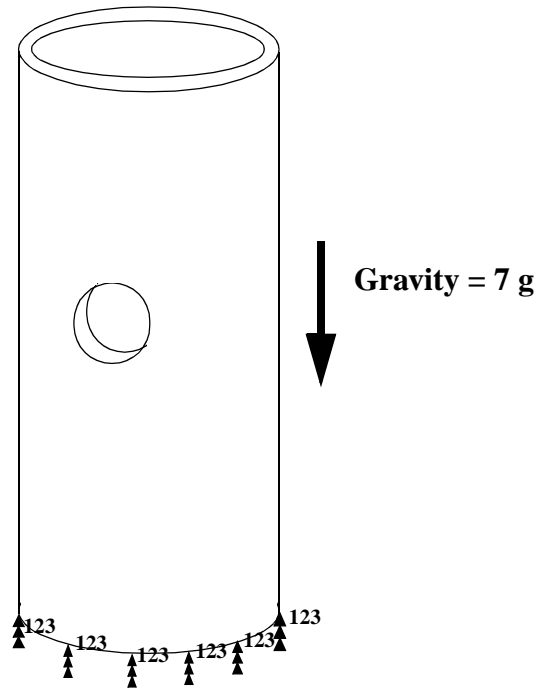
Model Description:

This exercise is designed to study the effect of gravity on a model. When modeling a gravity load in English units, users may sometimes forget to convert the mass density to weight density. Failure to do so will yield results that are incorrect.

Figure C3.1-Model Geometry**Table C3.1**

Outer Diameter of Cylinder (OD)	4 in
Inner Diameter of Cylinder (ID)	3.25 in
Height (B)	16 in
Hole Diameter (h)	1.5 in
Weight Density	0.101 lbs/in³
Weight/Mass Factor	2.59E-3 sec²/in
Elastic Modulus	10.0E6 lbs/in²
Poisson's Ratio	0.33

Figure C3.2-Loads and Boundary Conditions



Suggested Exercise Steps

- Open the previous workshop.
- Create a new group that includes only a quarter of the model.
- Define the x- and y-symmetry condition (SPC1).
- Prepare the model for a static analysis (SOL 101).
- Generate an input file and submit it to the MSC.Nastran solver for static analysis.
- Review the results.

Exercise Procedure:

1. Users who are not utilizing MSC.Patran for generating an input file should go to Step 7, otherwise, proceed to step 2.
2. Open the database named **Solid.db**.

File/Open...

Change to the directory where the database is located.

Existing Database Name

Solid.db

OK

3. Create a new group of entities that includes only a quarter of the model.

First, reset the graphics by clicking on this icon:



Reset Graphics

Change the picking preference so that only the entities that are fully enclosed in the selection rectangle are selected.

Preferences/Picking...

Rectangle/Polygon Picking

Enclose entire entity

Close

While selecting any quarter-section of the model will yield the same result, the bottom right will give users the best view. Create a group containing only the section of the model illustrated in Fig. C3.3.

Switch the view to *Front View* for easier picking.



Front view

Group/Create...

New Group Name

quarter_model

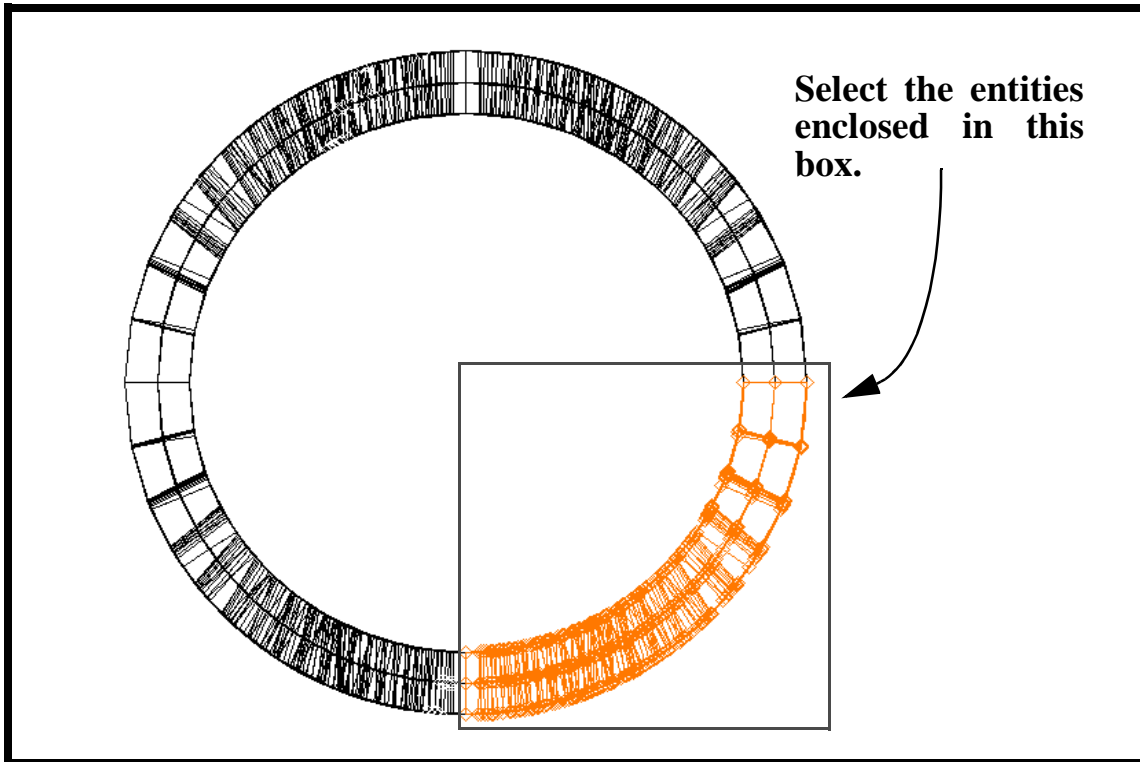
Unpost All Other Groups

Entity Selection

<Select the boxed entities shown in Figure C3.3

Apply

Figure C3.3-Front View of the Model



4. Create a load case for the axisymmetric model.

For this load case, the inertial load (gravity) and the displacement (pinned) are also included.

◆ Load Cases

Action:

Create

Load Case Name

quarter_model

■ Make Current

Assign/Prioritize Loads/BCs

Select Loads/Bcs to Add to Spreadsheet

Displ_pinned
Inert_gravity

In the form, there should now be a displacement (pinned) and inertial load (gravity), both with *LBC Scale Factor* of ONE.

OK

Apply

5. Apply the axisymmetric constraints to the model.

◆ Load/BCs

Action:

Create

Object:

Displacement

Type:

Nodal

New Set Name

x-sym

Input Data...

Translations <T1 T2 T3>

<0 , , >

Rotations <R1 R2 R3>

< , 0 , 0 >

OK

Select Application Region...

● FEM

Select Nodes
(see Figure C3.4)

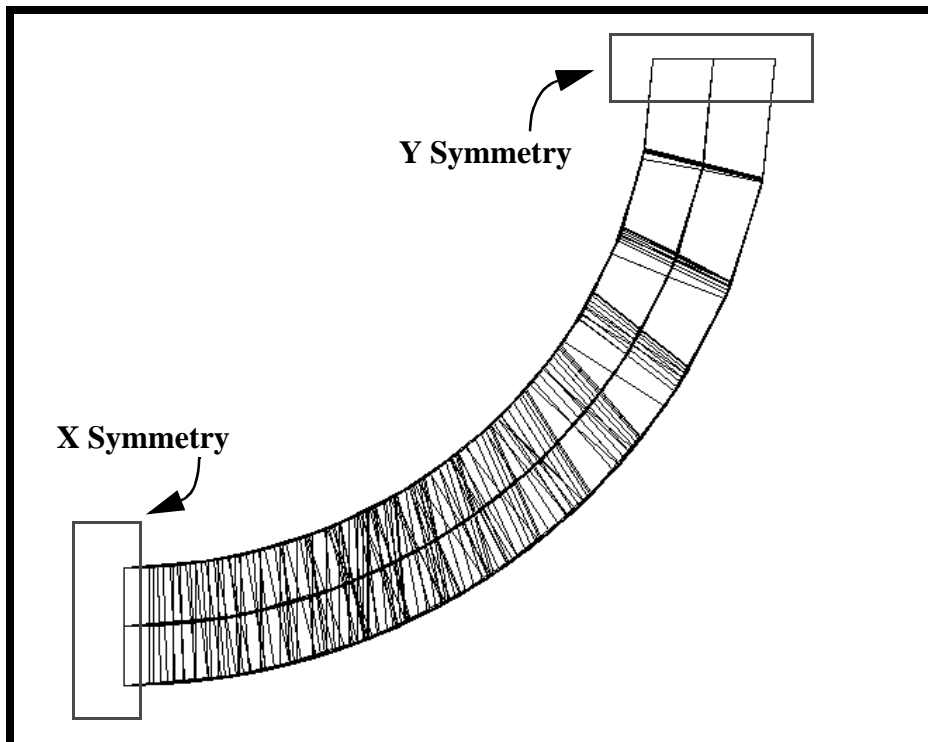
<Select all nodes enclosed in the X-Symmetry Box (Lower left edge in the display)>

Add

OK

Apply

Figure C3.4 - Axisymmetric Constraints



New Set Name

y-sym

Input Data...

Translations <T1 T2 T3>

< , 0 , >

Rotations <R1 R2 R3>

< 0 , , 0 >

OK

Select Application Region...

● *FEM*

Select Nodes
(see Figure C3.4)

<Select all nodes enclosed in the Y-Symmetry Box (Upper right edge in the display)>

Add

OK

Apply

Return to the *Iso 3 side view*.



Iso 3 view

6. Run the analysis.

Change the *Object* to analyze Current Group. Otherwise, Patran will submit an input file that contains the entire model, which defeats the purpose of this workshop.

◆ Analysis	
<i>Action:</i>	Analyze
<i>Object:</i>	Current Group
<i>Method</i>	Analysis Deck
<i>Job Name</i>	solid- axisym
Solution Type...	● LINEAR STATIC
Solution Parameters...	
<i>Wt.-Mass Conversion =</i>	0.00259
<i>Node i.d. for Wt.Gener. =</i>	0
OK	
OK	
Subcase Select...	
<i>Subcases Selected:</i>	Default <i>(Select to remove)</i>
<i>Subcases For Solution Sequence: 101</i>	quarter_model

Quarter_model should now be the only subcase that is in the *Subcases Selected* Box.

OK
Apply

An MSC.Nastran input file called **solid-axisym.bdf** will be generated. The process of translating your model into an input file is called Forward Translation. The Forward Translation is complete when the Heartbeat turns green.

Submitting the input file for analysis:

7. Submit the input file to MSC.Nastran for analysis.
 - 7a. To submit the MSC.Patran.**bdf** file for analysis, find an available UNIX shell window. At the command prompt enter: **nastran solid-axisym.bdf scr=yes**. Monitor the run using the UNIX **ps** command.
 - 7b. To submit the MSC.Nastran.**dat** file for analysis, find an available UNIX shell window. At the command prompt enter: **nastran solid-axisym scr=yes**. Monitor the run using the UNIX **ps** command.
8. When the run is completed, edit the **solid-axisym.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.

Comparison of Results

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

DIRECTION						
MASS	AXIS	SYSTEM (S)	MASS	X-C.G.	Y-C.G.	Z-C.G.
	X		1.680995E+00	0.000000E+00	-1.142889E+00	8.000008E+00
	Y		1.680995E+00	1.171046E+00	0.000000E+00	8.000008E+00
	Z		1.680995E+00	1.171046E+00	-1.142889E+00	0.000000E+00

SPCFORCE RESULTANT							
	T1	T2	T3	R1	R2	R3	
0							
0							
0	1	4.5186077E-14	9.8837605E-14	-1.1776093E+01	1.3458763E+01	1.3790349E+01	1.5137891E-13

Verify the SPCFORCE Resultant:

$C(\text{weight/mass conversion}) * \text{Mass} * \text{gravity} = \text{Resultant}$

$(1/386.4) * 1.681 * (7 * 386.4) = \underline{11.767}$

-
10. Proceed with the Reverse Translation process, that is, importing the **solid-axisym.op2** in the Analysis form and proceed as follows:

◆ **Analysis**

Action:

Read Output2

Object:

Result Entities

Method

Translate

Select Results File...

Select Results File

solid-axisym.op2

OK

Apply

11. Plot the results of the analysis.

First, reset the graphics by clicking on this icon:



Reset Graphics

To plot results of the posted FEM, use the **Results Application radio button**.

◆ **Results**

Action:

Create

Object:

Quick Plot

Select the *Fringe Attributes* icon.



Select Result Case

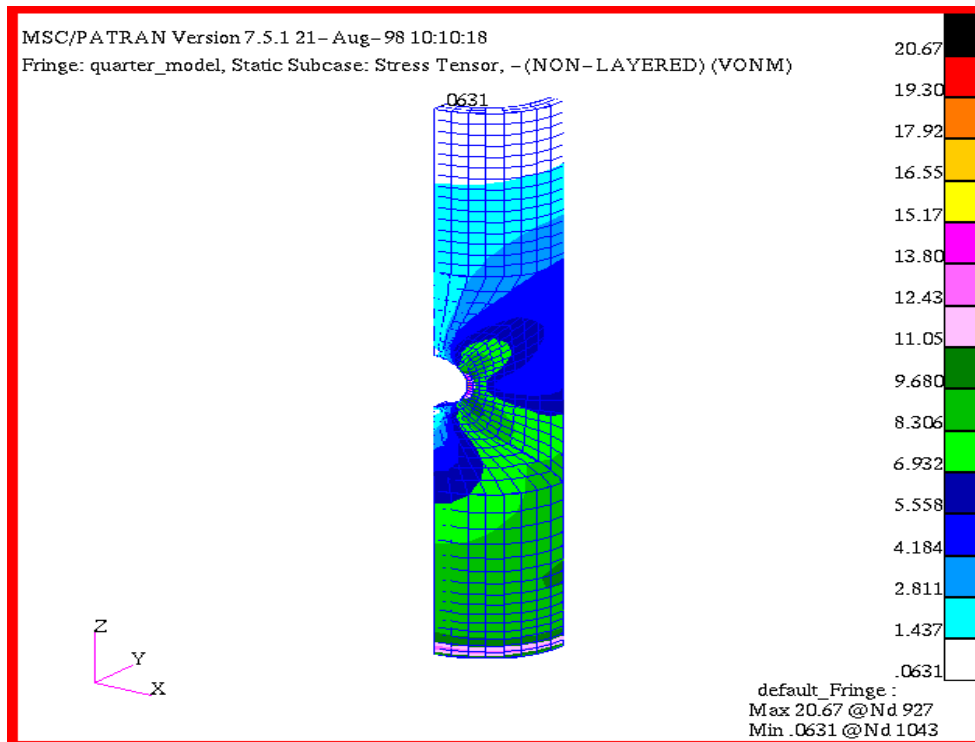
quarter_model, Static Subcase

Select Fringe Results

Stress Tensor,

Apply

The results should resemble Figure C3.5.

Figure C3.5

Compare this solution with the solutions of previous runs. Also compare the analysis time and the size of the .f06 and .op2 files.

This concludes our workshop.

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

