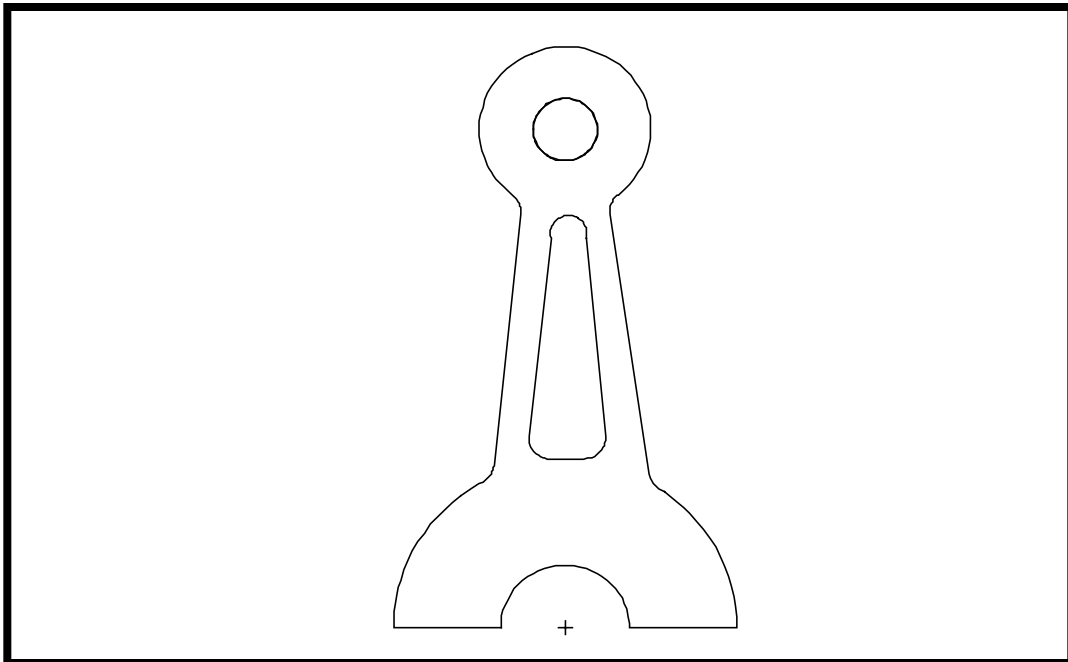# LESSON 8

Projected Coordinate Systems

Objectives:

■ To become familiar with the difference between Global and Projected-Global coordinate systems.

■ To realize the importance of both coordinate systems.

Projected Coordinate Systems

Model Description:

In the following exercise, a two-dimensional model of a connecting rod (planar, shell elements) is built in the YZ plane of the Global coordinate system. Stresses in the x-direction (out of plane) should be zero, by definition of the model. In order to insure that the user gets the correct results, PATRAN utilizes a Projected-global coordinate system.

Often times, this makes interpreting results easier for the user as well. Since the model is not built in the XY plane, the Global results will differ from the Projected-global results. For example, the stresses out of plane will be zero in both the Global x-direction as well as the Projected z-direction. This makes sense when viewing the model from the point of view of the normal (which is what PATRAN assumes you are doing with a shell model).

The purpose of this exercise is to determine exactly how this system of Projected-global results works; i.e., which Global results correspond to which Projected results.

Exercise Procedure:

1. Open up a new database and name it **connect2.**

File/New ...

New Database Name | **connect2** |

| **OK** |

In the *Model Preferences* form, change the maximum model dimensions to 100.

Tolerance: ◆ **Default**

Analysis Code: | **MSC/NASTRAN** |

Analysis Type: | **Structural** |

| **OK** |

2. Read a NASTRAN results file into the database, including both the results and the entities.

◆ **Analysis**

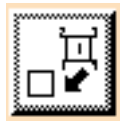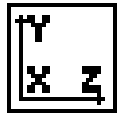|	
Action:	**Read Output 2**
Object:	**Both**
Method:	**Translate**
Select Results File ...	
	connect.op2

OK

Apply

3. Clean up the display and change the viewpoint in order to properly view the model.

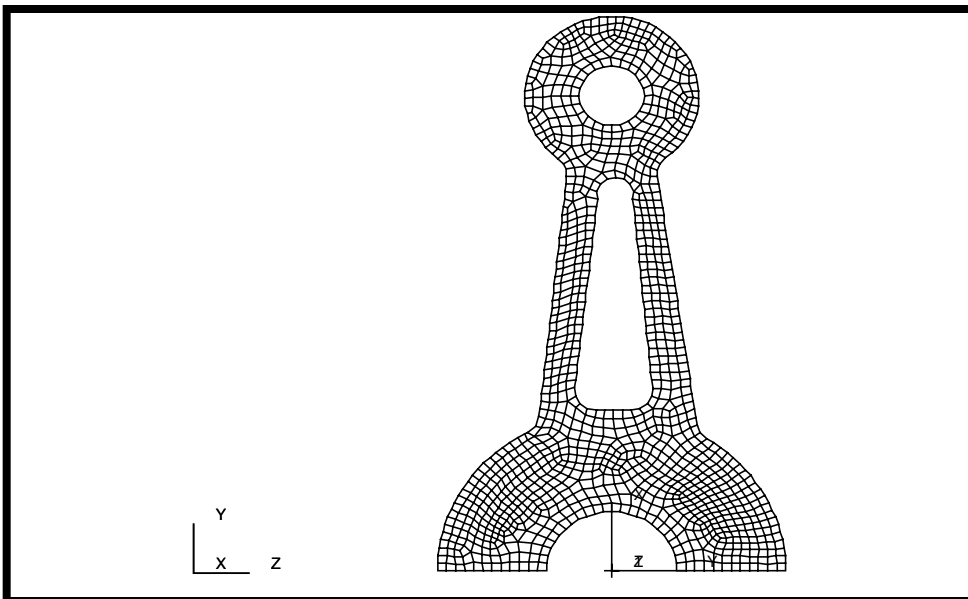Select the following two icons from the toolbar:

Hide labels

Left side view

You should now see a meshed connecting rod, as shown below:

4. Create a deformation plot to get an idea of what is happening with the model.
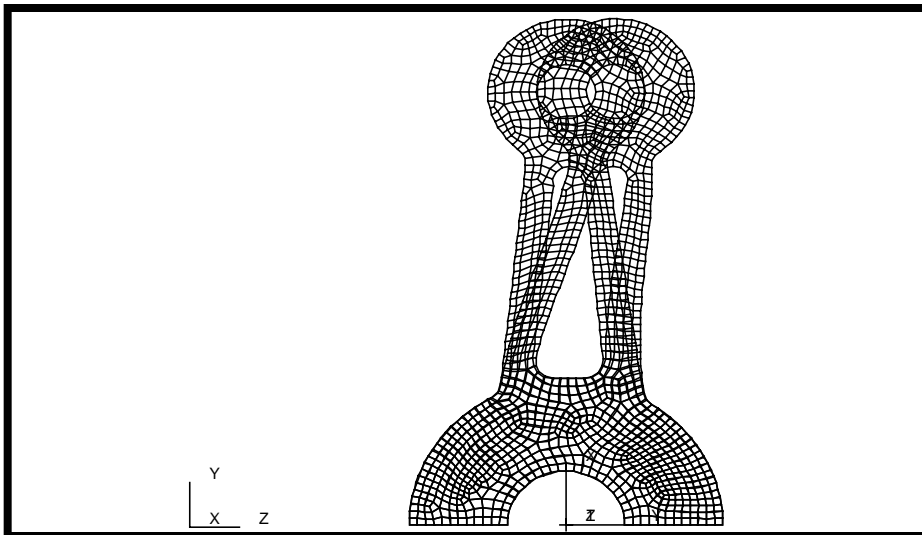
◆ **Results**

Form Type: | **Advanced** |

Select Result: | **Displacement, Translational** |

| **Plot** |

The following deformation plot should appear:

Now that you have an understanding of how the model is behaving, clear up the display with the **Reset graphics** toolbar icon.

5. Calculate and compare the stress components for both a global and projected-global coordinate system.

This next step will involve using multiple advanced results plots in order to determine how a projected-global coordinate system operates when compared to a global coordinate system.

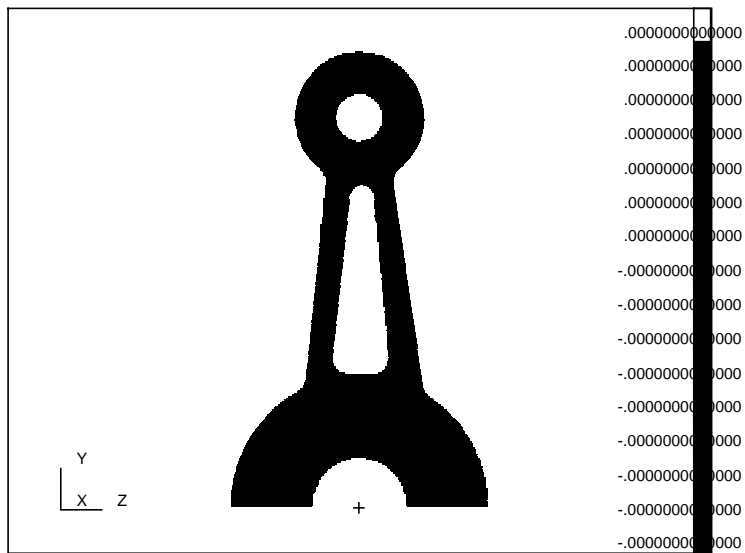◆ **Results**

Form Type: | **Advanced** |

Select Results: | **Stress Tensor** |

Type and Components ...

Display Results As: ◆ **Scalar**

Type Change: ◆ **XX Comp**
From Tensor to Scalar

Coordinate Transformation ◆ **Global**
Options: Finite Elements

OK
Plot

The following should appear on your viewport:

What you have just done is plot the tension in the x-direction of the global coordinate system. Write down the range of stresses in the following table. The purpose of this will become evident soon.*

NOTE: The *Coordinate Transformation Options* always resets to Projected-Global. Be sure to check this toggle before getting the results for the Global coordinate cases.

	Global	Proj-Global
XX Comp		
YY Comp		
ZZ Comp		

Repeat the above procedure for the other five cases. To check the validity of your results, there is a table at the end of the exercise to compare them to.

The projected system is defined as follows. First, the normal to the shell surface is calculated. This varies for curved elements and is constant for flat elements. If the angle between the normal and the global x-axis is greater than .01 radians, the global x-axis is projected onto the shell surface as the local x-axis. If the angle is less than .01 radians, either the global y-axis or the z-axis (whichever makes the largest angle with the normal) is defined to be the local x-axis. The local y-axis is perpendicular to the plane defined by the normal and the local x-axis.

In the case of this exercise, the normal of the shell elements points in exactly the same direction as the Global x-direction. Therfore, either the y or z global axis will become the Projected x-axis. Since they both make the same angle with the normal, the global y-axis is arbitrarily made the new projected x-axis. The projected Y axis becomes the direction perpendicular to the plane defined by the normal (Global x) and local x-axis (Global y axis), which in this case happens to be the Global z-axis.

By comparing the results written in the table, the above statement can be proven true.

6.   Exit PATRAN.

File/Quit ...

This ends the exercise.

	Global	Proj-Global
XX Comp	-0 to 0	-560.8 to 588.4
YY Comp	-560.8 to 588.4	-282.7 to 232.3
ZZ Comp	-282.7 to 232.3	-0 to 0