EN1740 Computer Aided Visualization and Design

Spring 2012

4/24/2012

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Last Time:

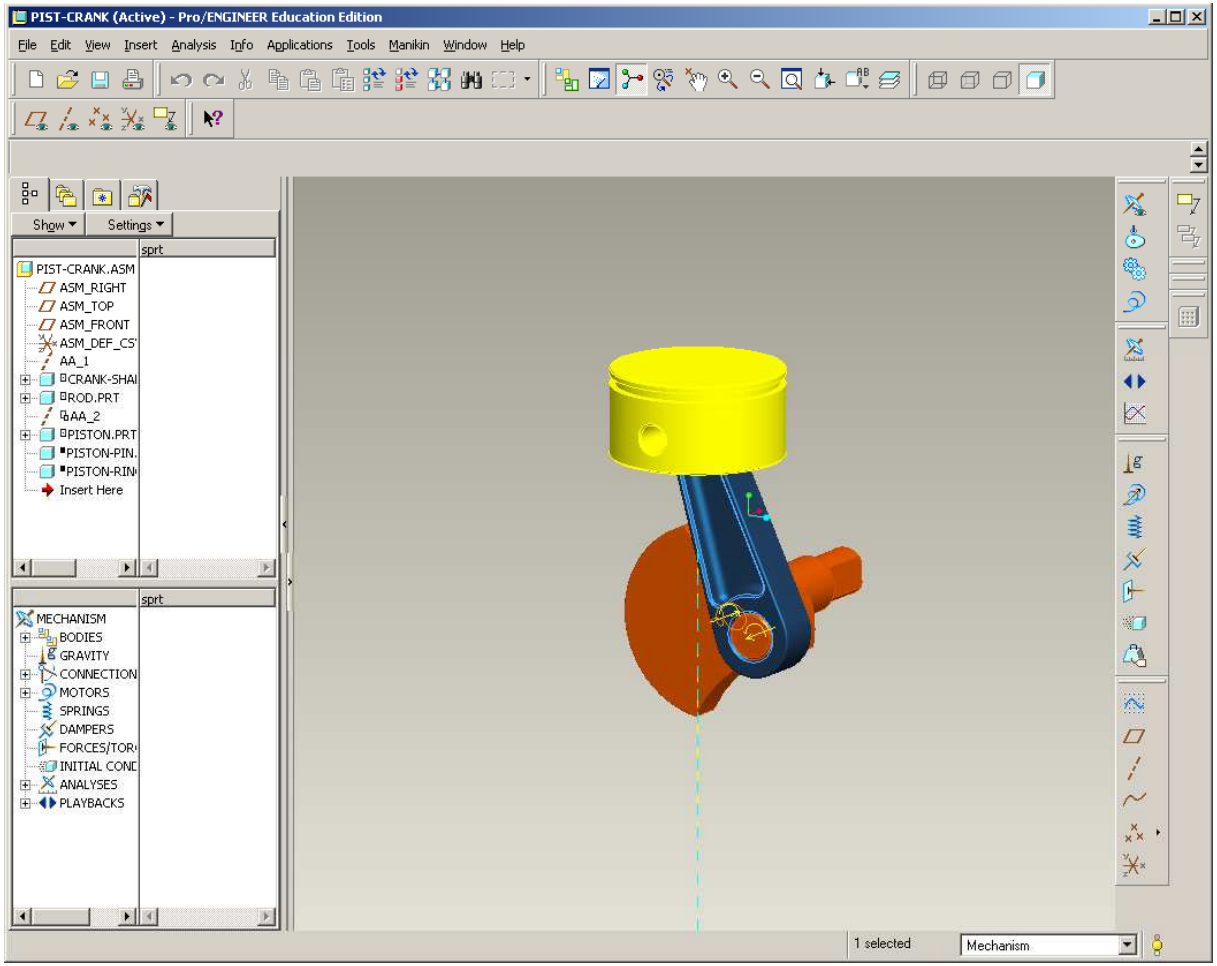
- Motion analysis with Pro/E

Tonight:

- Motion analysis with Pro/E (cont.)

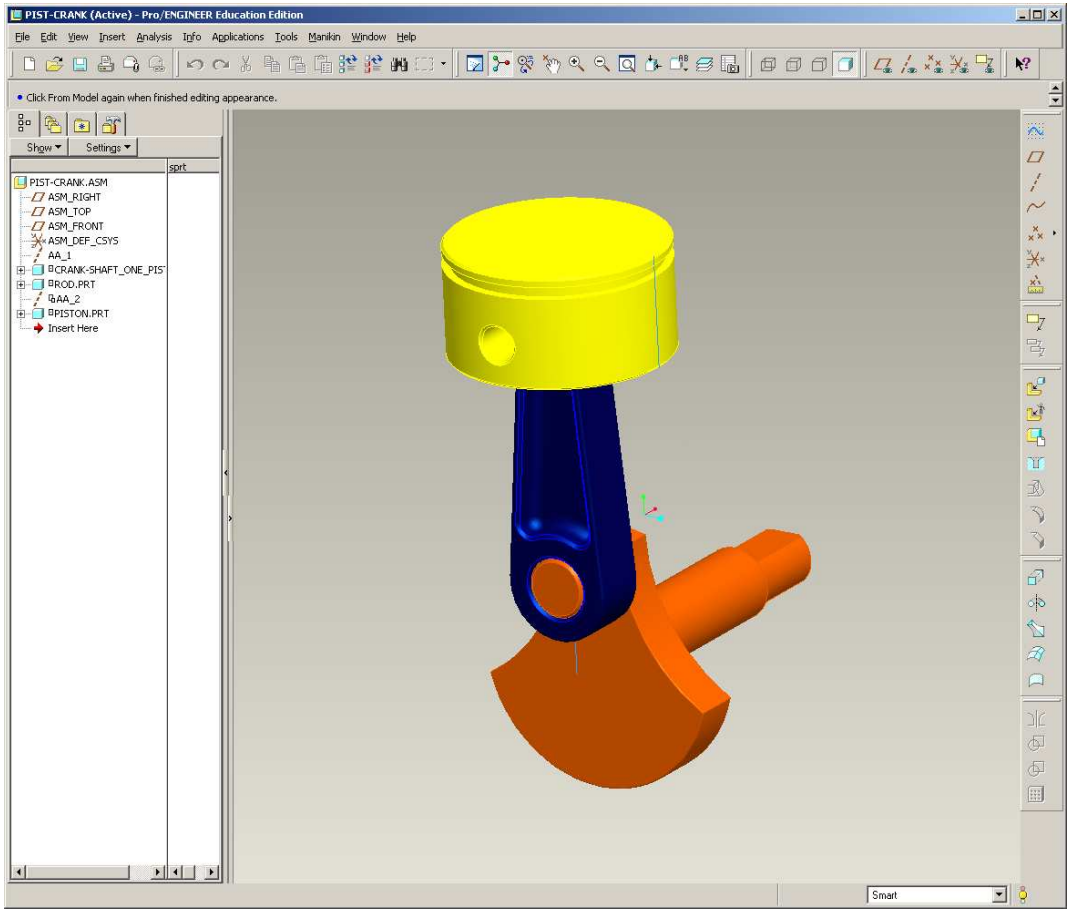
Motion Analysis

- Further functions within the mechanism application:
  - Gears
  - Cams
  - Springs



Motion Analysis

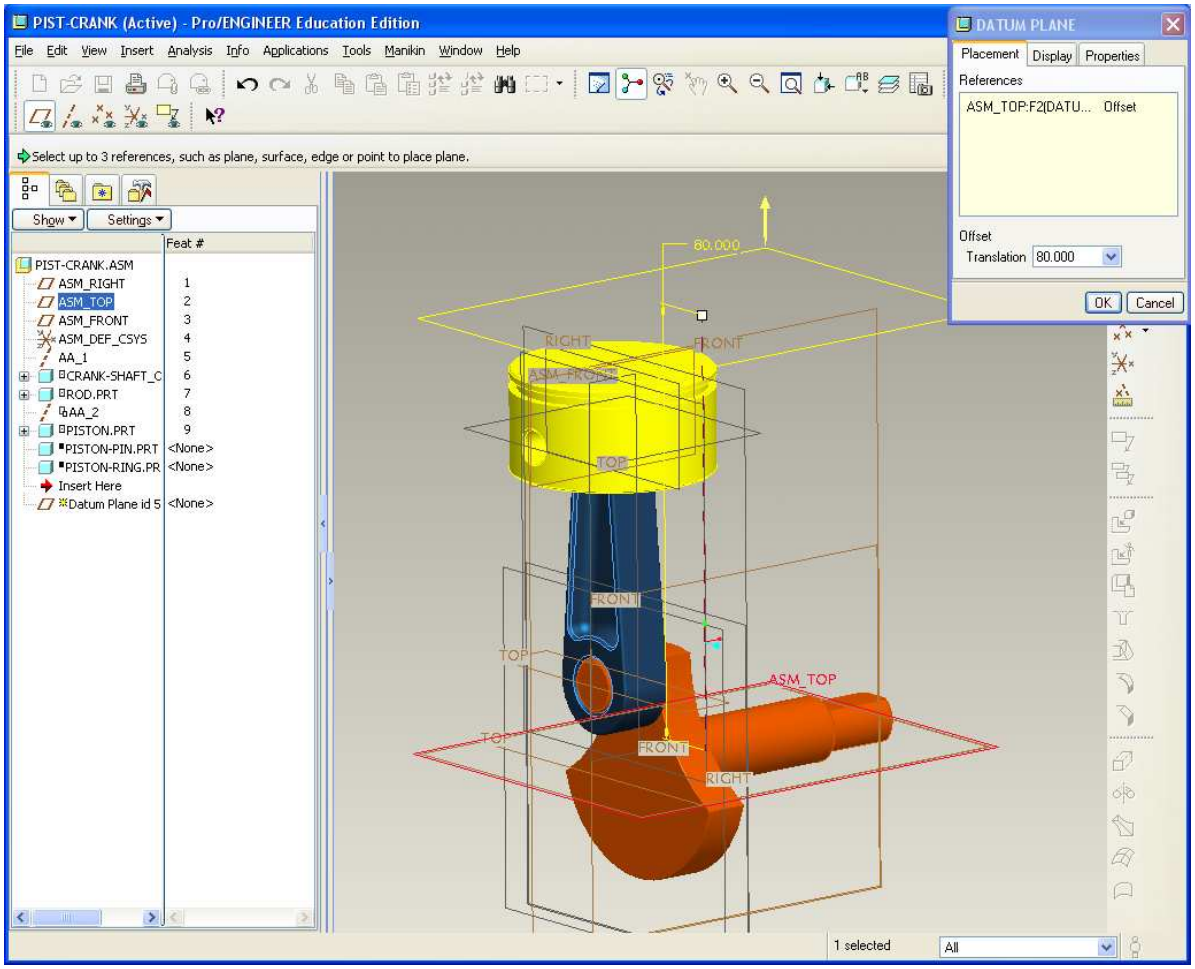
- From the Supporting Materials page download and open pist-crank_2.zip
    - This will pick up where we left off
    - Has additional parts
- Tonight we'll add:
    - A set of "gears" for timing
    - A cam to open and close the valve
    - A valve with spring force



EXERCISE - Motion Analysis

Create Valve height reference

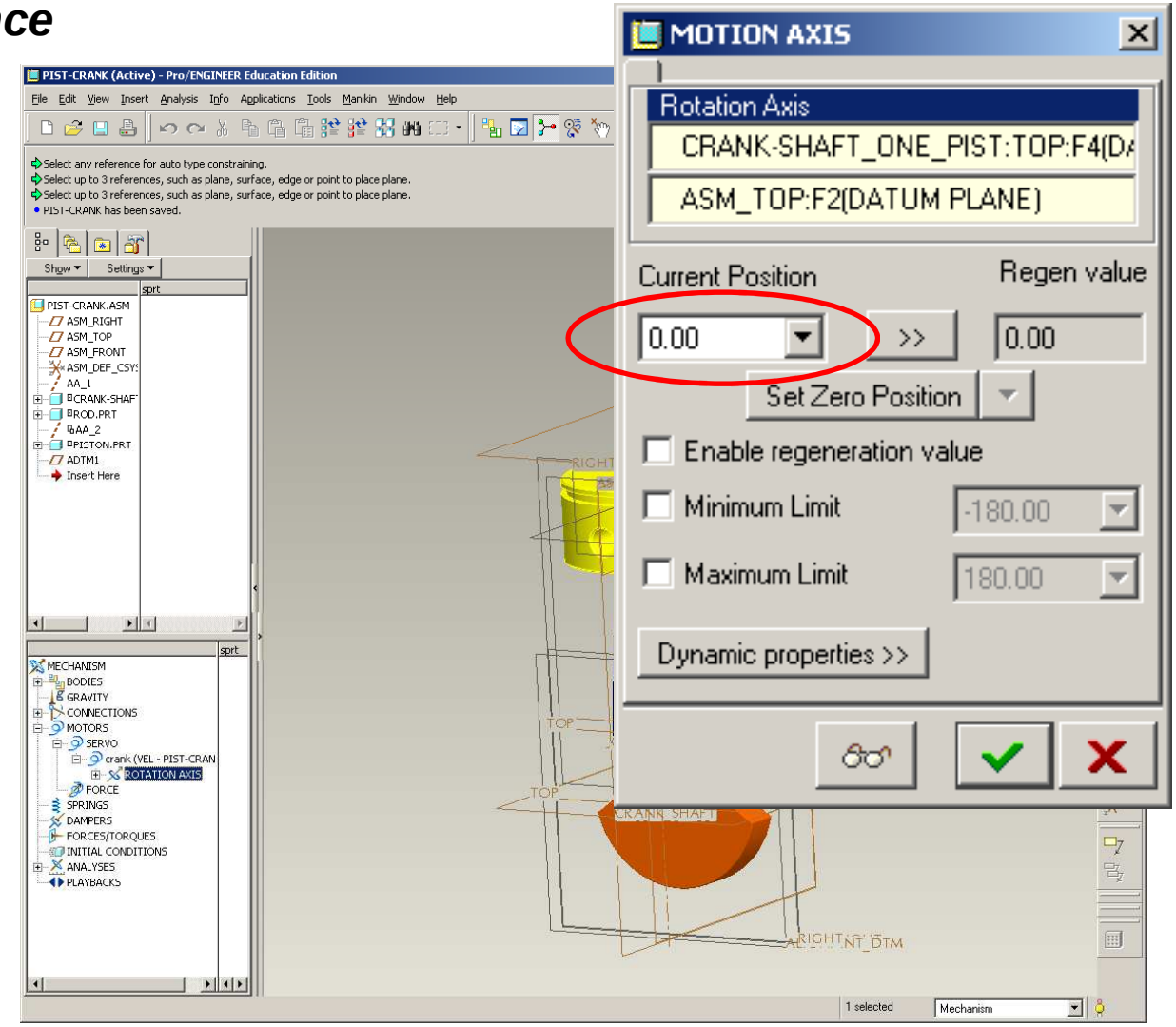
- Go back to the Standard Application
- Create a new datum plane, offset up from ASM_TOP 80mm



EXERCISE - Motion Analysis

Create Valve height reference

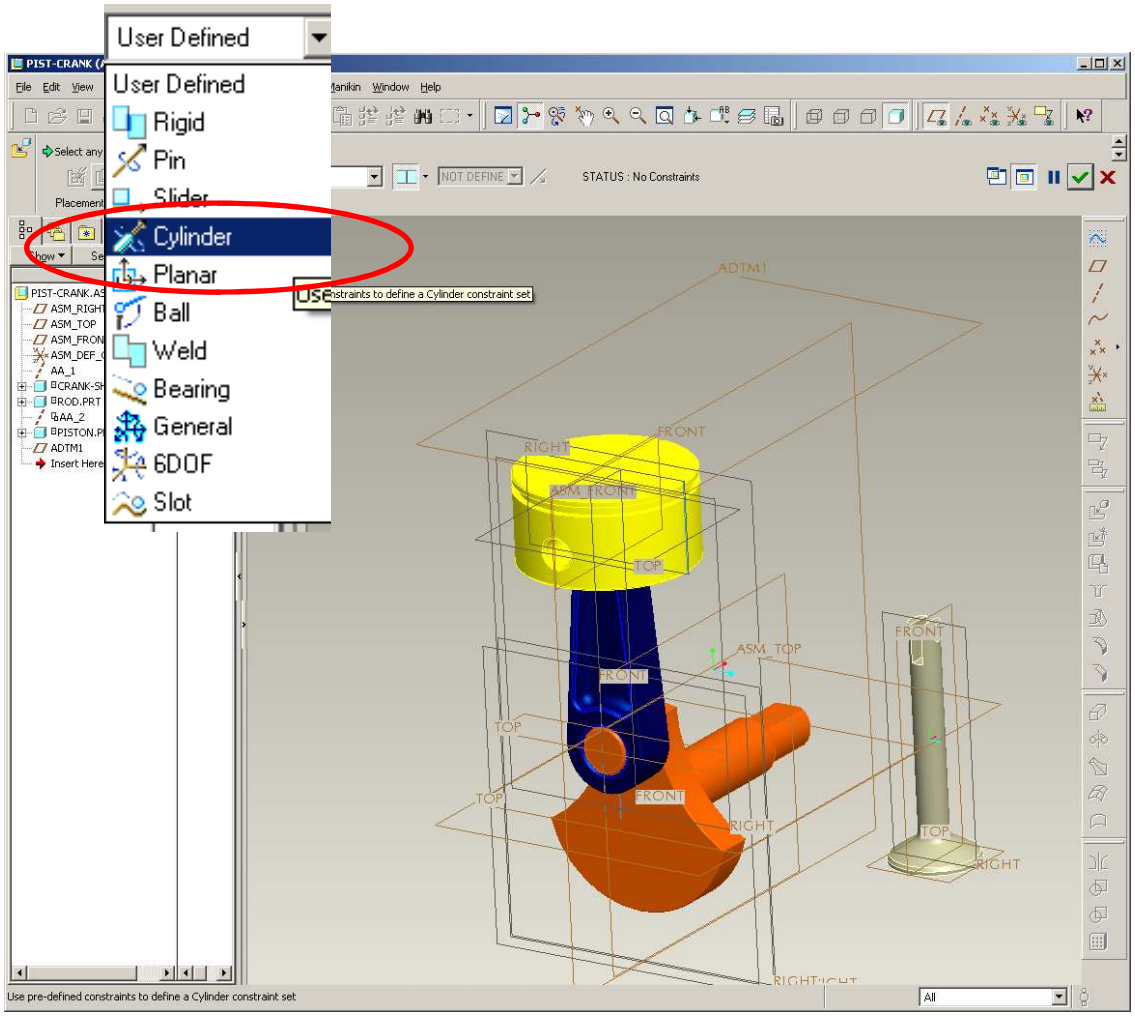
- Switch to the Mechanism application
  - Application > Mechanism
- Make sure the mechanism is in its home position
  - From mechanism tree, Expand Motors > Servos > crank
  - RMB on Rotation Axis > Edit Definition…
  - Set Current Position to 0.00



EXERCISE - Motion Analysis

Assemble Valve component

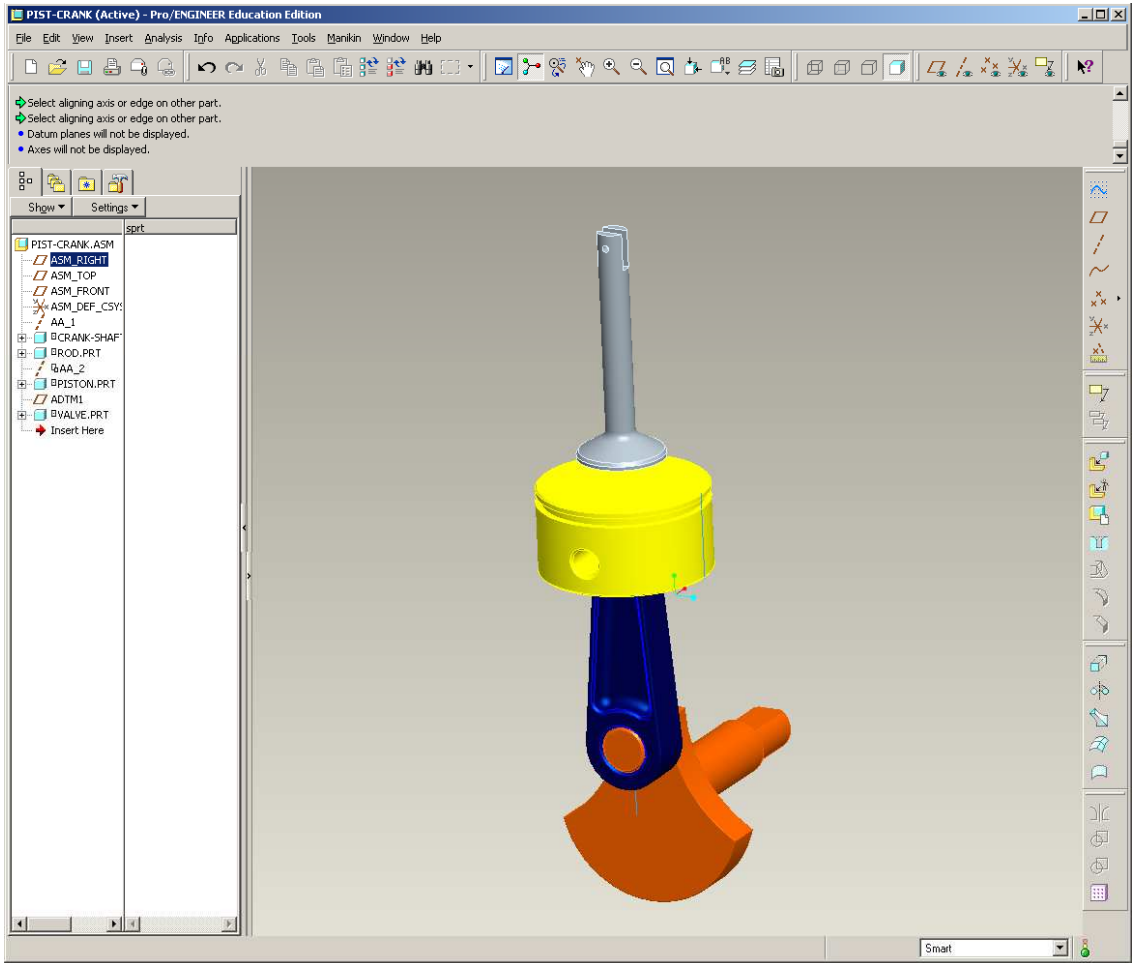
- Switch back to the Standard application
- Assemble in the *valve* component
  - Insert > Component > valve.prt
  - From Constraint Type drop-down select Cylinder



EXERCISE - Motion Analysis

Assemble Valve component

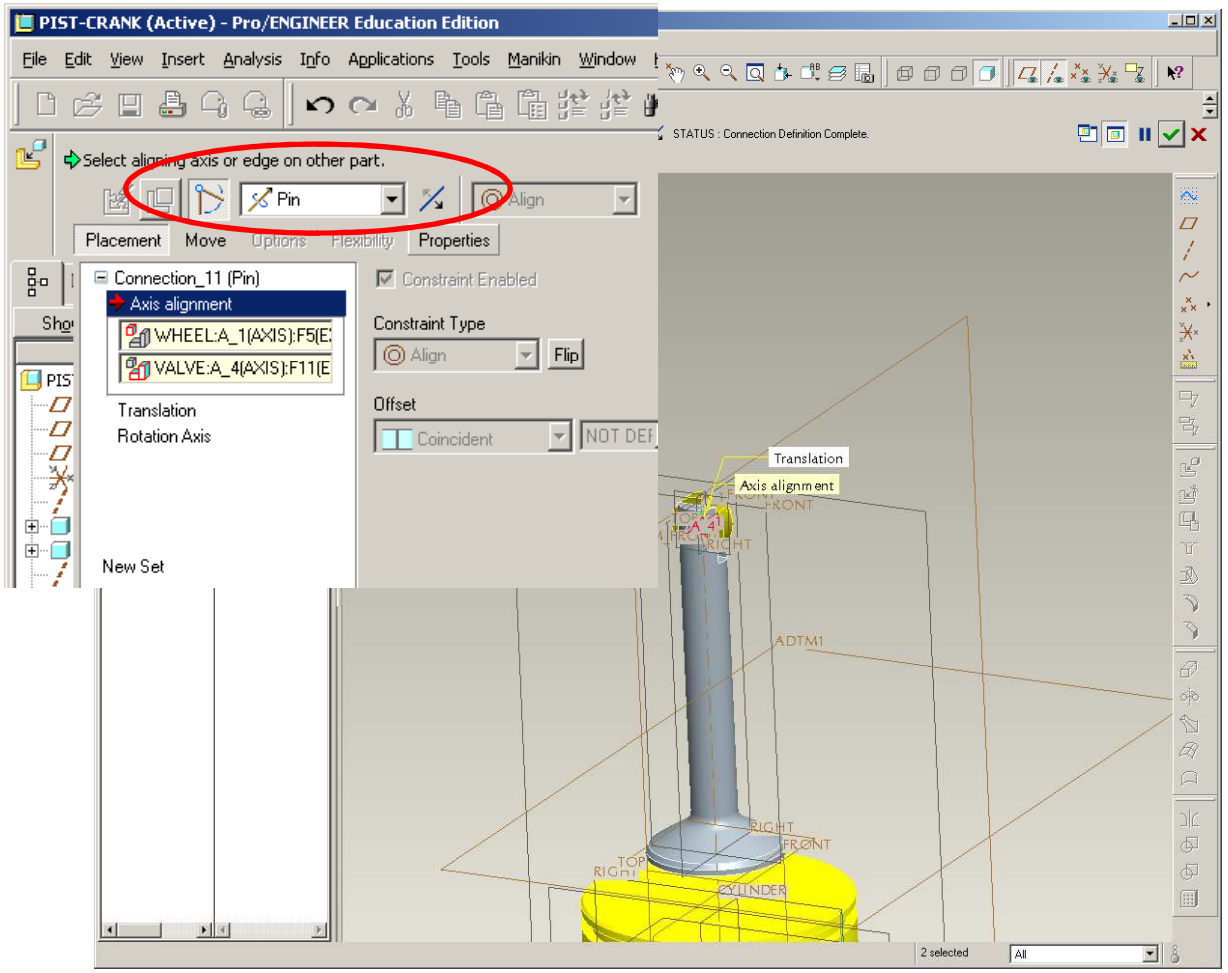
- Use the following constraints:
  - Align the Valve axis to the axis we created through the center of the *rod*
  - Select Valve's Top and the new datum plane (ADTM1) for Translation
  - Align Valve's Front and ASM Right for Rotation
- ***Make sure the slot for the wheel is oriented as shown***



EXERCISE - Motion Analysis

Assemble Wheel component

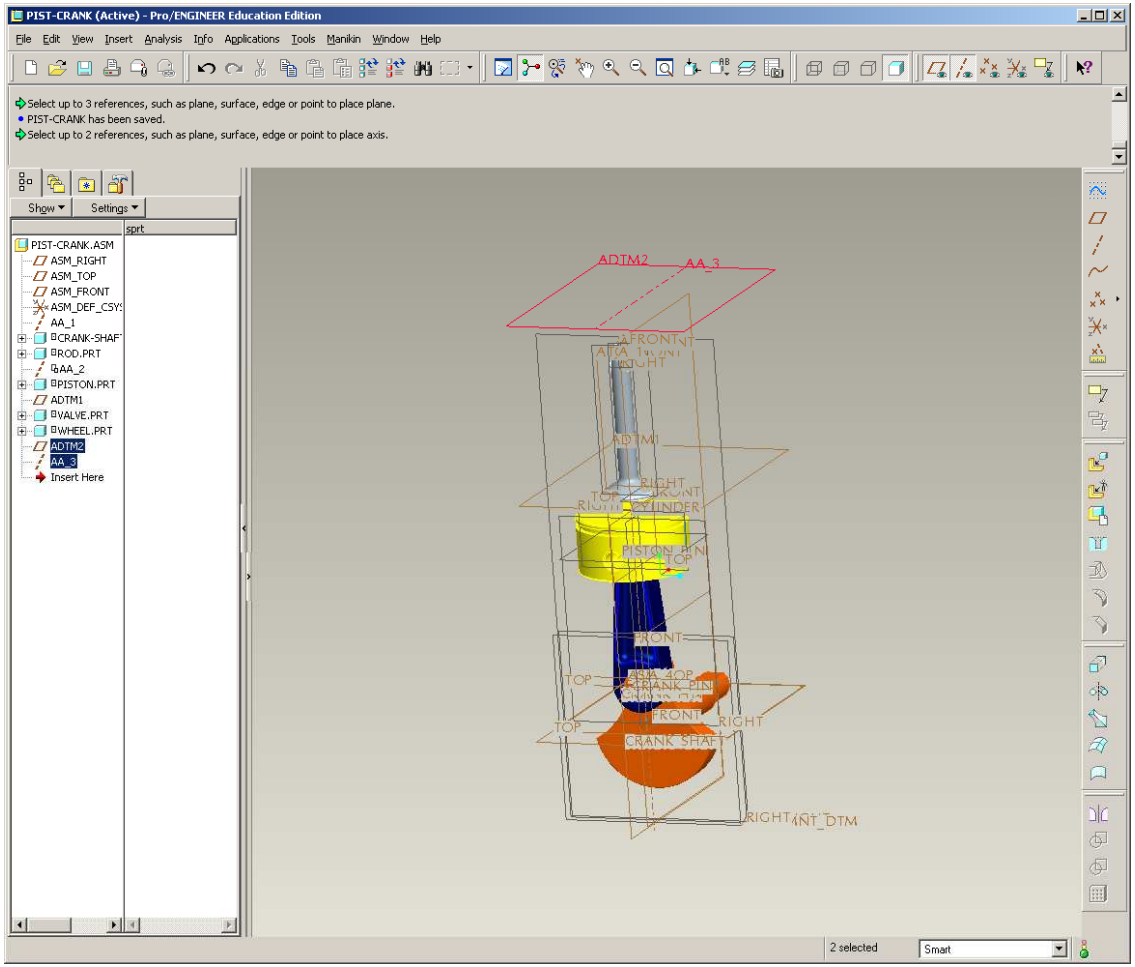
- Insert > Component > wheel.prt
- Select Pin from Constraint type
  - Align center axis with through hole in Valve
  - For Translation, align the Wheel's Front plane with the Valve's Front plane
  - For Rotation, align the Wheel's Top to the Valve's Top



EXERCISE - Motion Analysis

Create a new datum and axis

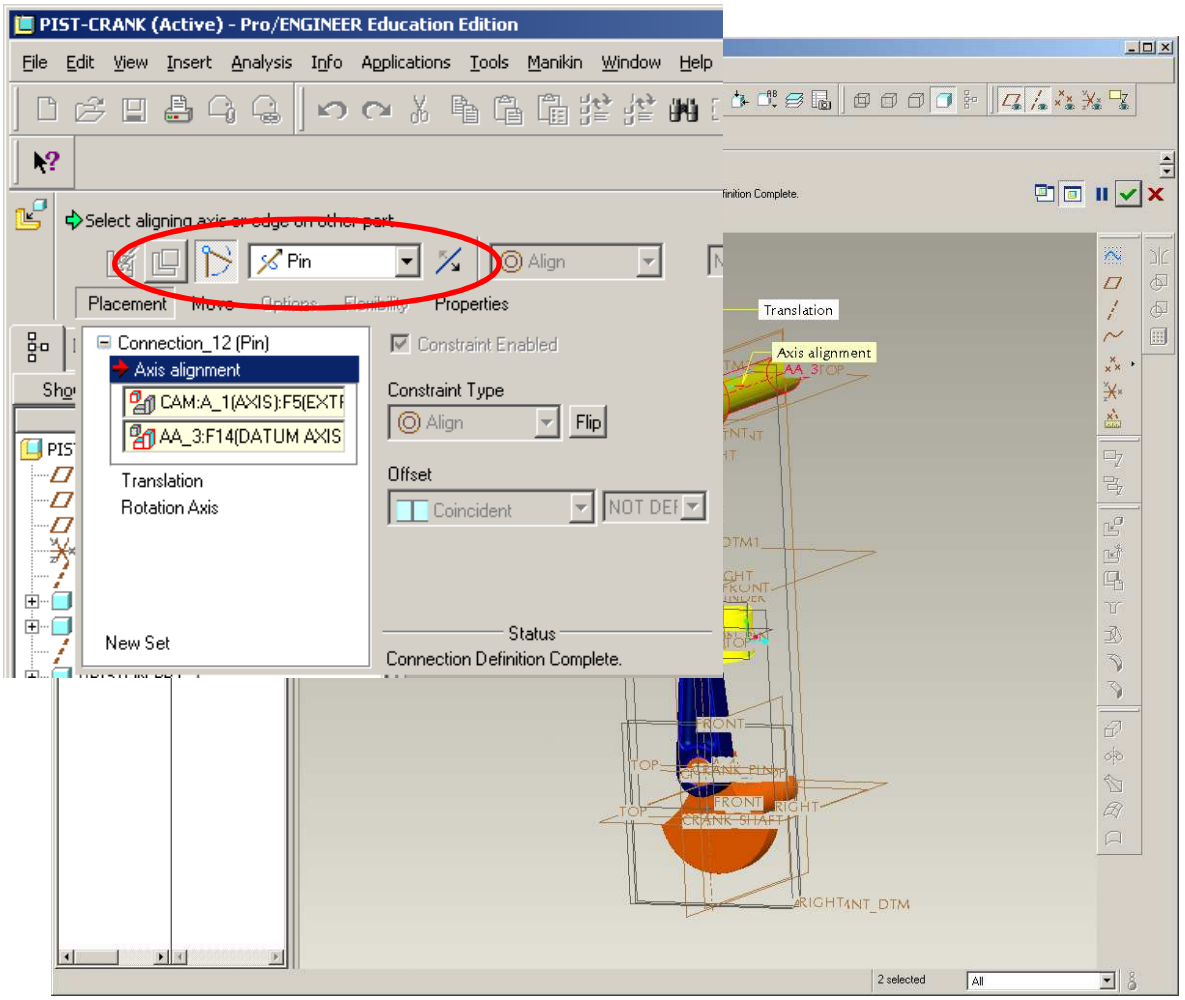
- Create a datum plane
  - Offset from ASM_TOP 141mm
- Create a datum axis
  - Create at intersection of planes
  - Use new datum and ASM Front



EXERCISE - Motion Analysis

Assemble Cam component

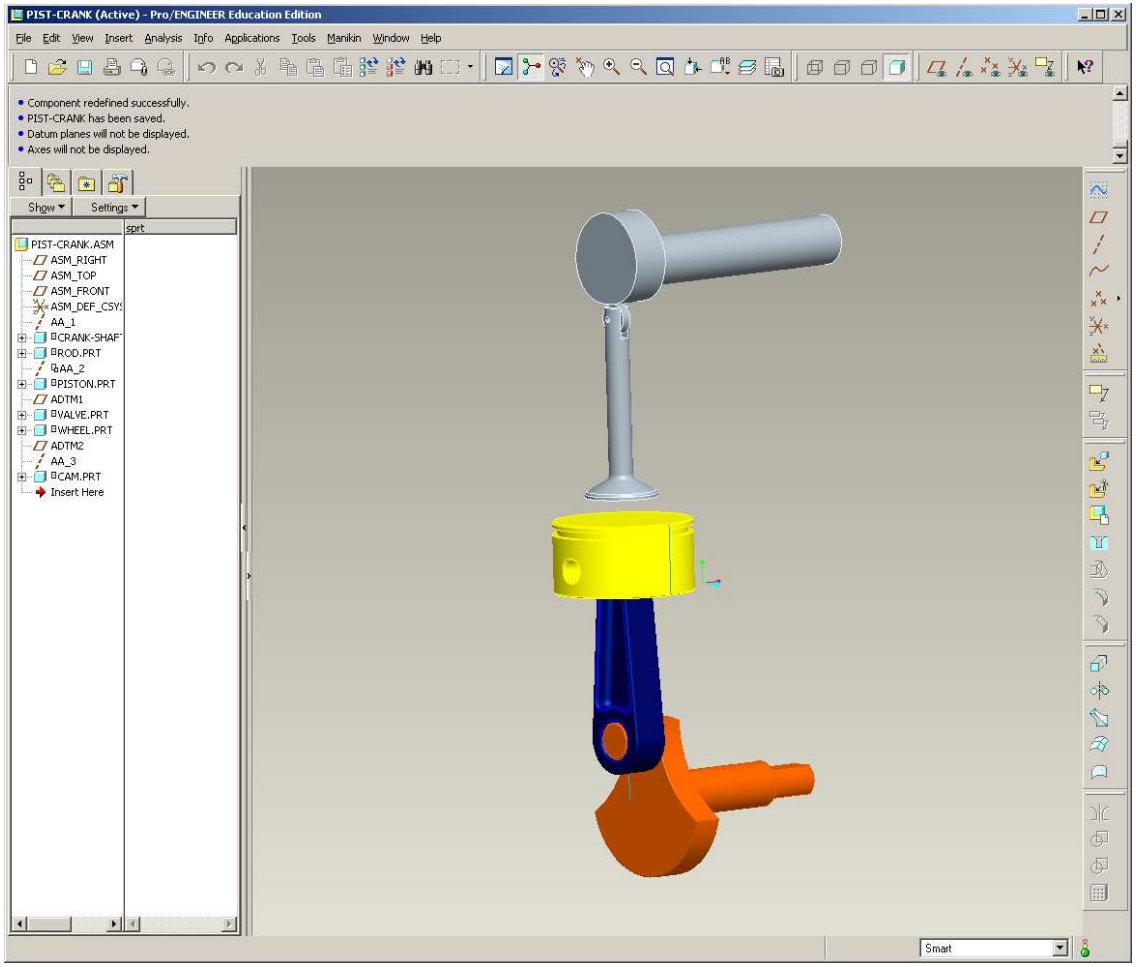
- Insert > Component > cam.prt
- Select Pin from Constraint type
  - Align center axis with new datum axis (AA_3)
  - For Translation, mate-offset the Cam's Front plane 8.00 from ASM Right
  - For Rotation, align the Cam's Top to the new datum plane (ADTM2)



EXERCISE - Motion Analysis

Save what we've got

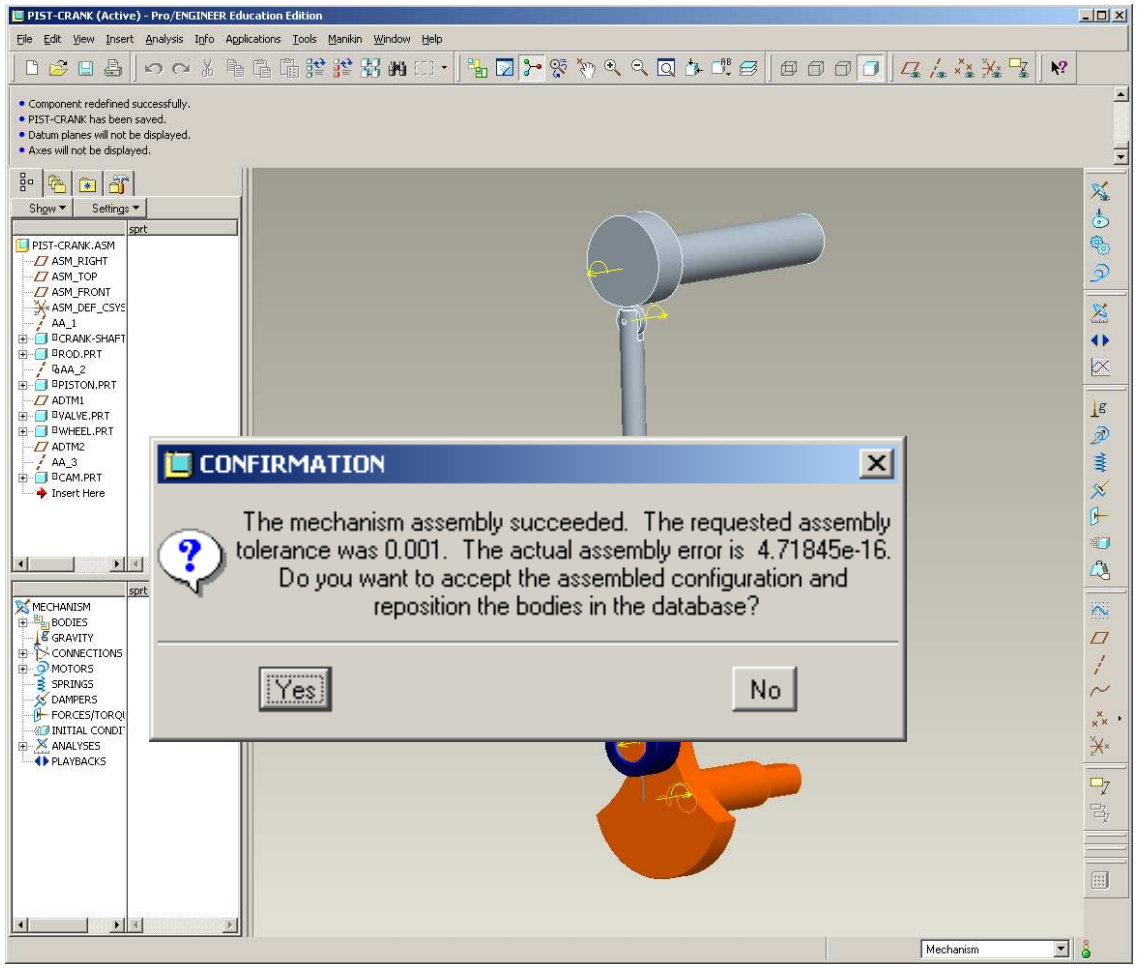
- ***SAVE!!***



EXERCISE - Motion Analysis

Switch Applications

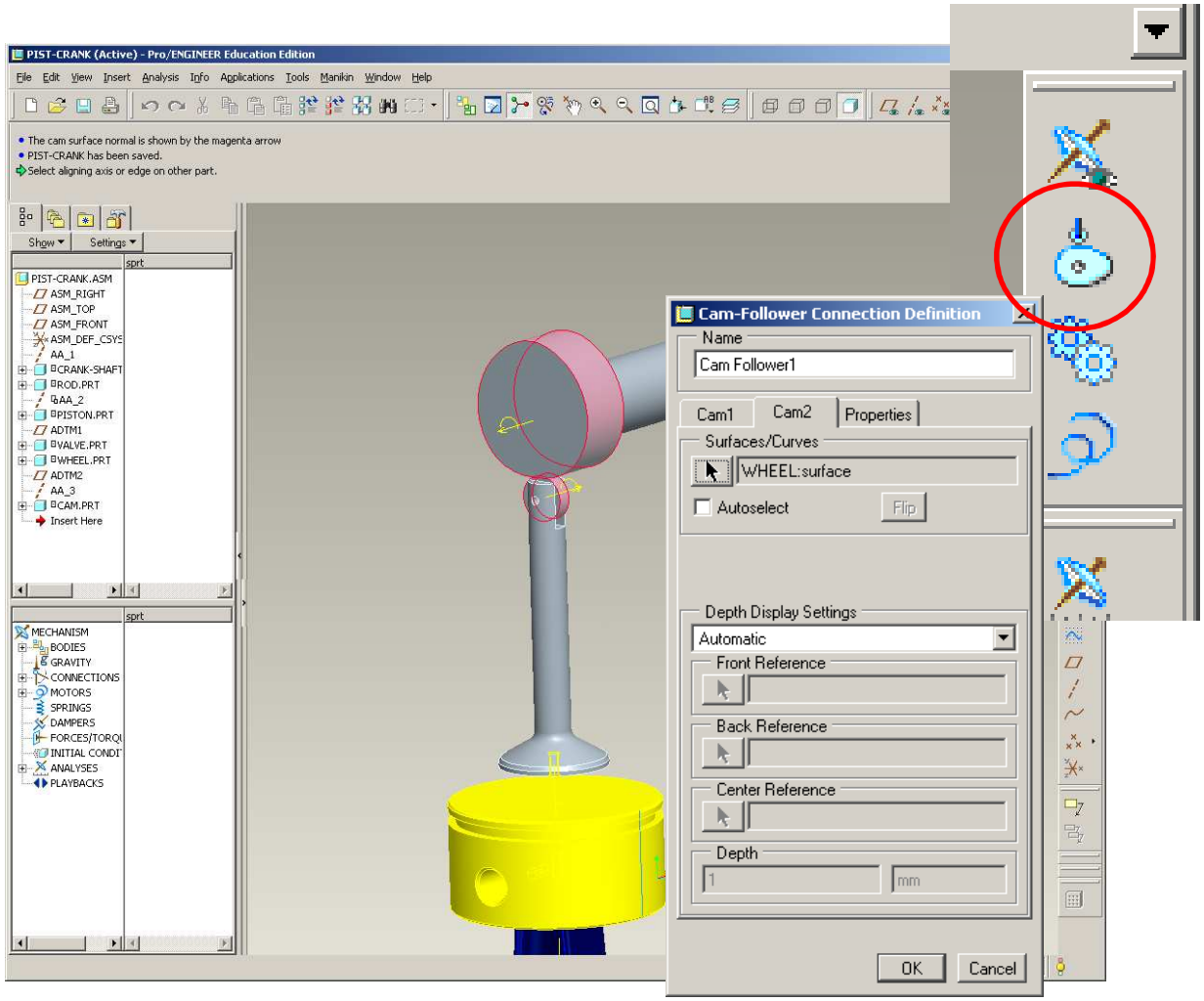
- Switch applications back to Mechanism
- Edit > Reconnect > Click Run…
- Should see a dialog saying mechanism assembly succeeded
- Click Yes



EXERCISE - Motion Analysis

Create Cam Connection between cam and wheel

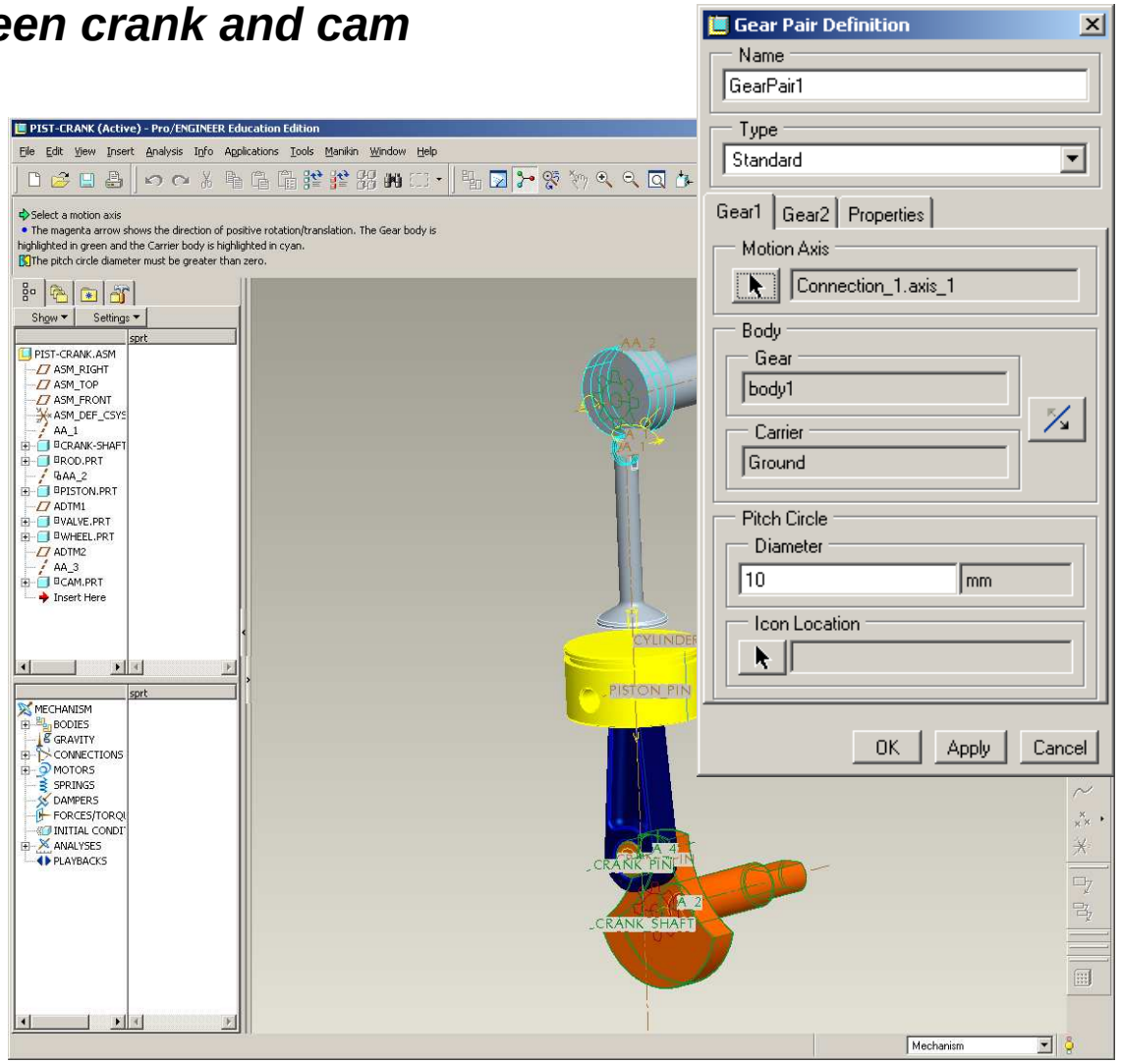
- Cam and Wheel surfaces need to be connected as a Cam
  - Click Cam
  - Select *Entire* outer surface of Cam
  - Select *Entire* outer surface of Wheel
  - Make sure normals are pointing in the right direction
- ***Use the Drag function to make sure this is working***



EXERCISE - Motion Analysis

Create Gear Connection between crank and cam

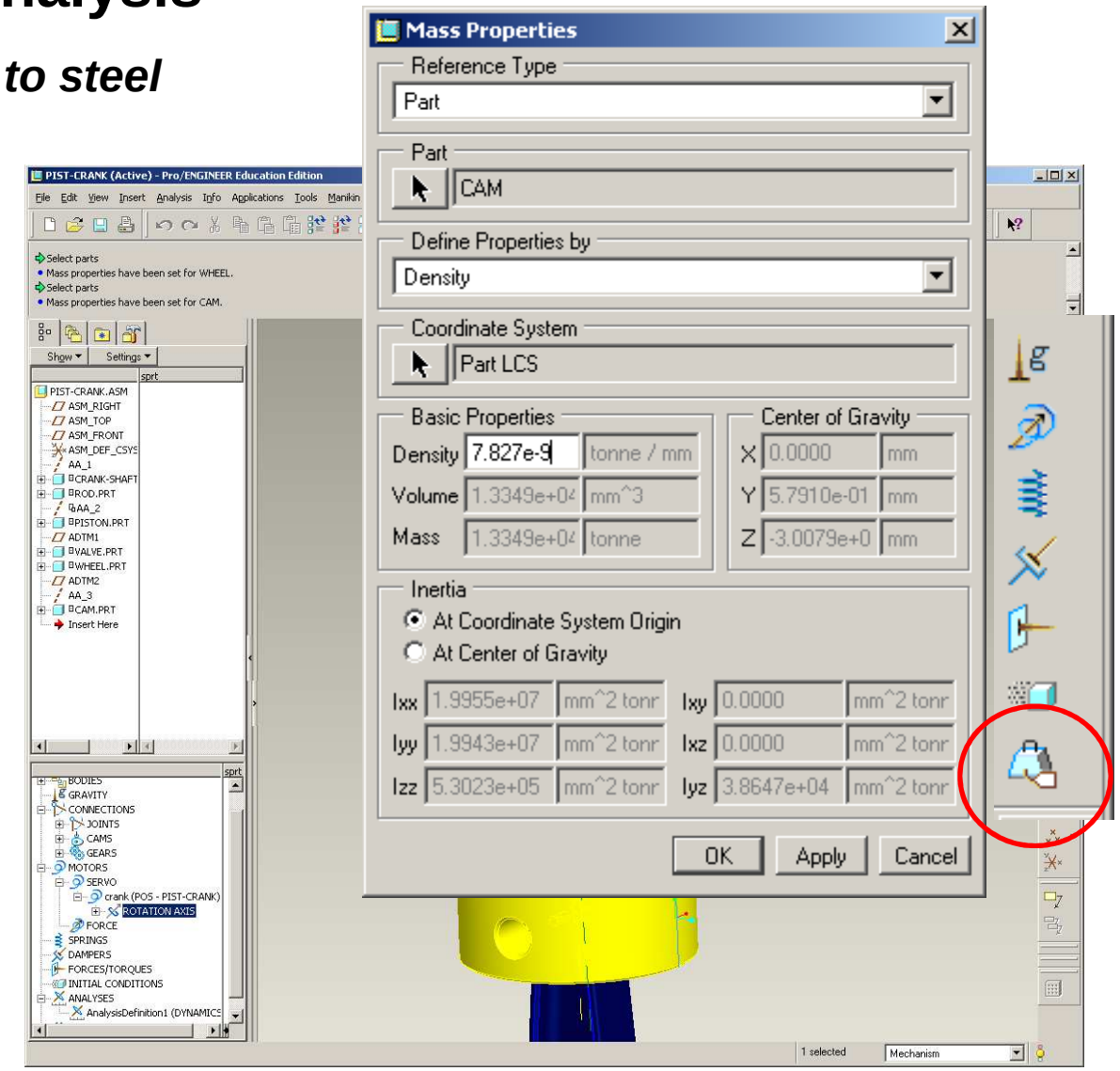
- These parts need to be connected by a set of “gears”
  - Click on Rotation Axis for the Crank for Gear 1
  - Click on Rotation Axis for the Cam for Gear 2
  - Use 10mm diameter for each gear
- ***Use the Drag function to make see output***



EXERCISE - Motion Analysis

Set remaining part densities to steel

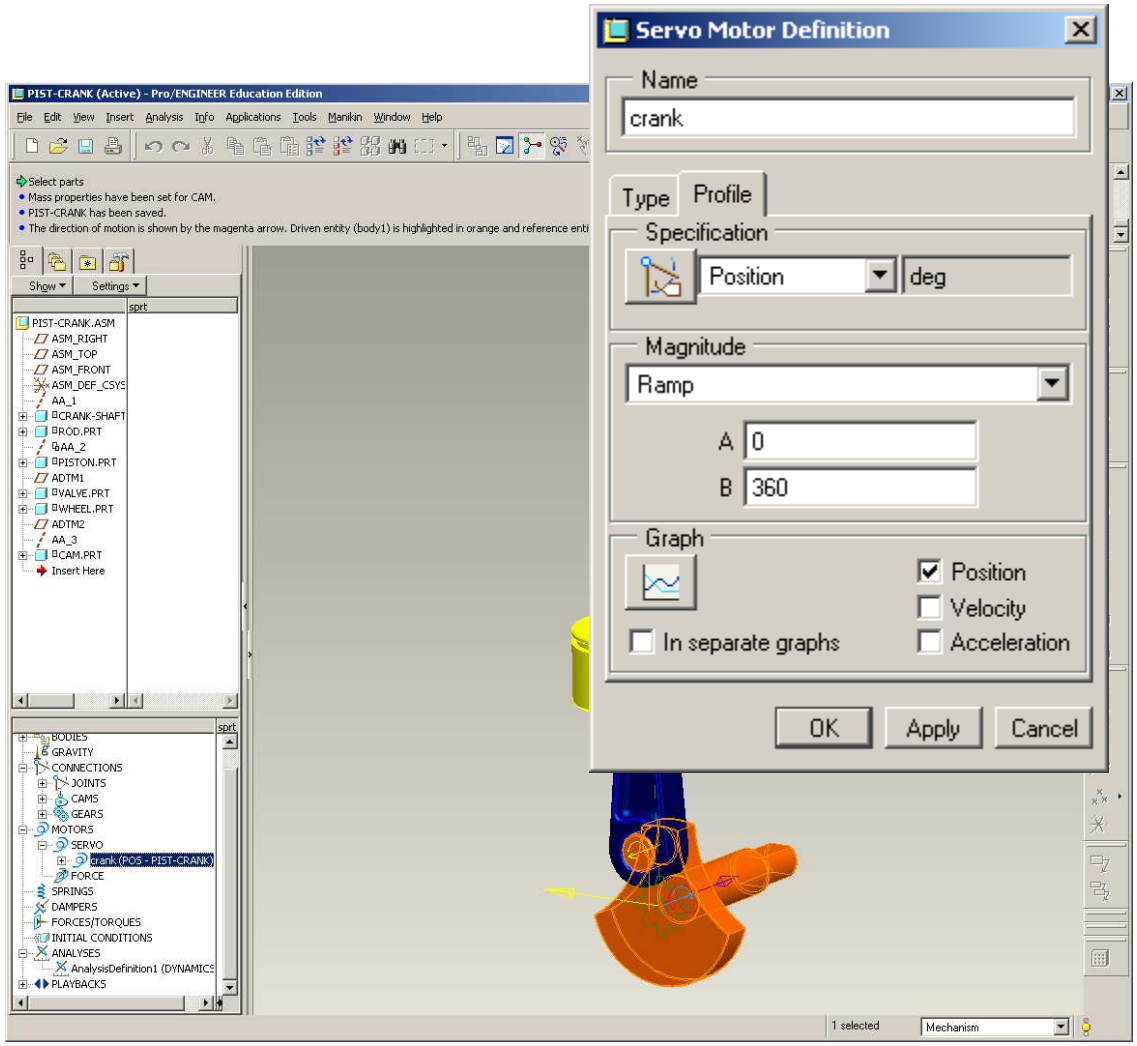
- New parts need densities set to steel
  - 7.827e-9 tonne/mm^3
- Use Mass Properties tool



EXERCISE - Motion Analysis

Redefine Servo Motor

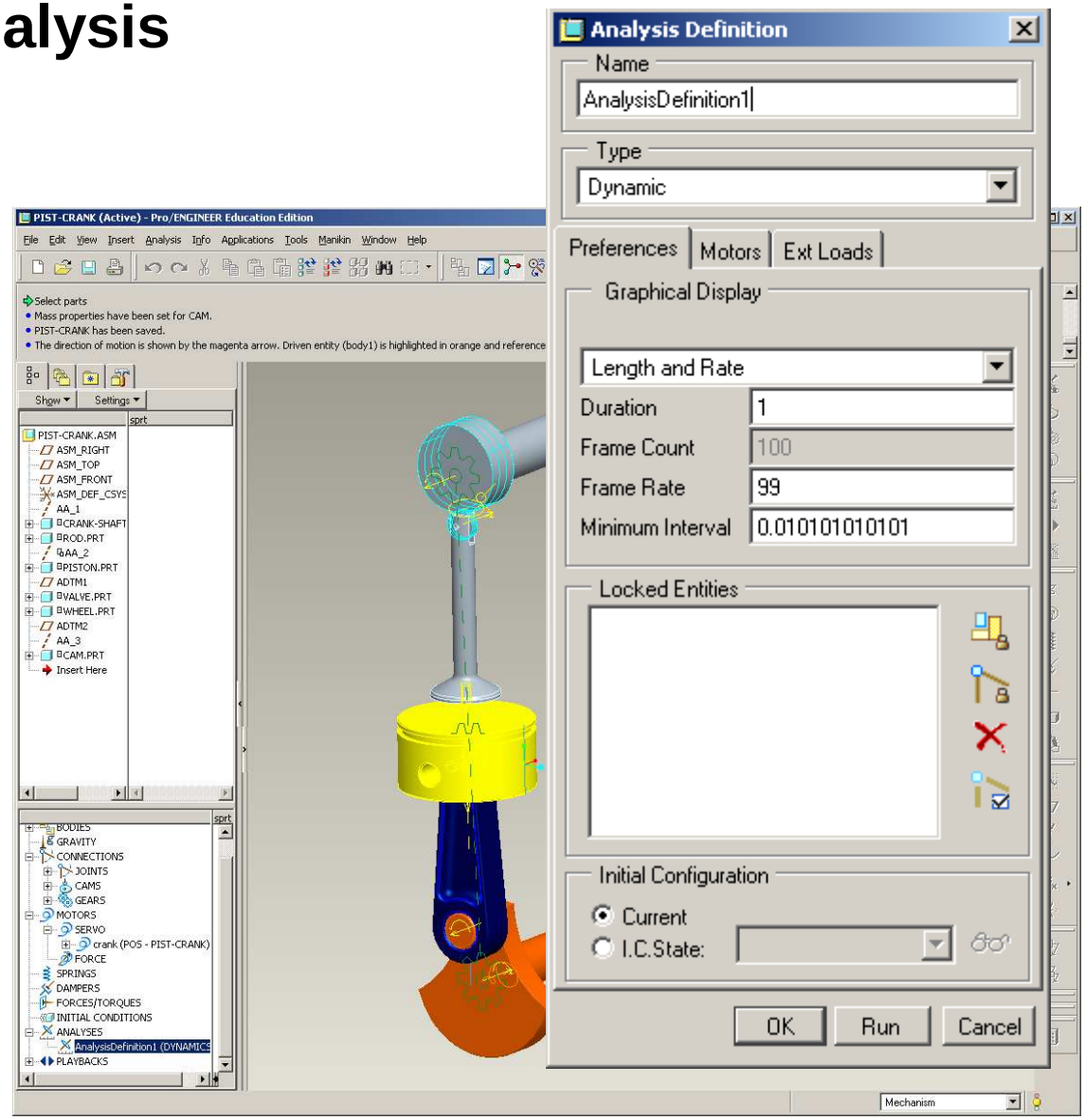
- From Mechanism tree, redefine the crank servo motor
- Use a Position specification
- For Magnitude select Ramp with constants A=0 and B=360



EXERCISE - Motion Analysis

Redefine Analysis

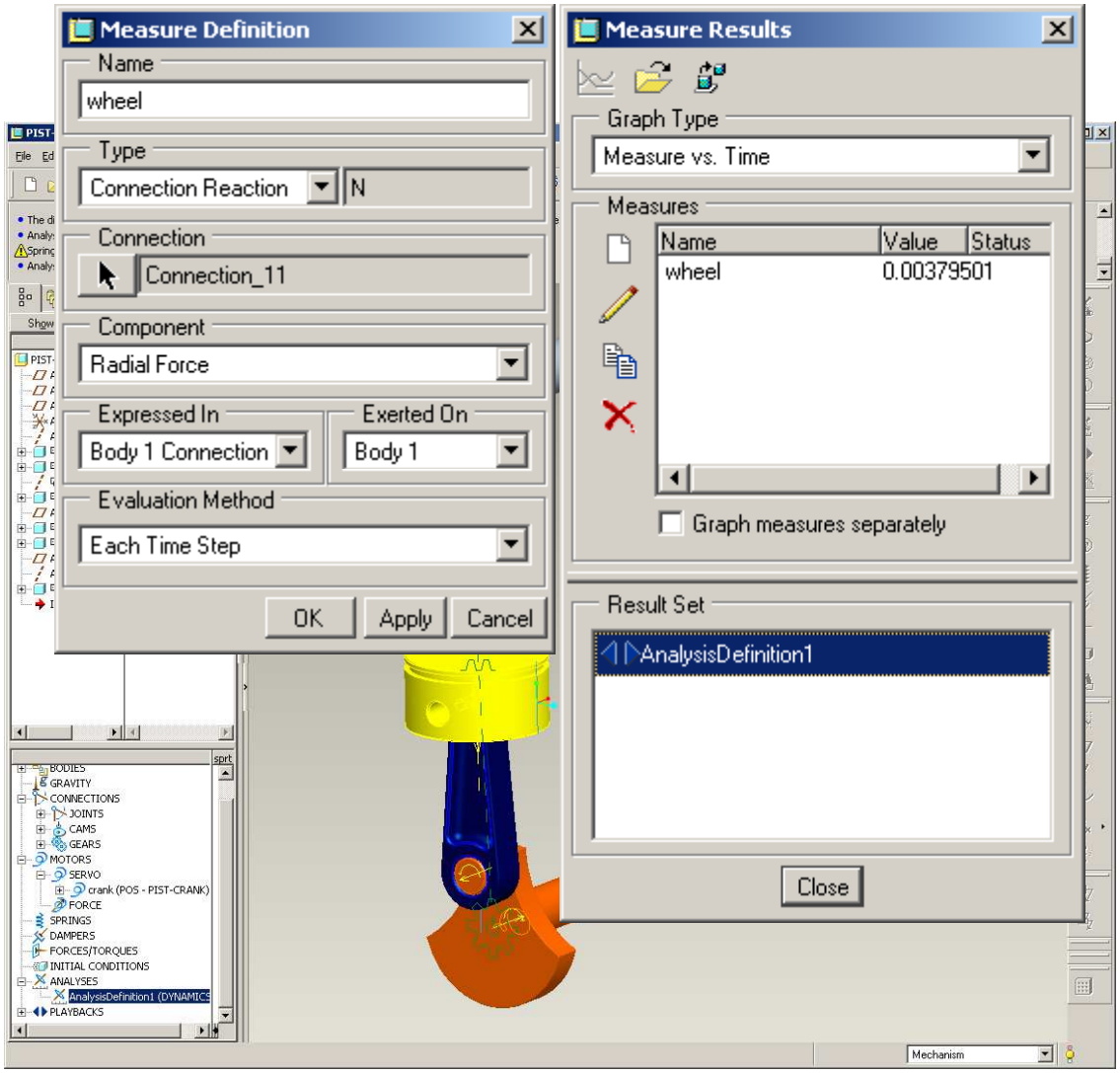
- Run a Dynamic analysis type
- Select Length and Rate for to specify analysis period
  - Duration=1
  - Frame Rate = 99
- ***Run the analysis***
- Click OK



EXERCISE - Motion Analysis

Evaluate key measures

- Open the Measures tool
- Load the results set
- Create a “Connection Reaction” measure for the center of the wheel
- Graph each measure and notice the limits



EXERCISE - Motion Analysis

Create a Spring

- Click on the Spring tool
- Set the rate to 10N/mm
- Set initial displacement to 2mm
- *Re-run the analysis and check the measure on the wheel*
    - ***What happened?***