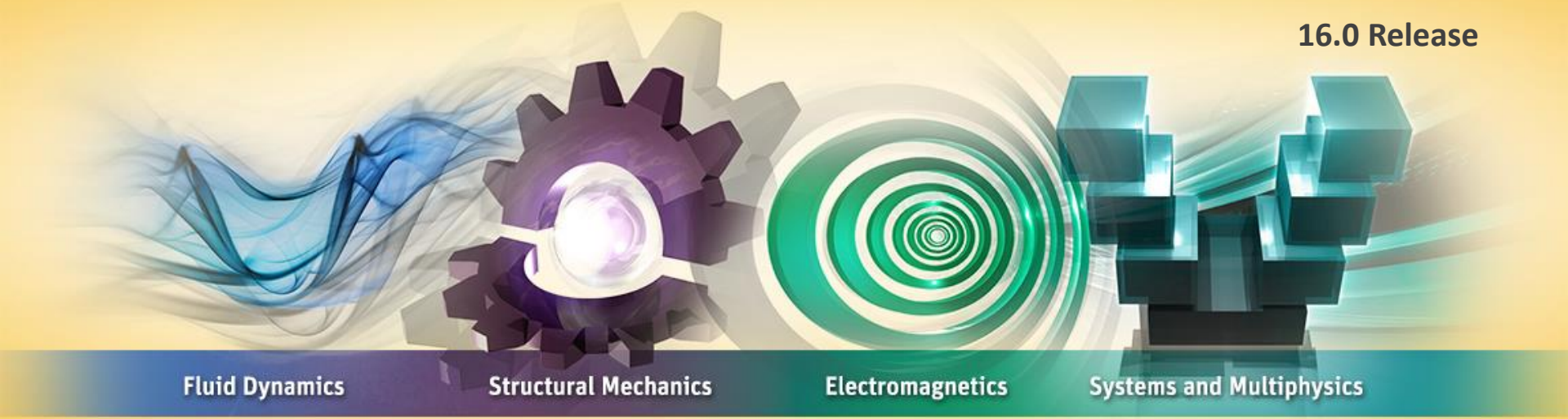
Workshop 5.2
Using Joints

16.0 Release



Introduction to ANSYS Mechanical

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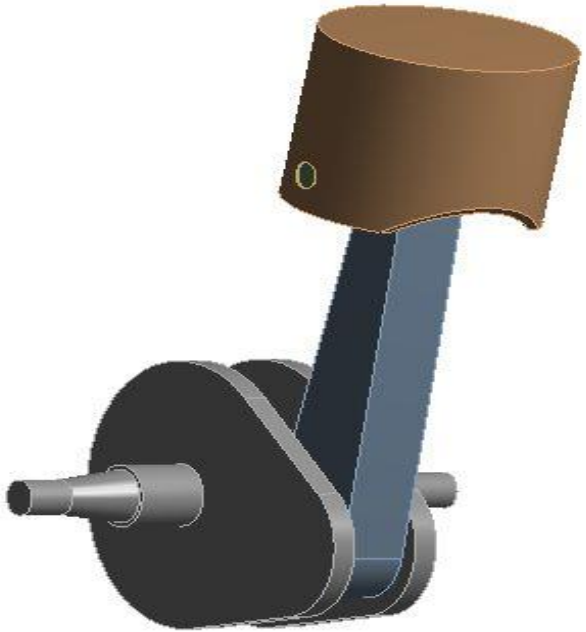
Goals

The goal of this workshop is to use joints to connect some parts in an assembly instead of contact. Joints can provide a convenient alternative to contact.

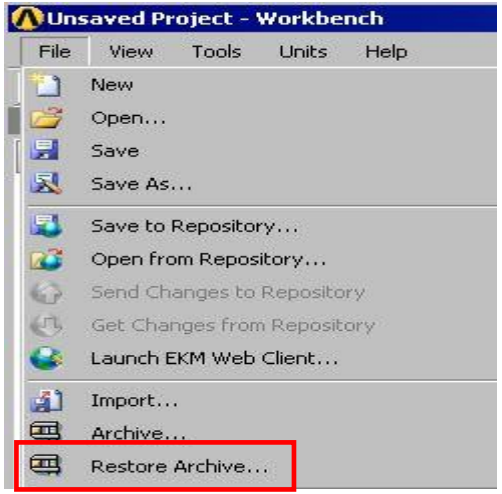
The 4 part assembly shown here would normally be connected using contact definitions. In this workshop the model contains a single contact region. We'll use the automatic joint feature to setup the remainder of the connections and make several modifications before solving.

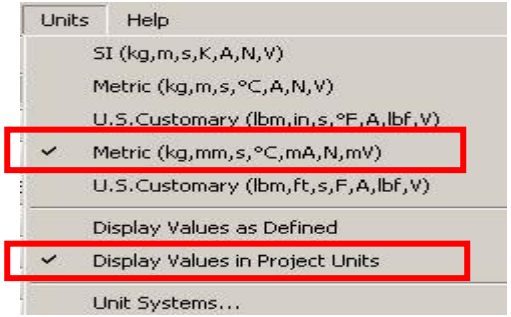


Project Schematic

Begin a new Workbench session and, from the Project page, choose “Restore Archive . . . “ and browse to the file “Joint_Connection.wbpz” and Open (location provided by instructor).

When prompted, “Save” using the default name in the same location as the archive file.





From the “Units” menu verify:

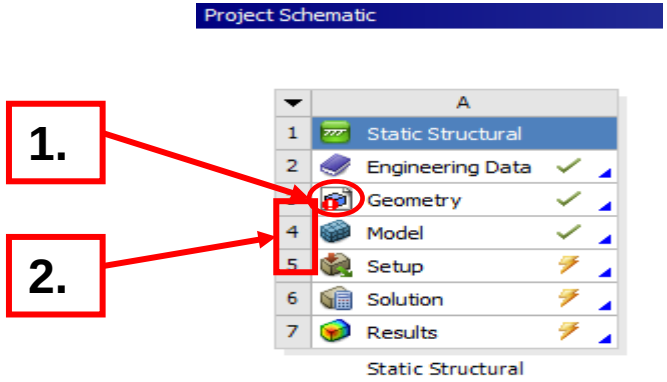
- **Project units are set to “Metric (kg, mm, s, ºC, mA, N, mV).**
- **“Display Values in Project Units” is checked (on).**

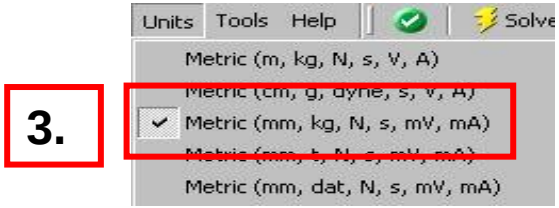
. . . Project Schematic

1. "!" show next to the geometry means that the geometry file is not available and so we can not open it in DesignModeler

2. From the Static Structural system double click (or RMB > Edit) the "Model" cell.

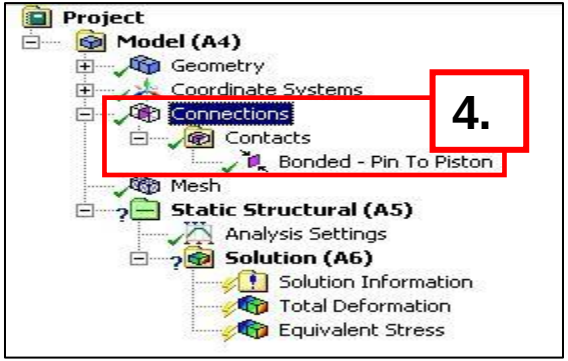
3. When Mechanical opens, verify the units are set to "Metric (mm, kg, s, mV, mA)".





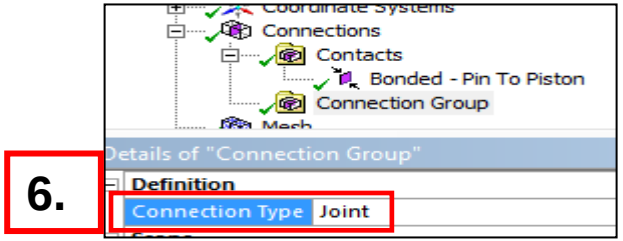
Preprocessing

4. Highlight the Connections branch. Notice that currently there is a bonded contact region between the Piston and Pin parts.



5. From the Connections branch, RMB > Insert > Connection Group.

6. In the connection group details change the connection type to “Joint”.

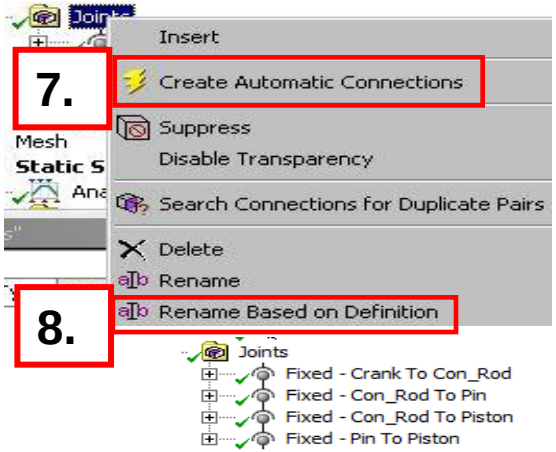


. . . Preprocessing

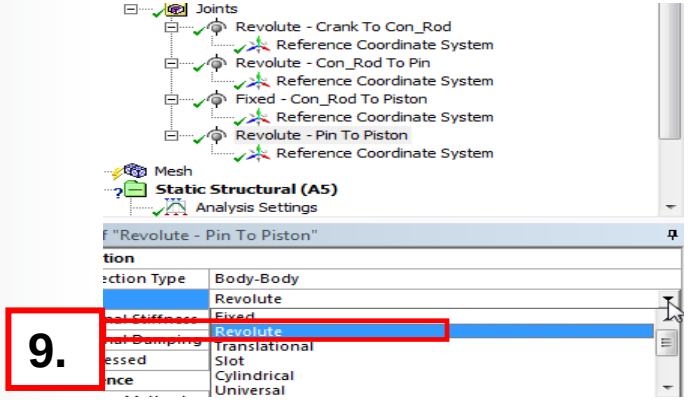
7. Highlight the “Joints” branch, RMB > Create Automatic Connections”.

You should see 4 new joints have been created. Before inspecting the joints, we’ll rename them to make the process easier.

8. Highlight the Joints branch, RMB > Rename Based on Definition.



9. Change the Cranck to Con_rod, Con_Rod to pin and Pin to Piston joints types from fixed to revolute.



. . . Preprocessing

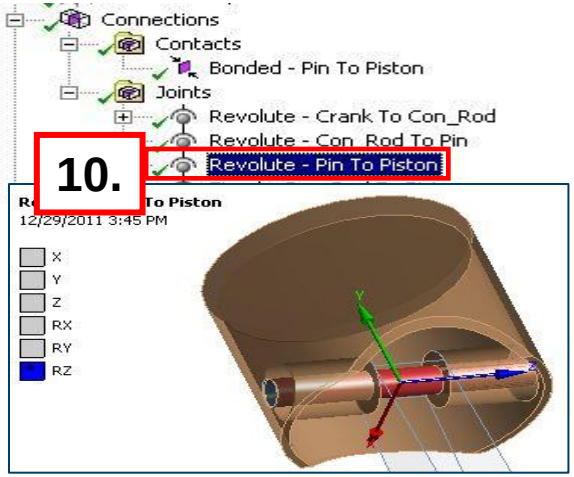
Highlight the "Pin To Piston" joint.

- **Notice in the Contacts branch there is a contact region already defined between these parts ("Bonded – Pin to Piston"). This joint can be removed.**

10. Highlight the joint "Revolute – Pin To Piston" > RMB > Delete.

11. Highlight the "Fixed - Con_Rod To Piston" joint, RMB > Delete the fixed joint.

- **A fixed joint has been defined between 2 adjacent faces. This joint is not only unnecessary, it will prevent proper motions in the assembly.**

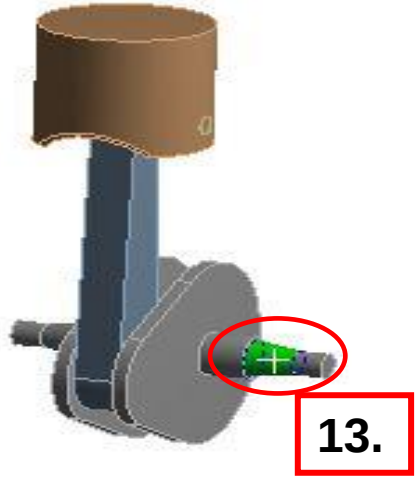


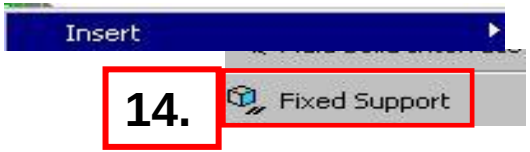
Environment

12. Highlight the Static Structural branch.

13. Highlight the tapered cylindrical face on the crank shown here.

14. RMB > Insert > Fixed Support.



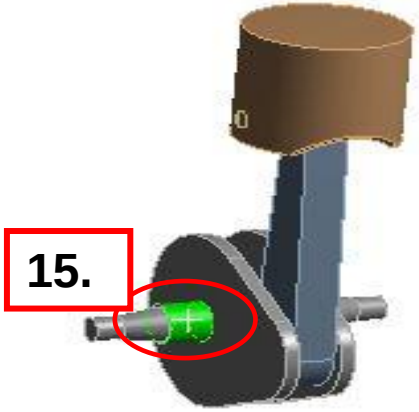


. . . Environment

15. Highlight the cylindrical face on the crank shown here.

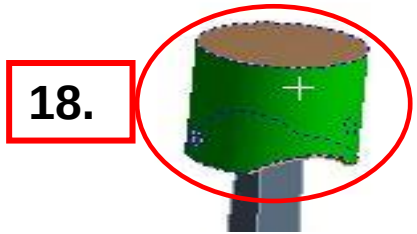
16. RMB > Insert > Cylindrical Support.

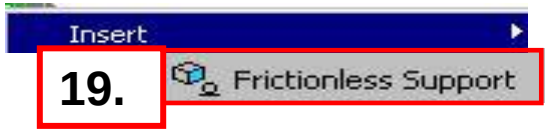
17. In the details configure:
    - Radial = Fixed
    - Axial = Free
    - Tangential = Free

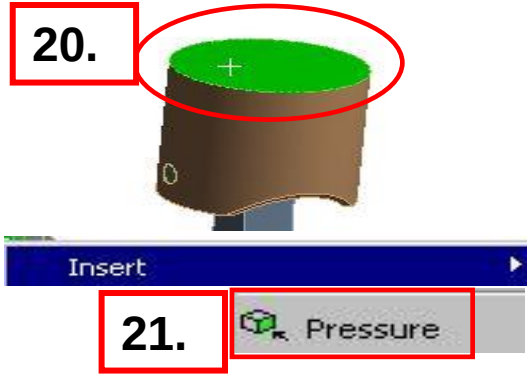


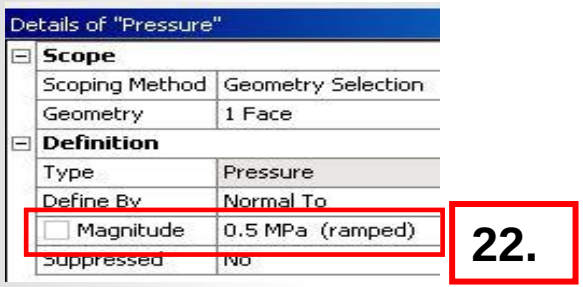
. . . Environment

18. Highlight the cylindrical face on the piston shown here.
19. RMB > Insert > Frictionless Support.
20. Highlight the circular top face on the piston shown here.
21. RMB > Insert > Pressure.
22. In the details enter a Magnitude = 0.5 MPa.



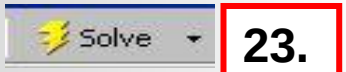






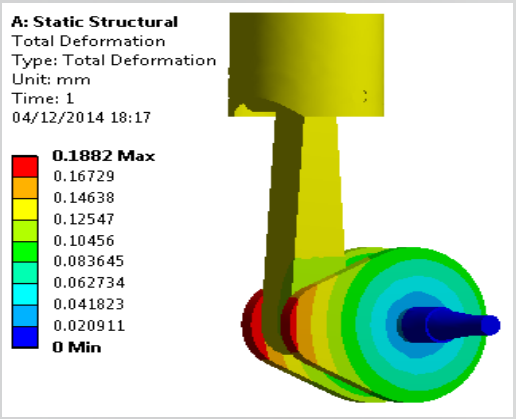
Solution

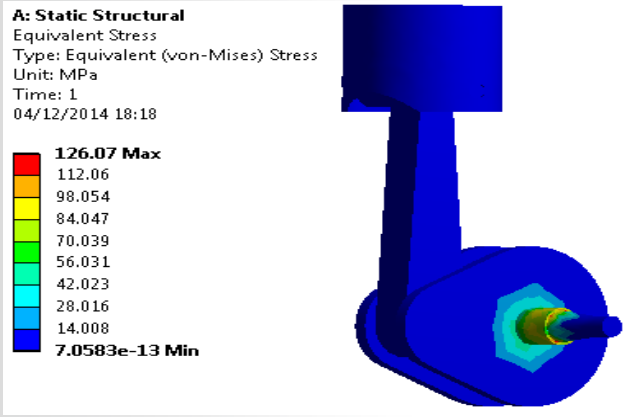
23. Solve the model.

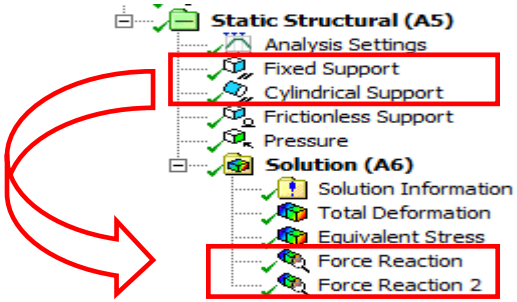


When the solution completes plot displacement and stress to review.

Drag and drop the “Cylindrical Support” and “Fixed Support” onto the Solution branch to obtain the reaction forces.



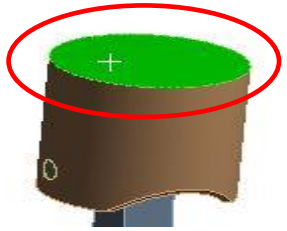




Postprocessing

Let's review the loading to determine if the forces balance:

- **Highlighting the top face of the piston shows (in the status bar), the approximate surface area is 9740 mm².**
- **Applying a 0.5 Mpa pressure should result in an approximate applied force of 4870 N in the –Y direction.**



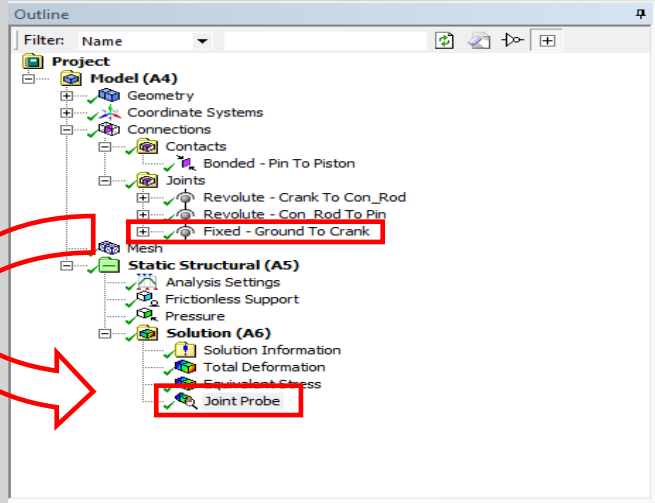
Reviewing the details for the reactions we see:

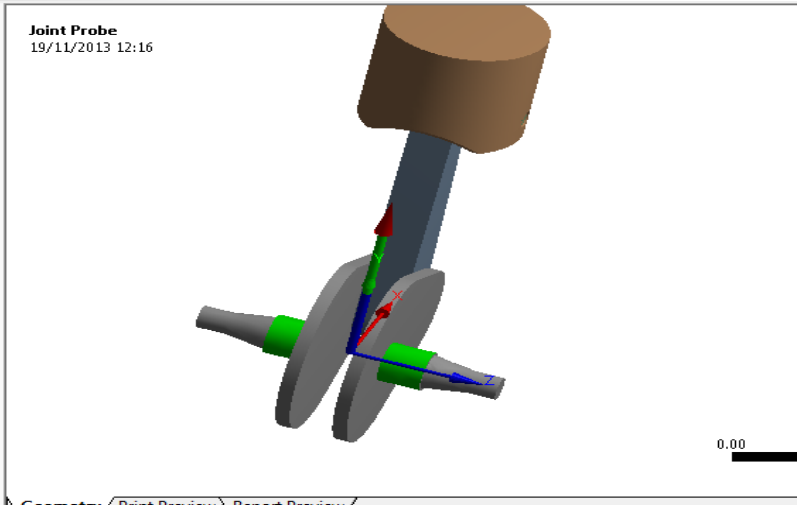
- **Y reaction at the fixed support = 3960 N**
- **Y reaction at the cylindrical support = 966 N**
- **Total Y reaction (3960 + 966) = 4926**

Note, using a default mesh may result in slight differences in your results compared to those here. The difference here, (~55 N) represents approximately a 1% difference.

Go further! (Reaction of a joint)

- Replace the cylindrical support and the fixed support by a fixed Joint.
- Reaction Force and Reaction Moment of the fixed joint can be post processed directly. Drag and Drop the fixed joint to the Solution.





Details of "Joint Probe"

Definition	
Type	Joint Probe
Boundary Condition	Fixed - Ground To Crank
Orientation Method	Joint Reference System
Suppressed	No
Options	
Result Type	Total Force

Graph

Animation

Tabular Data

	Time [s]	Joint Probe (Total Force X) [N]	Joint Probe
1	1.	-3.2378e-010	4926.

. . . Go Further!

- **Replace the fixed joint previously created by a Revolute joint. Drag and Drop the revolute joint to the Static Structural, and define a Moment of 4e5 N.mm.**
- **Suppress the pressure and add a fixed support on the top face of the piston.**