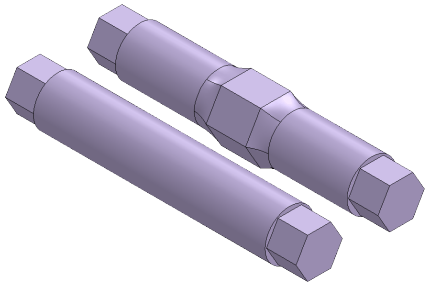
Chapter 4

Wind Up Car
Axles



A. Extrude.

Step 1. Click File Menu > New, click **Part Metric** and OK.

Step 2. Click **Right Plane** in the Feature Manager and click **Sketch** on the context toolbar, **Fig. 1**.

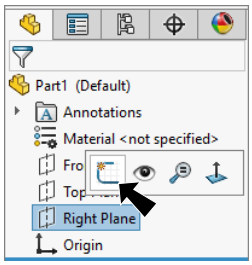


Fig. 1

Step 3. Click **Circle** (**S**) on the Sketch toolbar.

Step 4. Sketch **circle** starting at the Origin , **Fig. 2**.

Step 5. Click **Smart Dimension** (**S**) on the Sketch toolbar.

Step 6. Dimension **diameter 10**, **Fig. 2**.

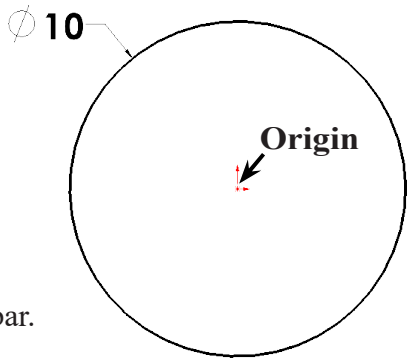


Fig. 2

Step 7. Click **Features** on the Command Manager toolbar.

Step 8. Click **Extruded Boss/Base** on the Features toolbar.

Step 9. In the Property Manager set:
under Direction 1, **Fig. 3**
End Condition **Mid Plane**
Depth **59**
click OK .

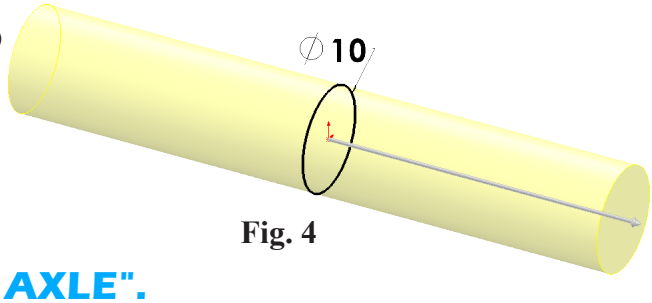


Fig. 4

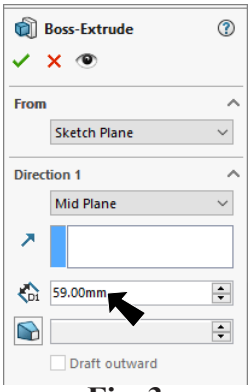


Fig. 3

B. Save as "FRONT AXLE".

Step 1. Click File Menu > Save As.

Step 2. Key-in **FRONT AXLE** for the filename and press ENTER.

C. Cut Hex.

Step 1. Click the **left side face** and click **Sketch**  on the context toolbar, **Fig. 5**.

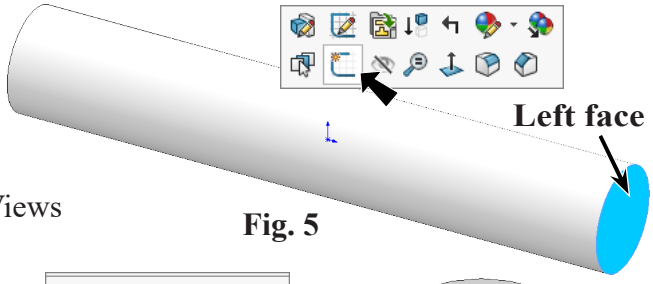


Fig. 5

Step 2. Click **Normal To**  on the Standard Views toolbar. **(Ctrl-8)**

Step 3. Click **Polygon**  on the Sketch toolbar.

Step 4. In the Polygon Property Manager set:
under Parameter, **Fig. 6**
Number of Sides  **6**

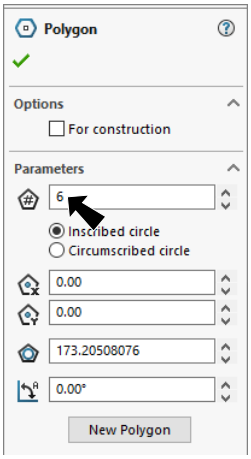


Fig. 6

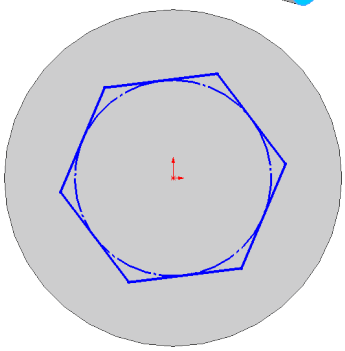


Fig. 7

Step 5. Sketch **polygon** at the Origin  , **Fig. 7**

Step 6. **Right click graphics area and click Select**  from menu to unselect Polygon tool.

Step 7. Click a **polygon segment** and click **Make Horizontal**  on the context toolbar, **Fig. 8**.

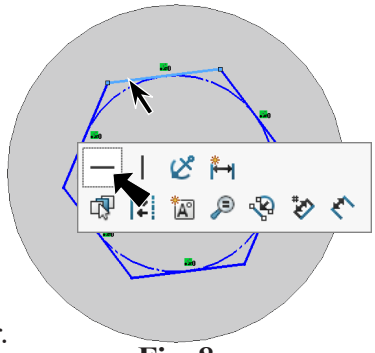


Fig. 8

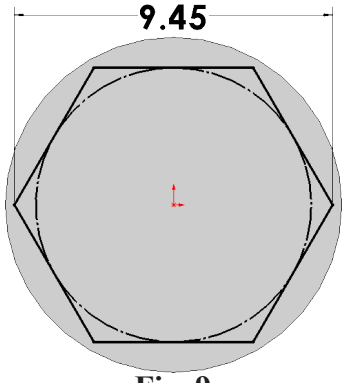


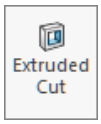
Fig. 9

Step 8. Click **Smart Dimension**  **(S)** on the Sketch toolbar.

Step 9. Dimension **9.45** across corners (not flats), **Fig. 9**.

Step 10. Click **Trimetric**  on the Standard Views toolbar.

Step 11. Click **Features**  on the Command Manager toolbar.

Step 12. Click **Extruded Cut**  on the Features toolbar.

Step 13. In the Cut-Extrude Property Manager set:
under Direction 1, **Fig. 10**
Depth  **6**
check **Flip side to cut**
click OK  .

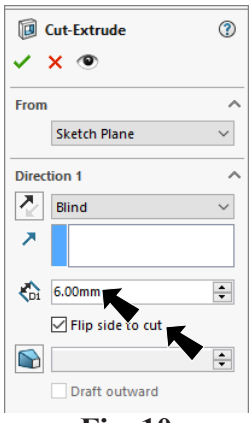


Fig. 10

Step 14. Save  **(Ctrl-S)**.

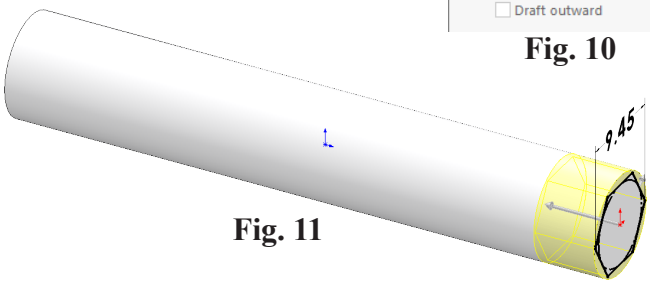


Fig. 11

D. Mirror Holder Features.

Step 1. **Ctrl click Right Plane** and **Cut-Extrude1** feature to select Plane and feature, **Fig. 12**.

Step 2. Click **Mirror** Mirror on the Features toolbar.

Step 3. In the Mirror Property Manager click OK , **Fig. 13**.

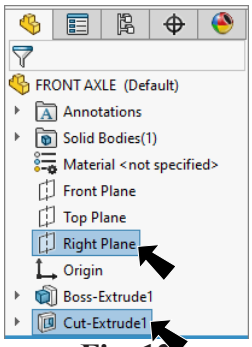


Fig. 12

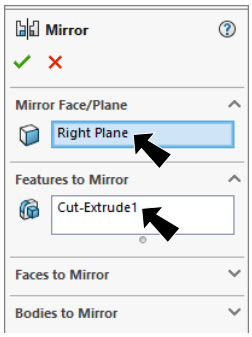


Fig. 13

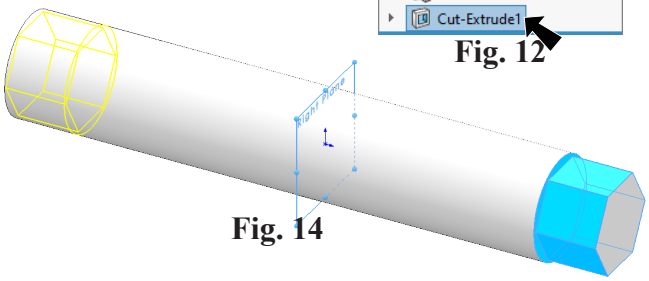


Fig. 14

E. Mate References.

Step 1. Click **Right Plane** in the Feature Manager to select Plane, **Fig. 15**.

Step 1. Click **Reference Geometry** Reference Geometry on the Features toolbar and **Mate Reference** from the menu.

Step 2. In the Mate Reference Manager:

under Primary Reference Entity, **Fig. 16**

Right plane was preselected

Mate Reference Type **Coincident**

under **Secondary** Reference Entity

click in Entity box

and click **cylindrical face of axle**, **Fig. 17**

click OK .

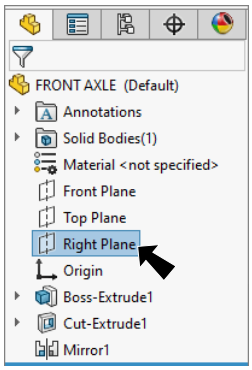


Fig. 15

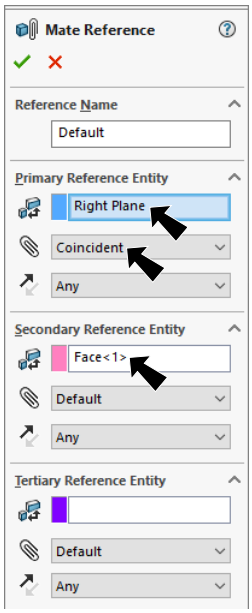


Fig. 16

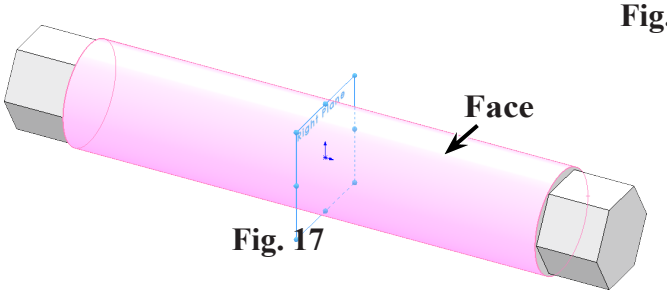


Fig. 17

F. Appearance.

Step 1. Click part, click **Appearance Callout** on the context toolbar and click **FRONT A...**, **Fig. 18**.

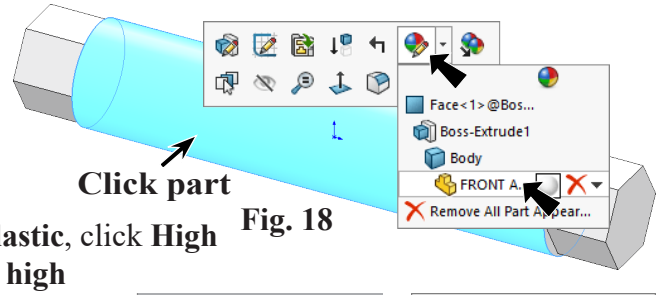


Fig. 18

Step 2. In the Appearances Task pane, expand **Plastic**, click **High Gloss** and in the lower pane select **white high gloss plastic**, **Fig. 19**.

Step 3. In the Appearances Property Manager set:
under Color, **Fig. 20**
set **RGB values**
R 188
G 173
B 217
click OK .

Step 4. Save (**Ctrl-S**).

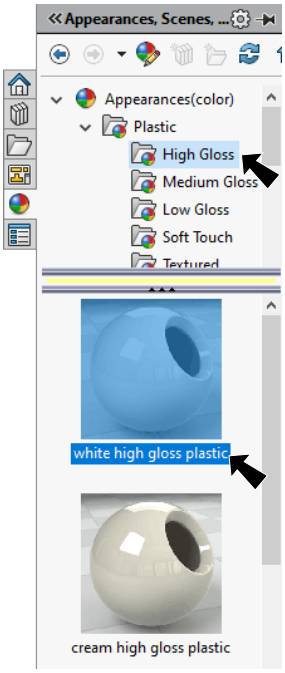


Fig. 19

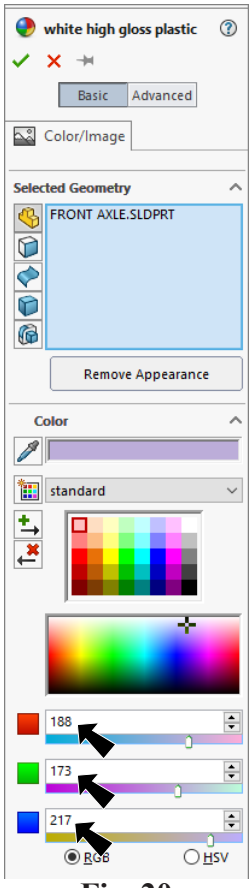


Fig. 20

G. Save As "REAR AXLE".

Step 1. Important to Save. Use **Ctrl-S** to save FRONT AXLE.

Step 2. Click File Menu > Save As.

Step 3. Key-in **REAR AXLE** for the filename and press ENTER.
You now have two axle files, FRONT and REAR. Next, we add hex flats to REAR axle.

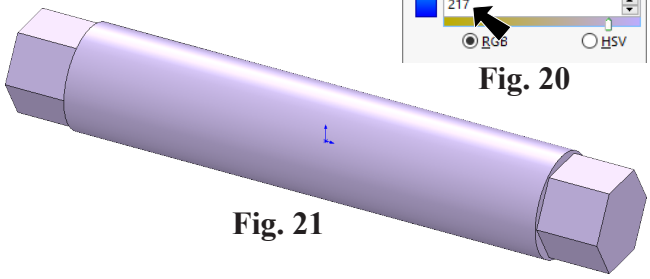


Fig. 21

H. Extrude Hex Flats.

Step 1. Click **Right Plane** in the Feature Manager and click **Sketch** on the context toolbar, **Fig. 22**.

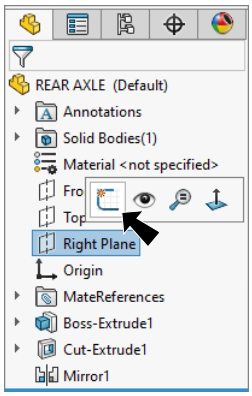


Fig. 22

Step 2. Click **Polygon** on Sketch toolbar.

Step 3. Confirm **6 sides** and sketch **polygon** starting at the Origin, **Fig. 23**.

Step 4. **Right click graphics area and click Select** from menu to unselect Polygon tool.

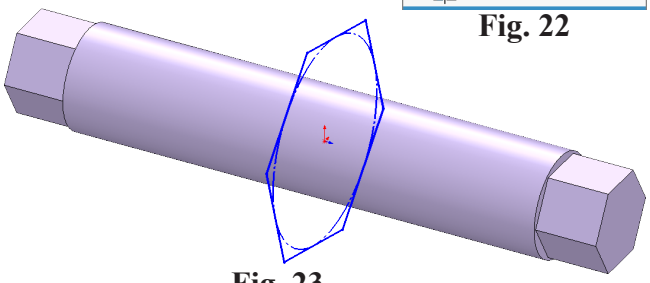


Fig. 23

Step 5. Click a **polygon segment** and click **Make Horizontal** on the context toolbar, **Fig. 24**.

Step 6. Click **Smart Dimension** **(S)** on the Sketch toolbar.

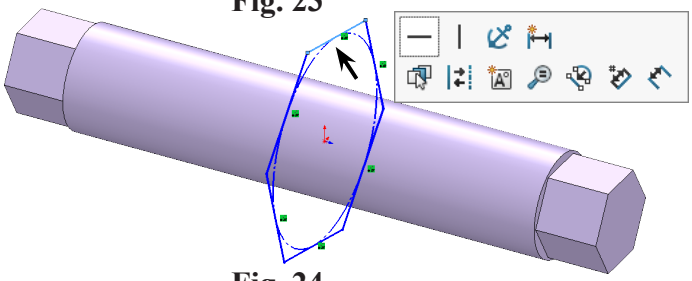


Fig. 24

Step 7. Dimension **12.2 across corners**, **Fig. 25**.

Step 8. Click **Features** on the Command Manager toolbar.

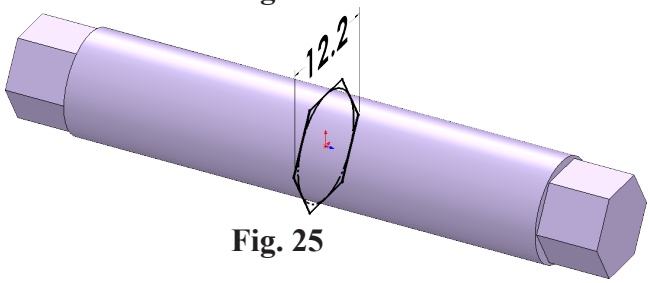


Fig. 25

Step 9. Click **Extruded Boss/Base** on the Features toolbar.

Step 10. In the Property Manager set:
under Direction 1, **Fig. 26**
End Condition **Mid Plane**
Depth **8**
click OK .

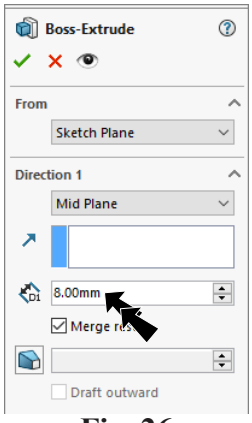


Fig. 26

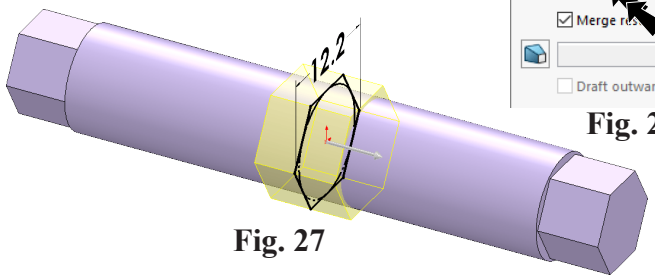


Fig. 27

I. Loft Profile 1 Sketch.

Step 1. Click **vertical face of hex extrude hex** in graphic area and click **Sketch** on the context toolbar, **Fig. 28**.

Step 2. With face still selected click **Convert Entities** 

on the Sketch toolbar, **Fig. 29**.

Step 3. Click **Exit Sketch** 

on the Sketch toolbar.

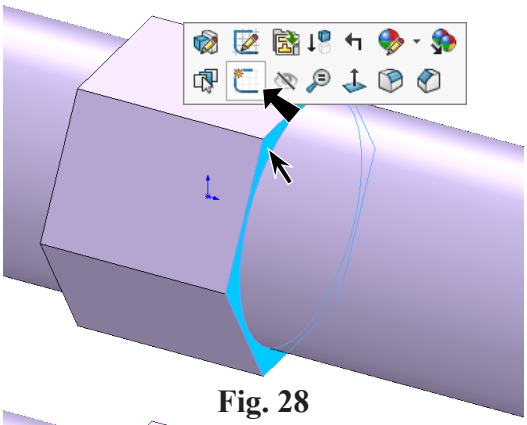


Fig. 28

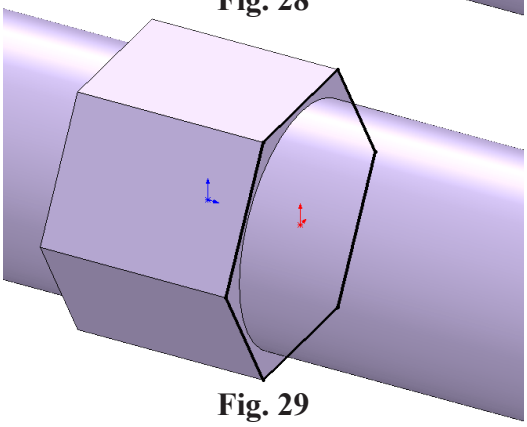
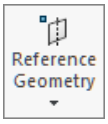


Fig. 29

J. Create Plane 1.

Step 1. Click **Reference Geometry** 

on the Features toolbar and **Plane** from menu.

Step 2. In the Plane Property Manager set:
under First Reference, **Fig. 30**
click **vertical face of hex extrude hex**, **Fig. 31**
Distance **3.5** and press **ENTER**
The new plane should be to **right**
if in wrong direction, check Flip offset
click OK .

Step 3. Save **(Ctrl-S)**.

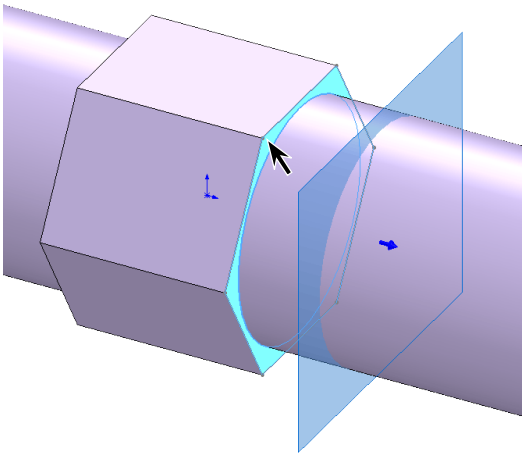


Fig. 31

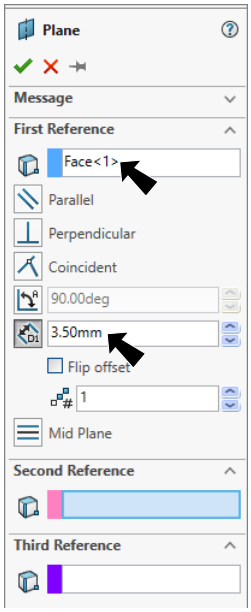


Fig. 30

K. Loft Profile 2 Sketch.

Step 1. Click **Plane1** in the graphics area and click **Sketch** on the context toolbar, **Fig. 32**.

Step 2. Click **Convert Entities** on the Sketch toolbar.

Step 3. In the Convert Entities Property Manager:
under Entities to Convert, **Fig. 33**
click **cylindrical edge**, **Fig. 34**
click OK .

Step 4. Click **Exit Sketch** on the Sketch toolbar.

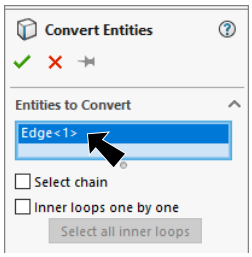


Fig. 33

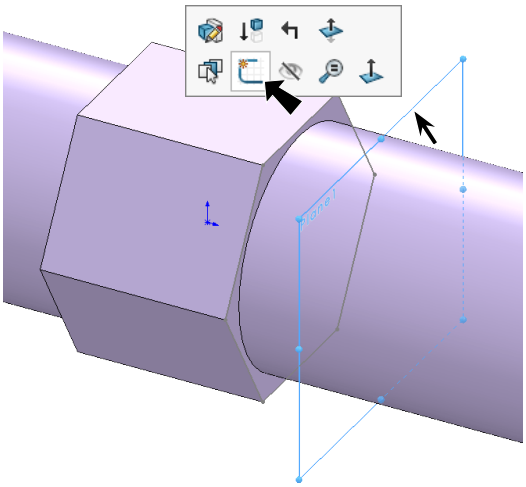


Fig. 32

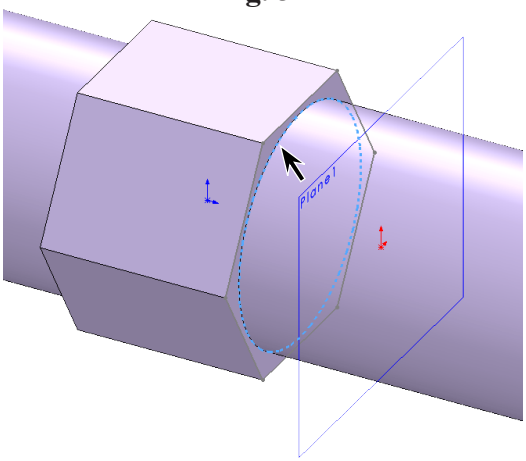


Fig. 34

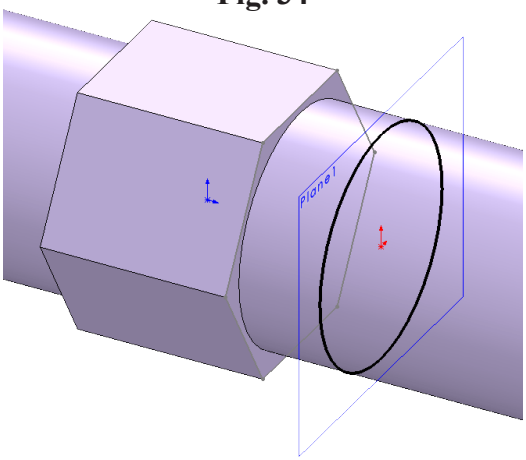


Fig. 35

L. Base Loft.

Step 1. **Hide** Plane. Click View Menu > Show/Hide > Planes, to hide Plane (**Alt-V then H P press ENTER**).

Step 2. Click **Features** Features on the Command Manager toolbar.

Step 3. Click **Lofted Boss/Base** Lofted Boss/Base on the Features toolbar.

Step 4. In the Loft Property Manager set:
under Profiles, **Fig. 36**
click **Sketch4 (**hex) and **Sketch5** (circle), **Fig. 37**
expand Start/End Constraints
End constraint **Normal To Profile**
click OK ✔ .

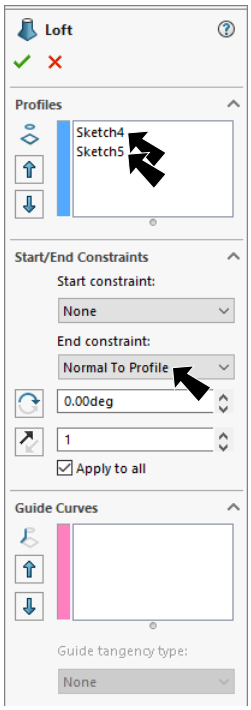


Fig. 36

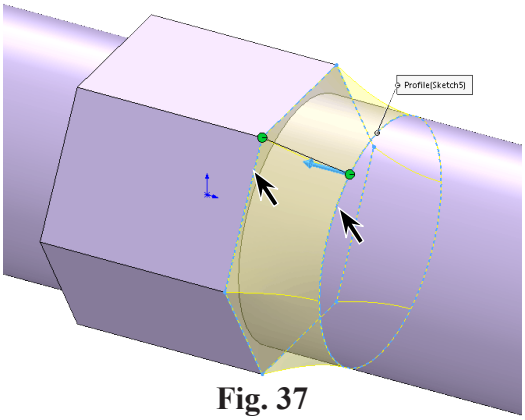


Fig. 37

M. Mirror Holder Features.

Step 1. **Ctrl click Right Plane** and **Loft1** feature to select both, **Fig. 38**.

Step 2. Click **Mirror** Mirror on the Features toolbar.

Step 3. In the Mirror Property Manager click OK ✔ , **Fig. 39**.

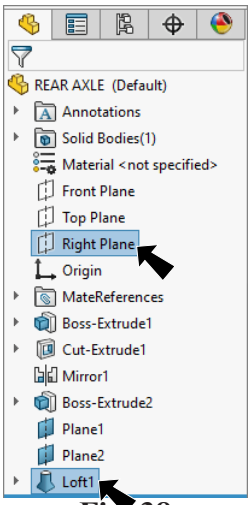


Fig. 38

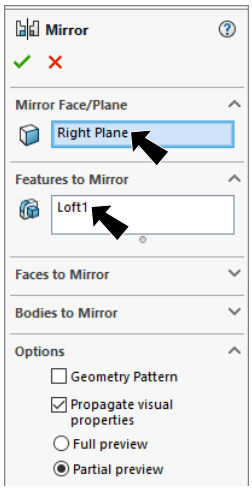


Fig. 39

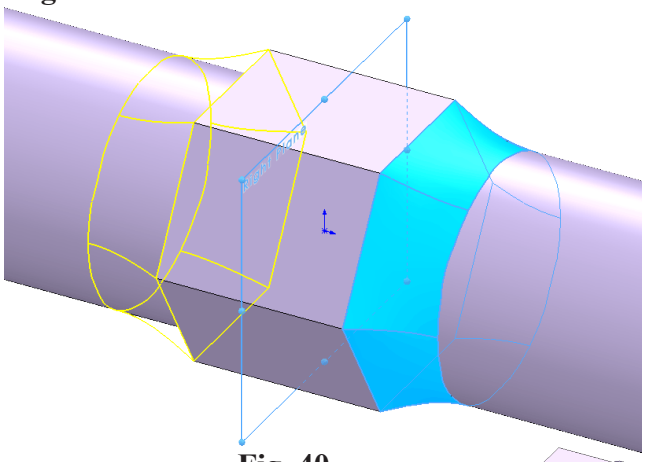


Fig. 40

Step 4. Save (**Ctrl-S**).

You should have 2 axles:
FRONT
REAR

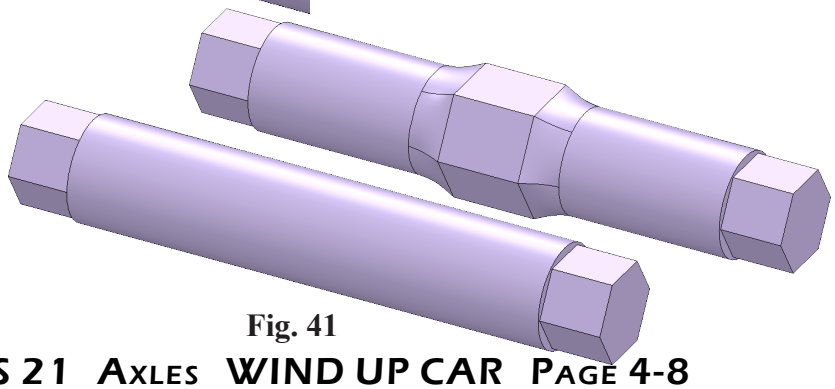


Fig. 41