

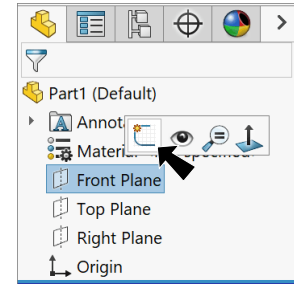


**A. Extrude1.**

Step 1. Click **New**  on the Standard toolbar, click **Part Metric**  and OK.

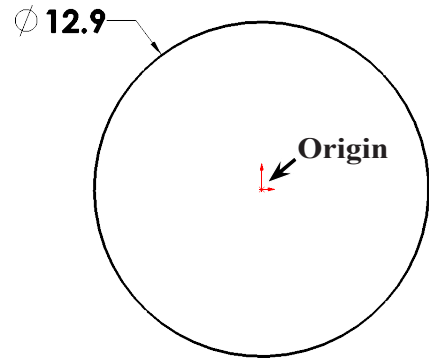
Step 2. Click **Front Plane**  in the Feature Manager and click **Sketch**  on the context toolbar, **Fig. 1**.



**Fig. 1**

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

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



**Fig. 2**

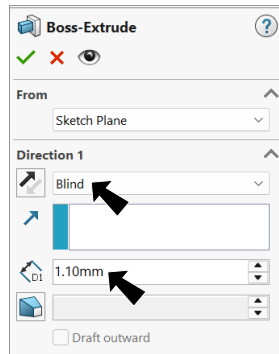
Step 5. Click **Smart Dimension**  (S) on the Sketch toolbar.

Step 6. Dimension **diameter 12.9**, **Fig. 2**.

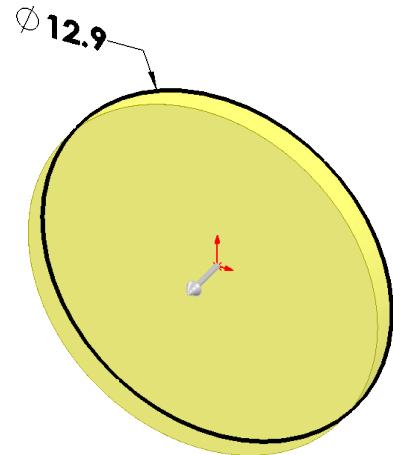
Step 7. Click **Features**  on the Command Manager toolbar.

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

Step 9. In the Property Manager set:  
 under Direction 1, **Fig. 3**  
 End Condition **Blind**  
**Depth**  **1.1**  
 click OK .



**Fig. 3**




**Fig. 4**

**B. Save as "BEVEL GEAR".**

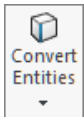
Step 1. Click File Menu > Save As.

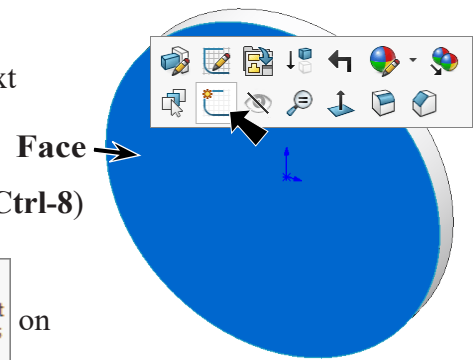
Step 2. Key-in **BEVEL GEAR** for the filename and press ENTER.

### C. Extrude2 Tooth.


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


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

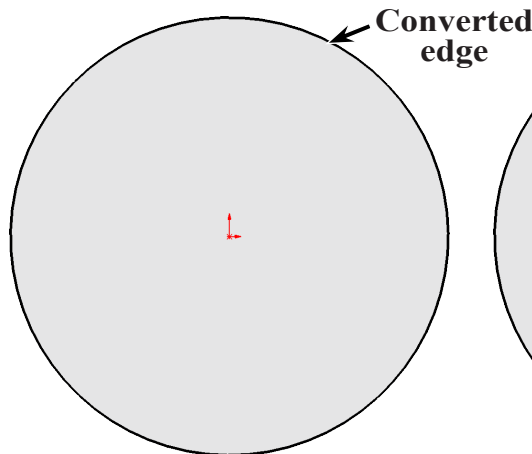
Step 3. With the face still selected, click **Convert Entities**  on the Sketch toolbar, **Fig. 6**.



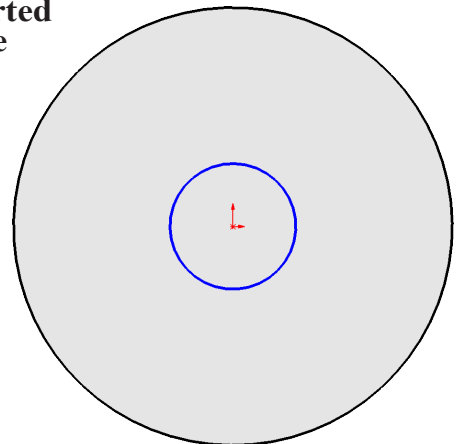
**Fig. 5**

Step 4. Click **Circle**  (**S**) on the Sketch toolbar.



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




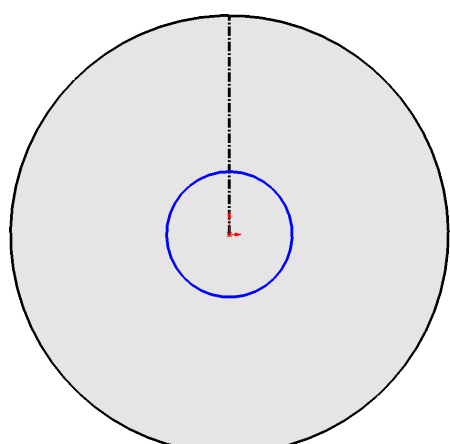
**Fig. 6**



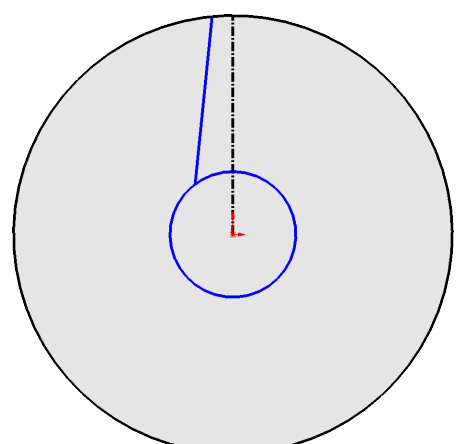
**Fig. 7**

Step 6. Click **Centerline**  in the **Line** flyout  on the Sketch toolbar.


Step 7. Sketch a **vertical centerline from the Origin**  **up to circular edge**, **Fig. 8**.



**Fig. 8**



**Fig. 9**

Step 8. Click **Line**  (**L**) on the Sketch toolbar.

Step 9. Sketch **line at angle from converted circular edge down to circle**, **Fig. 9**.

Step 10. **Unselect Line tool**. To unselect, right click graphics area and click **Select**  from menu.

Step 11. **Ctrl drag a selection to left to select spoke geometry, Fig. 10.**

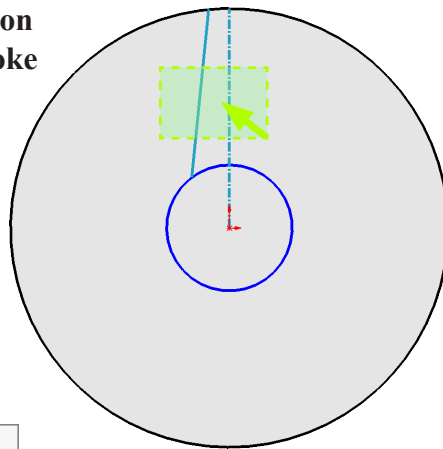
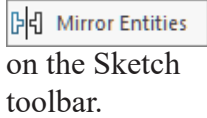


Fig. 10

Step 12. Click **Mirror Entities**



on the Sketch toolbar.

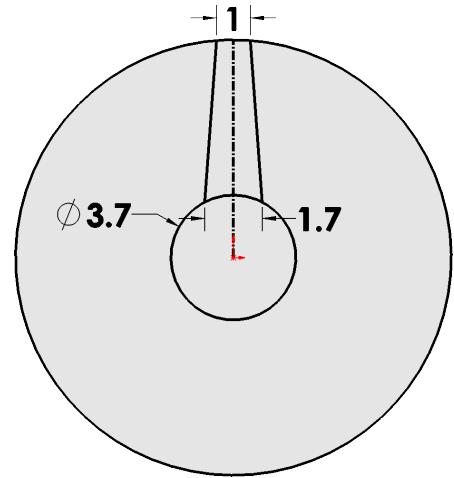


Fig. 11


Step 13. Click **Smart**



**Dimension** (S) on the Sketch toolbar.

(S) on the Sketch toolbar.

Step 14. Add dimensions, **Fig. 11.**

Step 15. Click **Isometric**  on the Standard Views toolbar. (**Ctrl-7**)

Step 16. Click **Features**  on the Command Manager toolbar.

Step 17. Click **Extruded Boss/Base**  on the Features toolbar.

Step 18. In the Boss-Extrude Property Manager set:

under Direction 1, **Fig. 12**

End Condition **Blind**

**Depth**  **3**

under Selected Contours

click the **two contours**, **Fig. 13**

click **OK** .

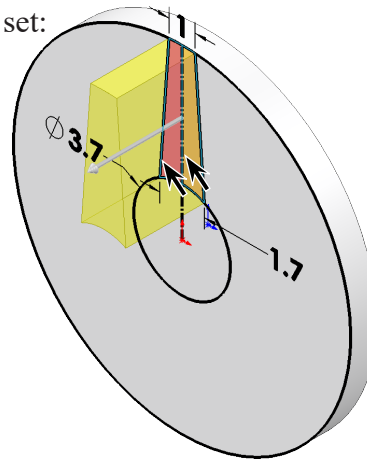


Fig. 13

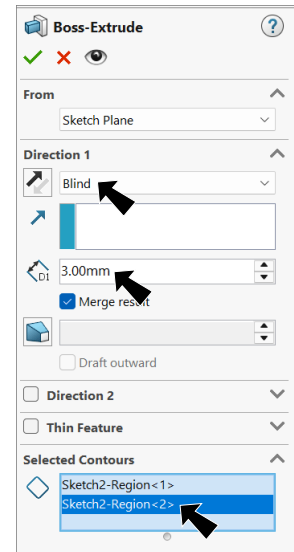
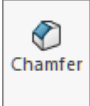


Fig. 12

## D. Chamfer.

Step 1. Click **Chamfer**  on the Features toolbar.

Step 2. In the Chamfer Property Manager set:  
under Chamfer Type, **Fig. 14**

select **Angle Distance** 

click **top outside edge**, **Fig. 15**

under Chamfer Parameters

**Distance**  .8

**Angle**  45°

click OK .

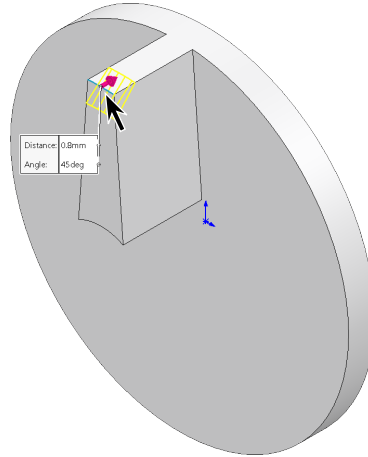


Fig. 15

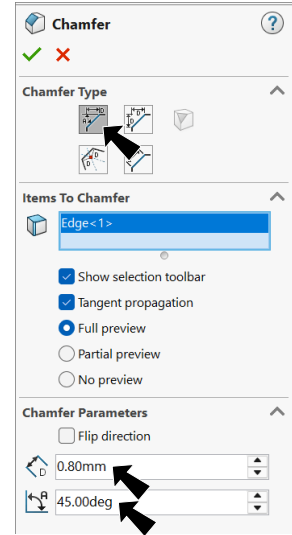
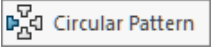



Fig. 14

Step 3. Save  (Ctrl-S).

## E. Circular Pattern.

Step 1. Click **Circular Pattern**  in the **Linear Pattern** flyout  on the Features toolbar.

Step 2. In the Circular Pattern Property Manager set:  
under Features and Faces, **Fig. 16**

click **Boss-Extrude2** and **Chamfer** in graphics area, **Fig. 17**

under Direction 1

click in Pattern Axis  box

click a **cylindrical face**

select **Equal spacing**

**Number of Instances**  12

click OK .

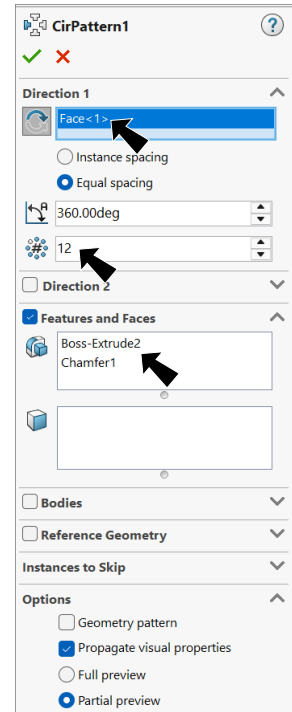


Fig. 16

Step 3. Save  (Ctrl-S).

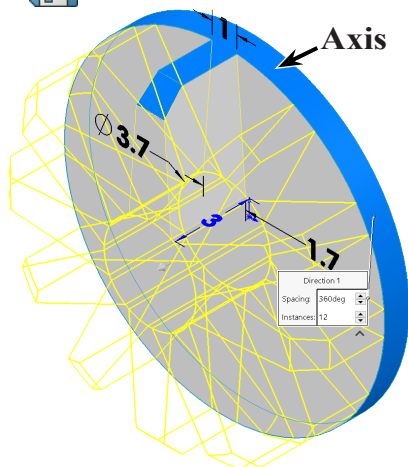


Fig. 17

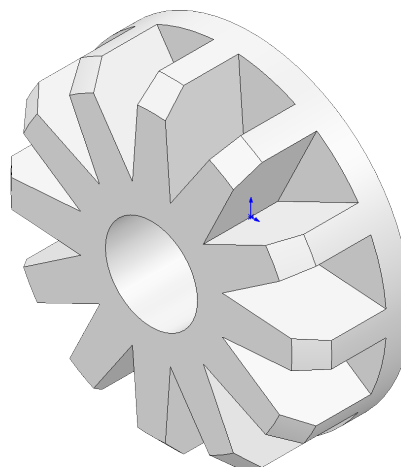


Fig. 18

## F. Extrude3 Hub.

Step 1. Click the **front face of Extrude1** and click **Sketch** on the context toolbar, **Fig. 19**.



Step 2. Click **Circle**  (S) on the Sketch toolbar.


Step 3. Sketch **circle at the Origin** , **Fig. 20**.

Step 4. Click **Smart Dimension**  (S) on the Sketch toolbar.

Step 5. Dimension **diameter 7.4**, **Fig. 20**.

Step 6. Click **Features**  on the Command Manager toolbar.

Step 7. Click **Extruded Boss/Base**  on the Features toolbar.

Step 8. In the Boss-Extrude Property Manager set:  
 under Direction 1, **Fig. 21**  
 End Condition **Through All**  
 click OK .

Step 9. Save  (Ctrl-S).

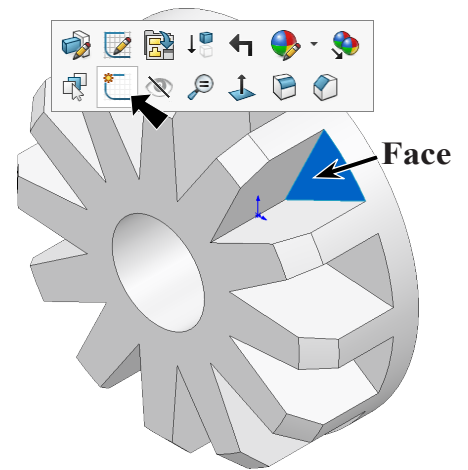


Fig. 19

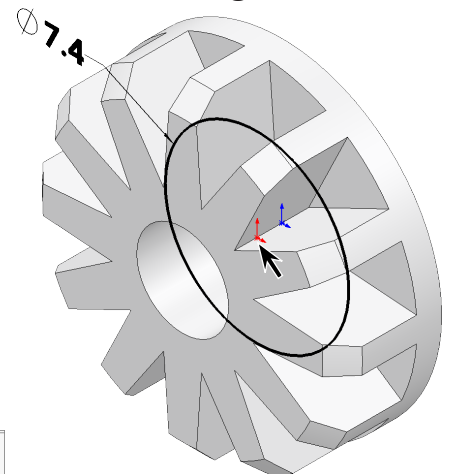


Fig. 20

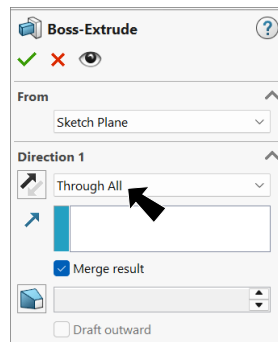


Fig. 21

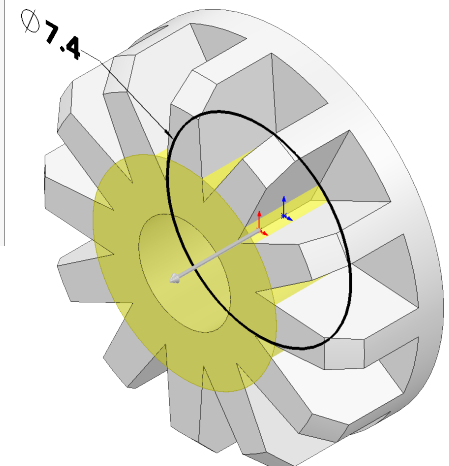


Fig. 22

## G. Insert LEGO AXLE Block and Cut.

Step 1. Click the **front face of Extrude2** and click **Sketch** on the context toolbar, **Fig. 23**.

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

Step 3. Click Tools Menu > Blocks > Insert.

Step 4. In Insert Block Property Manager, click **Browse**, **Fig. 24** in the Open dialog box, navigate to: **Documents\Tech Ed 25-26\ESCar** and open **LEGO AXLE BLOCK** file, **Fig. 25** under Parameters

**Block Scale** 1  
**Block Rotation** 0°

click **Origin**, **Fig. 26**  
 click **OK**.

Step 5. Edit Block, **Fig. 27**. To edit block, **right click the block** and click **Edit Block**.

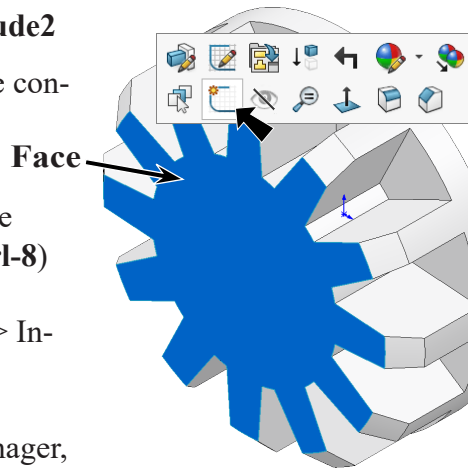


Fig. 23

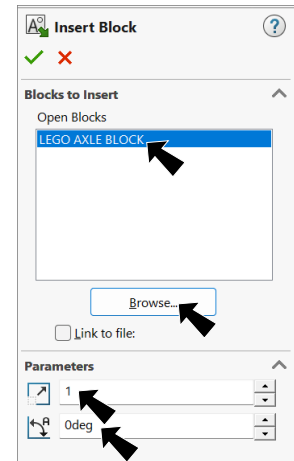


Fig. 24

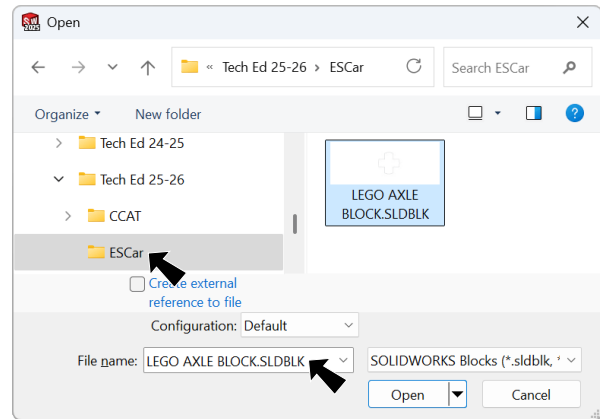


Fig. 25

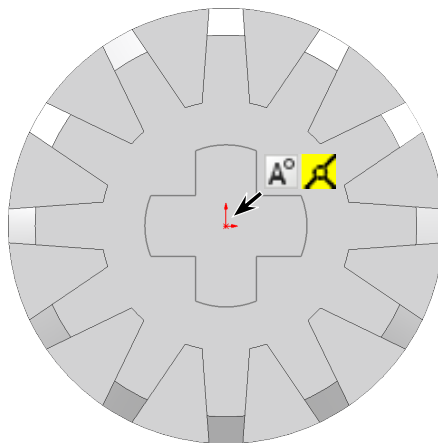


Fig. 26

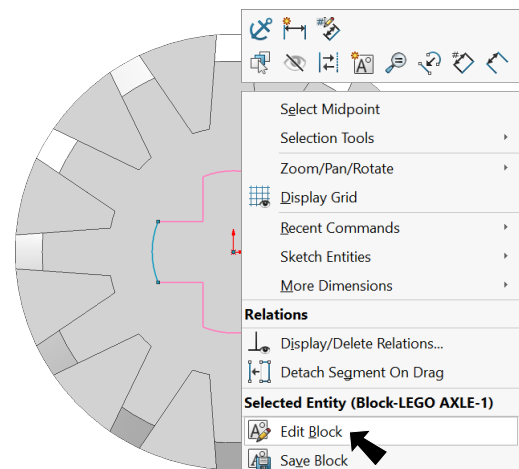


Fig. 27

Step 6. Click **Offset Entities**  on the Sketch toolbar.

Step 7. In the Offset Entities Property Manager set:  
under Parameters, **Fig. 28**

**Distance**  **.05 (clearance for Lego Axle hole)**

uncheck **Reverse**

check **Select chain**

uncheck **Bi-directional**

under Construction geometry

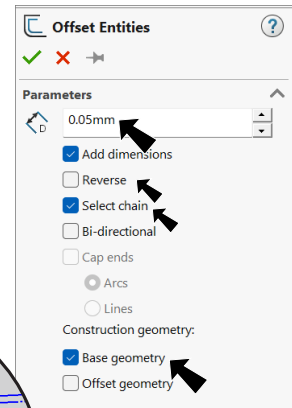
check **Base geometry**

click an entity, **Fig. 29**

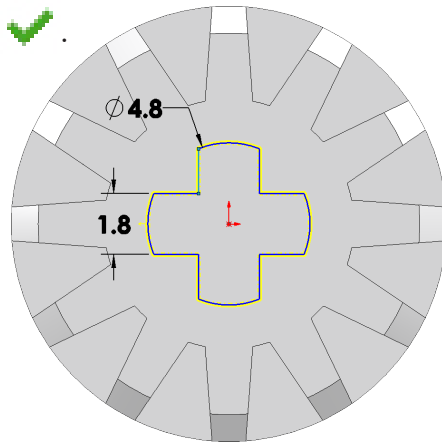
**yellow offset circle on outside -**

**base geometry (construction) on inside**

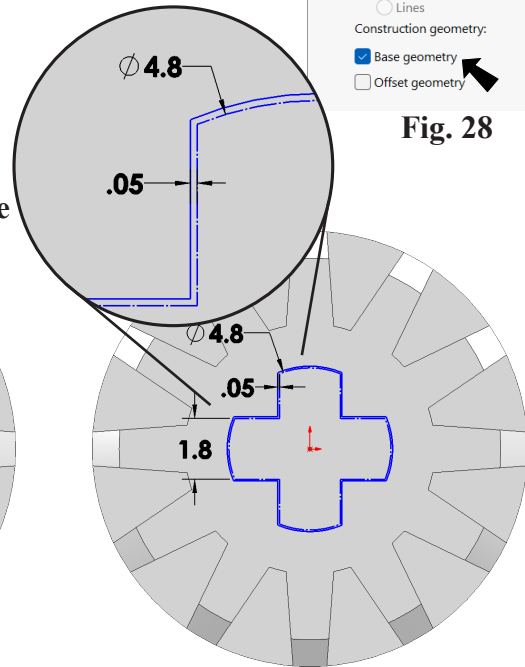
click OK .



**Fig. 28**



**Fig. 29**



**Fig. 30**

Step 8. Exit **Block**. To Exit, click **Block Confirmation**  in top right corner of graphics area.

Step 9. Click **Isometric**  on the Standard Views toolbar. (**Ctrl-7**)

Step 10. Click **Features**  on the Command Manager toolbar.

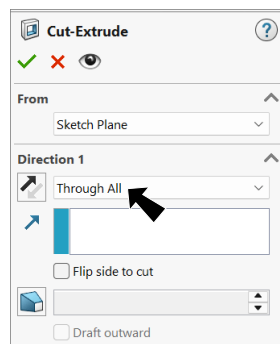
Step 11. Click **Extruded Cut**  on the Features toolbar.

Step 12. In the Cut-Extrude Property Manager set:

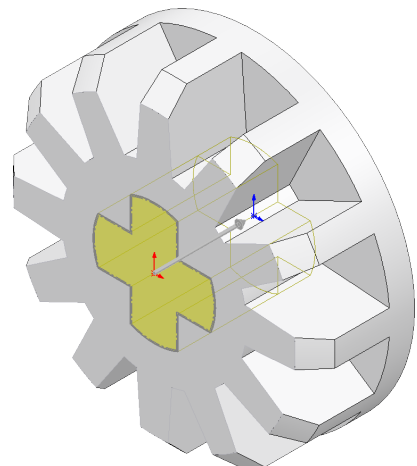
under Direction 1, **Fig. 31**

End Condition **Through All**

click OK .



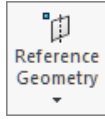
**Fig. 31**



**Fig. 32**

## H. Mate Reference.

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



Step 2. In the Mate Reference Manager set: under **Primary Reference Entity** click **cylindrical face**, Fig. 34 click OK ✓.

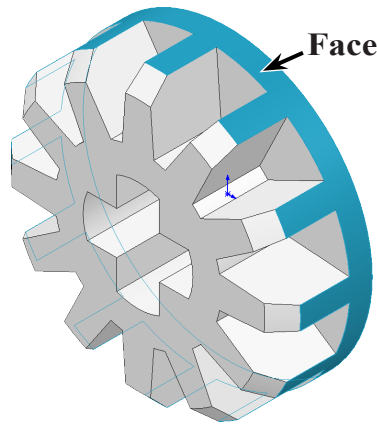


Fig. 34

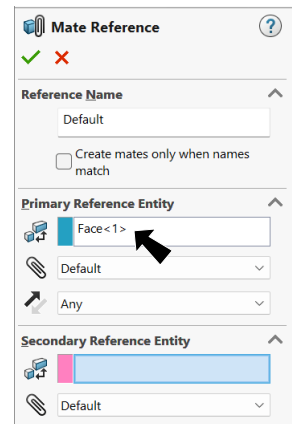


Fig. 33

## I. Material: Brown (Husk).

Step 1. Click part, click **Appearance Callout** on the context toolbar and click **BEVEL GEAR**, Fig. 35.



Step 2. In the Appearances Task pane, expand **Plastic**, click **Medium Gloss** and in the lower pane select **blue medium gloss plastic**, Fig. 36.

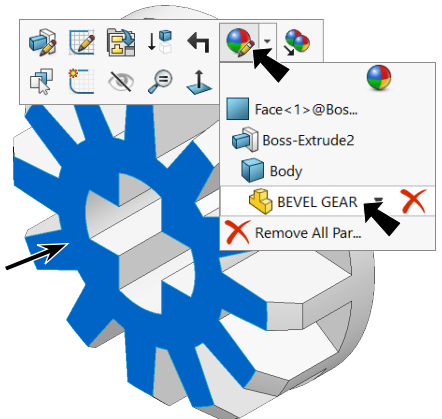


Fig. 35

Step 3. In the Appearances Property Manager set: under **Color**, Fig. 37 set **RGB values**  
**R 144**  
**G 172**  
**B 223**  
 click OK ✓.

Step 4. Save (Ctrl-S).

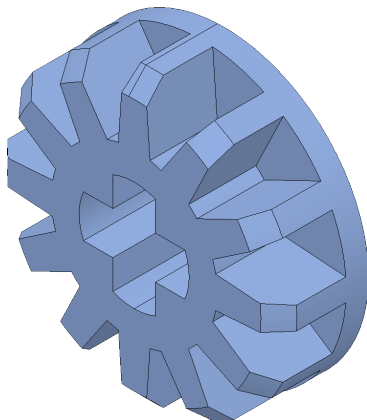


Fig. 38

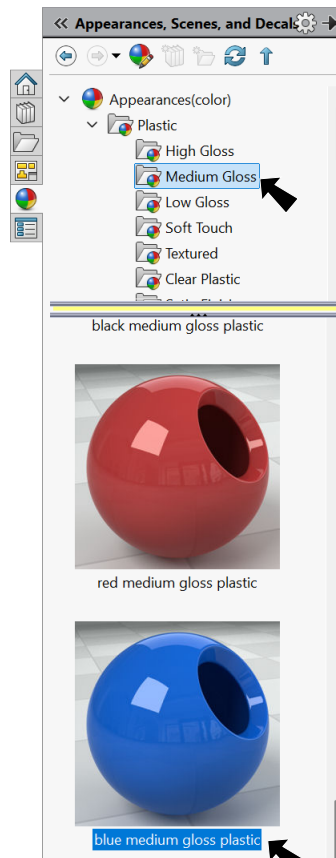


Fig. 36

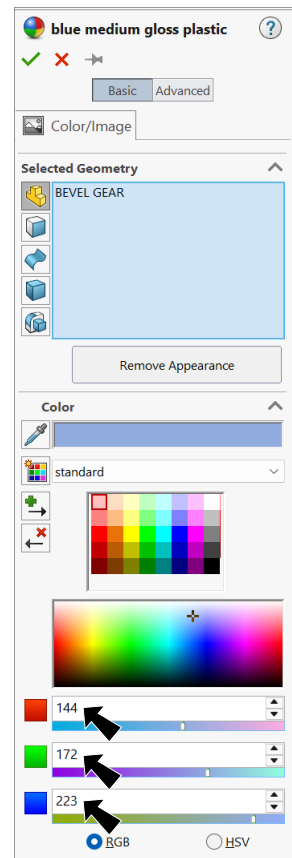


Fig. 37