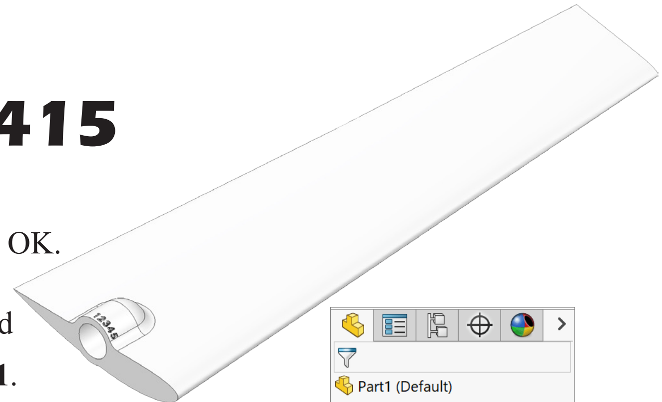
# HAWT
# Blade 4415



## A. Revolve.

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

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

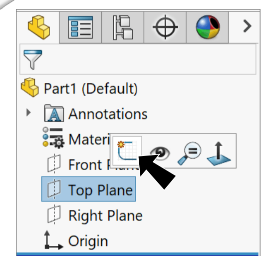


**Fig. 1**

Step 3. Click **Line** (**L**) on the Sketch toolbar.

Step 4. Starting from the Origin sketch 3 lines and tangent arc. Autotransition to Tangent Arc tool and sketch arc, **Fig. 2**. To autotransition to arc, after sketching endpoint of line, move cursor away and back. The preview shows a tangent arc. Click to place the arc. Autotransition back to Line tool and sketch vertical down
**Tip:** Toggle between line and arc without returning to the endpoint, use **A** key.

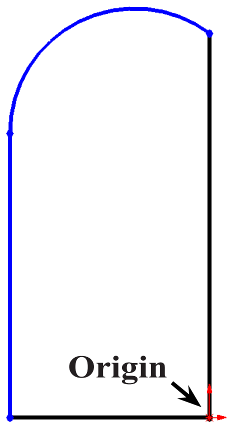


**Fig. 2**

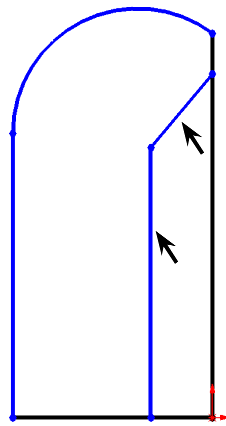


**Fig. 3**

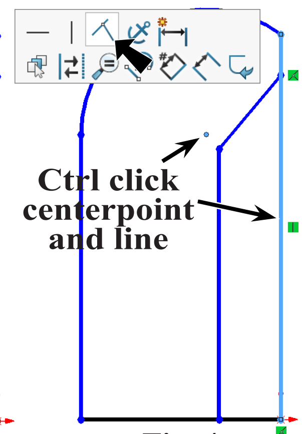


**Fig. 4**

Step 5. Sketch **2 lines**, **Fig. 3**.

Step 6. **Unselect Line tool**. To unselect, **right click graphics area and click Select** from menu.

Step 7. **Ctrl click centerpoint of arc** and **vertical centerline** to select both. Release Ctrl key and click **Make Coincident** on the context toolbar, **Fig. 4**. To wake up center-point, hover cursor over arc.

Step 8. **Ctrl click bottom endpoint of arc** and **bottom endpoint of angled line** to select both. Release Ctrl key and click **Make Horizontal** on the context toolbar, **Fig. 5.**

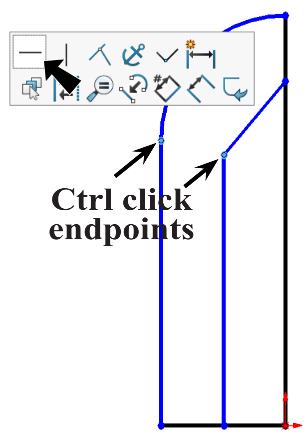


**Fig. 5**

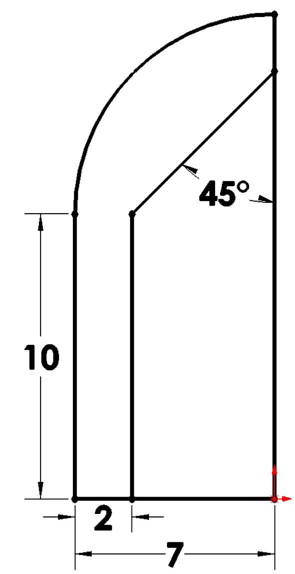


**Fig. 6**

Step 9. Click **Smart Dimension** (**S**) on the Sketch toolbar.

Step 10. Add dimensions, **Fig. 6**.

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

Step 12. Click **Revolved Boss/Base** Revolved Boss/Base on the Features toolbar.

Step 13. In the Revolve Property Manger set:

under Axis of Revolution
click **vertical line at Origin**, **Fig. 7**
uncheck **Thin Feature**
under Selected Contours
click the **contour**, **Fig. 8**
click OK .

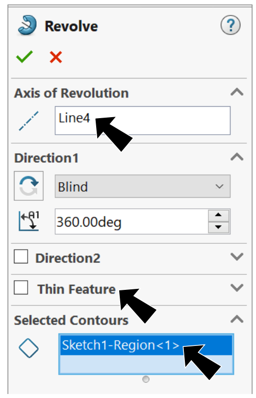



**Fig. 7**

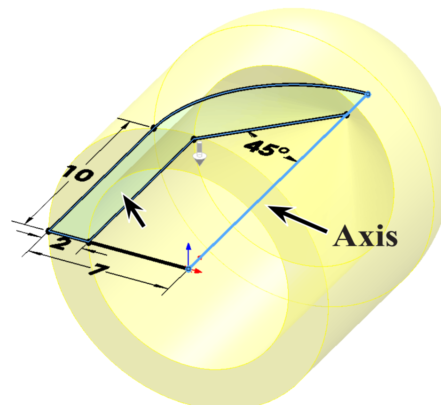



**Fig. 8**

## B. Save as "BLADE 4415".

Step 1. Click File Menu > Save As.

Step 2. Key-in **BLADE 4415** for the filename and press ENTER.

## C. Sketch2 for Plane1.

Step 1. Click **Front Plane** in the Feature Manager and click **Sketch** on the context toolbar, **Fig. 9**.

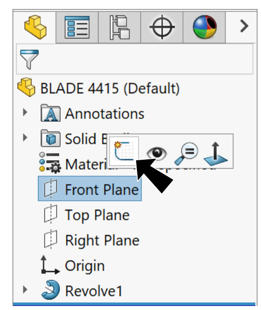



**Fig. 9**

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

Step 3. Click **Line** (**L**) on the Sketch toolbar.

Step 4. Sketch **line at angle from Origin** , **Fig. 10**.

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

Step 6. Add dimensions, **Fig. 11**.
To dimension angle to imaginary line, click line and Origin , then click the **right horizontal crosshair** and place dimension.

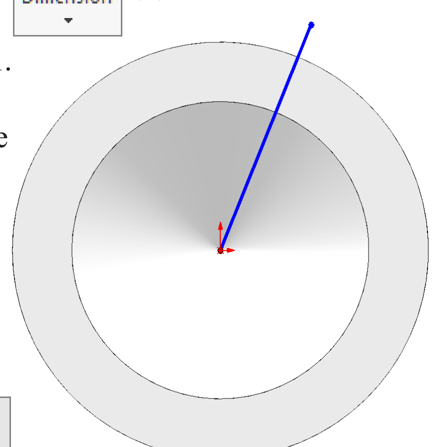


**Fig. 10**

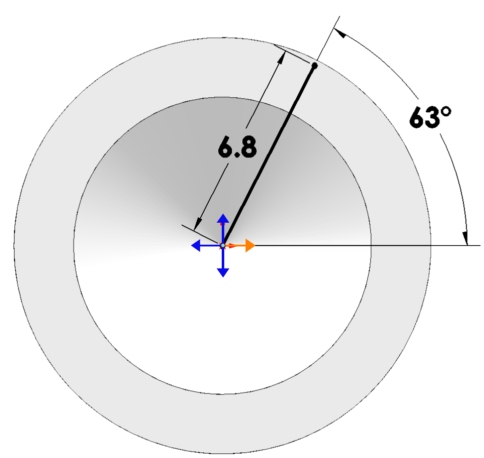



**Fig. 11**

Step 7. Click **Exit Sketch** Exit Sketch on the Sketch toolbar.

# D. Create Plane1.

Step 1. Click **Features** [Features] on the Command Manager toolbar.

Step 2. Click **Plane** [Plane] in the **Reference Geometry flyout** [Reference Geometry] on the Feature toolbar.

Step 3. In the Plane Property Manager set:
- under First Reference, **Fig. 12**
  - click **Line in Sketch2**, **Fig. 13**
- under Second Reference
  - click **top endpoint**

The new plane should be just inside cylindrical face of body.

Click OK ✔.

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

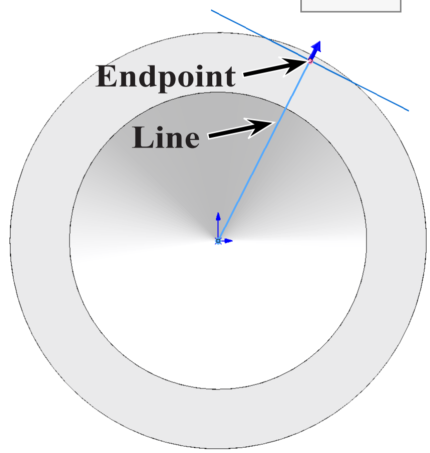



**Fig. 13**

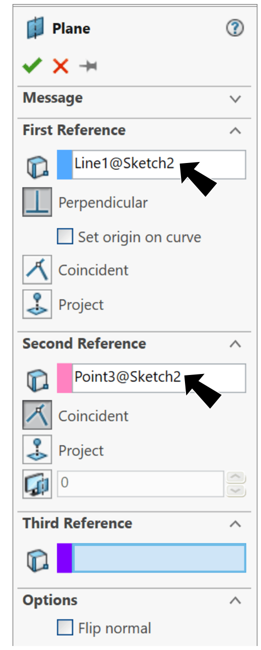



**Fig. 12**

# E. Text.

Step 1. **Hide Sketch2**. To hide, click **Sketch2** in the Feature Manager and **Hide** on the context toolbar, **Fig. 14**.

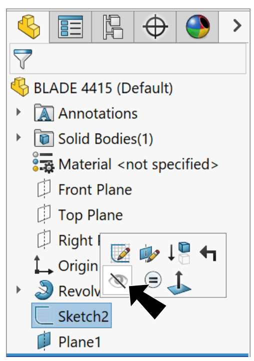



**Fig. 14**

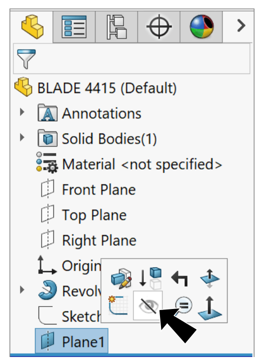



**Fig. 15**

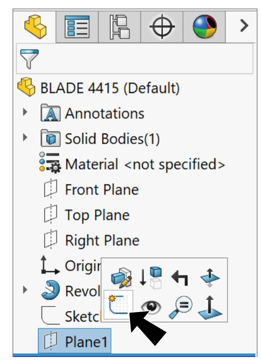



**Fig. 16**

Step 2. **Hide Plane1**. To hide, click **Plane1** in the Feature Manager and **Hide** on the context toolbar, **Fig. 15**.

Step 3. Click **Plane1** in the Feature Manager and click **Sketch** on the context toolbar, **Fig. 16**.

Step 4. Click **Normal To** on the Standard Views toolbar. **(Ctrl-8)**

Step 5. Click **Centerline** in the **Line flyout** on the Sketch toolbar.

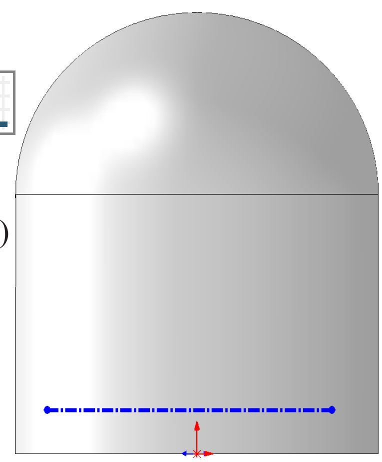


**Fig. 17**

Step 6. Sketch **horizontal centerline above Origin**, **Fig. 17**.

Step 7. **Unselect Centerline tool**. To unselect, **right click graphics area and click Select** from menu.

Step 8. **Ctrl click midpoint** of line and

**Origin** to select both.
Release Ctrl key and click

**Make Vertical** on the context toolbar, **Fig. 18**.

Step 9. Click **Smart Dimension** (S) on Sketch toolbar.

Step 10. Add dimensions, **Fig. 19**.

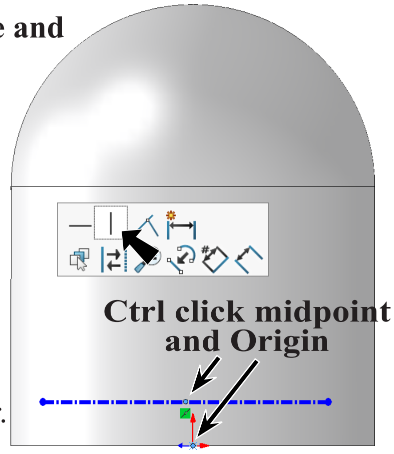


**Fig. 18**

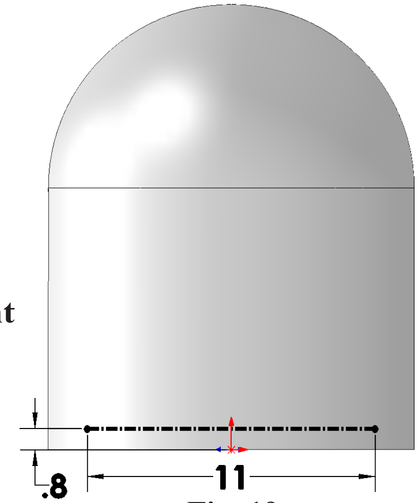


**Fig. 19**

Step 11. Click **Text Tool** on the Sketch toolbar.

Step 12. In the Sketch Text Property Manager set:
under Curves, **Fig. 20**
click **horizontal construction line**, **Fig. 21**
under Text
click in the box and key-in **12345**
**Center Align**
uncheck **Use document font** checkbox
**Spacing** **110**
click **Font** button.

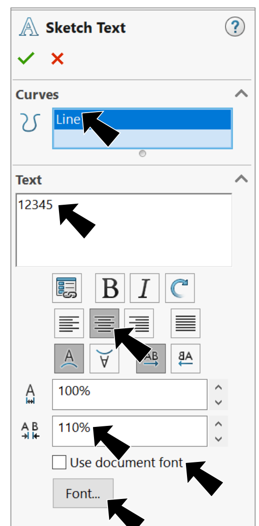


**Fig. 20**

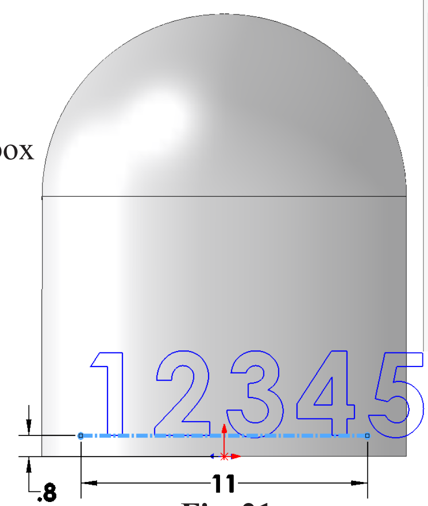


**Fig. 21**

Step 13. In the Choose Font dialog box select:
under Font, **Fig. 22**
select **Century Gothic**
under Font Style
**Bold**
under Height select
**Points Size 8**
click **OK** button
click OK .

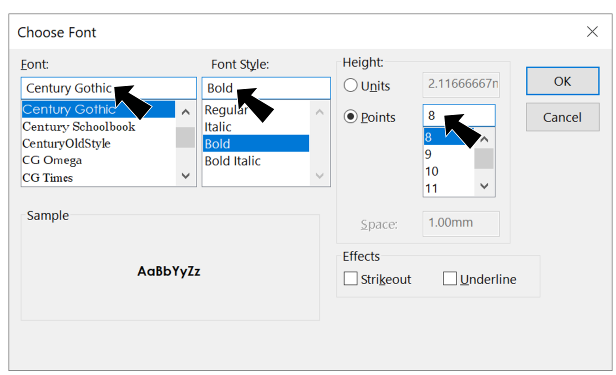


**Fig. 22**

Step 14. Click **Exit Sketch** on the Sketch toolbar.

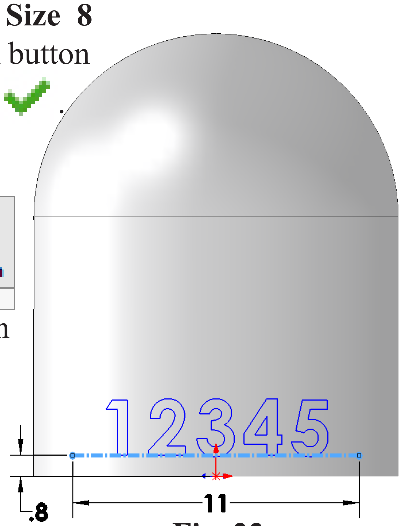


**Fig. 23**

## F. Wrap Text.

Step 1. Click **Isometric** on the Standard Views toolbar. **(Ctrl-7)**

Step 2. Click **Sketch3** in the Feature Manager to select sketch, **Fig. 24**.

Step 3. Click **Features** [Features] on the Command Manager toolbar.

Step 4. Click **Wrap** [Wrap] on the Features toolbar.

Step 5. In the Wrap Property Manager:

under Wrap Type, **Fig. 25**

select **Emboss**

under Wrap Method

select **Analytical**

under Wrap Parameters

Source Sketch

**Sketch3 was preselected**

Face for Wrap Sketch

click **cylindrical face, Fig. 26**

**Depth** T1 **.2**

click OK .

Step 6. Save **(Ctrl-S)**.

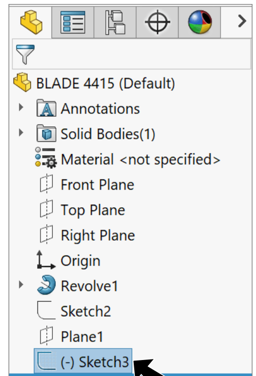



**Fig. 24**

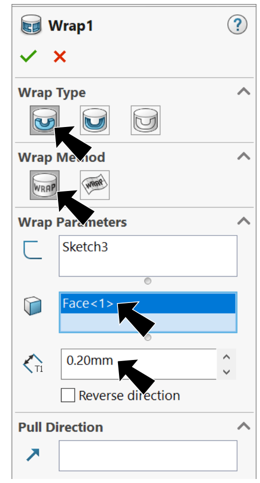



**Fig. 25**

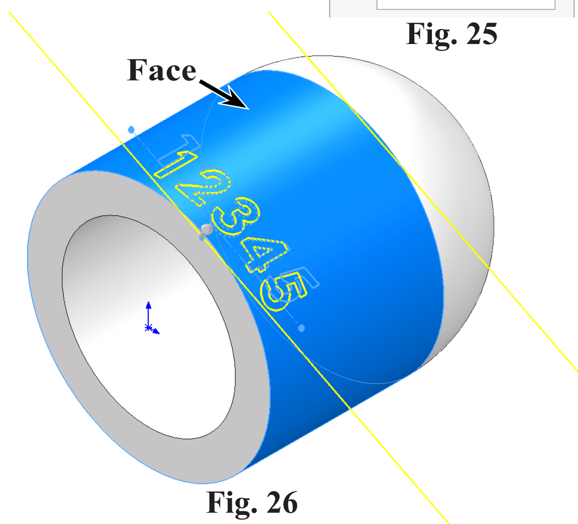



**Fig. 26**

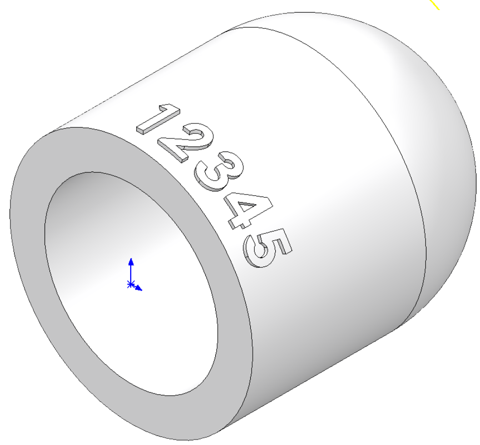



**Fig. 27**

## G. Chamfers.

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

Step 2. In the Chamfer Property Manager set:

under Chamfer Type, **Fig. 28**

select **Angle Distance**

under Chamfer Parameters

**Distance** **.15**

**Angle** **45º**

under Items To Chamfer

**Tip:** Toggle filter Faces with **X key**.

Or use **Filter Faces** on the **Selection Filter toolbar (F5)** at the bottom of the graphics area, **Fig. 29**.

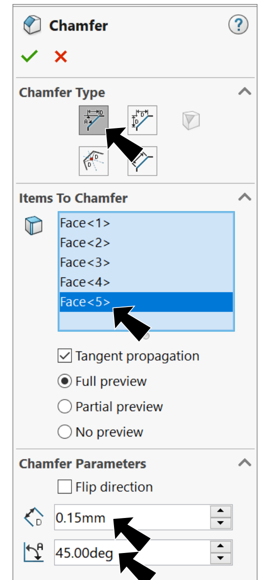



**Fig. 28**

**Fig. 29**

Click **top face of each letter** (5), **Fig. 30**

Click OK .

Toggle filter off when done.

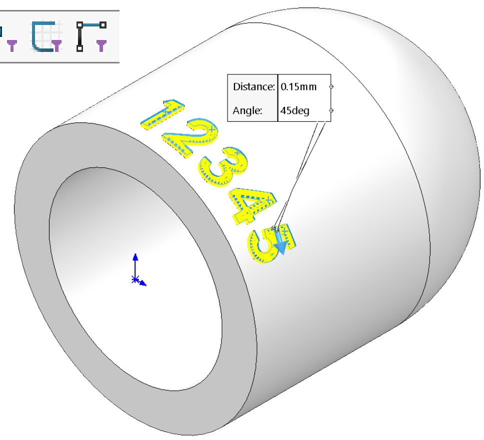



**Fig. 30**

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

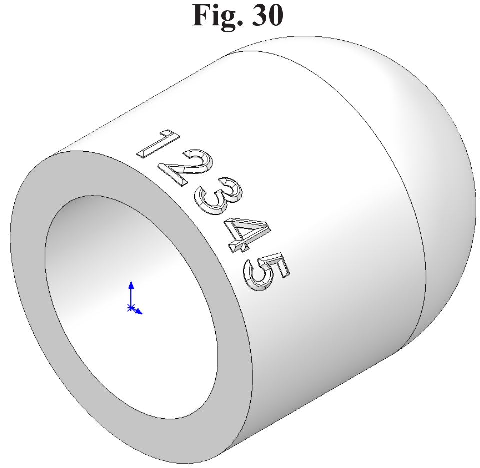


**Fig. 31**

## H. Airfoil 4415 On Web.

Step 1. In your web browser, go to NACA 4415 airfoil at airfoiltools.com.
http://airfoiltools.com/airfoil/details?airfoil=naca4415-il

Step 2. Click **Selig format dat file, Fig. 32**.

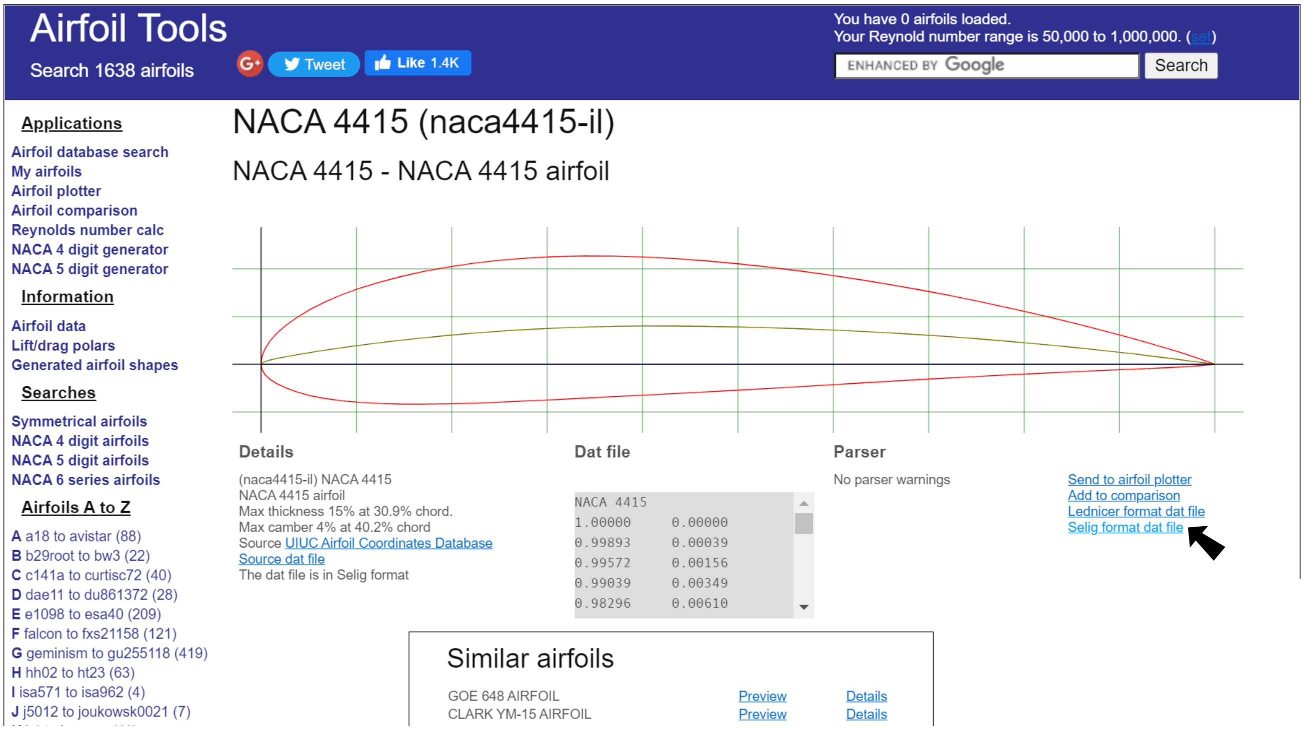



**Fig. 32**

Step 3. In the new browser tab that opens, drag to **select all but the top header line and Copy. (Ctrl-C), Fig. 33**.

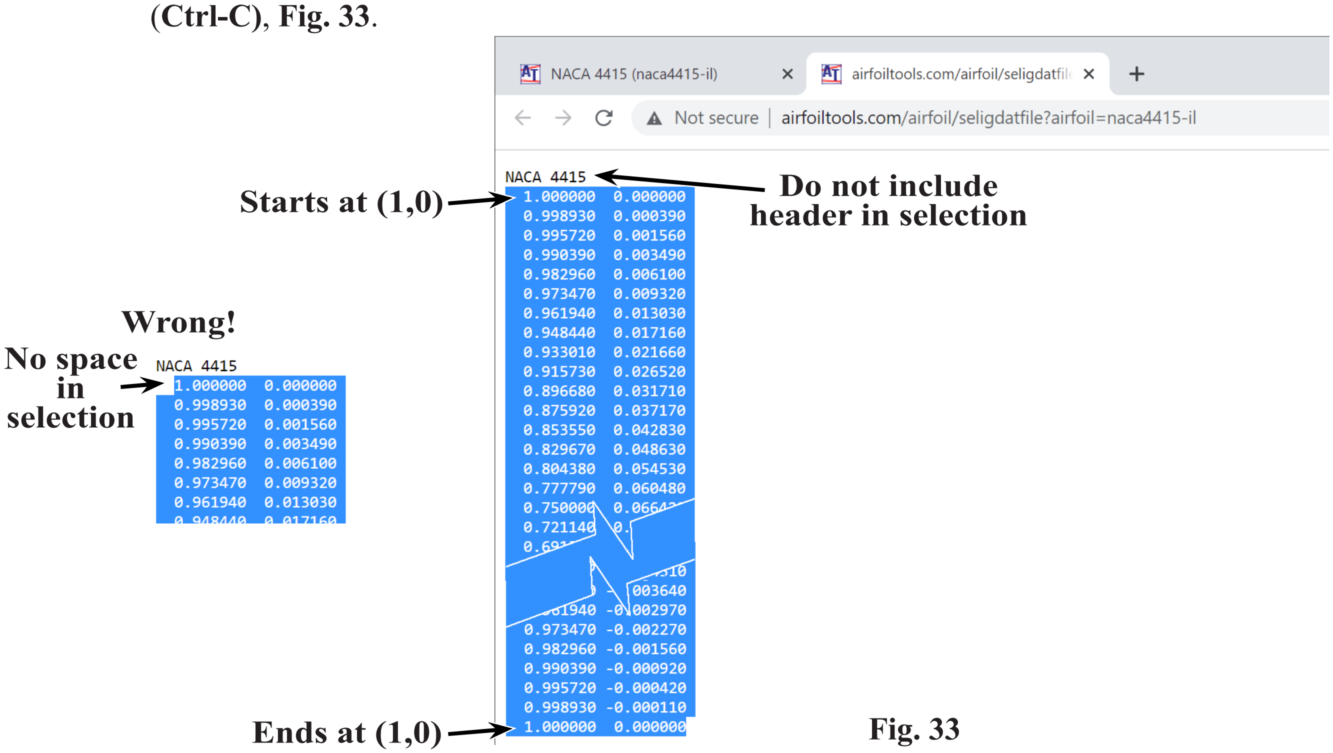
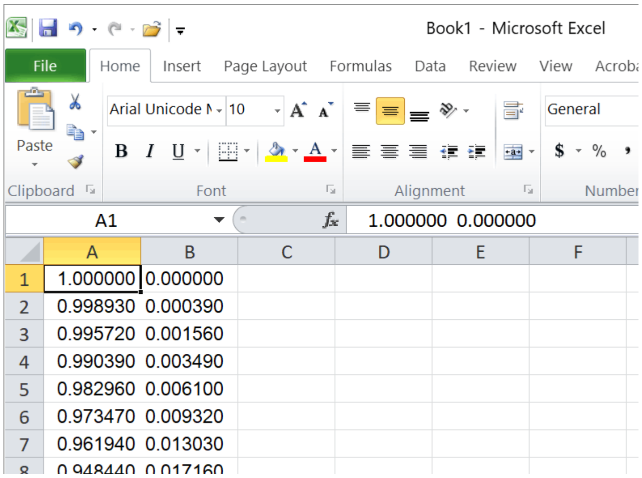



**Fig. 33**

# I. New File in Excel.

Step 1. Open **Excel and paste data into a new Excel file (Ctrl-V), Fig. 34**.

Step 2. You can scroll to bottom and confirm **97 rows, Fig. 35**.



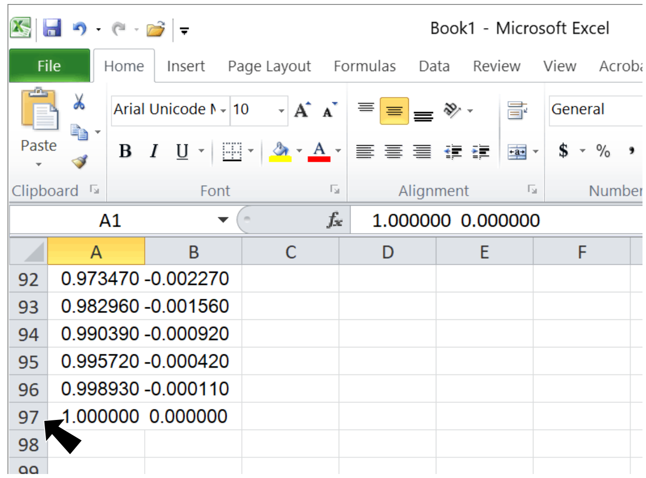
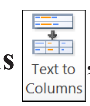




**Fig. 34** **Fig. 35**

Step 3. Scroll back to top and select **first column**, **Fig. 36**. To select column, click **letter A** heading at top of column.

Step 4. On the **Data tab** in the Data Tools group, click **Text to Columns** , **Fig. 36**.



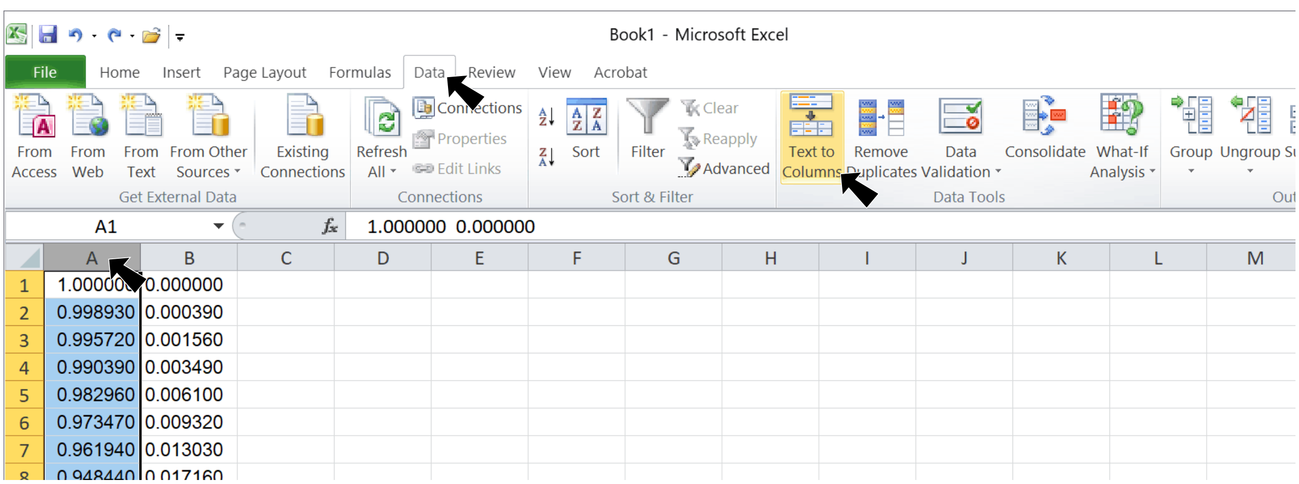



**Fig. 36**

Step 5. In the Convert to Columns Wizard

Step 1 Select **Delimited**
click Next
**Fig. 37**

Step 2 Check **Tab and Space**
click Next
**Fig. 38**

Step 3 Click **Finish**
**Fig. 39**.

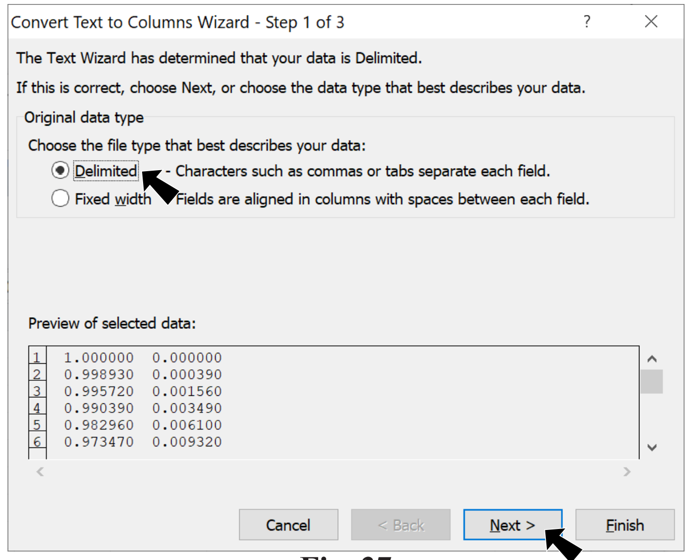



**Fig. 37**

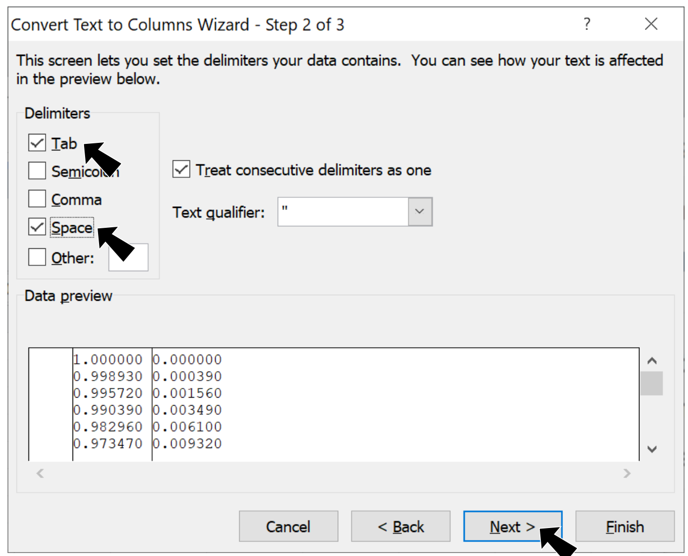



**Fig. 38**

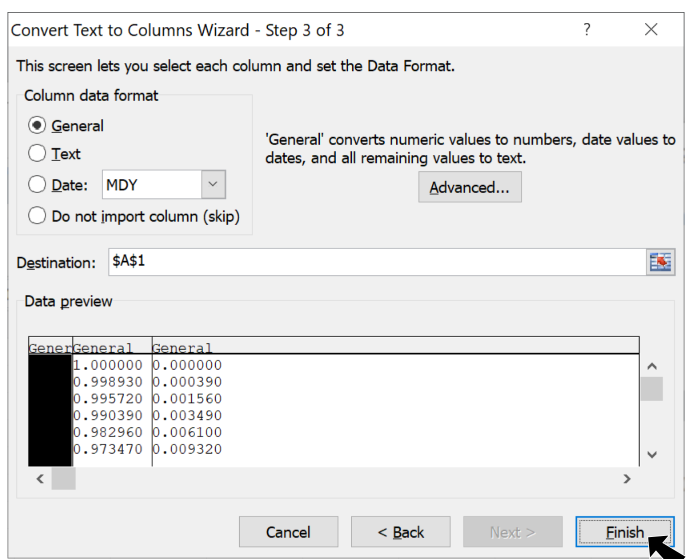



**Fig. 39**

Step 6. **Delete first blank column**, **Fig. 40**. To delete column, click **column A heading**, **Right click** and click **Delete**.

Step 7 . Key-in a **0** (zero) **in column C**, **Fig. 41**.

Step 8. Auto-populate all the way down. To auto-populate, **double click on bottom right corner of cell (plus sign)**, **Fig. 42**.

Step 9. Click File Menu > Save As.

Step 10. In the Save As dialog box, **Fig. 43**.
Key-in **AIRFOIL4415**
**No spaces in filename**
Navigate to **My Documents/Tech Ed 21-22/Wind Turbine** folder
Set Save as type **Text (Tab delimited)**
Click **Save**.

Click **Yes**.

Step 11. **Close the Excel file**, no need to save again.

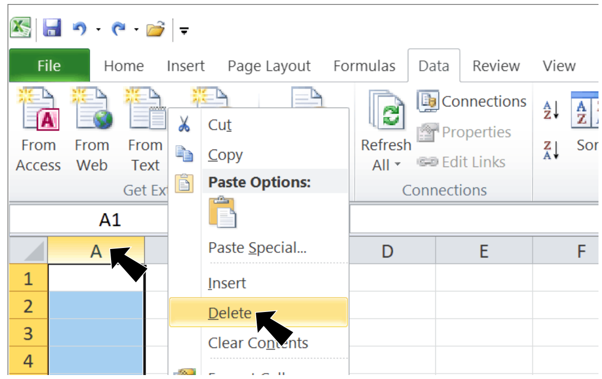



Fig. 40

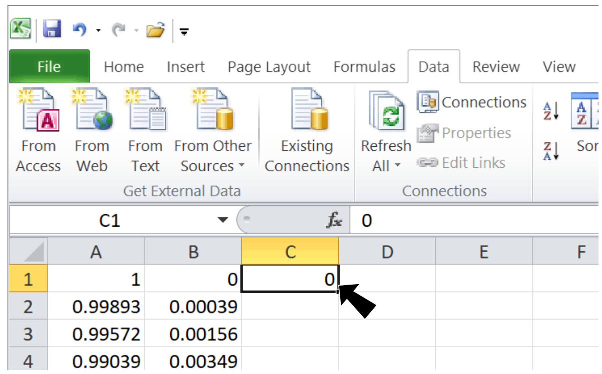



Fig. 41

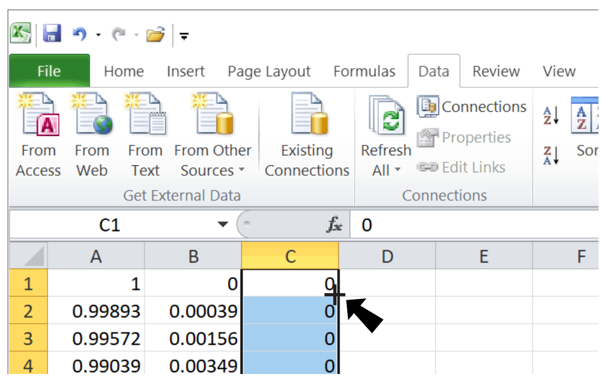



Fig. 42

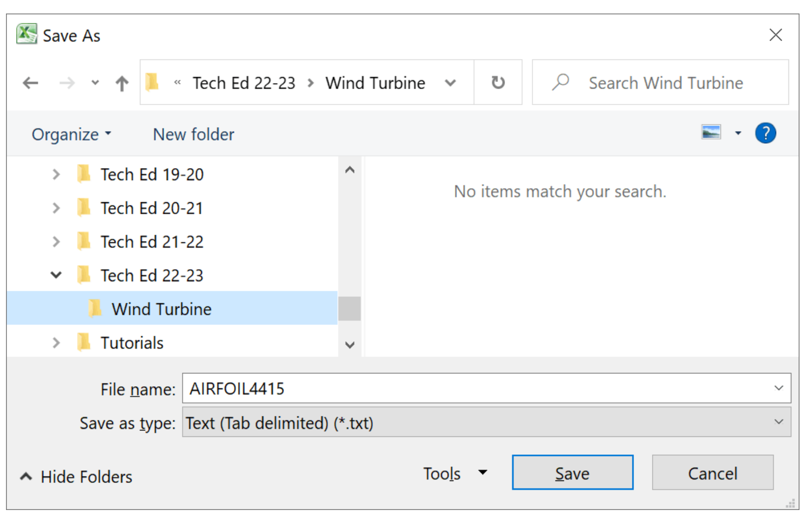



Fig. 43

# J. Back in SOLIDWORKS Import Curve.

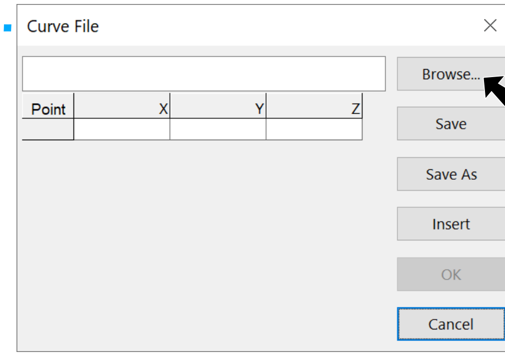



Fig. 44

Step 1. If necessary, open your **Blade part file**.

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

Step 3. Click **Curve Through XYZ Points**

Curve Through XYZ Points in the **Curves flyout** 

on the Features toolbar.

Step 4. In the Curve Point dialog box:

click **Browse button**, **Fig. 44**
**change file type to txt**
select your txt file from Excel, **Fig. 45**
click Open
click OK, **Fig. 46**.

The curve will be very small, you can zoom on the Origin to view, **Fig. 47**.

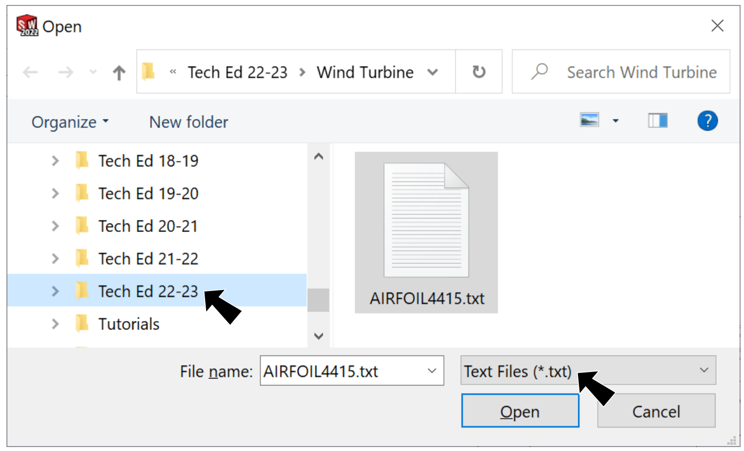



Fig. 45

Step 5. Save  **(Ctrl-S)**.

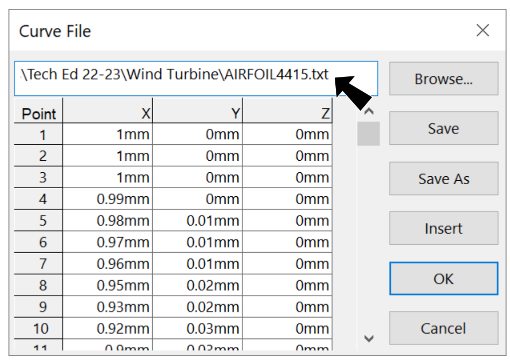



Fig. 46

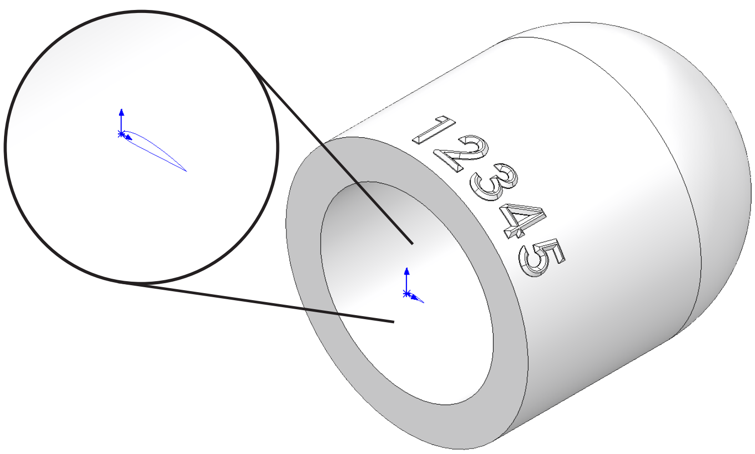



Fig. 47

## K. Sketch4 for Loft.

Step 1. **Hide Revolve** body. To hide, expand Solid Bodies folder in the Feature Manager. Click **Chamfer1** body in Feature Manager and **Hide** on the context toolbar, **Fig. 48**.

Step 2. Click **Front Plane** in the Feature Manager and click **Sketch** on the context toolbar, **Fig. 49**.

Step 3. Click **Normal To** on the Standard Views toolbar. **(Ctrl-8)**

Step 4. Click **Convert Entities** on the Sketch toolbar.

Step 5. In the Convert Entities Property Manager:
under Entities to Convert, **Fig. 50**
click **Curve**, **Fig. 51**
click OK.

Step 6. **Hide Curve1**. To hide, click **Curve1** in the Feature Manager and **Hide** on the context toolbar, **Fig. 53**.

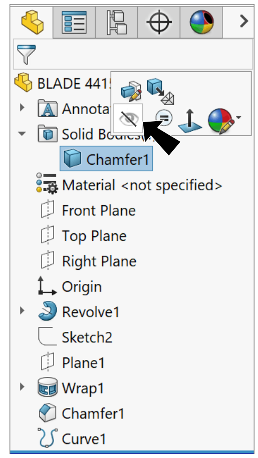


**Fig. 48**

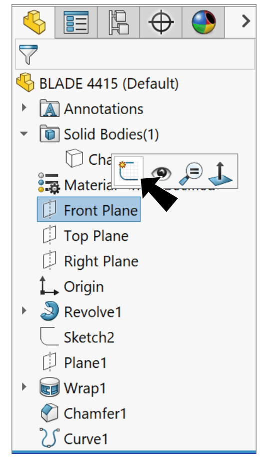


**Fig. 49**

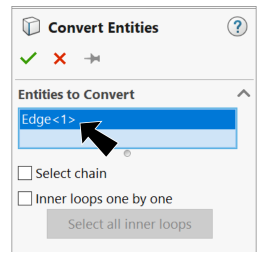


**Fig. 50**

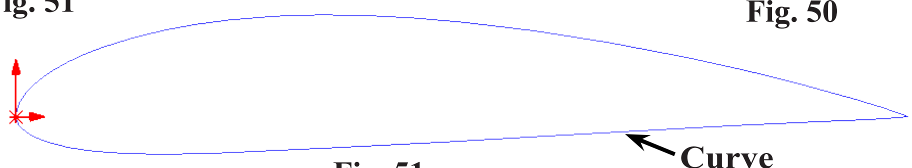


**Fig. 51**

**Fig. 52**

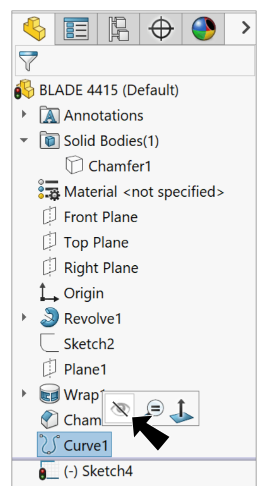


**Fig. 53**

Step 7. Click **Scale Entities** in the **Move Entities flyout** on the Sketch toolbar.

Step 8. In the Scale Property Manager set:
under Entities to Scale, **Fig. 54**
click **converted curve**, **Fig. 55**
under Parameters
click in Scale about box
click **Origin**
**Scale Factor** **63**
uncheck **Copy**
**Tip:** Click in the graphics area and use F key to Zoom to Fit
click OK .

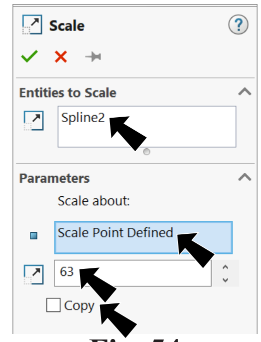


**Fig. 54**

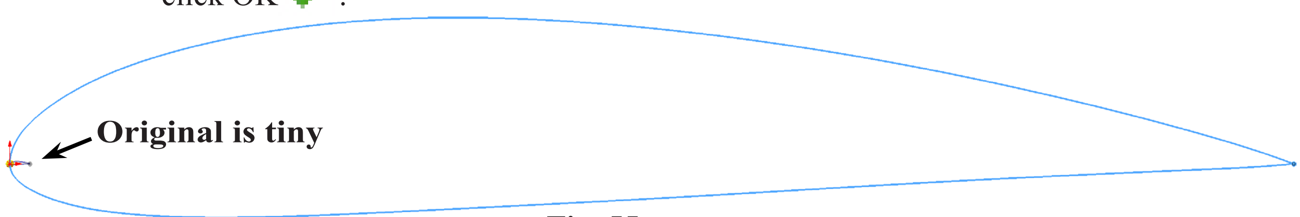


**Fig. 55**

Step 9. Click **Rotate Entities** in the **Move Entities flyout** on the Sketch toolbar.

Step 10. In the Rotate Property Manager set:
under Entities to Rotate, **Fig. 56**
click **converted curve**, **Fig. 57**
under Parameters
click in Center of rotation box
click **top of converted curve**
**Angle** **176º**
press ENTER
click OK .

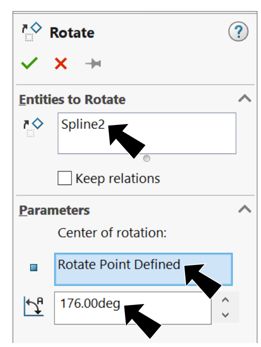


**Fig. 56**

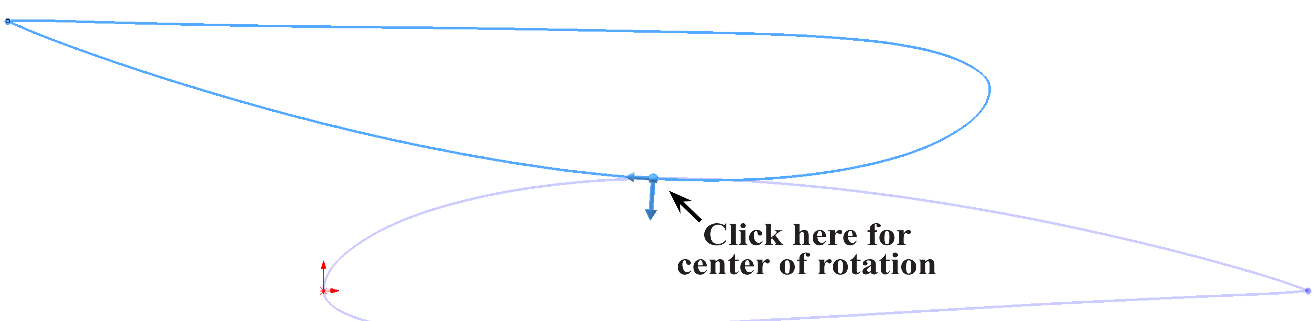


**Fig. 57**

Step 11. Click **Centerline** in the **Line flyout** on the Sketch toolbar.

Step 12. Sketch **cord construction line from trailing edge to leading edge and a perpendicular construction line down from endpoint of cord**, **Fig. 58**. As you sketch, position cursor until it changes to to show perpendicular relations is added, **Fig. 58**.

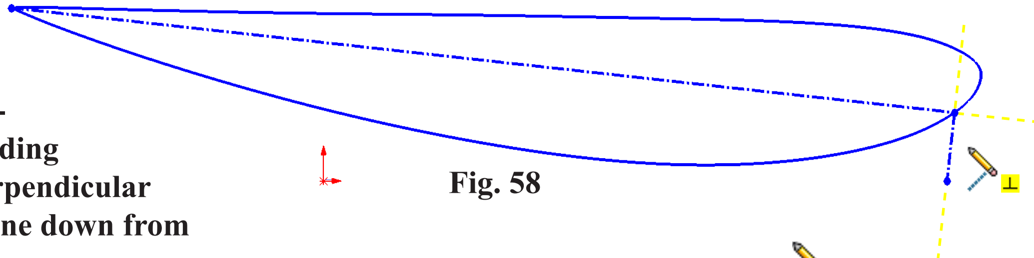


**Fig. 58**

Step 13. **Unselect Centerline tool**. To unselect, **right click graphics area and click Select** from menu.

Step 14. **Ctrl click leading edge of converted airfoil and perpendicular line** to select both. Release Ctrl key and click **Make Tangent** on the context toolbar, **Fig. 59**.

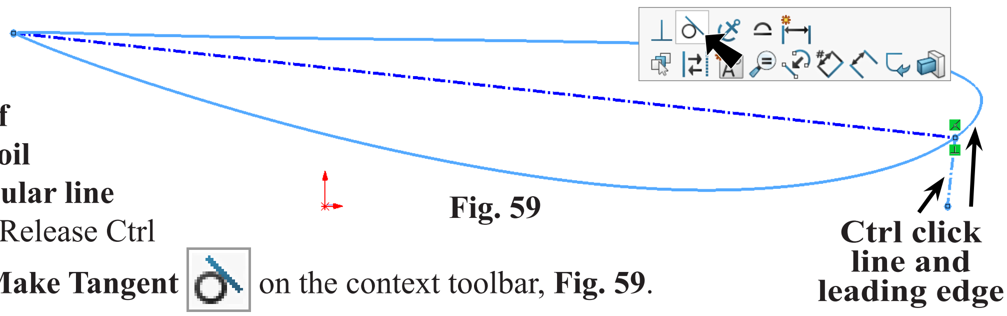



**Fig. 59**

Step 15. **Ctrl click cord line** and **Origin** to select both. Release Ctrl key and click **Make Coincident** on the context toolbar, **Fig. 60**.

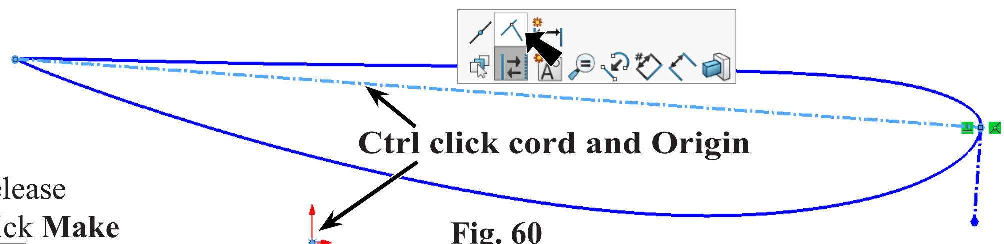



**Fig. 60**

Step 16. Click **Centerline** in the **Line flyout** on the Sketch toolbar.

Step 17. Sketch **horizontal construction line out to right from Origin**, **Fig. 61**.

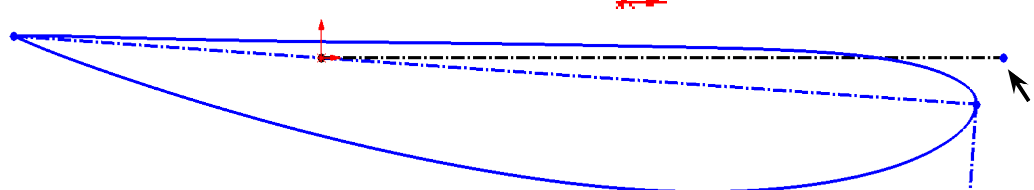


**Fig. 61**

Step 18. Click **Smart Dimension** (**S**) on the Sketch toolbar.

Step 19. Add dimensions, **Fig. 62**. Dimension parallel not horizontal. **Tip: To lock dimension:** click the item to dimension. Move the cursor until the preview indicates dimension type parallel, right click to lock dimension type. Click to place dimension.

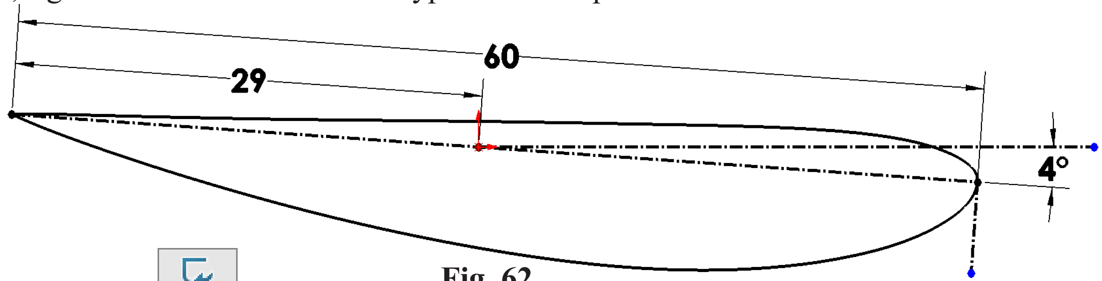



**Fig. 62**

Step 20. Click **Exit Sketch** on the Sketch toolbar.

Step 21. Save (**Ctrl-S**).

## L. Create Plane2 for Loft.

Step 1. Click **Isometric** on the Standard Views toolbar (**Ctrl-7**) and zoom out.

Step 2. Click **Front Plane** in the Feature Manager to display Plane is graphics area, **Fig. 63**.

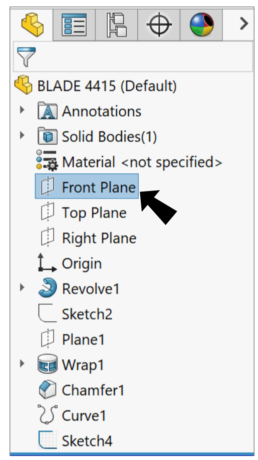



**Fig. 63**

Step 3. In graphics area **Ctrl drag Front plane to rear** and release, **Fig. 64**.

Step 4. In the Plane Property Manager set:
under First Reference, **Fig. 65**

**Distance** 190
and press **ENTER**.
**Tip:** Click in the graphics area and use F key to Zoom to Fit
The new plane should be towards rear, **Fig. 64**.

Click OK.

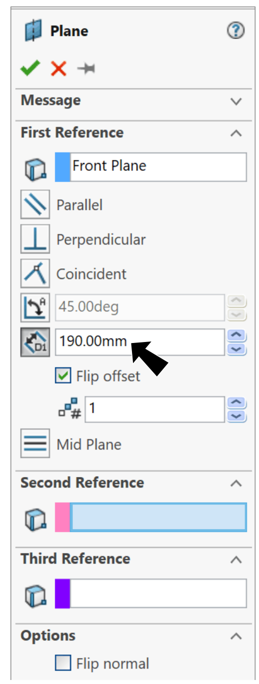
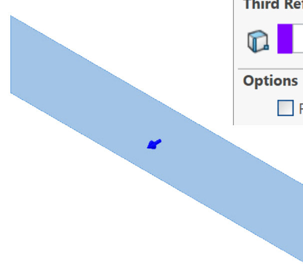
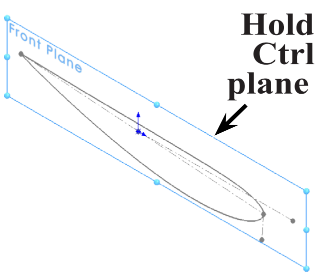



**Fig. 65**

Step 5. Save (**Ctrl-S**).



**Drag to rear**
**set distance to 190**




**Hold down**
**Ctrl drag**
**plane to rear**

**Fig. 64**

## M. Copy Sketch4 into Plane 2.

Step 1. **Hide Plane2**. To hide, click **Plane1** in the Feature Manager and **Hide** on the context toolbar, **Fig. 66**.

Step 2. Click **Sketch4** in the Feature Manager **and copy**, **Fig. 67**. Use **Ctrl-C** to copy sketch.

Step 3. Click **Plane2** in the Feature Manager **and paste sketch**, **Fig. 68**. Use **Ctrl-V** to paste sketch, **Fig. 69**.

Step 4. **Hide Sketch4**. To hide, click **Sketch4** in the graphics area and **Hide** on the context toolbar, **Fig. 69**.

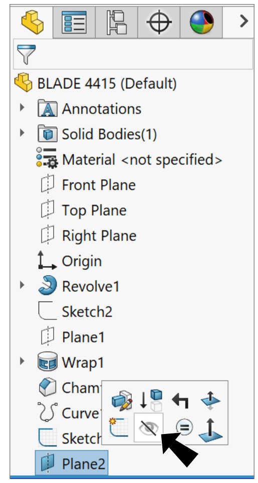



**Fig. 66**

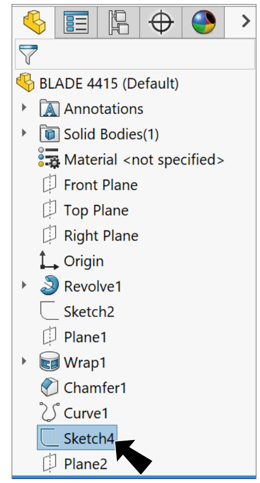
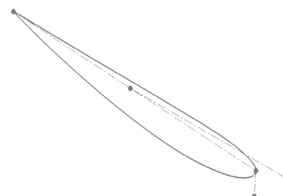



**Fig. 67**



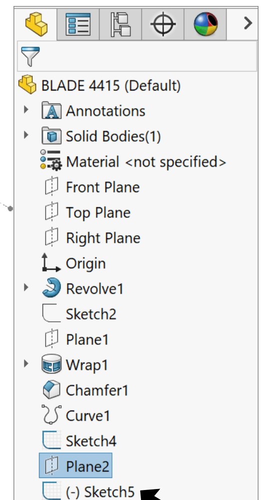



**Fig. 68**

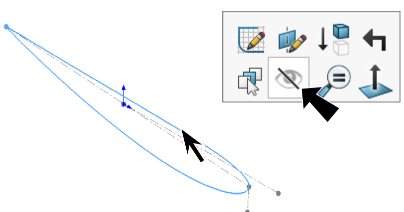


**Fig. 69**

## N. Edit Sketch5.

Step 1. Click **Sketch5 (pasted sketch)** in the graphics area and click **Edit Sketch**  on the Context toolbar, **Fig. 70**.

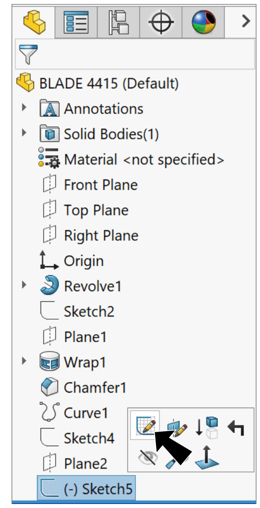



**Fig. 70**

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

Step 3. Drag the **cord line off of Origin** , **Fig. 71** and **Fig. 72**.

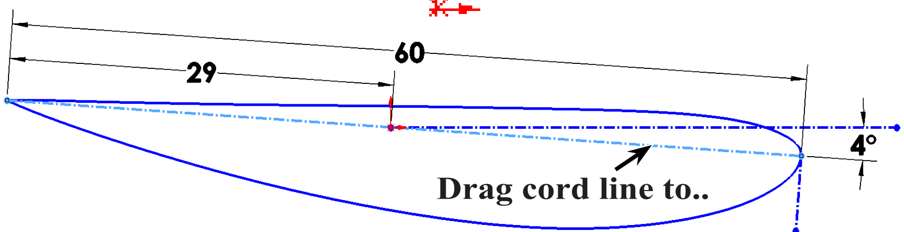



**Fig. 71**

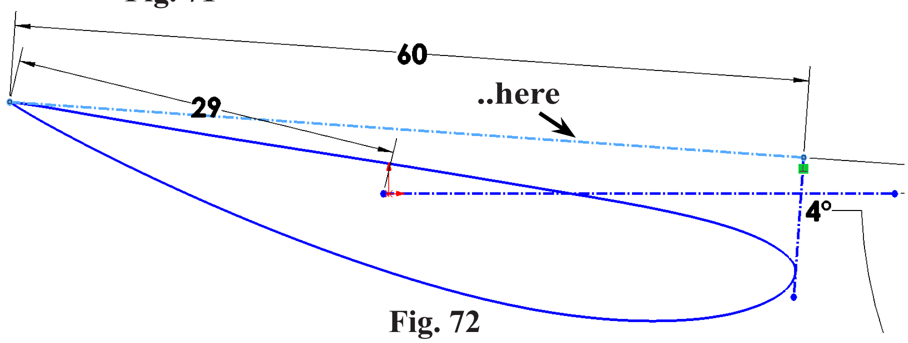



**Fig. 72**

Step 4. Drag the **horizontal line off of Origin** , **Fig. 73** and **Fig. 74**.

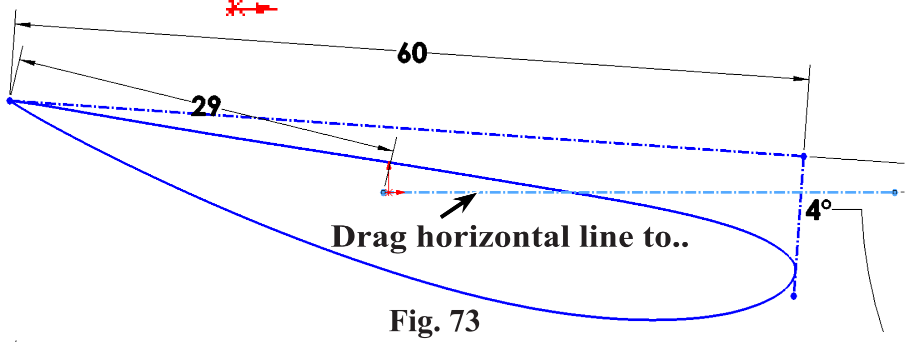



**Fig. 73**

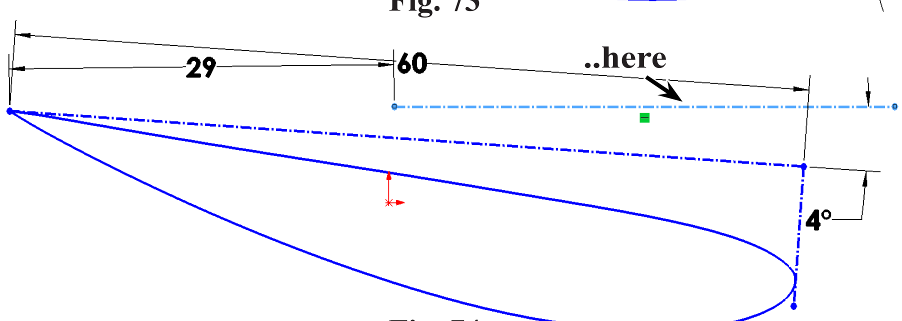
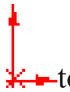



**Fig. 74**

Step 5. **Ctrl click left endpoint of horizontal line** and

**Origin**  to select both. Release Ctrl key and click **Make Coincident**  on the context toolbar, **Fig. 75**.

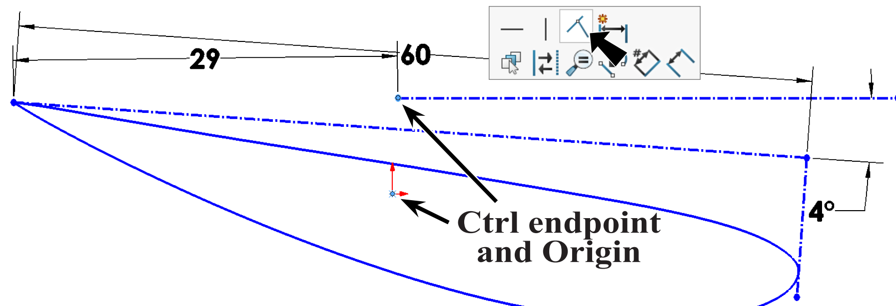



**Fig. 75**

Step 6. **Ctrl click cord line**

and **Origin**  to select both. Release Ctrl key and click **Make Coincident**  on the context toolbar, **Fig. 76**.

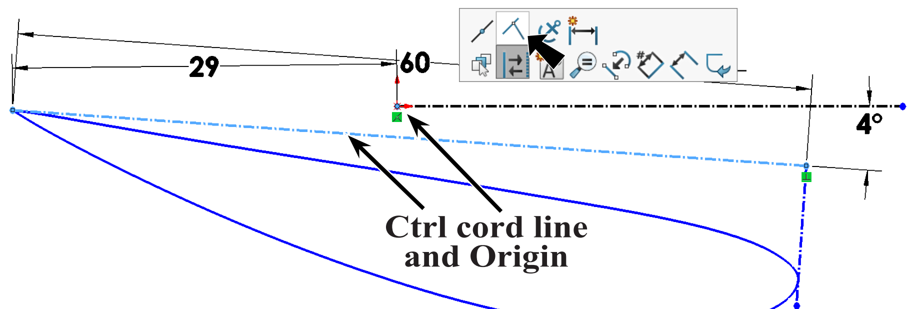



**Fig. 76**

Step 7. **Ctrl click leading edge of converted airfoil and endpoint of perpendicular line** to select both. Release Ctrl key and click **Make Coincident**  on the context toolbar, **Fig. 77**.

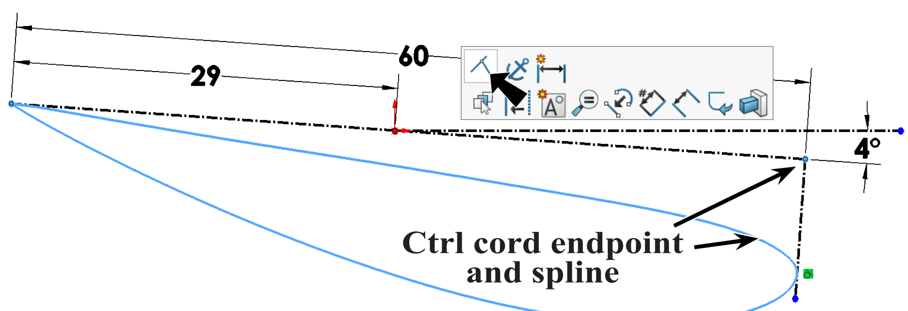



**Fig. 77**

Step 8. Change dimensions, **Fig. 78**.

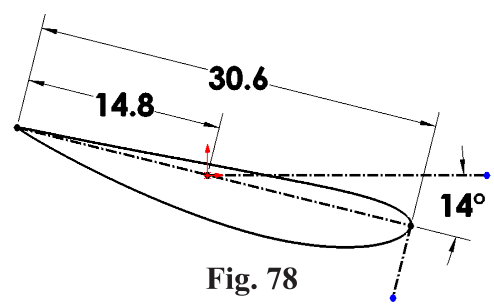



**Fig. 78**

Step 9. Click **Exit Sketch** 

on the Sketch toolbar.

## O. Loft.

Step 1. **Show Revolve** **body** (Chamfer1). To show, expand Solid Bodies folder in the Feature Manager. Click **Chamfer1** **body** in Feature Manager and **Show** on the context toolbar, **Fig. 79**.

Step 2. **Show Sketch4** . To show, click **Sketch4** in the Feature Manager and **Show** on the context toolbar, **Fig. 80**.

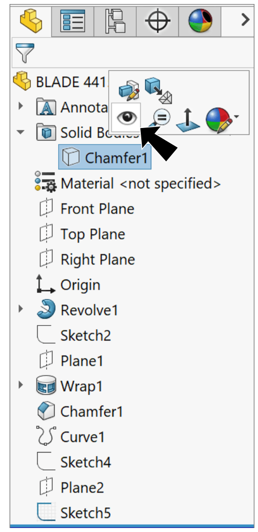


**Fig. 79**

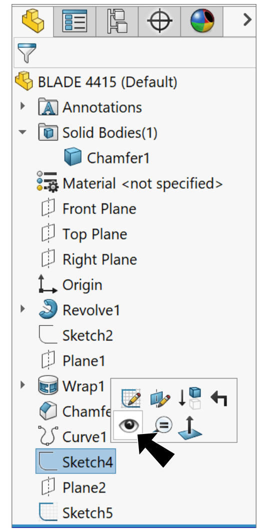


**Fig. 80**

Step 3. Click **Isometric** on the Standard Views toolbar. **(Ctrl-7)**

Step 4. Click Zoom to Fit **(F)** on the View toolbar.

Step 5. Click **Features** Features on the Command Manager toolbar.

Step 6. Click **Lofted Boss/Base** Lofted Boss/Base on the Features toolbar.

Step 7. In the Loft Property Manager set:

under Profiles, **Fig. 81**

click **same position on the two Profile sketches, Fig. 82**

Sketch4

Sketch5

click OK .

Step 8. Save **(Ctrl-S)**.

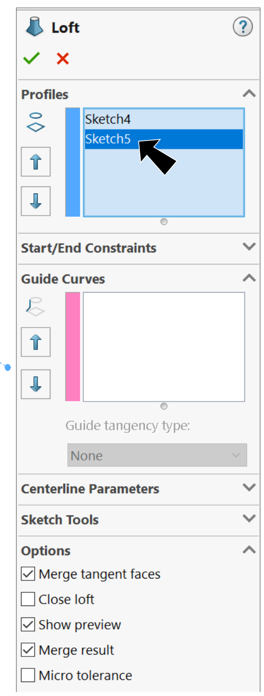


**Fig. 81**

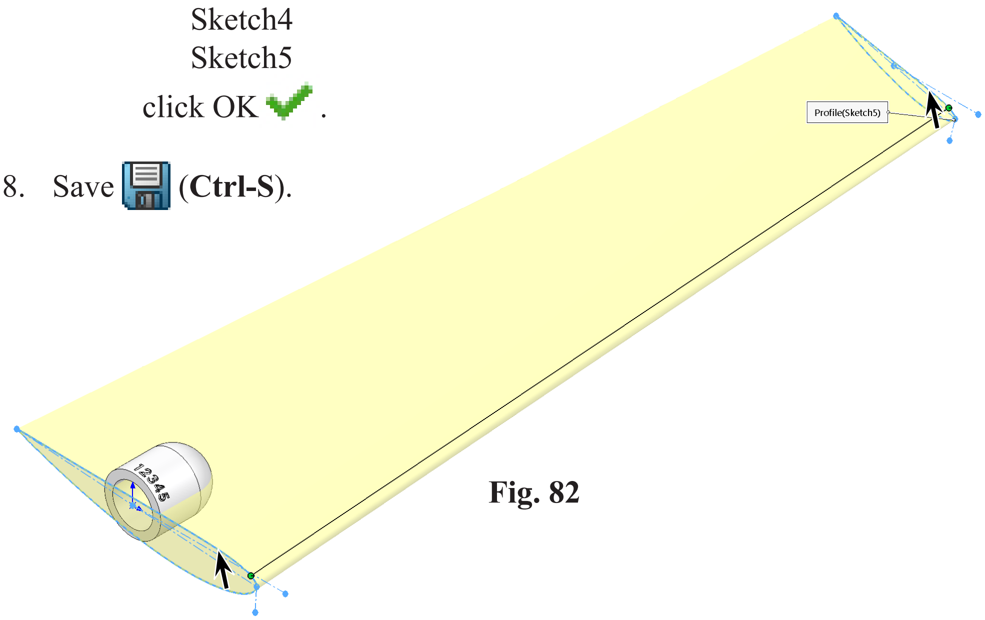


**Fig. 82**

## P. Delete Face.

Step 1. Click **Surfaces** on the Command Manager toolbar.

Step 2. Click **Delete Face** on the Surfaces toolbar.

Step 3. In the Delete Face Property Manager:
under Selections, **Fig. 83**
click **top face loft inside of revolve**, **Fig. 84**
under Options
**Delete and Patch**
click OK .

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

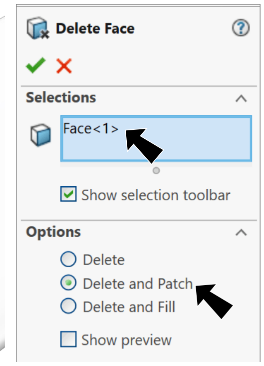



**Fig. 83**

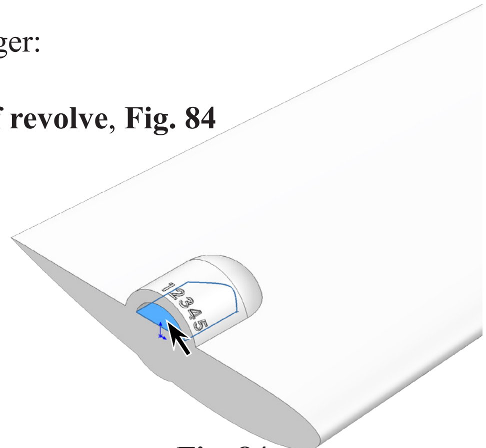



**Fig. 84**

## Q. Fillet Edges.

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

Step 2. In the Fillet Property Manager set:
select **FilletXpert**, **Fig. 85**
**Radius** 3
click the **top edges of Revolve at Loft**, **Fig. 86**
click OK .

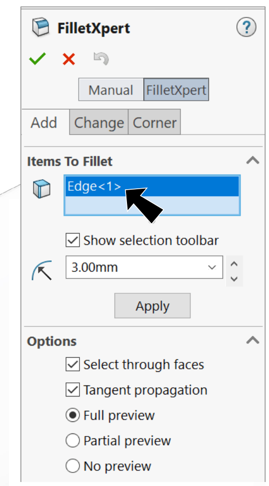



**Fig. 85**

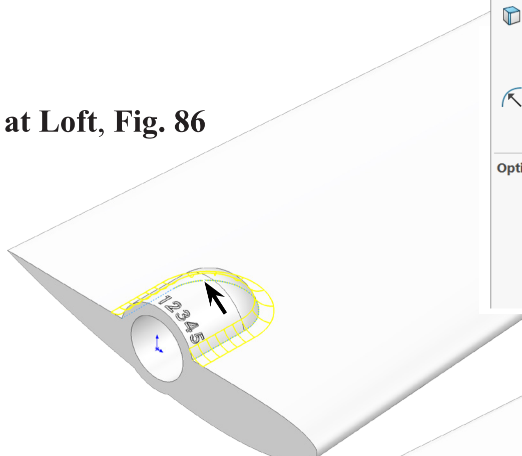



**Fig. 86**

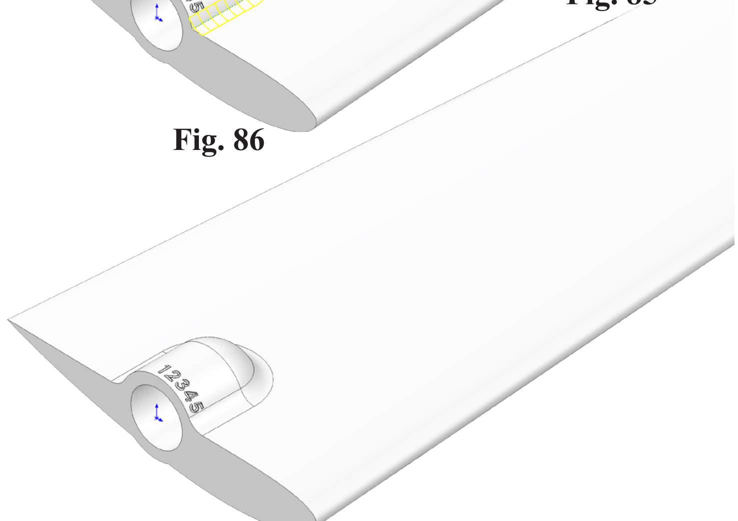



**Fig. 87**

## R. Appearance: White Plastic.

Step 1. Click part, click **Appearance Callout** on the context toolbar and click **BLADE 4415**, **Fig. 88**.

Step 2. In the Appearances Task pane, expand **Plastic**, click **High Gloss** and in the lower pane select **white high gloss plastic**, **Fig. 89**.

Step 3. Click OK In the Appearances Property Manager.

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

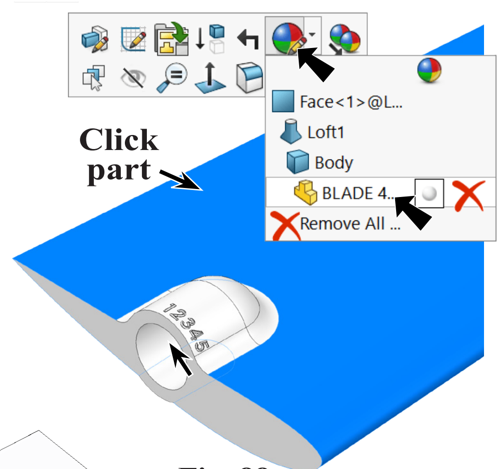



Fig. 88

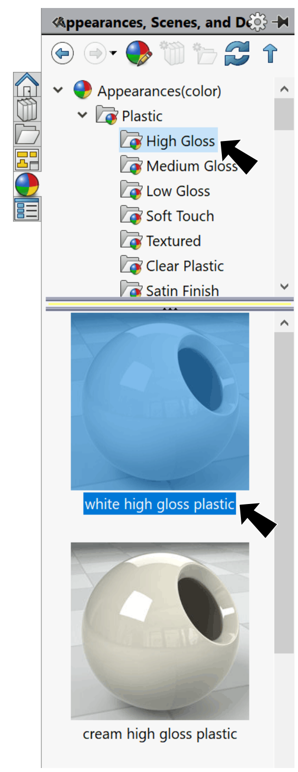



Fig. 89

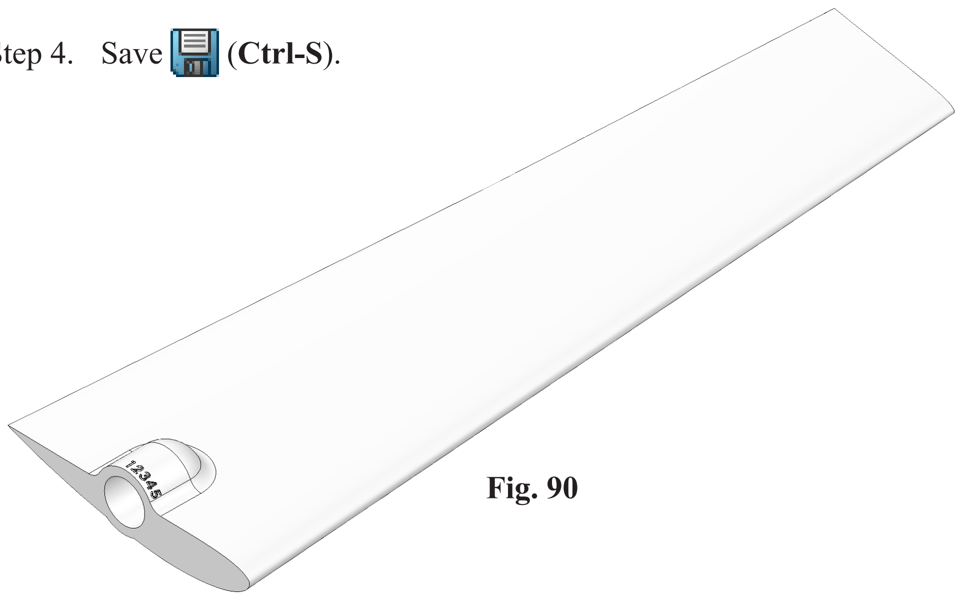



Fig. 90